EFJohnson®

Service Manual

PRELIMINARY

AURIS™ RS-5300 MOBILE RADIO
DIGITAL/ANALOG
VHF and 800 MHz

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2.1033(c)(3) SERVICE MANUAL

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2.1033(10) CIRCUIT DESCRIPTION

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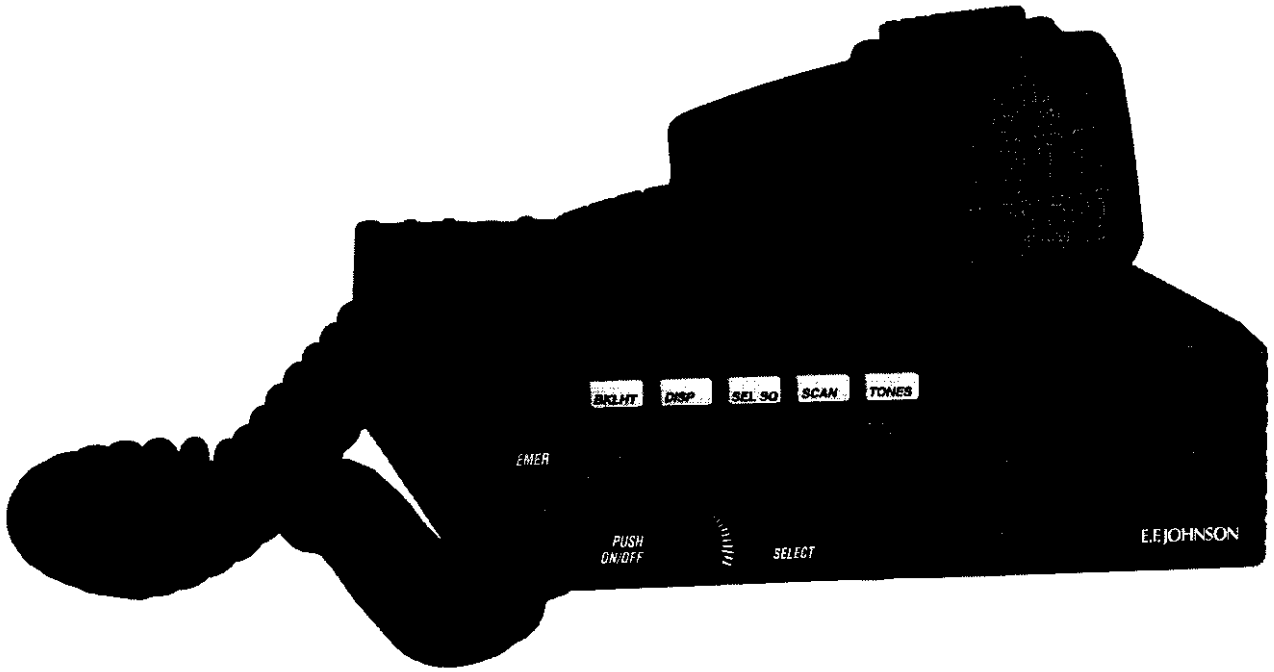

First Printing
April 1999

EFJohnson®

AURIS RS-5300 SERIES MOBILE RADIO

VHF and 800 MHz PROJECT 25 (DIGITAL) AND ANALOG

13.6 VDC
10-50 Watts (VHF), 10-35 Watts (800 MHz)
Part No. 242-53xx-xxx

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

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April 1999
Part No. 001-5300-001

SECTION 1 GENERAL INFORMATION

1.1 SCOPE OF MANUAL

This service manual contains installation, operation, programming, alignment, and service information for the EFJohnson® RS-5300 Auris™ mobile transceivers.

1.2 TRANSCEIVER DESCRIPTION

1.2.1 GENERAL

The Auris™ RS-5300 mobile transceivers can operate on various types of channels and with various signaling protocols (see following information). Models are or will be available for operation in the VHF 136-174 MHz and 800 MHz 806-870 MHz frequency ranges. Repeater talk-around is also available with all bands. Power output is user switchable for low and high levels as follows:

VHF - 10 - 50 watts, low and high switchable
800 MHz - 10 - 35 watts low and high switchable

1.2.2 ANALOG/DIGITAL OPERATION

The Auris RS-5300 transceivers use a digital signal processor (DSP) to provide the signal modulation required to operate on the following types of channels. This provides backwards compatibility with existing equipment and also the ability to operate on various types of radio systems.

Narrow Band Analog - FM modulation is used with a maximum deviation of 2.5 kHz. This mode is usually used in systems with a channel spacing of 12.5 kHz.

Wideband Analog - FM modulation is used with a maximum deviation of 5 kHz. This mode is usually used in systems where the channel spacing is 25 kHz or 30 kHz.

Project 25 Digital - Operates on Project 25 compatible systems. The voice is digitized, error corrected, optionally encrypted, and then transmitted using C4FM modulation according to the Project 25 standard. This mode uses a channel spacing of 12.5 kHz.

1.2.3 OPERATING PROTOCOLS

The RS-5300 can be programmed for all the following operating protocols. Refer to Section 3 for more operation information.

- Conventional analog
- Conventional Project 25 (digital)
- SmartNet®/SmartZone® analog or Proj 25 (digital)

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).

Channels

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

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

Conventional Project 25 Mode - A channel selects a specific radio channel, NAC squelch coding, and other parameters unique to that channel.

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

A maximum of up to 256 channels can be programmed with the preceding modes. The conven-

tional system can be programmed with up to 256 channels, and each of the SmartNet/SmartZone systems 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 4.1.9 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 SECURE COMMUNICATION

Secure communication is available with all the preceding protocols. The following types of encryption are available:

Conventional Analog and SmartNet/SmartZone Operation

- SecureNet™ DES/DES-XL, DVP/DVP-XL
- 460 Scrambling (Transcrypt)

Conventional Project 25 Operation

- DES-OFB

1.2.6 PROGRAMMING

Transceiver programming is performed using a PC-compatible computer and an EFJohnson RPI (Remote Programming Interface) and PCTrunk™ programming software (see Table 1-1). Programming is described in Section 4.

1.2.7 ALIGNMENT

Transceiver alignment is performed using the same computer and RPI used for programming (see preceding section) and special PCTune™ software. All adjustments are made using the software (no manual adjustments are required). Alignment is described in Section 6.

1.3 PRODUCT WARRANTY

The warranty statement for this transceiver is available from your product supplier or from the Warranty Department, EFJohnson, 299 Johnson Avenue, P.O. Box 1249, Waseca, MN 56093-0514. This information may also be requested from the Warranty Department by phone as described in Section 1.7. The Warranty Department may also be contacted for Warranty Service Reports, claim forms, or any other questions concerning warranties or warranty service.

1.4 PART NUMBER BREAKDOWN

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

242-53FT-SEC-OADE

F (Frequency Band)
- 1 - VHF (136-174 MHz)
- 3 - UHF* (403-470 MHz)
- 4 - UHF* (450-512 MHz)
- 8 - 800 MHz

T (Type)
- 5 - Mid Power*, Dash Mount
- 6 - Mid Power*, Remote Mount
- 7 - High Power, Dash Mount
- 8 - High Power, Remote Mount

* These models are currently not available

S (Signaling, Primary)
- 0 - Analog
- 1 - Project 25
- 3 - SmartNet II
- 5 - SmartZone
- 7 - Project 25 Trunking

E (Encryption, Hardware)
- 0 - No encryption hardware
- 1 - DES
- 2 - DES/DES-XL
- 3 - DVP
- 4 - DVP/DVP-XL
- 5 - Project 25 DES
- 6 - Project 25 DES/DES-XL
- 7 - DVP/DES-XL

C (Configuration)
- 1 - 6 Button

O (Options, Installed Conventional)
- A - No installed options
- D - Data cable

A (Analog or Additional Signaling)
- A - No additional signaling
- C - SmartNet II
- E - SmartZone

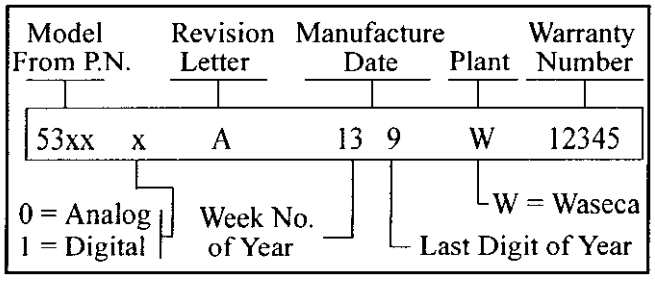
D (Data Options)
- A - No data
- B - Circuit Data*
- C - Packet Data*
- D - Circuit and Packet Data*

* These models are currently not available

E (Encryption and Security Software)
- A - No encryption
- B - SC20-460
- C - SC20-DES/460

1.5 TRANSCEIVER IDENTIFICATION

The transceiver identification number is printed on a label that is attached to the chassis. The following information is contained in the identification number:



1.6 ACCESSORIES

The accessories available for this transceiver are listed in Table 1-1. A brief description of some of these accessories follows:

Key Cap Kit - The key cap kit includes 19 key caps labled for various function, 5 blank key caps, and 5 plugs that can be inserted in the front panel if a key is not used. Refer to Section 2.5 for more information .

Table 1-1 RS-5300 Mobile Acc e s s o r i e

Accessory	Part No.
Key Cap Kit	587-5300-001
Mounting Accessories	
Mounting bracket & hardware kit	023-9750-012
DC power cable & hardware, 22 ft.	023-9750-010
Accessory cable	023-9750-011
Lockable Mounting Tray	585-7000-185
Adapter cable (to use 86xx-series power cable)	023-9650-006
Microphones	
Standard amplified dynamic	250-0740-310
Standard, environ sealed	587-9650-010
DTMF w/o mem	589-0016-028
DTMF w/o mem, env seal WR805	587-9650-015
DTMF w/20 no. mem, envir seal	587-9650-012
Desk microphone	250-0742-011
External speaker, 5" 15W 3.2 ohm environmental sealed	250-0151-006
Control station power supplies	
15 amp, 117 VAC, 60 Hz (light duty)	585-4001-202
15 amp, 230 VAC, 50 Hz (light duty)	585-4001-204
15 amp, 117 VAC (heavy duty)	239-0226-111
15 amp, 230 VAC (heavy duty)	239-0226-211
DC and speaker cable adapter for -0226 supply	023-9650-004
Programming Accessories	
Remote prog interface (RPI)	023-5300-000
Cable, RPI to transceiver (std)	023-9750-005
Cable, xcvr-xcvr (cloning)	597-2002-268
Cable, RPI to computer DB9M-DB9F 6 ft	597-5900-002
Cable, RPI to computer DB25M-DB25F	023-5800-017
PCTrunk prog software, 3-1/2" disks	023-5000-003
PCTune software, 3-1/2" disk	023-5000-093

Mounting Hardware - The mounting hardware and DC power cable are shown in Figures 2-1 and 2-3 in Section 2. A 22-foot DC power cable is used for both front and remote mount applications. The cable is cut to the required length at installation and any excess discarded. The accessory cable is used to connect such things as an external speaker, ignition sense input, and a horn alert to the transceiver. It includes two 22-foot and three 2-foot wires that are connected as required to external points. The adapter cable is used to connect a 86xx-series power cable to these transceivers.

Lockable Mounting Tray - This bracket allows the transceiver to be locked in place to guard against theft. In addition, it allows it to be easily unlocked and removed from the vehicle. Refer to Section 2 for installation information.

Microphones and Speaker - The microphones in Table 1-1 have an impedance of 620 ohms. All DTMF microphones are backlighted. The environmentally sealed microphones are sealed against such things as rain, sand, and dust. The desk microphone can be used for control station applications.

The external 15-watt speaker can be used in place of the internal 5-watt speaker. It is non-amplified and weatherproof. This speaker is connected to pins 1 and 2 of the accessory connector pigtail on the back of the transceiver.

Control Station Power Supply - With the -4001 light duty power supplies, the transceiver slides into the power supply housing and receives power from banana jacks on the back of the power supply. The standard power cable is used for connecting power, and the internal transceiver speaker provides speaker audio.

With the -0226 heavy duty power supplies, the transceiver mounts on a pedestal. The -004 adapter cable is used to connect the transceiver DC and accessory pigtail cables to the power supply power cable and speaker. The transceiver internal speaker also can be used if desired.

Programming Hardware and Software - The RPI provides the interface between the programming computer and transceiver. The cables from the RPI to computer and transceiver are not included with the RPI and must be ordered separately. The transceiver programming software is available for PC-compatible computers only. The cloning cable allows one transceiver to program another with identical information (a computer is not required). For security purposes, encryption and scrambling keys are not transferred.

Scrambling and Encryption Options - These options allow secure communication with other radios equipped with Transcrypt 460 scrambling or the Motorola DES/DES-XL module. The keyloader cable connects the Keyloader system to the transceiver to allow the DES/DES-XL encryption keys to be loaded.

1.7 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 EFJohnson, 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:

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

1.8 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.

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 1.7) 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.

1.9 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 1.7. 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 1.7.

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

1.10 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.

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AURIS RS-5300 MOBILE SPECIFICATIONS

The following are general specifications intended for use in testing and servicing this transceiver. For current advertised specifications, refer to the specification sheet available from your sales representative. Values are typical and are subject to change without notice.

GENERAL

Frequency Range	VHF: 136-174 MHz 800 MHz: 806-870 MHz
Operating Modes	Conventional, Project 25 Conventional, SmartNet, SmartZone
Mounting Location	Dash Mount (Remote mount optional)
Zones/Channels	Up to 16 zones with 16 channels per zone
Transmit/Receive Separation	Any frequency within the range
Channel Spacing	VHF: 12.5, 15, 25, and 30 kHz 800 MHz: 12.5 and 25 kHz
Maximum Deviation	25 kHz analog - 5 kHz 12.5 kHz analog - 2.5 kHz 12.5 kHz analog NPSPAC - 4.0 kHz
Frequency Stability Rx and Tx	2.5 PPM VHF, 1.5 PPM 800 MHz –22° to +140° F (–30° to +60° C)
Dimensions (w/o antenna)	2.1" H x 7.2" W x 8.3" D (5.3 cm x 18.2 cm x 21.1 cm)
Weight (w/std battery)	5 lbs 4 oz. (2.38 kg)
Supply Voltage	13.6 volts DC nominal, negative ground
Current Drain (maximum)	Standby - 600 mA Receive (rated audio out) - 2.7 A Rated Tx Power - 13.2 A

RECEIVER

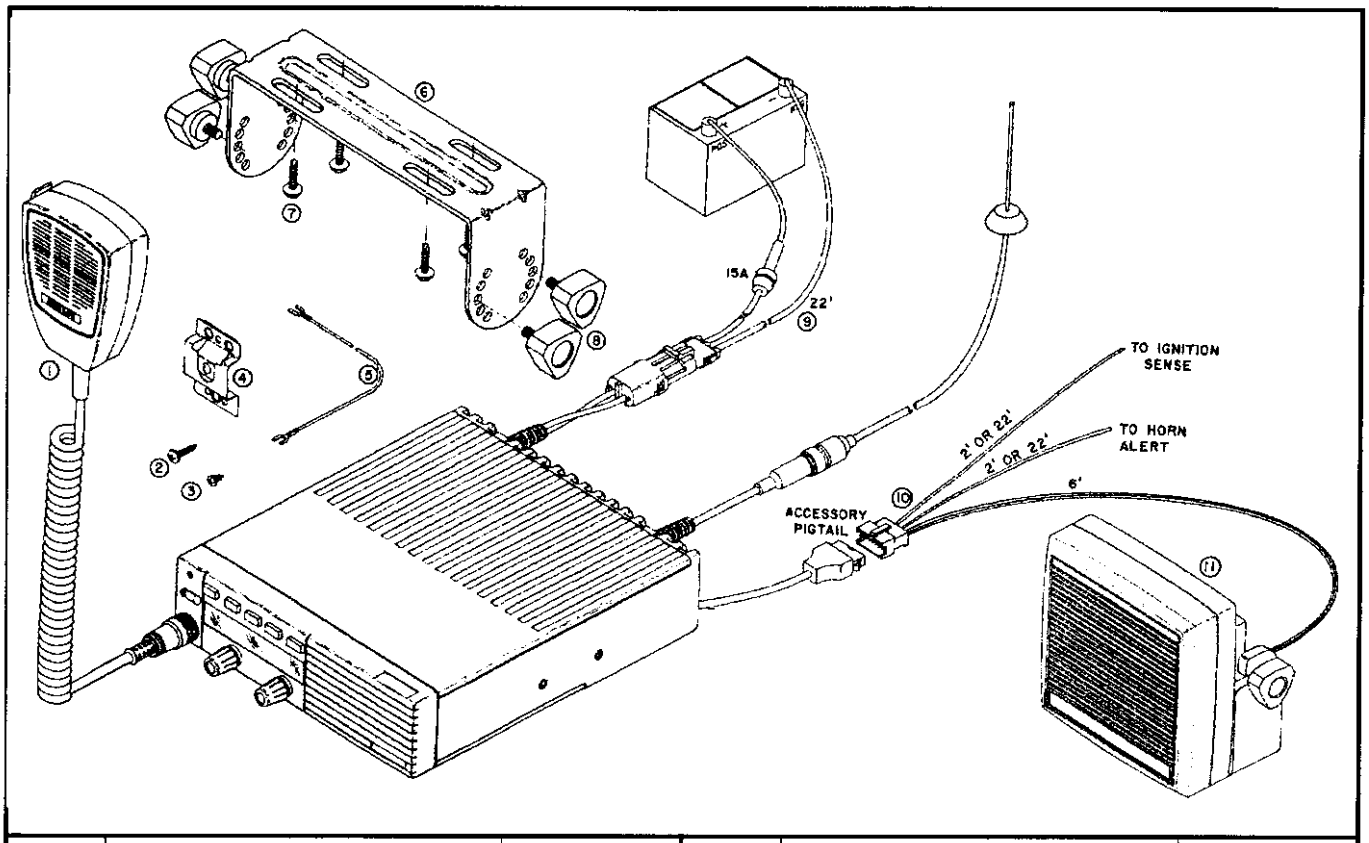
Sensitivity	0.35 µV (analog mode 12 dB SINAD), 0.35 µV (digital mode 5% BER)
Selectivity	–75 dB
Spurious and Image Rejection	–75 dB
Intermodulation	–75 dB at VHF, –73 dB 800 MHz
Hum and Noise	40 dB at 25 kHz, 34 dB at 12.5 kHz
Maximum Frequency Spread	Any spread within the range
Audio Power Output	5 W with internal speaker (12 W w/external 4-ohm speaker)
Audio Distortion	Less than 3% at 1 kHz

TRANSMITTER

RF Power Output	VHF: 10 - 50 W variable 800 MHz: 10 - 35 W variable
Spurious and Harmonic Emissions	–70 dB (VHF), –60 dB (800 MHz)
FM Hum and Noise	–45 dB at 25 kHz bandwidth
Audio Modulation	11K0F3E, 16K0F3E, 8K10F1E, 20K0F1E, 18K8F1E, 14K0F3E
Audio Distortion	Less than 3% at 1 kHz
Maximum Frequency Spread	Any spread within the band

NOTES

SECTION 2 INSTALLATION



Item No.	Description	Part No.	Item No.	Description	Part No.
1	Amplified dynamic mic	250-0740-310	7	Self-drilling screw (4)	575-9077-565
2	Screw, 4-20 x 5/8" thread frmg (3)	575-5604-020	8	Knob (4)	547-0016-003
3	Screw, 4-24 x 1/4" sheet metal (3)	575-3604-008	9	Power cable (22') and hardware	023-9750-010
4	Microphone hanger clip	023-3514-001	10	Accessory wire and hardware	023-9750-011
5	Mic hanger ground wire	023-7171-911	11	5" remote speaker	250-0151-006
6	Transceiver mounting bracket	017-2226-034	---	Butt splice connector (2)	586-9008-061

Figure 2-1 Front Mount Installation Components

2.1 GENERAL

2.1.1 SCOPE OF INSTRUCTIONS

Since each installation is somewhat unique, the following installation instructions are intended only as a general guide to installing this transceiver. Described are the intended use of the mounting hardware and the electrical connections that should be made.

2.1.2 PERFORMANCE TESTS

Although each transceiver is carefully aligned and tested at the factory, shipment can alter these settings or damage the transceiver. Therefore, it is good practice to check transceiver performance before it is placed in service.

2.1.3 TRANSCEIVER PROGRAMMING

The transceiver needs to be programmed before it is placed in service unless it was ordered as factory programmed. Programming instructions are located in Section 4. Transceivers not factory programmed are shipped programmed with test channels and other factory test parameters.

2.1.4 POWER SOURCE

This transceiver is designed for installation only in vehicles which have a 12-volt, negative ground electrical system. This type of electrical system has the negative battery terminal connected directly to the vehicle chassis. Other types of electrical systems require a voltage converter.

2.2 TRANSCEIVER INSTALLATION

2.2.1 GENERAL

Cable and Hardware Kit, Part No. 023-9750-010, includes a 22-foot power cable, microphone hanger, hanger ground wire, splice connectors, and all the hardware (such as screws) that is normally required for installation. Transceiver Mounting Kit, Part No. 023-9750-012, includes a mounting bracket with knobs and mounting screws. Accessory Wire Kit, Part No. 023-9750-011, includes a wire assembly that is used to connect the ignition sense input and accessories. These components are shown in Figures 2-1 and 2-3.

2.2.2 SELECTING A MOUNTING LOCATION

Front-mount transceivers are designed for mounting in a location near the operator such as the dash, console, or transmission hump. Remote-mount transceivers are designed for mounting in a location such as the trunk.

WARNING

The mounting location of the transceiver or control unit can affect safe operation of the vehicle. Follow these precautions when installing this transceiver:

- Mount it where it does not interfere with operation of the vehicle controls.
- Mount it where the operator can easily see the display and reach the controls.
- Mount it where it is least likely to cause additional injury in case of an accident.
- Airbags deploy with great force. Therefore, do not mount the transceiver anywhere near the deployment area. In addition, do not place any other objects in the deployment area.

2.2.3 MOUNTING TRANSCEIVER

1. Check the area underneath the selected mounting area for wiring, brake and gas lines, or other components that could be damaged when the mounting bracket is installed. Then install the mounting bracket using the included self-drilling screws or other screws if desired.
2. Install the transceiver in the bracket using the included knobs.
3. With front-mount transceivers, install the microphone hanger in a convenient location using the screws for sheet metal or plastic. The hanger must be connected to chassis ground for proper operation of functions such as monitoring and scan. If required, ground the hanger using the included ground wire.

2.3 POWER CABLE INSTALLATION

NOTE: Both leads of the power cable should be connected directly to the vehicle battery. Connection to other points may result in increased interference from the vehicle's electrical system. If noise is still a problem, an optional DC noise filter is available (see Table 1-2).

1. Disconnect the negative cable from the battery to prevent damage from accidental short circuits.

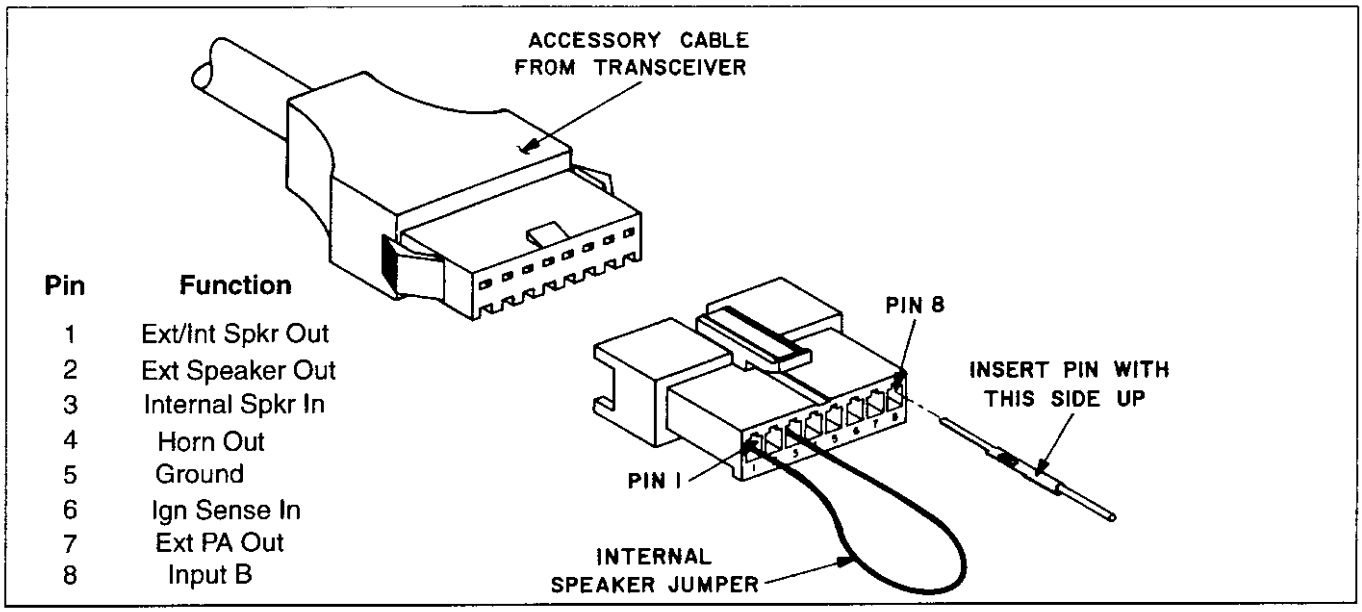


Figure 2-2 Accessory Jack

2. Route the red power cable to the battery. If there is excess cable, cut it off at a convenient location and then splice it using the included butt splice connectors. You may also need to cut the cable if it must be routed through the firewall and there is no opening large enough to clear the fuseholder. If a hole is drilled in the firewall, be sure to seal it when the installation is complete.

3. Connect the red power cable to the positive (+) terminal of the battery.

4. Connect the blue cable to the negative (–) battery terminal.

5. Plug the power cable into the transceiver and reconnect the negative battery cable.

6. Install the antenna according to the manufacturer's instructions. The transceiver has an "N" connector. Check VSWR. Reflected power should be less than 4% of forward power (VSWR less than 1.5 to 1).

2.4 ACCESSORY CABLE INSTALLATION

2.4.1 GENERAL

Accessory Cable Kit, Part No. 023-9750-011, is standard with this transceiver. The cable in this kit plugs into the accessory pigtail coming from the back of the transceiver. It is used for connecting the ignition sense input and the external speaker and horn alert accessories.

Two 8-pin connectors are included. One has a jumper installed from pin 1 to 3 for routing audio to the internal speaker (see next section) and the other does not have any wires installed. Also included are two 22-foot and three 2-foot wires with attached pins that can be used as required. Refer to Figure 2-2 and install this cable as described in the following information.

NOTE: The ignition sense input must always be connected because the transceiver does not operate if it is not. In addition, the speaker jumper must be installed to route audio to the internal speaker (except remote-mount models).

2.4.2 INTERNAL/EXTERNAL SPEAKER

CAUTION

Do not connect either speaker output to a supply voltage because serious damage to the audio amplifier will result. (The amplifier is designed to withstand momentary grounding of the speaker outputs.)

Internal Speaker

To enable the internal speaker of front-mount transceivers, insert the plug with the jumper from pin 1 to 3 into the accessory jack. This routes the audio on pin 1 back in to the internal speaker connected to pin 3. The other internal speaker terminal is internally connected to pin 2.

External Speaker

With front-mount transceivers, 4-ohm, 15-watt external speaker, Part No. 250-0151-006, or equivalent can be connected to pins 1 and 2 of the accessory connector. Proceed as follows:

a. Locate the connector included in the Accessory Wire Kit that does not have pins 1 and 3 jumpered.

b. If installing the external speaker listed above, the connector pins are already attached to the speaker wires. Insert one pin into the pin 1 location and the other into the pin 2 location. If installing some other speaker, use a 2- or 22-foot wire as required.

2.4.3 IGNITION SENSE

This ignition sense line is pin 6 of the accessory connector. It is connected using an included wire assembly. When the ignition sense input is connected to a source switched by the vehicle ignition switch, it provides the following functions.

a. Power automatically turns on and off with the ignition switch.

b. A turn-off delay can be programmed (see Section 3.4.4). An automatic turn-off delay may prevent accidental discharge of the vehicle battery if the transceiver is left on for extended periods (1 or 2 days). Standby current is approximately 600 mA.

If these features are not used and transceiver power is to be controlled by the front-panel power switch only, the ignition sense input can be connected to an unswitched source.

2.4.4 HORN ALERT

The horn alert is currently not available.

2.4.5 EXTERNAL PUBLIC ADDRESS

The speaker signal is routed to pin 7 of the accessory connector. This output can be used for external accessories such as a public address system. Use one of the included accessory cable wire assemblies to connect this output.

2.4.6 INPUT B (EMERGENCY SWITCH)

If an emergency switch is used to set up a high priority call (see Section 3.6.8), a front panel option switch or an external switch such as a foot-operated type can be used.

If an external emergency switch is used, the input is pin 8 of the accessory connector. This input is active high and requires a +12 VDC signal to activate. Use an accessory cable wire assembly to connect this switch.

2.5 KEY CAP INSTALLATION

Key Cap Kit, Part No. 587-5300-001, is included with each transceiver. This kit includes 5 blank key caps, 6 plugs that can be inserted in the front panel if the key is not used, and keys labeled as follows. The caps indicated by an asterisk (*) are installed at the factory. Determine the function of each key and then install the applicable key cap. To remove a key cap, gently pull it out of the front panel with a wide-nose pliers. A key extraction tool is included in the DC power cable kit.

EMER*	BKLHT*	DISP*	SEL SQ*	SCAN*
TONES*	C/S	TG SEL	TX PWR	CALL
MON	RWS	PRI ED	ALERT	RESP
MSG	NUIS	PHONE	STATUS	

2.6 TRANSCEIVER MOUNTING TRAY INSTALLATION

2.6.1 DESCRIPTION

Optional Transceiver Locking Tray, Part No. 585-7000-185, is a lockable mounting bracket for RS-5300 transceivers and other transceivers that use that chassis. This bracket provides theft protection and also allows the transceiver to be quickly removed from the vehicle with a key.

2.6.2 INSTALLATION

Refer to Figure 2-3 and proceed as follows:

a. Install the transceiver in bracket MP2 using the four 10-32 x 1/2" screws (HW2) included. If desired, this mounting bracket can be used to mount the transceiver directly to the vehicle.

b. Install lock bracket MP1 using the four self-drilling screws (HW3) and washers (HW5) included. Make sure that there is nothing under the mounting location that will be damaged.

2.6.3 LOCKING AND UNLOCKING TRANSCEIVER

To insert the transceiver with attached mounting bracket into the locking bracket, set it over the locking bracket and push it rearward slightly if necessary so that it seats. Then pull it forward until it latches.

The lock operates in a manner similar to most glove compartment locks. To release the transceiver, press the button and at the same time push the transceiver rearward. The key locks the button so that it cannot be pressed.

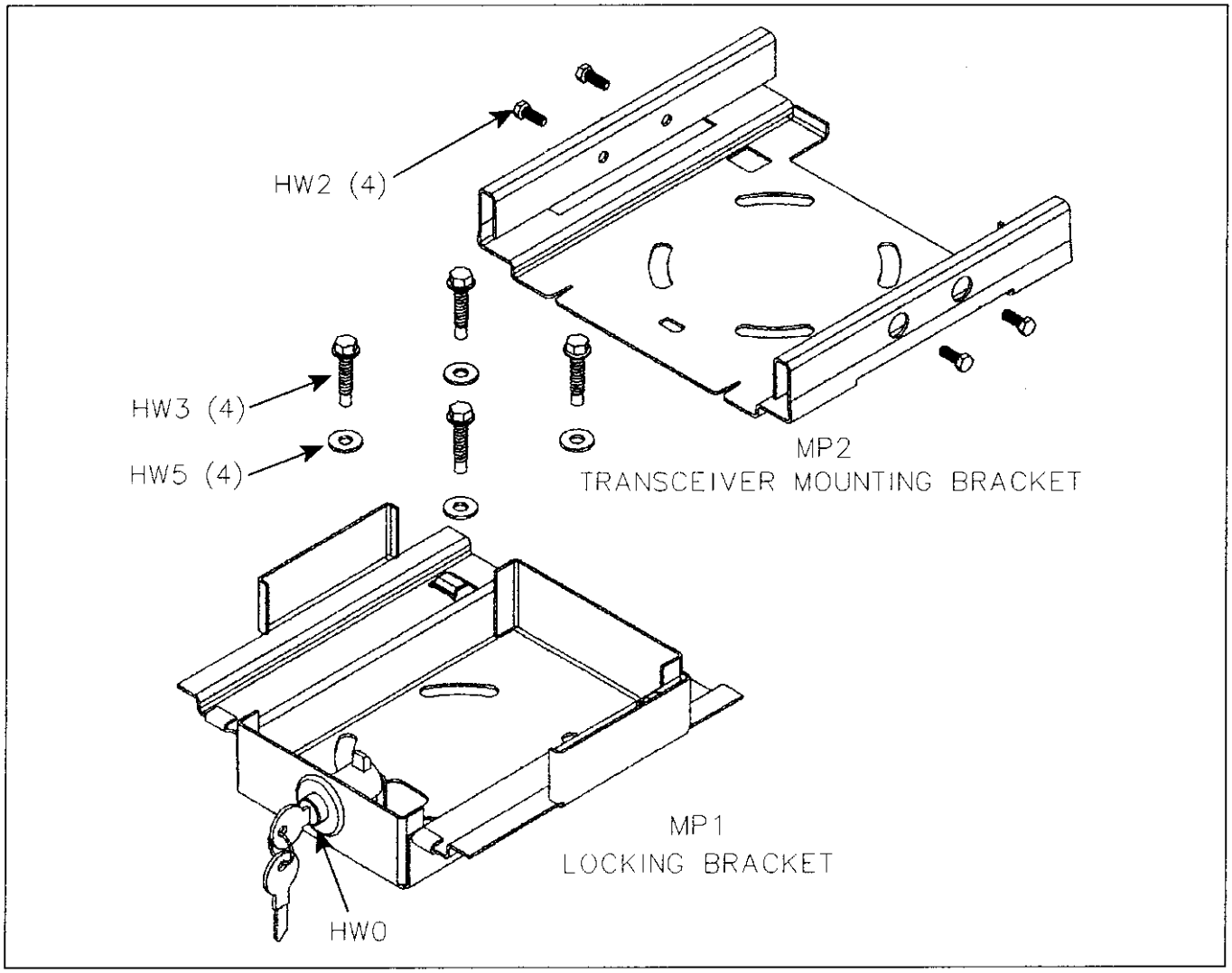


Figure 2-3 Locking Tray Installation Diagram

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SECTION 3 OPERATION

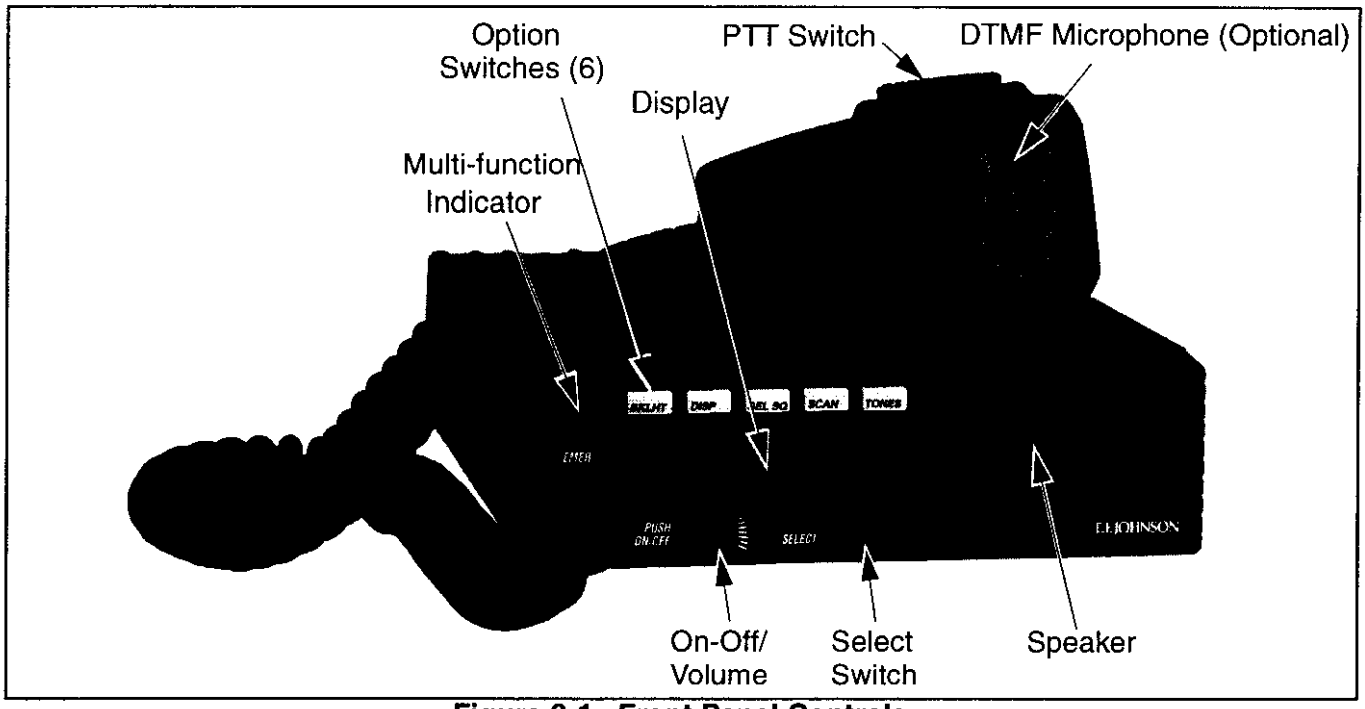


Figure 3-1 Front Panel Controls

3.1 FEATURES

3.1.1 GENERAL FEATURES

- Each channel programmable for one of the following operating modes:
  - Conventional analog or Project 25 (digital)
  - SmartNet™/SmartZone™ trunked analog or Project 25 (digital)
- Up to 16 zones with up to 16 channels each programmable (256 channels total)
- Large liquid crystal display (LCD) with backlight
- Six option switches that can be programmed with a different function for each operating mode (conventional and SmartNet)
- Standard and radio-wide scan modes
- Operation on both narrow and wideband channels
- Time-out timer

3.1.2 CONVENTIONAL FEATURES

- Each channel selects a different radio channel and squelch coding
- Repeater talk-around
- Normal/Selective squelch selected by microphone hanger or option switch
- Carrier, tone (CTCSS), or digital (DCS) controlled Call Guard® squelch on analog channels or NAC on Project 25 channels
- Penalty and conversation timers
- Priority channel sampling when scanning
- Busy channel lockout (Transmit Disable On Busy)
- ANI (Automatic Number Identification)
- SecureNet™ or 460 secure communication available on analog channels or DES-OFB on Project 25 channels
- User selectable high and low power output
- Individual ID calls on Project 25 channels
- Emergency switch

3.1.3 SMARTNET/SMARTZONE FEATURES

- Channels select talk groups
- Unit-to-unit and telephone calling
- Emergency alarms to alert dispatcher of emergency conditions
- Emergency calling for high priority system access
- Failsoft operation on a predefined conventional channel if trunked system fails

- Priority group calls detected while listening to other group calls
- Call alert (send and receive pages)
- Predefined messages (up to 16) can be sent to a dispatcher
- Predefined status conditions (up to 8) can be sent to a dispatcher
- Dynamic regrouping (dispatcher can automatically gather users on a channel to receive a message)
- Roaming (SmartZone only)
- SecureNet™ or 460 secure communication available on analog channels, DES-OFB available on Project 25 channels

NOTE: The availability of many of the preceding features is controlled by transceiver programming (see Section 4) and the capabilities of the radio system being accessed.

3.2 CONTROLS AND DISPLAY

NOTE: The controls and indicators described in the following information are shown in Figure 3-1.

3.2.1 FRONT PANEL CONTROLS

On-Off/Volume - Pressing this control turns power on and off, and rotating it sets the volume level.

Select Switch - Selects zones/channels and is also used for other functions such as selecting names from a call list. When selecting zones/channels, a bar above the zone or channel display indicates which is currently being changed (see Figure 3-3). To switch this bar between displays, press this switch, and to select zones or channels, rotate it (see Section 3.3.5).

Multi-function Indicator - This is a two-color LED that indicates the following:

Red (constant) - Transmitter keyed (PTT switch pressed).
Green (constant) - Busy condition (carrier detected in receive mode).

Option Switches - Each of the six options switches on the front panel (including the one located to the left of the display) can be programmed to control a function. Different functions can be programmed for each operating mode (conventional and SmartNet). Therefore, up to 12 different functions can be programmed. Refer to Section 3.4.1 for more information.

Speaker - An internal 16-ohm, 5-watt speaker is located behind the grille. An optional 4-ohm, 12-watt external speaker may be used if desired. The internal speaker is disabled when an external speaker is used.

PTT Switch - This push-button switch on the microphone is pressed to talk (key the transmitter) and released to listen.

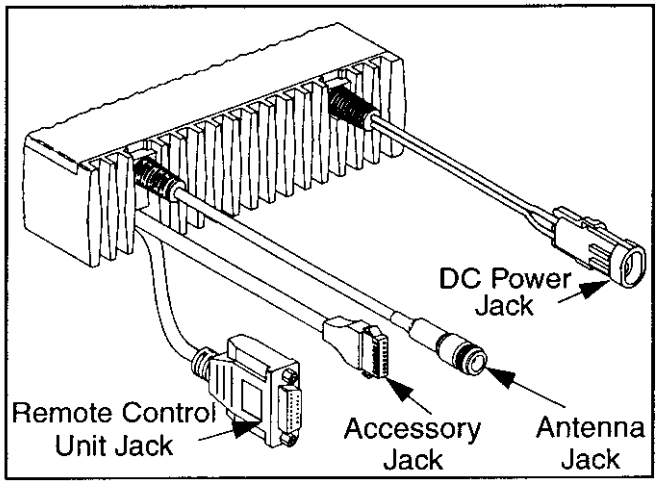


Figure 3-2 Rear Panel Jacks

3.2.2 REAR PANEL JACKS

DC Power Jack - Connection point for a nominal 12-volt, negative ground power source (see Figure 3-2).

Antenna Jack - Type N jack for connecting the 50-ohm antenna.

Accessory Jack - Connection point for optional accessories such as an external speaker, horn alert, and ignition sense line (see Section 2.4).

Remote Control Unit Jack - Connection point for a remote control unit (if used). This cable is optional with front-mount models.

3.2.3 DISPLAY

Zone Number - Indicates the currently selected zone from 1 up to 16 (see Figure 3-3). A zone is a collection of channels that can be any combination of the conventional and SmartNet/SmartZone types (see Section 1.2.4).

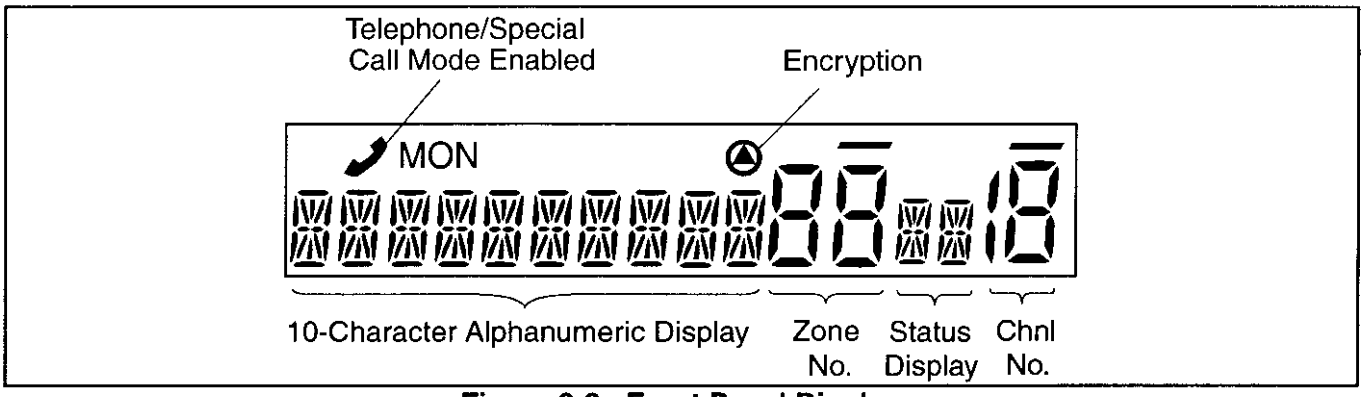


Figure 3-3 Front Panel Display

Channel Number - Indicates the currently selected radio channel (conventional) or talk group (SmartNet).

Alphanumeric Display - This 10-character area of the display indicates the alias (alpha tag) for the selected channel. It may also display other information such as the channel frequency (conventional) if certain option switches are programmed. It also displays various status and error messages.

Status Display - These two characters indicate the following status information:

- This rotating clock-like symbol in the left position indicates that scanning is occurring.

- This symbol in the right position indicates that the displayed channel is in the scan list (scanned normally).

- Indicates that the telephone call mode or other special call modes are selected.

- Indicates that voice encryption is enabled.

MON - Indicates that the conventional monitor mode is enabled by taking the microphone off-hook or pressing the MON switch (if available). This mode disables squelch control features so that all messages are heard on the channel (see Section 3.5.3).

- The lines above the zone and channel displays indicate which display is changed if the Select switch is turned. To switch between displays, press the Select switch (see Section 3.3.5).

3.3 GENERAL OPERATION

3.3.1 TURNING POWER ON

Turn power by pressing the On-Off/Volume knob. The multi-function indicator then flashes green, a series of beeps sound, and an initial greeting is indicated by the alphanumeric display. The zone and channel displays then indicate the currently selected zone and channel. Programming determines if the last selected or home zone is selected at power up.

3.3.2 BACKLIGHT

The backlight for the display and option keys can be programmed to automatically turn on with transceiver power or it can be disabled. If the Backlight option switch is programmed, the user can manually turn the backlight on and off.

3.3.3 SETTING VOLUME LEVEL

The relative volume setting can be determined by noting the index on the On-Off/Volume knob. Otherwise, a reference tone can be enabled as follows:

- If the key press tones are enabled (see Section 3.4.5), a short tone sounds when an option switch is pressed or the Select switch is pressed or rotated.

- If a conventional channel is selected, take the microphone off-hook and if someone is talking, voice is heard. If the Monitor option switch is programmed (see Section 3.5.3), pressing it unsquelches the transceiver and either voice or background noise is

heard. If a SmartNet/SmartZone channel is selected, the transceiver cannot be manually unsquelched.

3.3.4 ZONE/CHANNEL DISPLAY

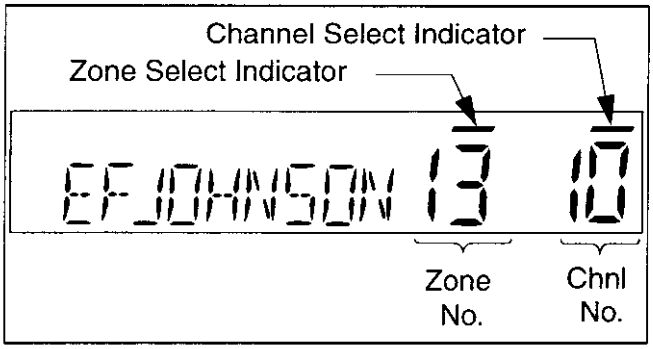
The selected zone and channel are displayed by the zone and channel displays shown in Figure 3-3. In addition, the unique alphanumeric identification (alias) programmed for the channel is displayed in the alpha-numeric display area. With conventional operation, the channel frequency may be displayed (see Section 3.5.10). Refer to Section 1.2.4 for more information on zones and channels.

3.3.5 ZONE/CHANNEL SELECT

The front panel Select switch is used to change the zone and channel. Pressing this switch toggles between the zone and channel select modes, and rotating it changes the zone or channel.

The current select mode is indicated by the bar over the zone or channel display (see below). For example, when the bar is over the zone display, the zone select mode is enabled. Rotating the Select switch clockwise increases the zone or channel and rotating it counterclockwise decreases the zone or channel number. After the highest zone or channel is displayed, wrap-around to the lowest zone or channel occurs and vice versa.

NOTE: When an unprogrammed channel is selected, "UNPROGRAMD" is displayed and a tone sounds.



Select Mode Indicators

The transceiver can be programmed so that the bar defaults to either the zone or channel display when power is turned on and after a change is made. The delay that occurs before it returns is programmable for 1-15 seconds or infinite ("infinite" causes it to remain in the last selected mode).

3.3.6 SETTING SQUELCH

This transceiver does not have a squelch control. The squelch level is preset during alignment and does not require readjustment by the user.

3.3.7 TRANSCEIVER OPERATING MODES

Each selectable channel can be programmed for any of the following modes. For example, Zone 1/ Channel 1 could be a conventional channel, Zone 1/Channel 2 a SmartNet channel, and so on. Refer to Section 1.2.4 for more information on systems, channels, and zones.

Conventional - This is a non-trunked operating protocol which accesses independent radio channels (there is no automatic access to several channels). Selecting a conventional channel selects a transmit and receive frequency and other channel parameters such as squelch control coding.

Conventional channels can be either standard (analog) or Project 25 (digital). With digital operation, the DSP (Digital Signal Processor) converts the audio signal to digital data which is sent over the air as complex tones. Another difference is that analog channels use Call Guard (CTCSS/DCS) squelch control and Project 25 channels use a NAC (Network Access Code). With NAC, a number similar to an ID code is transmitted, and for communication to occur, it must match one programmed in the base equipment and the mobile(s) being called.

With conventional operation, a busy channel condition is detected automatically if the busy channel lockout (transmit disable on busy) feature is programmed. Otherwise, it must be detected manually. An out-of-range condition is not indicated by special tones or messages as with SmartNet operation because there is no initial data exchange with the repeater that allows this condition to be detected. Operating features unique to conventional channels are described in Section 3.5.

SmartNet/SmartZone - This is a Motorola trunked protocol. Talk group ID codes are used to select what

mobiles are being called and what calls are received. Monitoring is also performed automatically and special messages and tones indicate busy and out-of-range conditions.

SmartNet and SmartZone operation and programming is very similar. Basically, SmartNet operation is limited to a single repeater site and SmartZone operation allows automatic roaming between sites.

Enhanced features available with this protocol include telephone, unit-to-unit, and emergency calls, call alert, messaging, and emergency calls. Either analog or digital (Project 25) signaling may be selected for each talk group. SecureNet™ or 460 secure communication is available with analog channels, and DES-OFB is available with digital channels. Operating features unique to SmartNet/SmartZone channels are described in Section 3.6.

3.4 RADIO-WIDE FEATURES

3.4.1 OPTION SWITCHES

The six option switches on the front panel (including the one to the left of the display) can be programmed to control different functions for each operating mode. Therefore, up to 12 different functions can be controlled by these switches (six each for conventional and SmartNet/SmartZone channels) The functions controlled in each mode and the section in which the function is described are as follows:

Conventional Option Switches

- Backlight (Section 3.3.2)
- Clear/Secure (Section 3.4.7)
- Digital TG Select (Section 3.5.14)
- Displayed Information (Section 3.5.10)
- Emergency (Section 3.5.11)
- Hi/Lo Power (Section 3.5.9)
- Home Zone (Section 3.4.3)
- Individual ID List (Section 3.5.14)
- Monitor (Section 3.5.3)
- Normal/Selective (Section 3.5.5)
- Priority (Section 3.5.12)
- Radio Wide Scan (Section 3.4.6)
- Repeater Talk-Around (Section 3.5.8)
- Scan (Section 3.4.6)
- Tones On/Off (Section 3.4.5)

SmartNet/SmartZone Option Switches

- Backlight (Section 3.3.2)
- Call Alert (Section 3.6.7)
- Call Response (Section 3.6.5)
- Clear/Secure (Section 3.4.7)
- Emergency (Section 3.6.10)
- Home Zone (Section 3.4.3)
- Message (Section 3.6.8)
- Nuisance Delete (Section 3.6.12)
- Phone (Section 3.6.6)
- Private Call (Section 3.6.5)
- Radio Wide Scan (Section 3.4.6)
- Scan (Section 3.4.6)
- Site Lock Function (Section 3.6.14)
- Site Search (Section 3.6.14)
- Status (Section 3.6.9)
- Tones On/Off (Section 3.4.5)

3.4.2 TIME-OUT TIMER

The time-out timer disables the transmitter if it is keyed for longer than the programmed time. It can be programmed for 15 seconds to 3 minutes, 45 seconds or it can be disabled. If the transmitter is keyed for longer than the programmed time, the transmitter is disabled, a continuous tone sounds, and "TX TIMEOUT" is displayed. Five seconds before time-out occurs, a warning beep sounds to indicate that time-out is approaching. The timer and tone are reset by releasing the PTT switch. A different time can be programmed for each system, and the timer can be enabled or disabled on each channel.

3.4.3 HOME ZONE SELECT

If the HOME zone option switch is programmed, it can be used to quickly select the preprogrammed home zone. The transceiver also can be programmed so that when power is turned on, either the home or last selected zone is automatically selected.

3.4.4 POWER TURN-OFF DELAY

The transceiver can be installed so that the vehicle ignition switch as well as the front-panel power switch controls transceiver power. This is done by connecting the accessory ignition switch wire to a power source switched by the ignition switch (see Section 2.4.3). Power off delays of 0-254 minutes or

Forever can then be programmed. This delay can be overridden at any time by turning power off using the front-panel power switch or turning the ignition switch back on.

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

3.4.5 TONE SELECT

The various alert tones that sound are described in Section 3.7. To toggle all these tones on and off, press the TONE option switch. When all tones are off, "TONE OFF" is momentarily displayed, and when all tones are on, "TONE ON" is momentarily displayed. If this switch is not programmed, tones are fixed in the on or off mode by programming.

3.4.6 SCANNING

Introduction

Scanning monitors the channels in the scan list for messages that the transceiver is programmed to receive. When a message is detected, scanning stops and the message is received. Shortly after the message is complete, scanning resumes (unless it has been disabled). Scanning occurs with the microphone off-hook. However, on conventional channels, selective squelch (such as CTCSS/NAC) is then disabled, so any call occurring on a scanned channel is detected.

There are two basic scan modes available: Standard and Radio Wide. The operation of the standard type is unique to the type of channel selected, and the operation of Radio Wide type is the same regardless of the type of channel selected. More information on these types of scanning follows.

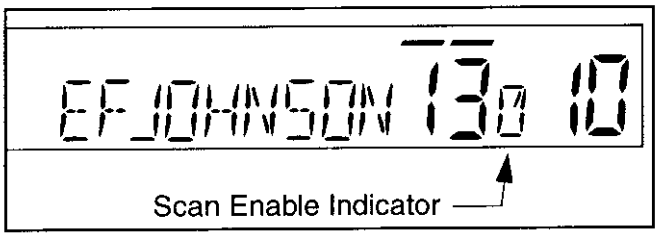
Standard Scanning

Standard scanning monitors only channels that are the same type as that currently selected (see "Scan Lists" which follows). More information on this type of scanning is located in the individual operating mode descriptions as follows:

Conventional Mode Scanning - Section 3.5.12
SmartNet Mode Scanning - Section 3.6.12

Standard scanning is turned on and off as follows:

- Briefly press the SCAN option switch. Scanning is enabled when "SCAN ON" is briefly displayed and a rotating is indicated in the left status display as shown below.



- To turn scanning off, briefly press the SCAN option switch again. Scanning is disabled when "SCAN OFF" is briefly displayed and is no longer indicated in the status display.

- If the zone or channel is changed while scanning is selected, scanning continues on the scan list programmed for the new channel.

Radio Wide Scanning

Radio wide scanning monitors the channels in the radio-wide scan list. This scan list can include up to 16 channels of any type and assigned to any zone (see "Scan Lists" which follows). Radio wide scanning is turned on and off by the RWD option switch as follows. If this switch is not programmed, radio wide scanning is not available.

- To turn radio wide scanning on, press the RWD option switch and "RWD ON" is briefly displayed. In addition, is displayed the same as with standard scanning.

- Only one type of scanning can be enabled. Therefore, it standard scanning is enabled when the RWD switch is pressed, it is automatically disabled and vice versa.

- To turn radio wide scanning off, press the RWD option switch again and "RWD OFF" is briefly displayed and  is no longer displayed.

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

Scan Resume Delay

When a message is received or transmitted while scanning, there is a 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 instead of another message occurring on some other channel.

With conventional systems, a delay of 0-7.5 seconds in 0.5-second steps can be programmed. With SmartNet/SmartZone systems, the delay is determined by the hangtime of the system. This delay is also used by other features such as to determine if a response occurs in the secure mode.

Transmitting in the Scan Mode

If the transmitter is keyed while scanning is enabled, transmissions occur on various channels as follows.

Conventional Operation - Transmissions can occur on the priority, selected, or receive channel. Refer to Section 3.5.12 for more information.

SmartNet/SmartZone Operation - If scanning is halted to receive a message, transmissions occur on the channel of the call. Transmissions made at other times occur on the selected channel.

Standard Mode Scan Lists

NOTE: The selected channel is always scanned.

Conventional Operation - Up to three scan lists, each containing up to 256 conventional channels, can be programmed for conventional operation. The list that is scanned is selected by the Scan option switch (see Section 3.5.12). Selecting another conventional channel does not change the scan list.

SmartNet/SmartZone Operation - Each SmartNet and SmartZone system can be programmed with up to three scan lists that can contain any combination of the possible 16 talk groups assigned to that system. Each SmartNet/SmartZone channel is then programmed to select one of these lists.

Radio Wide Mode Scan List

With radio wide scanning, there is only one scan list available regardless of the type of channel selected. This scan list can contain up to 16 channels of any type. For example, it could include six conventional channels and ten SmartNet/SmartZone channels.

Scan List Channel Add/Delete

All scan lists are preprogrammed and new channels cannot be added by the user. However, channels can be temporarily deleted from a scan list. For example, a channel may be deleted if the messages on it become annoying. Proceed as follows:

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

1. While receiving a message on the channel to be deleted, press and hold for approximately 2 seconds the option switch used to enable scanning (SCAN or RWD).

2. After the channel is deleted, scanning of the remaining channels in the scan list resumes.

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

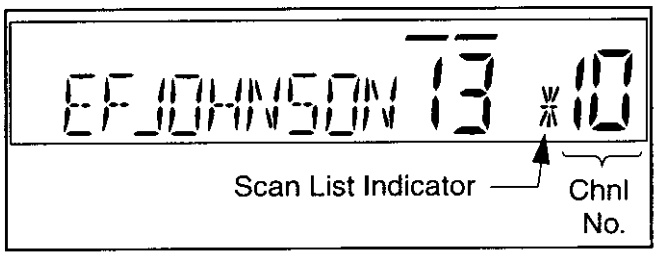
   - Scanning is turned off and then on again using the scan switch.
   - Transceiver power is turned off and then on again.
   - When standard scanning, if another scan list is selected such as by changing channels (SmartNet/SmartZone) or using the Scan List Select switch (conventional).

Determining Which Channels are in Scan List

The channels in the radio-wide and conventional scan lists are indicated as follows. Channels in the SmartNet/SmartZone lists are not indicated.

1. To view the conventional scan list, enable standard scanning by pressing the Scan switch. Likewise, to view the radio wide scan list, enable radio wide scanning by pressing the RWD switch. With conventional scanning which can have up to three lists, also select the scan list if applicable (see Section 3.5.12).

2. Select the desired zone and then scroll through the channels by rotating the Select switch. When the displayed channel is in the scan list (scanned normally), the W symbol is displayed next to the channel number as follows.



3.4.7 SECURE COMMUNICATION

This transceiver may be equipped to provide secure communication on some or all channels. This feature encrypts your voice so that it can be understood only by someone using a transceiver equipped with a similar encryption device and encryption codes.

When a secure call is received or transmitted, is indicated in the display. If equipped with the Clear/Secure option switch and the current channel is programmed to allow switch selection, secure communication can be manually enabled and disabled by that switch. Secure communication can be programmed on a per channel basis to operate in various ways. Refer to the following sections for more information:

Conventional Mode - Section 3.5.15
SmartNet/SmartZone Mode - Section 3.6.15

3.5 CONVENTIONAL MODE FEATURES

3.5.1 INTRODUCTION

An overview of the conventional and SmartNet/SmartZone operating modes is located in Section 3.3.7. The following information describes the features unique to conventional operation (both analog and digital (Project 25). Refer to the preceding section (3.4) for information on features common to all operating modes.

3.5.2 MONITORING BEFORE TRANSMITTING

With conventional operation, you may need to manually monitor the channel before transmitting to make sure that it is not be used by someone else. With SmartNet/SmartZone operation, monitoring is always performed automatically. Monitor conventional channels automatically or manually as follows:

Automatic Channel Monitoring

If the selected channel is programmed with the Busy Channel Lockout (Transmit Disable On Busy) feature, monitoring is performed automatically. Refer to Section 3.5.4 for more information on this feature.

Manual Channel Monitoring

The automatic monitoring just described may occasionally disable the transmitter when the channel is not in use, such as if the repeater has extended hang time. In this case, you may not want to use it and the channel must then be monitored manually as follows:

Busy Indicator - With scanning disabled, note if the multi-function indicator on the front panel is steady green (see Figure 3-1). If it is not, the channel is not being used and a call can be transmitted. It it is green, a carrier is being detected.

Monitor Mode - If the busy indication is displayed, the channel can be monitored to see if someone is actually using it (see next section).

3.5.3 MONITOR MODE

Taking the microphone off-hook disables Call Guard squelch (or NAC with Project 25 channels) so that all messages occurring on the channel are heard (unless off-hook detection is disabled by programming). In addition, if the Normal/Selective option switch is programmed, it can be used to monitor the channel. Refer to Section 3.5.5 for more information on this switch. When monitoring is enabled by either of these methods, the receiver unsquelches only if a carrier is present.

If the Monitor option switch is programmed, pressing it unsquelches the receiver so that all traffic on the channel can be monitored. Pressing this switch briefly monitors the receive frequency, and pressing it for at least 2 seconds monitors the transmit frequency. To re-enable normal operation, briefly press the Monitor switch again. When monitoring is enabled by this switch, "MON" is indicated in the display and scanning is disabled.

3.5.4 BUSY CHANNEL LOCKOUT

The Busy Channel Lockout (also called Transmit Disable on Busy) feature automatically disables the transmitter if the channel is busy when the PTT switch is pressed. When the transmitter is disabled by this feature, "BUSY" is displayed, a busy tone sounds, and the transmitter is disabled.

The Busy Channel Lockout feature can be programmed to operate as follows. Each conventional channel can be programmed differently.

Off - Busy channel lockout is disabled and the transmitter keys even if the channel is busy.

Noise - If a carrier is detected on the channel, the transmitter is disabled when the PTT switch is pressed.

Tone (NAC) - If an incorrect Call Guard (CTCSS/DCS) or NAC code (see Section 3.5.14) is detected, the transmitter is disabled when the PTT switch is pressed. An incorrect code is any code other than the one programmed for the current channel.

Tone (NAC) w/Lockout - Like "Tone" above except transmitting is permitted if the "Normal" condition is selected by the Normal/Selective option switch (see next section).

3.5.5 CALL GUARD SQUELCH

Introduction

Tone or digital Call Guard squelch (also called CTCSS/DCS signaling) can be programmed on each conventional analog transmit and receive channel in any order desired. The reverse burst and turn-off code are always transmitted and also detected on channels programmed with Call Guard squelch.

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

Call Guard Squelch Enable/Disable

The Normal/Selective option switch (if programmed) can be used to temporarily disable receive Call Guard squelch on the current channel. When Call Guard squelch is disabled, "NORMAL" is flashed in the display. Conversely, when it is enabled, "SELECTIVE" is flashed. It is automatically re-enabled on the channel when another channel is selected or transceiver power is turned off and on.

Tone Call Guard Squelch

Tone-type Call Guard squelch utilizes subaudible CTCSS tones from 67-254.1 Hz. Although there are 42 tones assigned, those above 33 (210.7 Hz) are normally not used because of their close proximity to the voice band which starts at 300 Hz. In addition, tones 11 (97.4 Hz), 39 (69.3 Hz), 40 (206.5 Hz), 41 229.1 Hz), and 42 (254.1 Hz) are normally not used because they may cause interference with adjacent tones.

A reverse burst is transmitted when the push-to-talk switch is released and also detected when calls are received. It is a 180-degree phase reversal for a period of time determined by the tone frequency, and it eliminates the squelch tail (noise burst) in the receiving transceiver. Both the transmitting and receiving transceiver must be equipped with this feature for it to be utilized.

Digital Call Guard Squelch

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

turn-off code is transmitted which eliminates the squelch tail similar to the reverse burst.

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

3.5.6 PENALTY TIMER

A penalty timer may be programmed on conventional systems to prevent transmissions for the programmed time after the time-out timer disables the transmitter (see Section 3.4.2). The penalty timer can be programmed for the same times as the time-out timer, and timing starts when the PTT switch is released. If the PTT switch is pressed during the penalty time, the time-out indication occurs again. When the penalty timer expires, a beep sounds and the transmitter can be keyed.

3.5.7 CONVERSATION TIMER

A conversation timer can be programmed on conventional systems in addition to the time-out timer (see Section 3.4.2). This timer limits that total length of a conversation rather than just the length of each transmission as with the time-out timer. The following is more information on this timer.

- It can be programmed for times up to 7.5 minutes.
- It is reset when the time between transmissions exceeds the time programmed for the penalty timer.
- A warning beep sounds 5 seconds before this timer disables the transmitter.
- When this timer disables the transmitter, a continuous tone sounds and the red transmit indicator turns off. The PTT switch must then be released until the penalty timer expires (indicated by a beep).

3.5.8 REPEATER TALK-AROUND

Normally, all transmissions go through a repeater which usually increases range. However, there may be times when a mobile is out of range of the repeater and therefore unable to talk to anyone even though the mobile being called is only a short distance away. To allow communication in this situation, repeater talk-around can be selected. Transmissions then occur on the receive frequency which permits direct mobile-to-mobile communication.

Repeater talk-around can be selected if the RTA option switch is programmed. When talk-around is enabled by this switch, "RTA ON" is flashed in the display, and when it is disabled, "RTA OFF" is flashed. This feature remains enabled during scanning, but changing channels or turning power off causes it to revert to the off condition. Talk-around is available on conventional channels only.

3.5.9 POWER OUTPUT SELECT

Each conventional channel can be programmed for high, low, or switchable power. If the High/Low Power option switch is programmed and selectable power is programmed on the current channel, high and low transmitter power can be selected. All models support high/low power.

Pressing this switch toggles the power setting. The new level is flashed in the display when this switch is pressed as either "HIGH POWER" or "LOW POWER". If selectable power is not permitted on the current channel, the programmed power level is flashed and no power change occurs.

3.5.10 DISPLAYING TX/RX FREQUENCY

If the Displayed Information option switch is programmed (see Section 3.4.1), it can be used to display the channel frequency in megahertz. Pressing this switch toggles between displaying the standard channel alias and the channel frequency. The receive frequency is displayed when receiving and the transmit frequency is displayed when transmitting. This feature is available on conventional channels only.

3.5.11 EMERGENCY MODE

An Emergency option switch may be programmed on conventional channels to alert a dispatcher or someone else of an emergency condition.

When this switch is pressed with an analog channel selected, a Transcrypt emergency packet (SC-460 emergency) is sent up to 20 times or until an acknowledgment is received.

When this switch is pressed with a Project 25 (digital) channel selected, all transmissions have the emergency flag set. Scanning is disabled and the transceiver remains in the emergency mode until power is cycled.

3.5.12 CONVENTIONAL MODE SCANNING

General

Channel scanning features common to all operating modes are described in Section 3.4.6. The following information describes features unique to conventional operation.

Scan Lists

Up to three scan lists are selectable when standard scanning with a conventional channel selected. The channels in these lists can be programmed only by the programming software, and each list can include up to 256 conventional channels. Scan lists are selected by repeatedly pressing the Scan option switch. For example, the first press of the Scan switch activates scan list 1, the second press activates scan list 2, the third press activates scan list 3, and the last press disables the scan mode. The currently selected scan list is flashed in the display as "SCAN x", where "x" is the scan list number.

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 "Priority Channel Sampling" which follows 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.

Priority Channel Sampling

The priority channel sampling feature ensures that messages on the priority channel are not missed while listening to a message on some other channel. The transceiver can be programmed as just described so that the priority channel is a fixed channel programmed in the current scan list, the currently selected channel, or not used.

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 conventional 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) or NAC 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.

3.5.13 PLACING AND RECEIVING CONVENTIONAL CALLS

NOTE: A DTMF microphone is required to place conventional mode telephone calls.

Placing a Standard Conventional Call

1. Turn power on and set the volume as described in Sections 3.3.1 and 3.3.3. Select the channel programmed for the mobile you want to call as described in Section 3.3.5.

2. Monitor the channel automatically or manually as described in Section 3.5.2.

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

   - If the Busy Channel Lockout feature is programmed on the channel (see Section 3.5.4), the transmitter is automatically disabled if the channel is busy.
   - 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. When the call is finished, place the microphone back on-hook.

Receiving a Standard Conventional Call

1. Select or scan the channel programmed for the call you want to receive (refer to Sections 3.4.6 and 3.5.12 for more scanning information).

2. When the call is received, take the microphone off-hook and press the PTT switch to talk and release it to listen. If scanning, responses may occur on the priority, selected, or receive channel as described in Section 3.5.12.

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

3.5.14 PROJECT 25 MODE FEATURES

Individual, Group, and NAC Codes

Individual ID - Each transceiver that operates on Project 25 (digital) channels is programmed with an 8-digit individual ID. This ID is unique for each transceiver and can be any number from 1-16777216. When power is turned on with a Project 25 channel selected, this ID is briefly displayed.

Group ID - Each Project 25 channel is programmed with a group ID that determines which group of mobiles will receive the call. A call is received if any Project 25 channel is programmed with that group and the correct NAC is detected (see following description). Group IDs can be any number from 0-4095.

NAC - Project 25 conventional channels use a NAC (Network Access Code) instead of Call Guard squelch coding (see Section 3.5.5) to control which calls are received on a channel. The NAC can be 0-4095, and each transmit and receive channel can be programmed for a different code. Other operation, such as monitoring before transmitting, is similar to that of standard analog channels.

To receive a Project 25 group call, the talk group programmed with the group ID being transmitted must be selected or scanned. In addition, the receive NAC programmed for that channel must be detected. An exception is if the receive NAC in the receiving radio is 659 (293 hex). The receiving radio then basically ignores the NAC so that all NACs can be received on a talk group.

Changing Talk Group Assigned To A Channel

Group calls are placed by simply selecting the channel programmed for the desired group, monitoring the channel if required, and transmitting. If the Digital TG Select option switch is programmed, the talk group

assigned to a channel can be permanently changed by the user. Therefore, the new talk group continues to be assigned to the channel even after radio power is cycled or another channel is selected. To change a channel talk group, proceed as follows:

1. Select the channel to be changed and then press the Digital TG Select option switch.

2. Rotate the Select switch until the alias (alphatag) of the desired talk group is displayed.

3. To select that talk group and return to normal operation, press the TG Select option switch again or press the Select switch. If talk group selection has been disabled on the channel by programming, "NO LIST" is displayed and a tone sounds.

Individual Calls

Individual calls can be placed to a specific radio on Project 25 channels if the Individual Call option switch is programmed. With these calls, only the individual ID of the target radio is sent (a talk group ID is not sent). When this call is received, the individual ID of the calling radio is transmitted back. Responses can be made without changing the selected channel as long as they are made before the call timer times out (set by programming) or the channel is changed. To place an individual call, proceed as follows:

1. Press the Individual ID List option switch and the alias (tag) of the last individual call is displayed.

2. If required, rotate the Select switch to display the desired number. The alias (alphatag) of each number is displayed.

3. Press the PTT switch and begin talking.

The transceiver can be programmed to display the following when an individual call is received (see Section 3.3.4).

- Alias (or freq.) of the currently selected talk group
- Alias of the talk group on which the call is being received
- ID of the mobile placing the call

3.5.15 CONVENTIONAL SECURE COMMUNICATION

Introduction

There are two different protocols that can be used to provide secure communication on conventional analog channels: SecureNet™ and 460 scrambling. More information on these protocols follows.

SecureNet

SecureNet is a proprietary Motorola protocol that digitizes the voice and then encrypts it using the DES algorithm. It provides the highest level of security. There are two DES protocols:

- DES (CFB) uses cipher feedback DES encryption. A disadvantage of this type is reduced communication range when compared to clear voice.

- DES-XL uses counter addressing feedback DES. It provides better range but at lower voice quality.

The transmission mode (DES or DES-XL) is selected by the programming software for each SecureNet analog channel. If a channel is programmed for DES-XL, it will also receive DES, but transmissions always occur in DES-XL.

Each SecureNet capable channel is assigned an encryption number from 0-15. The key corresponding to this number is loaded into the radio using the Motorola key loader. There is a maximum of 16 keys that can be loaded into the radio at one time.

Transmissions on an analog channel are in the clear mode if the channel has been strapped to the clear mode by programming, and in the SecureNet mode if it has been strapped to SecureNet. If the channel has been strapped to "switched", the mode is selected by the Clear/Secure option switch. When a message is received or transmitted in the secure mode,  is displayed.

If an attempt is made to transmit a secure message without loading the corresponding key, "KEYFAIL" is displayed. The message must then be

transmitted in the clear mode (this is possible only if the channel is strapped to "switchable") or the key must be loaded.

460 Scrambling

The 460 Scrambling protocol is a proprietary Transcrypt protocol that is compatible with the stand-alone scrambling option from Transcrypt. If equipped with the 460 Scrambler, a Clear/Secure option switch may be programmed. Pressing this switch changes the transmission mode for the selected channel and momentarily displays either "CLEAR" or "SECURE".

In the coded mode, transmissions are in scrambled voice on any 460-enabled channel and the mobile receiving the call automatically responds in the scrambled mode because the receiver automatically switches between the clear and coded modes.

Although 16 generic codes are loaded, only one is active and all 460-enabled channels use this code. The 460 scrambling option also provides several other signaling enhancements including Digital ID, Automatic Status and Location Update, Individual and Group ID calling, and Emergency.

Transmit Mode Options

Either the SecureNet or 460 protocol can be selected, and then the following transmit options are available for each:

Clear - All calls are in the clear mode unless responding to a secure call. If the response is then made within the delay time (see Section 3.4.6), it occurs in the secure mode.

Coded - All calls are made in the selected secure mode.

Switched - The mode is selected by the Clear/Secure switch. With 460 scrambling, if responding to a secure call, the secure mode is automatically selected if the response occurs within the delay time. When the clear mode is selected by this switch, "CLEAR" is flashed, and when the secure mode is selected, "SECURE" is flashed.

Receive Mode Options

With 460 scrambling, clear and scrambled signals are always autodetected. In addition, the user can switch between the clear and secure mode at any time using the Clear/Secure option switch. SecureNet signals are unintelligible when 460 scrambling is used and vice versa.

With the SecureNet protocol, the following receive options can be programmed:

No Autodetect - Only signals coded like the transmit signals are received.

Secure Autodetect - Both clear and SecureNet signals are automatically detected. This mode is automatically selected if the transmit mode is switch selectable.

Proper Key Autodetect - An incoming Securenet call is compared against all of the available keys programmed into the radio. If a match is found, the call is decrypted using matched key.

Project 25 (Digital) Channels

Project 25 digital channels use the DES-OFB protocol. Using this protocol on digital channels does not result in the degraded range that occurs with analog channels. The same transmit mode options are available as with the preceding analog operation. In the receive mode, clear and secure messages are always automatically detected.

3.6 SMARTNET/SMARTZONE FEATURES

3.6.1 INTRODUCTION

An overview of the SmartNet/SmartZone operating mode is located in Section 3.3.7. The following information describes the features unique to the SmartNet and SmartZone modes of operation. Refer to Section 3.4 for information on features common to all operating modes.

3.6.2 ANALOG AND DIGITAL OPERATION

Either analog or Project 25 (digital) operation can be selected for communication on SmartNet traffic

channels. Each talk group can be programmed for either type of operation.

3.6.3 VIEWING UNIT ID

When power is turned on with a SmartNet/SmartZone channel selected, the six-digit Unit ID is briefly displayed as IDxxxxxx.

3.6.4 GROUP CALLS

Placing a Group Call

1. Turn power on and set the volume as described in Sections 3.3.1 and 3.3.3. Select the channel programmed for the talk group you want to call (see Section 3.3.5). A regular or announcement talk group can be selected.

2. If the talk group is not strapped to Clear or Coded, select the desired mode by pressing the Clear/Secure option switch. The status of that switch is ignored if the talk group is strapped to Clear or Coded. Refer to Section 3.6.15 for more information.

3. Press the PTT switch and begin talking. A talk permit tone may sound to indicate when talking can begin. Events that may occur are as follows:

   - If in the secure mode and your transceiver is not programmed with the proper encryption key, "KEYFAIL" is displayed and the call must be made in the clear mode or the proper key must be programmed.

   - 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.

   - If a continuous tone sounds and "NO SYS" is displayed, you may be out-of-range. Drive closer or away from shielding objects and try again.

   - If your unit ID is invalid, the call is being made to an invalid group ID, group calls are not enabled, or the selected talk group is not programmed for the selected secure mode, "DISABLED ID" is displayed and an alert tone sounds.

   - If an attempt is made to change an analog call from the clear to secure mode and there is no available secure channel, "NO SEC" is flashed and the call continues in the clear mode.

   - If an attempt is made to change an analog channel from the secure to clear mode, "SEC ONLY" is displayed and the call continues in the secure mode. (Calls on digital channels can be changed if not strapped.)

Receiving a Group Call

Group calls are automatically received if a SmartNet/SmartZone channel is selected. The display alternates between the selected channel alias (alphatag) and the received talk group alias.

3.6.5 UNIT-TO-UNIT CALLS

Unit-to-unit calls allow calls to be placed to a specific mobile unit. Either the Enhanced Private Conversation™ or Private Conversation II™ modes may be programmed. Operation in each mode is as follows:

Placing a Unit-To-Unit Call
(Private Conversation II)

1. Momentarily press the Private Call option switch. The alias of the last called mobile is displayed.

2. If required, select another mobile by rotating the Select switch until the alias for the desired mobile is displayed.

3. Press the PTT switch. Events that may occur are as follows:

   - The called party answers the call.

   - The called party does not answer. Press the Private Call option switch to end the call.

   - If the selected mobile ID is not valid, "INVALID" is displayed and an alert tone sounds.

   - If the call is in the secure mode and the transceiver does not have the proper encryption key, "KEYFAIL" is displayed and the call must be made in the clear mode by pressing the

Clear/Secure option switch (if strapped to switchable). Otherwise, load the correct key.

4. When the call is finished or if it is not answered, end it by pressing the Private Call option switch and placing the microphone on-hook.

Placing a Unit-To-Unit Call
(Enhanced Private Conversation)

1. Momentarily press the Private Call option switch. The alias of the last called mobile is displayed.

2. If required, select another mobile by rotating the Select switch until the alias for the desired mobile is displayed.

3. Press the PTT switch. Events that may occur are as follows:

   - If the mobile being called is on the air, "WAIT" is displayed and ringing is heard until the called party answers or for 20 seconds, whichever occurs first. When the call is answered, the voice of the called party is heard.

   - If the called mobile does not answer within 20 seconds, a continuous tone sounds and "NO ANS" is displayed.

   - If the called mobile is not on the air, a continuous tone sounds instead of the ringing tone and "NO ACK" is displayed.

   - If the busy tone sounds and "BUSY" is displayed, the called mobile has answered the call but the system is busy. When the system is no longer busy, the call back tone sounds.

   - If your transceiver or the called transceiver is inhibited or not programmed to make this type of call or for the requested secure mode, "REJECT" is displayed and an alert tone sounds.

   - If your transceiver does not have the proper encryption key, "KEYFAIL" is displayed and the call must be made in the clear mode by pressing the Clear/Secure option switch (if strapped to switchable). Otherwise, load the correct key.

4. When the call is finished or is not answered, end it by pressing the Private Call option switch and placing the microphone back on-hook.

Receiving a Unit-To-Unit Call

1. When a unit-to-unit call is received, "CALL" is displayed and a recurring call tone sounds.

2. To answer the call, press the Private Call option switch and then the PTT switch and begin speaking. The unit ID of the calling mobile is displayed. More information follows:

   - If the PTT switch is pressed before the Private Call option switch, the call is transmitted as a group call.

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

   - The call must be answered within 20 seconds or it is automatically terminated.

   - If the system is busy when a response is made, "BUSY" is displayed and the busy tone sounds.

3.6.6 TELEPHONE CALLS

The telephone call feature allows telephone calls to be placed and received over the public telephone system using your transceiver. The type of call (secure/clear) is determined by the mode selected by the Clear/Secure option switch. Telephone calling is programmed to operate in one of the following modes:

- Disabled
- Answer-only capability
- Telephone numbers can be recalled from memory only

Placing a Telephone Call by Recalling a Number From Memory

1. With a SmartNet/SmartZone channel selected, momentarily press the Phone option switch. The alias of the last called telephone number is displayed.

2. If required, rotate the Select switch to display the desired number. The alias of each number is displayed.

3. Press and release the PTT switch and "DIALING" is displayed. Events that may occur are as follows:

   - If the access is successful, a dial tone sounds and the dialed number is displayed and sent. Either ringing or a busy signal is then heard as with a standard telephone call. When the called party answers, press the PTT switch to talk and release it to listen (since the transceiver is half-duplex, it is not possible to talk and listen at the same time). Each time the PTT switch is released, a go-ahead tone is sent to the landside party to indicate when they can respond. To dial a number after the connection is made, press the PTT switch and dial the number using the microphone keypad.

   - If the selected telephone number is not valid, "INVALID" is displayed and an alert tone sounds. Select a valid number.

   - If the system is busy, "BUSY" is displayed and the busy tone sounds. The call will automatically proceed when the system becomes available.

   - If you are out-of-range or the radio cannot be accessed for some reason, "NO PHONE" is displayed and an alert tone sounds.

   - If the interconnect call you are making or the selected secure mode is not authorized, "REJECT" is displayed and an alert tone sounds.

   - If your transceiver does not have the proper encryption key, "KEYFAIL" is displayed and the call must be made in the clear mode (press the Clear/Secure option switch).

4. When the telephone call is finished or if it could not be completed for some reason, end it by pressing the Phone option switch and placing the microphone back on-hook.

Answering a Telephone Call

1. When a telephone call is received, "ringing" similar to a standard telephone is heard and "PHONE" is displayed.

2. To answer the call, press the Phone option switch and press the PTT switch to talk and release it to listen (since the transceiver operates half duplex, it is not possible to talk and listen at the same time).

3. When the call is finished, end it by pressing the PHONE option switch and placing the microphone back on-hook.

3.6.7 CALL ALERT

The call alert feature allows pages to be sent and received. Your transceiver may be programmed to answer pages in the Private Conversation II™ or Enhanced Private Conversation™ modes. The operation differences are noted in the procedure which follows.

Answering a Page

1. When a page is received, four beeps sound and "PAGE" is displayed. The ID of the mobile paging you is stored as the last ID received.

2. To clear or ignore the page, press any option switch. If the PTT switch is pressed, a group call is placed on the selected channel.

3. To answer the page as a unit-to-unit call (see page 15), press the Private Call option switch and the alias of the mobile paging you is displayed. Press the PTT switch and respond. One of the conditions that follow may also occur:

Private Conversation II Mode

   - If the mobile being called is not on the air or does not answer, you will simply not hear a response.

Enhanced Private Conversation

   - If the mobile being called is on the air, ringing is heard until the called party answers or for 20 seconds, whichever occurs first. If no answer occurs within 20 seconds, "NO ANS" is displayed.
   - If the mobile being called is not on the air, no ringing is heard and "NO ACK" is displayed.

4. When the call is finished or it could not be completed for some reason, end it by pressing the

Private Call option switch and placing the microphone back on-hook.

Initiating a Page

1. With a SmartNet/SmartZone channel selected, momentarily press the Call Alert option switch. The alias of the last ID called is displayed.

2. If required, rotate the Select switch to display the desired mobile. The alias of each number is displayed.

3. Press the PTT switch and one of the following occur:

   - If a continuous tone sounds, the system received the page but the called mobile is not on the air. Try again later or cancel the page by pressing the Call Alert switch again.

   - If the called mobile does not answer within 6 seconds, a continuous tone sounds and "NO ACK" is displayed. Try again later or cancel the page by pressing the Call Alert switch again.

   - If five beeps sound, the system received the page and the paged mobile is on the air and received it. The page mode is automatically exited.

3.6.8 MESSAGING

The messaging feature allows preprogrammed messages to be sent to a dispatcher. Up to 16 messages can be preprogrammed, and they are identified by an 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. If required, rotate the Select switch to display the desired message. Then send the message by momentarily pressing the PTT switch. One of the following events then occurs:

   - If five beeps sound, the message was received and acknowledged by the dispatcher.

   - If after 6 seconds, the message is not acknowledged, a tone sounds and "NO ACK" is displayed. Press and release the PTT switch to send it again or press the Message option switch to exit the messaging mode.

3.6.9 SENDING STATUS CONDITIONS

The status feature allows you to manually or automatically send your current status to your dispatcher. Up to eight status conditions can be preprogrammed, and they are identified by an alias. If the Status option switch is programmed, status conditions are sent as follows:

1. Momentarily press the Status option switch. The alias of the current status condition is displayed.

2. To change the current status, rotate the Select switch until the desired status is displayed. Then press the Select switch to accept that status.

3. You can wait to send the current status until polled by the dispatcher or it can be sent immediately by briefly pressing the PTT switch. One of the following events then occurs:

   - If five beeps sound, the status was received and acknowledged by the dispatcher

   - If after 6 seconds, the message is not acknowledged, a tone sounds and "NO ACK" is displayed. Press and release the PTT switch to send it again or press the Status option switch to exit this mode and return to normal operation.

3.6.10 EMERGENCY ALARM/CALL

An emergency alarm is a special data transmission to alert the dispatcher of an emergency situation. An emergency call is an urgent request for access to a voice channel. It is placed if the PTT switch is pressed during an emergency alarm condition. The Emergency option switch must be programmed to have these features. Proceed as follows:

1. With a SmartNet/SmartZone channel selected, press and hold the Emergency option switch for at least 2 seconds.

2. The emergency mode is then indicated by a red front panel LED and "EMERGENCY" in the display. The emergency alarm is transmitted on the preprogrammed emergency talk group or announcement group (which can be different for each channel).

   NOTE: The transceiver may be programmed for silent emergency. If this is the case, no audio and visual emergency indications occur such as those just described.

3. When the emergency alarm is acknowledged, four beeps sound (unless silent emergency is programmed) and normal operation resumes. To cancel the emergency alarm before this occurs, press the Select switch.

4. To transmit and emergency call, simply press the PTT switch after pressing the Emergency option switch (but before the acknowledgment is received).

3.6.11 FAILSOFT OPERATION

If a failure occurs in the SmartNet/SmartZone system so that it cannot be used, the transceiver automatically enters the failsoft mode. When in this mode, "FAILSOFT" and the alias of the selected channel are alternately displayed.

When in the failsoft mode, operation is in the conventional mode on the preprogrammed failsoft channel (a different failsoft channel can be programmed on each talk group). If a transmission is attempted before a failsoft channel is located, a continuous tones sounds until the PTT switch is released. When the radio system returns to normal operation, this is automatically detected and normal operation resumes. The secure mode is controlled by the Clear/Secure option switch and indicated by ⓐ in the display. Secure calls are always automatically detected.

3.6.12 SMARTNET/SMARTZONE SCANNING

General

Scanning on a SmartNet/Smartzone system is similar to the standard scanning described in Section 3.4.6. Each SmartNet/SmartZone system can be programmed with up to three scan lists with each including up to 15 channels plus a priority channel. One of these lists can then be selected for each SmartNet channel. In addition, autoscanning can be selected on each channel. Scanning then automatically begins on that channel when it is selected. It is not necessary to press the Scan option switch.

Messages on the priority channel are received while listening to lower priority messages. However, unit-to-unit and telephone calls are not interrupted by priority messages. Pages, unit-to-unit calls, and telephone calls are received while scanning.

Nuisance Channel Delete

If messages on a talk group become annoying, that talk group can be temporarily removed from the scan list by pressing the Nuisance Delete option switch. The deleted talk group is added back into the scan list when power is cycled, scanning is turned off, or another channel is selected (see Section 3.4.6). With radio-wide scanning, the RWD option switch is used to delete channels as described in Section 3.4.6.

3.6.13 DYNAMIC REGROUPING

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

1. When this command is received, alternating tones sound for 5 seconds and the transceiver automatically changes to the regrouping channel and the display indicates the alias of the channel.

2. Manually select the channel corresponding to that alias. If this is not done, transmission still occurs on the new channel, but the alternating tones sound each time the PTT switch is pressed.

3. Talk and listen as usual. The dispatcher will cancel dynamic regrouping. If a standard channel is not selected after this occurs, an error tone periodically sounds.

3.6.14 SMARTZONE FEATURES

Introduction

As described in Section 3.3.7, 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:

Busy Override

The busy override feature allows a call to be placed even if not all sites you are calling have a free traffic channel. The only sites guaranteed to be included are the Critical Sites and the sites where a Critical User is located. This feature is enabled and disabled by the system manager, and it operates as follows:

1. Assume that you have attempted to place a call and the system was busy ("BUSY" displayed and busy tone sounded).

2. Release the PTT switch and then press it for 5 seconds or more. If a chirp tone sounds with the PTT switch pressed, busy override is occurring.

   NOTE: Remember that not all members of the talk group are receiving your message. Missing members will start receiving your message as channels become available.

Site Trunking

Site trunking occurs when a site can no longer participate in wide area trunking. When site trunking is occurring, the radio searches for other sites that may provide wide area coverage. Site trunking ends when a wide area coverage site is located, the current site is operating again as a wide area coverage site, an out-of-range condition occurs, or the failsoft mode is entered.

Determining Current Site

To determine the current radio site, momentarily press the Search option switch. If currently registered on a site, "SITE xx" is displayed. If the site is locked (see following), "LOCK xx" is displayed.

Searching For a New Site

To search for a new site, press and hold the Search option switch of 2 seconds or more. The display indicates "SEARCH" until a new site is found. The display then indicates "SITE xx". Press the Search option switch to return to the normal display.

Locking/Unlocking a Site

It is sometimes desirable to stay on a site. To prevent the transceiver from searching for a new site, it can be locked on the current site. To lock on the current site, press the LOCK option switch. The display indicates the first site in the list of SmartZone sites. Even when locked on a site, searching for a new site can be forced as described in the preceding paragraph.

3.6.15 SMARTNET/SMARTZONE SECURE COMMUNICATION

On analog SmartNet/SmartZone channels, either the SecureNet or 460 protocols can be selected. Operation is similar to conventional channel secure communication described in Section 3.5.15.

On digital SmartNet/SmartZone channels, only the DES-OFB protocol is available. Talk groups can be strapped to Clear, Coded, or Switch selectable, and clear and secure messages are always autodetected.

The following calls require their own encryption key selection: emergency, failsoft, patch, telephone, unit-to-unit, and system-wide.

3.7 SUPERVISORY TONES

Single Beep (Alert Tone)

- Power was turned on and a successful power-up sequence occurred (Section 3.3.1).
- The time-out timer is about to expire or the penalty timer has expired (Section 3.4.2).
- The conversation timer is about to expire (Section 3.5.7).
- The system received your page but the paged mobile is not on the air (Section 3.6.7).

- Telephone interconnect is not operational (Section 3.6.6).

Continuous Tone (Invalid Condition)

- A transmission is being attempted on a conventional channel programmed as receive-only.
- The transmitter is disabled by the busy channel lockout feature (Section 3.5.4).
- The transmitter has been disabled by the time-out timer feature (Section 3.4.2).
- The transmitter has been disabled by the conversation timer (Section 3.5.7).
- An out-of-range condition exists (SmartNet/SmartZone only).
- A transmission is being attempted before the penalty timer has expired (Section 3.5.6).
- Dynamic regrouping has been exited but the dynamic regrouping channel is still selected (Section 3.6.13).

Single Short Medium-Pitch Tone

- A valid key has been pressed.

Single Short Low-Pitch Tone

- An invalid key has been pressed.

Medium Tone (No Acknowledge)

- The paged mobile did not acknowledge the page (Section 3.6.7).
- The message that was sent has not been acknowledged (Section 3.6.8).
- The status condition that was sent has not been acknowledged (Section 3.6.9).

Five Beeps (Recurring)

- The page was received (Section 3.6.7).

Two Short Tones

- A unit-to-unit call was received (Section 3.6.5).

Five Beeps

- The paged mobile received the page and acknowledged it (Section 3.6.7).
- The message that was sent has been received and acknowledged (Section 3.6.8).
- The status condition that was sent has been received and acknowledged (Section 3.6.9).

Four Beeps

- The emergency alarm condition was acknowledged (Section 3.6.10).

Alternating Tone

- Dynamic regrouping has occurred (Section 3.6.13).
- Dynamic regrouping has occurred but the regrouping channel is not selected (Section 3.6.13).

Busy Signal

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

Three Medium Pitch Tones

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

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SECTION 4 TRANSCEIVER PROGRAMMING

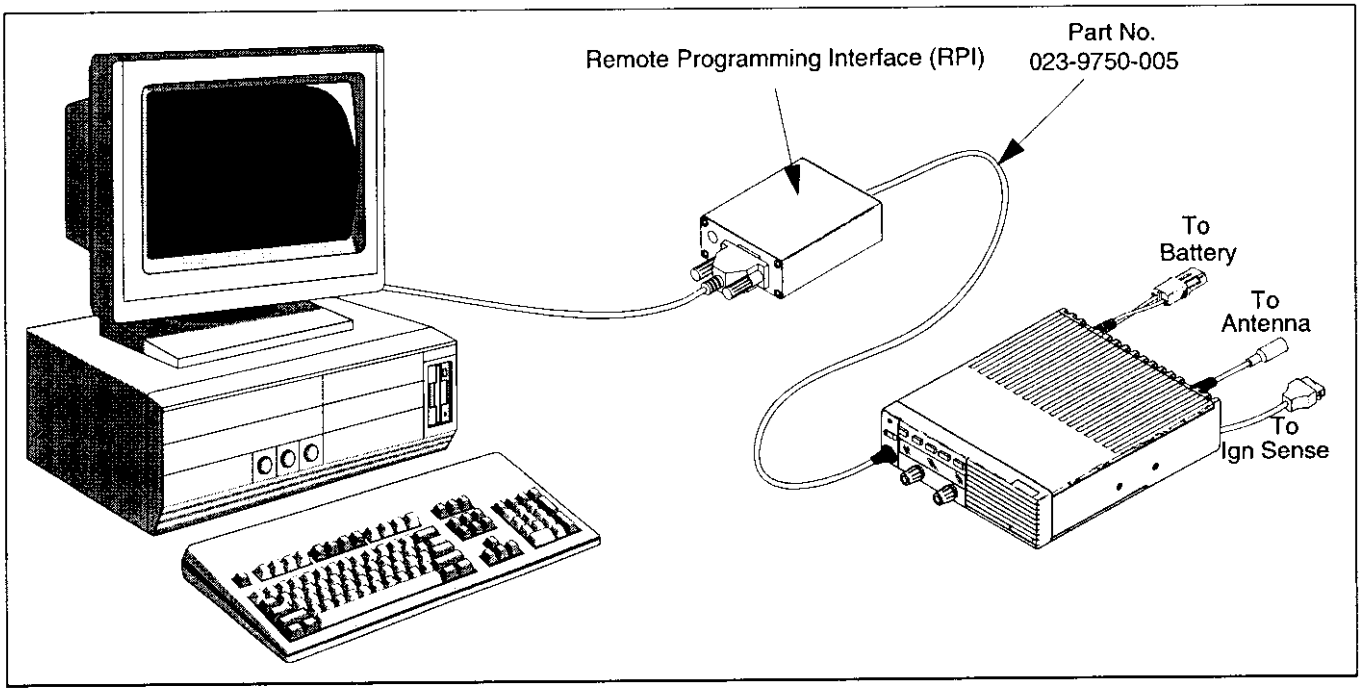


Figure 4-1 Programming Setup

4.1 GENERAL

4.1.1 PROGRAMMING SETUP

The following items are required to program the transceiver and control unit. The part numbers of this equipment are shown in Table 1-2 in Section 1. The programming set-up is shown above.

- IBM® PC or compatible personal computer
- Remote Prog. Interface (RPI) P.N. 023-5300-000
- Cables from the RPI to the computer and transceiver or control unit
- EFJohnson PCTrunk programming software.

4.1.2 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.

4.1.3 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.

4.1.4 CONNECTING RPI TO COMPUTER AND TRANSCEIVER

NOTE: A new RPI, Part No. 023-5300-000, is required to program this transceiver. Earlier RPIs such as 023-9800-000 and 023-9750-000 cannot be used.

The cables from the RPI to the computer and transceiver are not included with the RPI. The -5300-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. Suitable cables are also listed in Table 1-1.

The cable from the RPI to the transceiver or control unit has a connector which plugs into the microphone jack. The cable for this application is also listed in Table 1-1.

The RPI provides the required interface between the computer and transceiver. It converts the RS-232 logic levels from the computer to the RS-485 logic levels required by the transceiver microprocessor and vice versa.

4.1.5 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.

4.1.6 PROGRAMMING FILE TYPES

Programming data is stored in two disk files that can be saved, read, copied, and deleted (see Section 4.3.1). The two types that are stored for each programming session have the same name but different extensions as follows:

Programming File (.DAT) - Contains all programming information except what is in the following .460 file.

Scrambling File (.460) - Contains all information relating to the Transcrypt 460 scrambler. This file is saved only if 460 scrambling is used.

4.1.7 HELP FILES

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

4.1.8 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 Mobile Options parameters. Refer to Section 4.4 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 4.1.10.

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 Analog, Conventional Project 25, SmartNet).

The preceding screens are displayed in cascade style or they can be minimized like any Windows

screen. To cascade the active screens, select Window > Cascade from the menu bar (see Section 4.3.6).

To pop a screen to the front, click the applicable button shown below. 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 or hidden by clicking Window > Toolbar. A window can also be displayed by selecting it in the Window Menu.

Screen Pop-Up Buttons and File Size Indicator

4.1.9 FILE SIZE INDICATION

The maximum number of channels that can be programmed may be limited by the available memory space in the radio (see 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.

4.1.10 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 4.3.6). This menu is also used to delete a system.

NOTE: Only one conventional system can be set up, and it is automatically created when a programming file is opened as described in Section 4.1.6. Therefore, there is no option to add a conventional system as just described.

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. Channels or talk groups from any programmed system can be set up in the Channels screen. Therefore, any system can be selected when programming channel information.

4.2 PROGRAMMING PROCEDURE

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

4.2.1 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 4.1.4. Then turn the radio on and select Upload from the menu bar. Only the .DAT programming file is uploaded. The .460 scrambling file cannot be uploaded for security reasons.

2. Before or after creating the programming file, be sure the correct type (portable or mobile) is selected by the Radio Type menu (see Section 4.3.2).

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 each type as described in Section 4.1.10.

4.2.2 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 4.1.8).

2. Program the applicable information in these screens as described in Section 4.4.

4.2.3 PROGRAMMING CONVENTIONAL CHANNELS

NOTE: If no conventional channels are to be 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 4.1.8).

3. Program the conventional systems and channels as described in Section 4.5.

4.2.4 PROGRAMMING SMARTNET AND SMARTZONE SYSTEMS

NOTE: If no SmartNet or SmartZone systems are to be programmed, skip this section.

1. Make sure the desired SmartNet or SmartZone system is displayed by selecting Window > Conventional 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 4.1.8).

3. Program the SmartNet/SmartZone system and talk groups as described in Section 4.6.

4. To program additional SmartNet/SmartZone systems, add a new system as described in Section 4.1.10 and repeat Section 4.6.

4.2.5 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 4.3.1). 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.

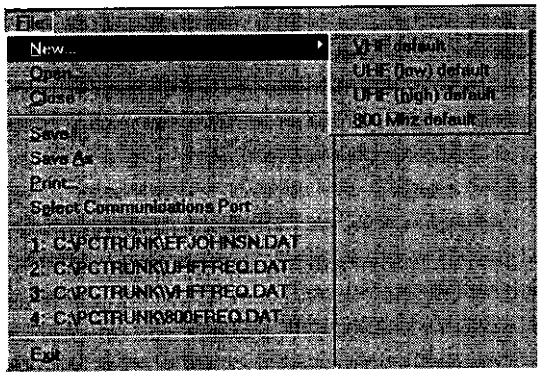
2. Repeat for the other file type (if required).

NOTE: The information which follows (Sections 4.3-4.6) provides detailed descriptions of the parameters in the various screens that are displayed by the PCTrunk program.

4.3 MENU COMMANDS

Menu Bar

4.3.1 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.

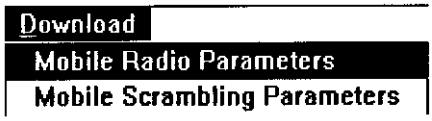
Select Communications Port - Displays the Communications Port dialog box which is used to select the serial port that is used to connect the transceiver to the computer (see Section 4.1.4).

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.

4.3.2 RADIO TYPE MENU

The Radio Type menu show above selects the radio type (Portable or Mobile) being programmed.

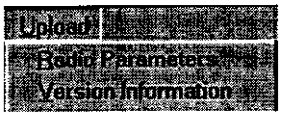
4.3.3 DOWNLOAD MENU



Mobile Radio Parameters - Transfers the current programming file to the radio connected to the computer.

Mobile Scrambling Parameters - Transfers the selected scrambling parameters file to the radio connected to the computer.

4.3.4 UPLOAD MENU

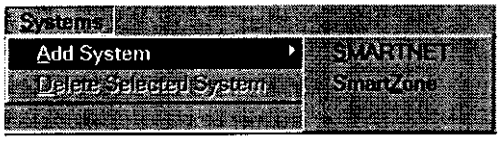


The Upload Menu is displayed only in the opening screen before a programming file is created. The following options are displayed:

Radio Parameters - 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. Scrambling parameters cannot be transferred out of a radio for security purposes.

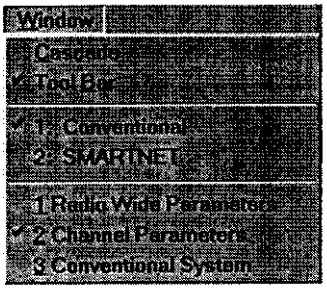
Version Information - Displays the software version number and serial number of the connected radio.

4.3.5 SYSTEMS MENU



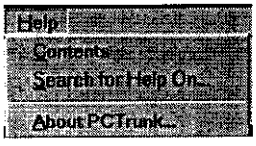
The Systems Menu is used to create new SmartNet and SmartZone systems. It is also used to delete current systems. Conventional systems cannot be added because only one can be created. Refer to Section 4.1.8 for more information.

4.3.6 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 4.1.8 for more information.

4.3.7 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 EFJohnson.

4.4 RADIO-WIDE PARAMETER SCREENS

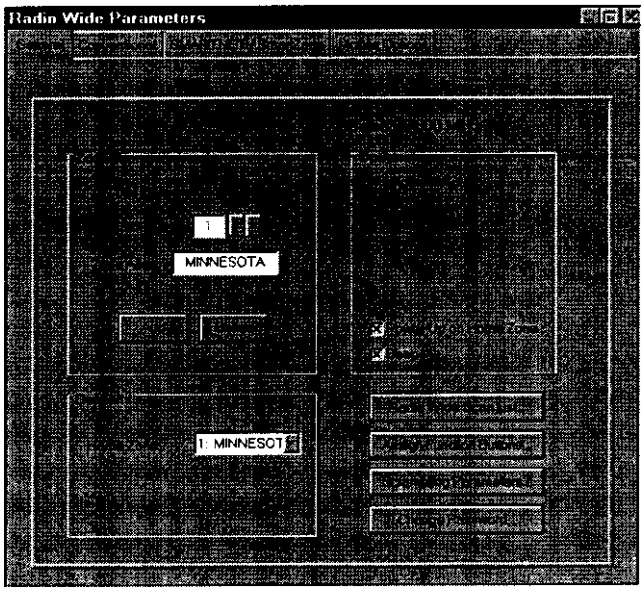
4.4.1 INTRODUCTION

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 Mobile Options parameters. Refer to the information which follows.

4.4.2 RADIO-WIDE GENERAL SCREEN

Band

Displays the operating band selected by the Radio Type Menu (see Section 4.3.2). The selected operating band must match that of the radio being programmed.



Radio-Wide General Screen

Zones

Total Zones - The total number of zones currently set up. The maximum number allowed is 16. Zones are added by clicking the Zone 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 10 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.

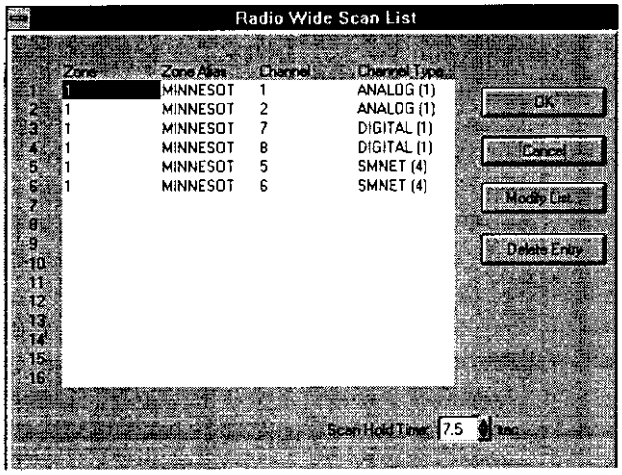
Options

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

Beeps - If checked, enables all tones. Otherwise, no tones sound (see Section 3.7).

Radio Wide Scan List... **Radio Wide Scan List**

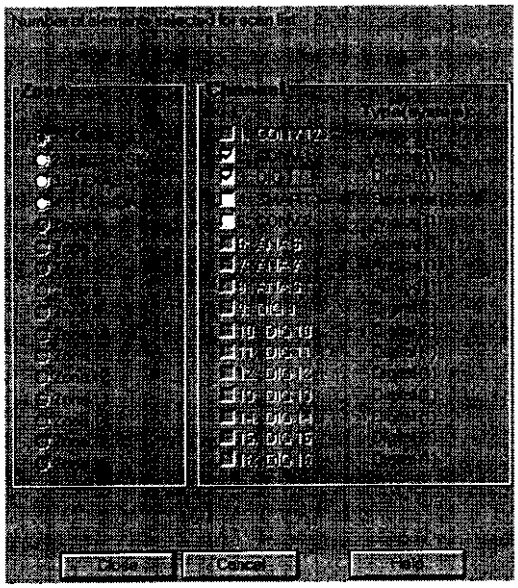
NOTE: The radio-wide scan list cannot be programmed until all channels to be included have been set up as described in the Conventional and SmartNet/SmartZone sections (4.5 and 4.6, respectively).



Radio-Wide Scan List Screen

Clicking the Radio Wide Scan List button in the General screen displays the above screen which programs the radio-wide scan list described in Section 3.4.6. The buttons and other parameters in this screen are as follows:

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.

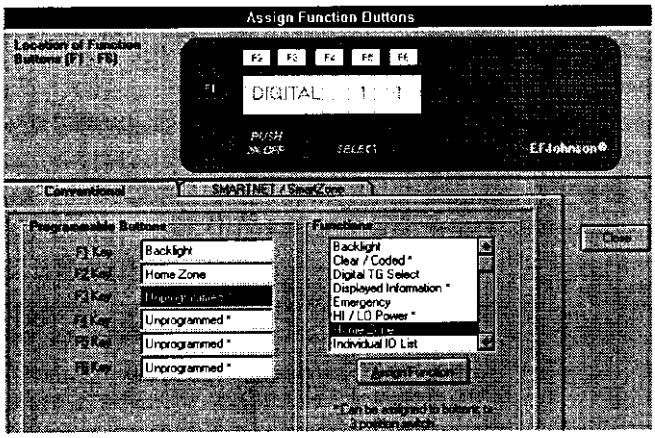
Scan Hold Time - This programs the delay that occurs before radio-wide scanning resumes after a message is no longer being received. Times of 0 - 7.5 seconds can be programmed (see Section 3.4.6).

Assign Function Buttons

Clicking the "Assign Functions Buttons" Button in the General screen displays the following screen which is used to program the six front panel option switches. The option switches can be programmed with a different set of functions for each operating mode (conventional, SmartNet/SmartZone). For example, selecting a conventional channel enables the conventional functions and selecting a SmartNet channel selects the SmartNet functions. The functions that can be programmed for each mode are listed in Section 3.4.1.

Program the option switches as follows:

1. Select the button to be programmed by clicking it in the left column. The F1 key is to the left of the display and the other keys are numbered consecutively from left to right (F2-F6).



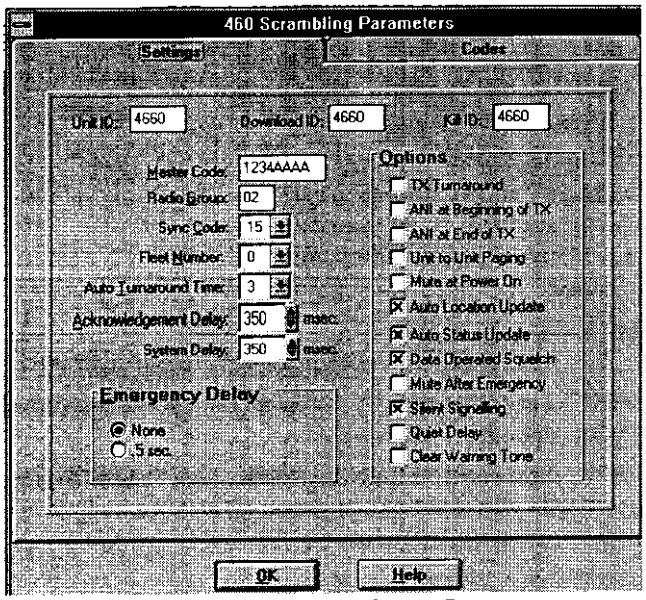
Assign Function Buttons Screen

2. Click the function to be assigned to that button by clicking it in the right column. Then click the "Assign Function" button.

3. Repeat for each button and operating mode (click the tab on top to display a different screen).

Scrambling Parameters

If 460 Scrambling is used (see Section 3.4.7), click the Scrambling Parameters button in the General screen to display the following screen. This screen programs scrambling and other signaling options, and the Codes screen modifies the list of scrambling codes which are stored in the radio. The buttons and other parameters in these screens operate as follows:



460 Scrambler Settings Screen

Settings Screen

Unit ID - Uniquely identifies the radio for Flashcall signaling.

Download ID - This ID must be received by the radio for it to accept a download of its scrambling parameters.

Kill ID - This ID must be received by the radio for the kill operation to occur.

Master Code - Displays the master code used by the scrambler. Two scramblers must be programmed with the same master code to communicate. The field is an 8-digit hexadecimal number (0-9, A-F).

Radio Group - Sets the group number of the scrambler from 00-99.

Sync Code - Scrambling sync code from 0-15. Two scramblers must have the same sync code to communicate.

Fleet Number - Number from 0-15 used when multiple fleets of scramblers are used.

Auto Turnaround Time - Time from 0-7 seconds after receiving a coded message that the scrambler ignores the clear code switch setting and forces the coded mode.

Acknowledgment Delay - Delay time from 50-1550 ms before the scrambler responds to information received from a controller.

System Delay - Delay time from 50-1550 ms between when the PTT switch is pressed and the scrambler transmits data over the air.

Emergency Delay - The amount of time the scrambler waits to send the emergency signal after the emergency switch is pressed. No delay or a 0.5 sec delay can be selected.

Tx Turnaround - If selected, inserts a delay between when scrambled information is received and then transmitted. This delay allows scramblers in the system to prepare for the new data.

ANI at Beginning of Tx - If selected, sends a Flashcall ANI at the beginning of every clear mode transmission.

ANI at End of Tx - If selected, sends a Flashcall ANI at the end of every clear mode transmission.

Unit-to-Unit Paging - If selected, enables a single unit page.

Mute at Power On - If selected, mutes the audio when powered up until the radio transmits, receives a Flashcall selective call, or OTAR reprogramming of scrambling parameters.

Auto Location Update - If selected, causes the scrambler to automatically send the user location every time it changes.

Auto Status Update - If selected, causes the scrambler to automatically send the user status each time it changes.

Data Operated Squelch - If selected, causes the scrambler to mute audio when incoming Flashcall data is received.

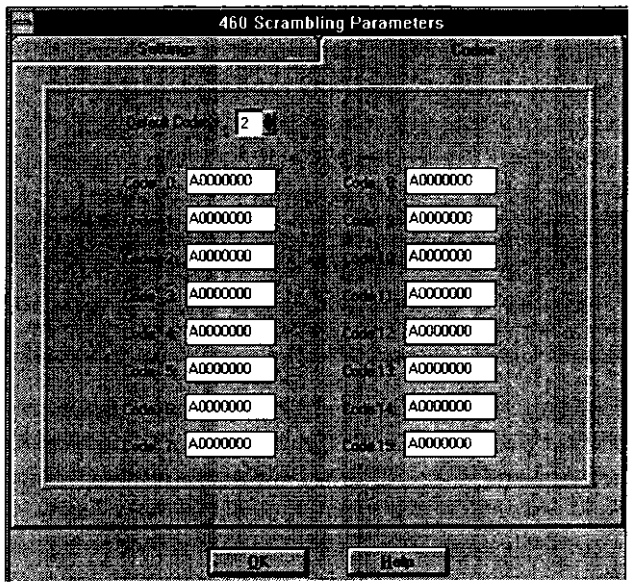
Mute After Emergency - If selected, causes the scrambler to mute the audio after sending an emergency signal until the unit transmits.

Silent Signaling - If selected, causes the scrambler to send a tone ahead of data packets that forces the receiving unit to mute its audio before the data burst is heard.

Quiet Delay - If selected, adds an extra 100 ms lead-in delay at the beginning of the silent signaling tone (if enabled).

Clear Warning Tone - If selected, sends a tone burst at 5-second intervals during clear mode transmissions. This alerts the listener that the conversation is not secure.

Codes Screen



460 Scrambler Codes Screen

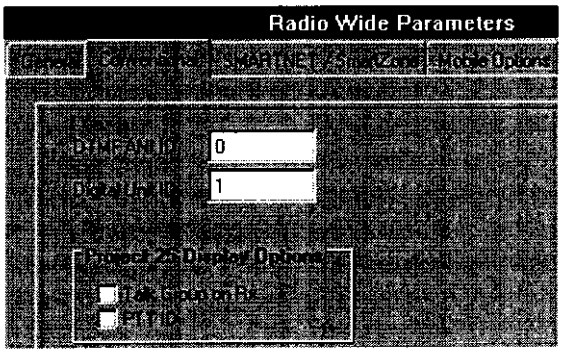
Default Code - Code space to use in the radio.

Codes 0 - 15 - Edit the box to enter a code. All codes must begin with A0. The last six digits can be programmed for any value using hex digits 0-9, A-F.

Change Password Button

The function is not used with mobile transceivers.

4.4.3 RADIO-WIDE CONVENTIONAL SCREEN



The radio-wide conventional screen is shown above, and is used to program the following parameters:

DTMF PTT ID - The PTT ID is used on a channel programmed for pre- or post-transmit ANI. This ID consists of eight digits from 0-9.

Digital Unit ID - When operating on a Project 25 (digital) channel, this number identifies the radio. Each radio must have a different ID, and it must be between 1 and 16777216.

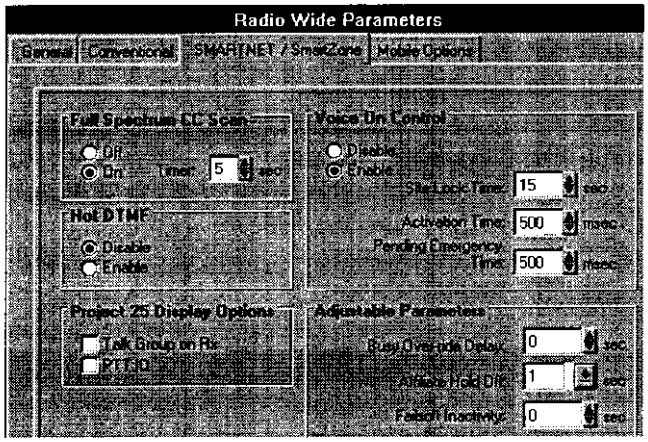
Project 25 Display Options

These functions select what is displayed when individual calls are received. If neither function is selected, the selected talk group alias or channel number is displayed (see "Indivual Calls" in Section 3.5.14). With group calls, the talk group or channel number is always displayed.

Talk Group on Rx - The alias of the talk group on which the call is being received is displayed.

PTT ID - The ID of the mobile placing the call is displayed.

4.4.4 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. This option is not functional with SecureNet operation.

Project 25 Display Options

See description in Section 4.4.3.

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.

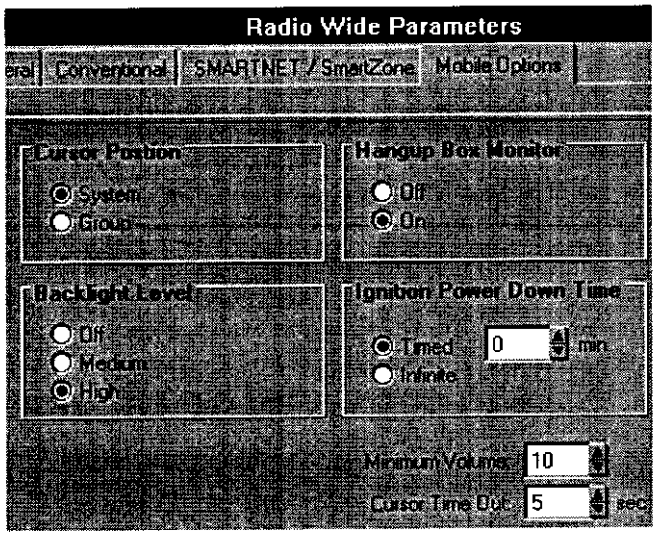
Adjustable Parameters

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 3.6.11). 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.

4.4.5 RADIO-WIDE MOBILE OPTIONS SCREEN



The radio-wide Mobile Options screen is shown above, and is used to program the following parameters:

Cursor Position - Selects if the Zone or Channel select mode is enabled when power is turned on or after a change is made (see next parameter). Refer to Section 3.3.5 for more information.

Backlight Level - Selects the default backlight level whenever power is on. This setting can be overridden by the backlight option switch if it is programmed.

Hang-Up Box Monitor - Selecting "Off" disables microphone off-hook detection. Taking the micro-

phone off-hook then does not enable the monitor mode or disable scanning. Selecting "On" enables microphone off-hook detection.

Ignition Power Down Time - When the ignition switch controls transceiver power, this sets the delay that occurs between when the ignition switch is turned off and when transceiver power actually turns off. Times of 0-254 minutes can be programmed or an infinite time (no turn-off) can be selected (Section 3.4.4).

Minimum Volume - Sets the minimum volume level that can be selected by the volume control. This can be used to prevent missed messages caused by inadvertently turning the volume down too far. Relative levels of 0-255 can be set ("0" sets the lowest minimum volume).

Cursor Time-Out - Programs the time delay that occurs before the cursor returns to the default position programmed in the preceding parameter. Times of 0-255 seconds can be programmed ("0" selects no return).

4.5 PROGRAMMING CONVENTIONAL SYSTEMS AND CHANNELS

4.5.1 INTRODUCTION

The following information describes how to program conventional channels (both analog and Project 25). Only one conventional system can be programmed, and it is automatically set up when the programming file is selected as described in Section 4.1.6. 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.

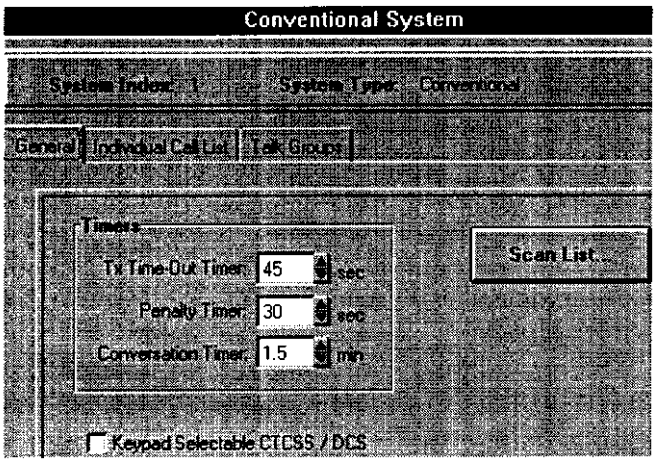
The following is the recommended procedure for programming conventional channels:

1. Program the radio-wide information as described in Section 4.4.

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 (both analog and Project 25 digital channels).

4.5.2 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 3.4.2). 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 3.5.6). Times up to 3 minutes, 45 seconds in 15-second steps can be programmed.

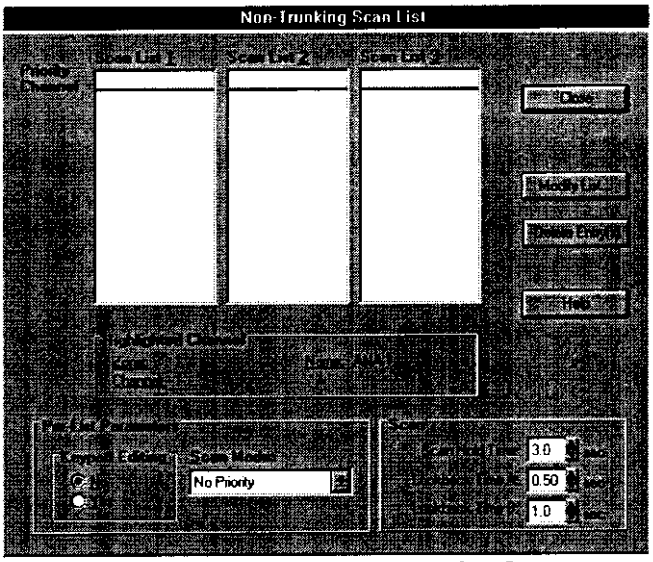
Conversation Timer - This timer limits the total length of a conversation (Section 3.5.7). Times up to 7.5 minutes in 0.5-minute steps can be programmed.

Scan List Button

Clicking the Scan List button displays the following screen which is used to program the conventional scan lists described in Section 3.5.12. If the Scan List option switch is not programmed, only one scan list can be programmed.

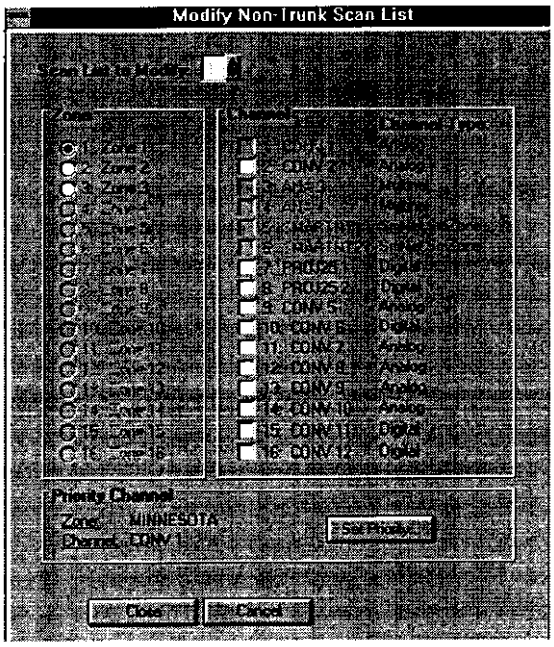
NOTE: The conventional scan lists cannot be programmed until all the conventional channels are

programmed. Therefore, first program the channels as described in Sections 4.5.5, 4.5.6, and 4.5.7.



Conventional System Scan List Screen

To modify a list, click Modify List 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. To select the priority channel for each scan list (if applicable), click the desired zone/channel and then the Sel Priority button. The Delete Priority button deletes the selected channel(s) from the scan list.



Conventional System Modify Scan List Screen

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

Priority Channel

The priority channel used for priority channel sampling (see Section 3.5.12) can be selected for each scan list as just described. The selected Scan Mode (see following) determines if this channel is sampled.

Keypad Editing

This function does not apply to mobile transceivers. It enables or disables scan list editing using an option switch programmed for that function.

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. The scan list to be programmed is selected by clicking it. 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 - No priority sampling occurs. 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 3.4.6).

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) or NAC 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.

4.5.3 CONVENTIONAL SYSTEM INDIVIDUAL CALL LIST SCREEN

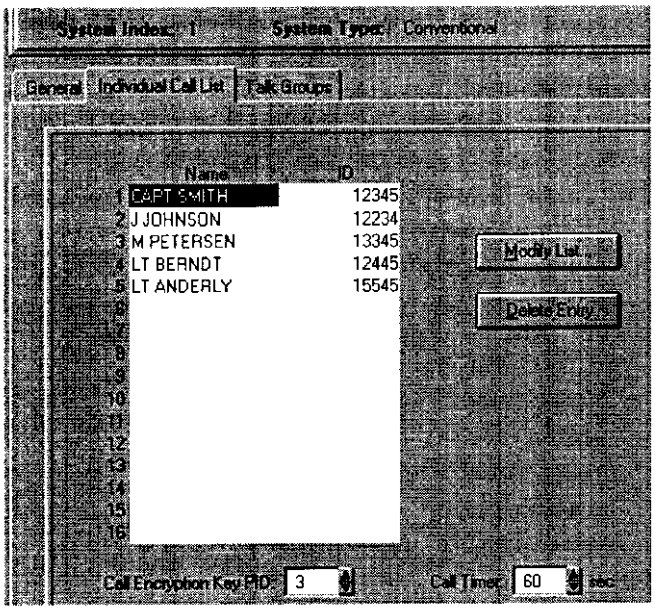
NOTE: This screen can be left unprogrammed if no conventional Project 25 digital channel are programmed or individual calling is not used.

Individual calls can be placed on Project 25 digital channels as described in Section 3.5.14. The IDs that can be called are programmed in the Individual Call List programmed by the Individual Call List screen. This screen and the parameters it programs are as follows:

Modify List Button - Clicking this button displays the screen that programs the alias (tag) and individual ID for each call. An alias can have up to 10 characters, and the individual IDs can be 1-16777216.

Delete Entry Button - Clicking this button deletes the selected entry.

Call Encryption PID - Indicates which DES-OFB encryption key should be used for secure private calls.



Conventional System Individual Call List Screen

Call Timer - Sets the maximum time that the radio remains in the individual call mode afteran individual call is received. A response must be made before this timer expires.

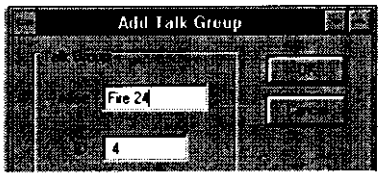
4.5.4 CONVENTIONAL SYSTEM TALK GROUP SCREEN

The conventional system Talk Group screen which follows is used to set up Project 25 talk groups (it is not used with analog channels). These talk groups are assigned to channels on the Channel screen (see Section 4.5.7). The parameters in this screen are as follows:

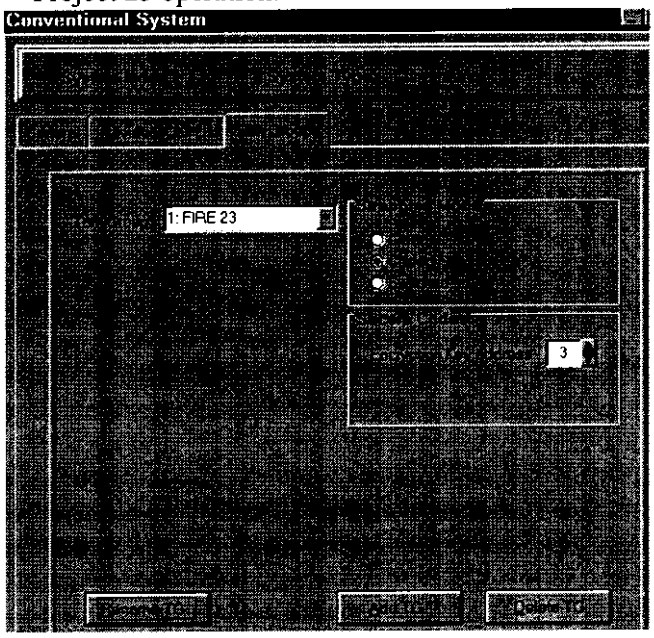
Talk Group - Displays the talk group to be edited. To select another, click the scroll button to the right of the box.

Rename TG - Displays the screen used to change the alias of the selected talk group.

Add TG - Displays the following screen that is used to add a new Project 25 talk group. The alias and ID of the talk group are specified in this screen.



Group IDs from 1-65535 can be programmed with Project 25 operation.



Conventional System Talk Group Screen

Delete TG - Deletes the selected talk group.

Strapping Mode - Selects if secure communication is not used, always selected, or is switch selectable on that talk group (see Section 3.5.15).

Secure Code - If secure communication is enabled, selects the secure code key used on that talk group.

4.5.5 SETTING UP CONVENTIONAL CHANNELS

The conventional Channel screen shown in Figure 4-2 is displayed when a conventional analog channel is selected, and the screen shown in Figure 4-3 is displayed when a conventional Project 25 (digital) channel is selected. These screens program unique channel parameters and also assign 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.

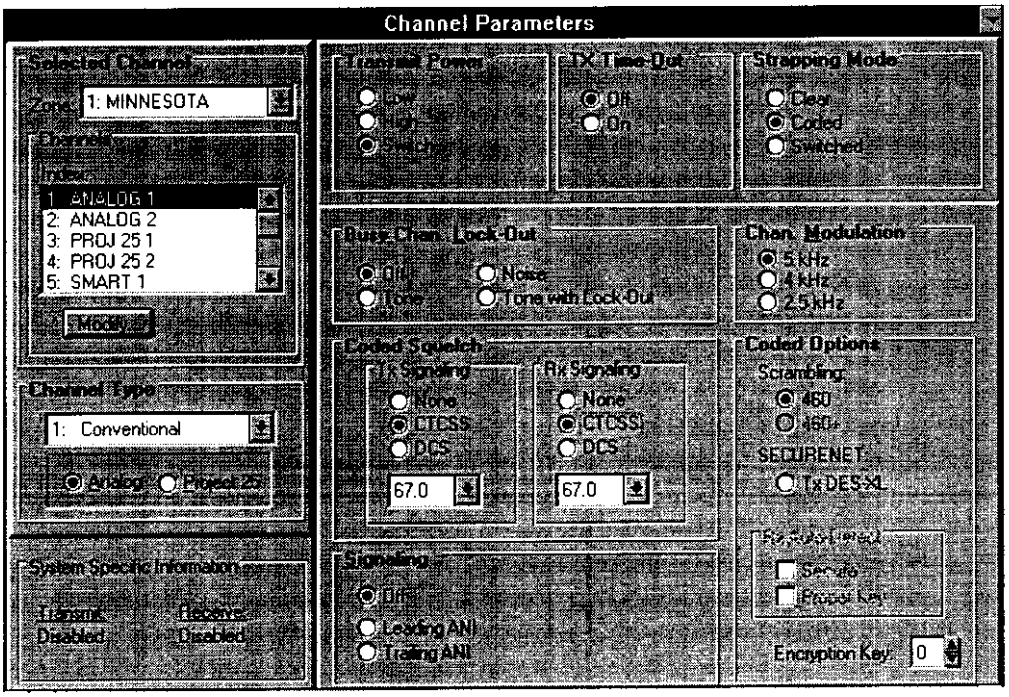


Figure 4-2 Conventional Analog Channel Screen

2. Select the channel number in the Channels Index box which is to be programmed with the channel (this will be the number displayed when the channel is selected).

3. To assign a conventional channel, select "Conventional" as the channel type. Then select "Analog" if it is an analog channel or "Project 25" if it is a Project 25 channel.

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 or Section 4.5.7 for more information, which is applicable.

4.5.6 CONVENTIONAL ANALOG CHANNEL SCREEN PARAMETERS

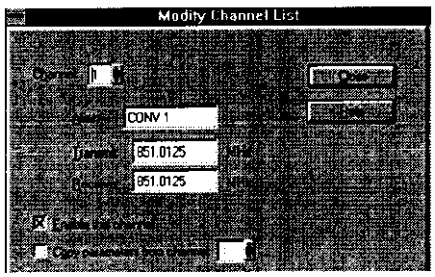
The following parameters are programmed in the conventional analog channel screen shown in Figure 4-2.

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 4.4.2.

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

Modify Modify Button - Displays the screen that follows which enables the channel (makes it selectable) 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 10 characters can be programmed.
Transmit - Programs the transmit frequency of the channel. If a transmit frequency of "0" is programmed, the channel is receive only.
Receive - Programs the receive frequency of the channel.
Enable This Channel - The box must be checked for the channel to be selectable.
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). In addition, with conventional channels, either analog or Project 25 is selected. 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 3.5.9 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 4.5.2).

Busy Channel Lockout

Off = disabled, Noise = transmit disallowed if carrier is detected, Tone = transmit allowed only if correct Call Guard code is detected, Tone w/Lockout = same as "Tone" except transmit allowed if "Normal" is selected by Normal/Selective option switch (Section 3.5.4).

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 3.5.5). The standard Call Guard tones and codes are listed in Table 4-1 located on page 4-27.

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 4.4.3).

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

Channel Modulation

This selects if the channel modulation is wide-band (5 kHz), narrowband (2.5 kHz), or NPSPAC (4 kHz). NPSPAC (public safety) modulation applies to 800 MHz models only.

Strapping Mode

NOTE: See Section 3.5.15 for more information.

Clear - All transmissions on the channel occur in the clear (unscrambled) mode.

Coded - All transmissions on the channel occur in the secure mode (scrambled) mode selected by Coded Options.

Switched - The clear or secure status of the channel is selected by the Clear/Secure option switch.

Coded Options

NOTE: See Section 3.5.15 for more information.

These options select either the 460 or DES type of secure communication when either the coded or switched strapping mode is selected.

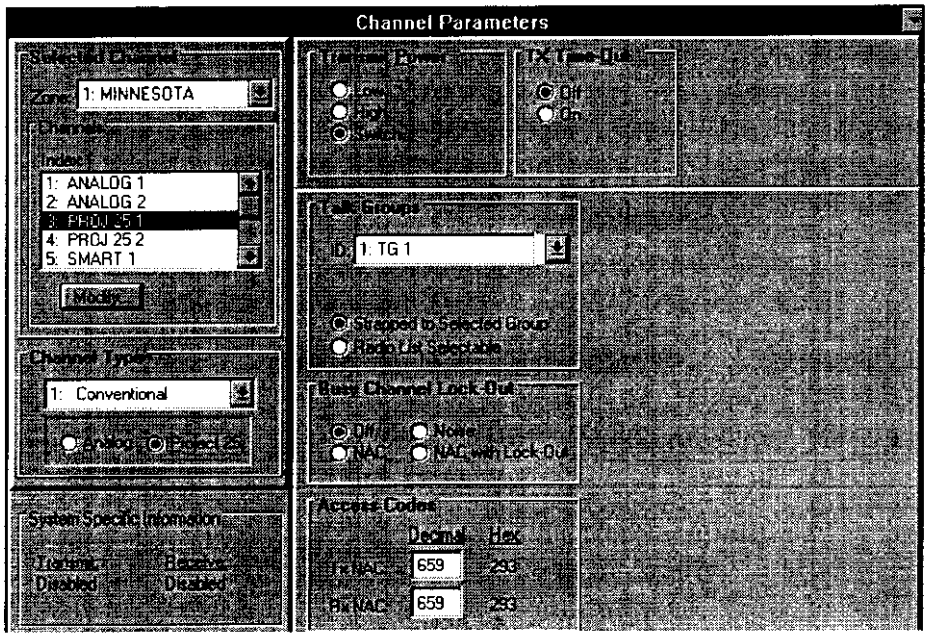


Figure 4-3 Conventional Project 25 Digital Channel Screen

Scrambling - Selects the Transcrypt 460 or 460+ (Phoenix) scrambling protocol.

SecureNet - Selects the DES-XL encryption protocol.

Rx AutoDetect - With the SecureNet protocol, selecting "Secure" enables automatic detection of encrypted receive signals. This may increase the response time of the radio to an incoming signal. Selecting "Proper Key" causes the radio to search the available SecureNet keys until it finds a match for the current transmission.

Encryption Key - Selects the encryption key from 0-15 that is used on the channel. This refers to the hardware location in the radio of the real key.

4.5.7 CONVENTIONAL PROJECT 25 (DIGITAL) CHANNEL SCREEN PARAMETERS

The following parameters are programmed in the conventional Project 25 digital channel screen shown in Figure 4-3. Refer to Section 3.5.14 for more information on Project 25 operation.

Selected Channel - Same as with analog channels described in preceding section.

Channel Type - Same as with analog channels described in preceding section.

Transmit Power - Same as with analog channels described in preceding section.

Transmit Time-Out - Same as with analog channels described in preceding section.

Talk Groups

This selects the Project 25 talk group that is assigned to the channel. The talk group programs the talk group ID, strapping mode, and encryption key address. Talk groups for Project 25 channels are programmed in the Conventional System Talk Group screen described in Section 4.5.4.

Strapped to Selected Group - If this parameter is selected, the talk group on that channel is always the selected talk group and cannot be changed.

Radio List Selectable - If this parameter is selected, the talk group may be changed by the radio operater using the "Digital TG Select" function button.

Busy Channel Lockout

Off = disabled, Noise = transmit disallowed if carrier is detected, NAC = transmit allowed only if correct NAC is detected, NAC w/Lockout = same as "NAC" except transmit allowed if "Normal" is selected by Normal/Selective option switch (Section 3.5.4).

Access Codes

Programs the transmit and receive NAC (Network Access Code). These codes can be 0-4095. Refer to Section 3.5.14 for more information.

4.6 PROGRAMMING SMARTNET/SMARTZONE SYSTEMS AND CHANNELS

4.6.1 INTRODUCTION

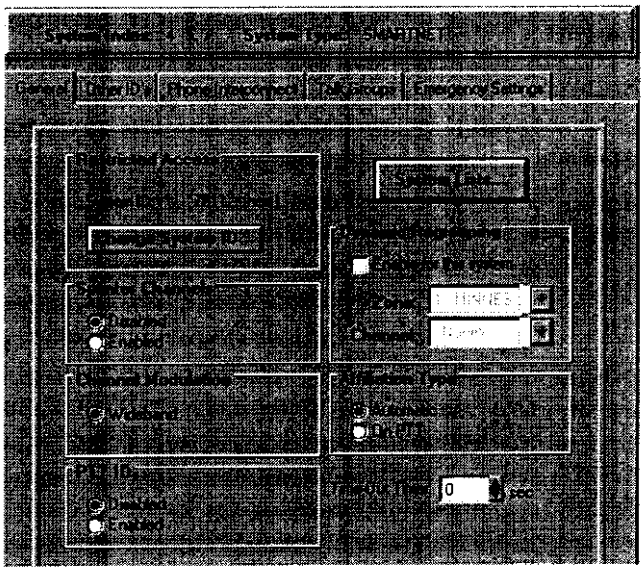
To program SmartNet and SmartZone systems and channels, proceed as follows:

1. Program the SmartNet/SmartZone radio-wide information as described in Section 4.4.

2. To create a new SmartNet/SmartZone system, select the Systems > Add Systems in the menu bar (see Section 4.1.10). 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 4.6.8.

4.6.2 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.

System Lists Button

This button displays the screens used to program the various per system lists. Refer to Section 4.6.7 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

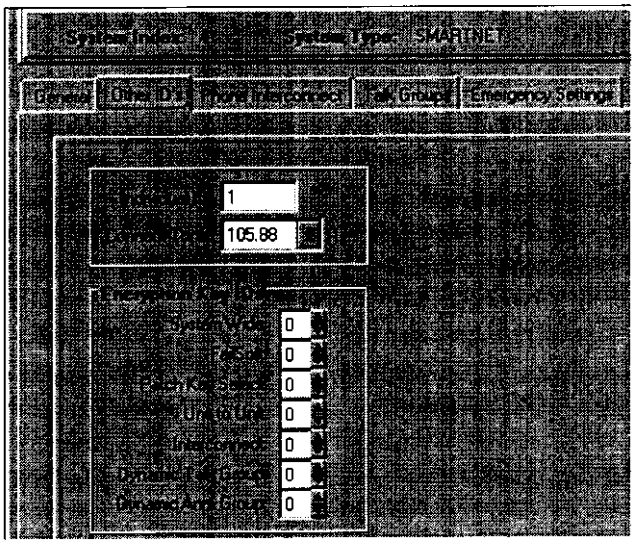
Automatic - The radio immediately affiliates with the central controller as soon as it is turned on and automatically re-affiliates each time the talk group is changed.

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 3.4.2).

4.6.3 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.

Encryption Key IDs

Programs SecureNet Encryption ID selection that is used in all except group calls.

System Wide - Key used for system-wide calls (typically originated by the dispatcher).

Failsoft - Key used in failsoft conditions (see Section 3.6.11).

Patch Key Select - Key used in patch calls.

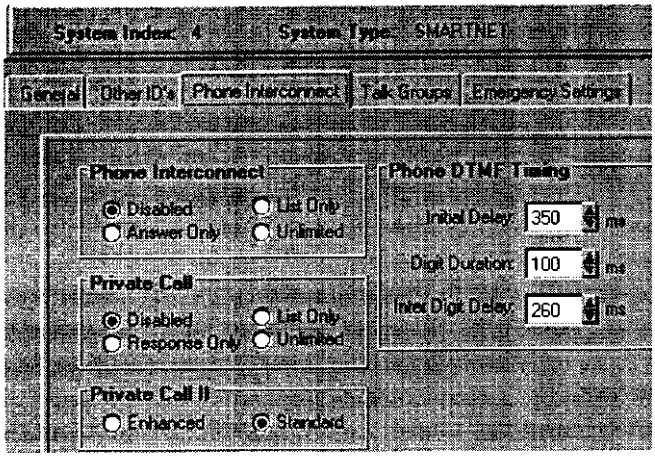
Unit To Unit - Key used for unit-to-unit (private) calls.

Interconnect - Key used for telephone interconnect calls.

Dynamic Talk Group - Key used for the dynamic regrouping talk group when it is a standard talk group.

Dynamic Ann. Group - Key used for the dynamic regrouping talk group when it is an announcement group.

4.6.4 SMARTNET/SMARTZONE SYSTEM PHONE INTERCONNECT SCREEN



The SmartNet/SmartZone Phone Interconnect screen is shown above, and it programs the following parameters.

Phone Interconnect

Refer to Section 3.6.6 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 a microphone keypad.

Private Call

Same as above, but for private (unit-to-unit) calls. Refer to Section 3.6.5 for more information.

Private Call II

Programs either standard or enhanced 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 Answer" 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.

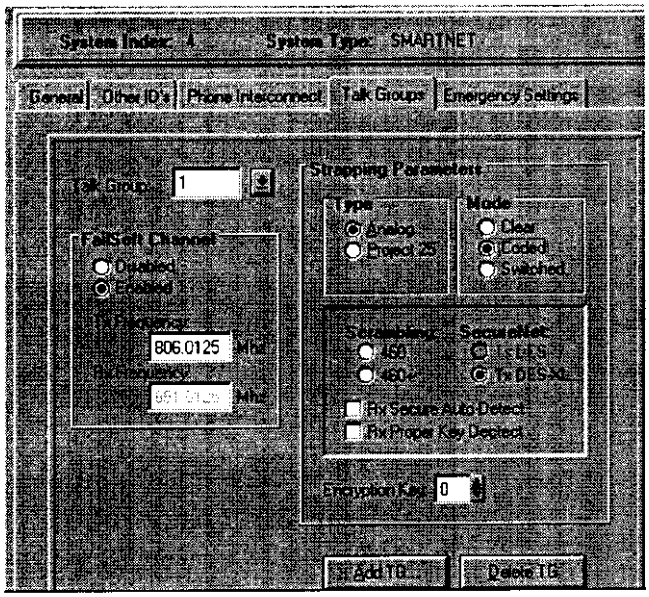
Digit Duration - Duration from 50-500 milliseconds of each phone number digit.

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

4.6.5 SMARTNET/SMARTZONE SYSTEM TALK GROUPS SCREEN

The SmartNet/SmartZone Talk Groups screen which follows is used to set up SmartNet/SmartZone talk groups and program unique talk group information. The parameters programmed in this screen 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 4.6.9).



SmartNet/SmartZone System Talk Groups Screen

Add TG - Clicking this button displays a dialog box that adds a new talk group. The alias (alphatag) of up to ten 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 3.6.11).

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

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

Strapping Parameters

The Strapping Parameters program the channel type (analog or Project 25 digital) and encryption on the talk group as follows:

Type - Selects the type of SmartNet/SmartZone channel as analog or Project 25 (digital).

Clear Mode - All transmissions on the talk group occur in the clear (unscrambled) mode.

Coded Mode - All transmissions on the talk group occur in the secure (scrambled) mode selected as follows.

Switched Mode - The clear or secure status of the talk group is selected by the Clear/Secure option switch.

NOTE: Refer to Section 3.6.15 for more SmartNet/ SmartZone encryption information.

Scrambling/SecureNet Mode - These options select either the 460 or DES type of secure communication when either the coded or switched strapping mode is selected.

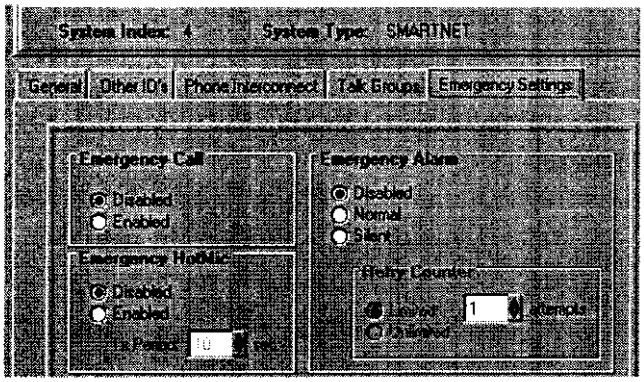
Rx Secure Autodetect - If this option is checked, a DES/DES-XL encrypted signal is automatically detected and received. This option may increase the response time to incoming signals. If it is not checked, those signals are detected only if they are coded like the transmit signals.

Rx Proper Key Detect - If this option is checked, the radio will search the available SecureNet keys until it finds a match for the current transmission.

Encryption Key - Selects the encryption key used on the talk group. This is a number from 0-15 that refers to a hardware location in the radio that contains the real key.

4.6.6 SMARTNET/SMARTZONE SYSTEM EMERGENCY SETTINGS SCREEN

The SmartNet/SmartZone Emergency Settings screen and the parameters programmed in this screen follow:



SmartNet/SmartZone System Emergency Settings Screen

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 Hot Mic

Enable - When an emergency alarm is generated and the emergency alarm acknowledgment received, the emergency mode is automatically entered and transmitting begins for the time specified by the Tx Period parameter (see following).

Disable - Automatic transmissions do not occur.

Tx Period - Defines the period during which transmissions occur with the microphone audio unmuted (without user intervention). Times of 10-120 seconds in 10-second steps can be selected.

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.

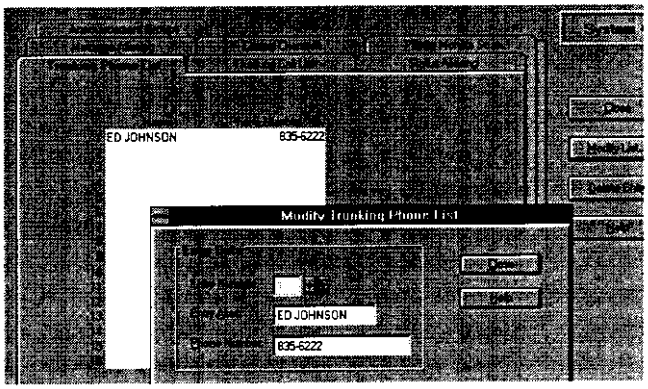
Silent - Same as "Normal" except no audio or visual feedback is provided.

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.

4.6.7 SMARTNET/SMARTZONE SYSTEM LISTS SCREENS

Clicking the [System Lists] button in the General screen described in Section 4.6.2 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 3.6.6). 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.

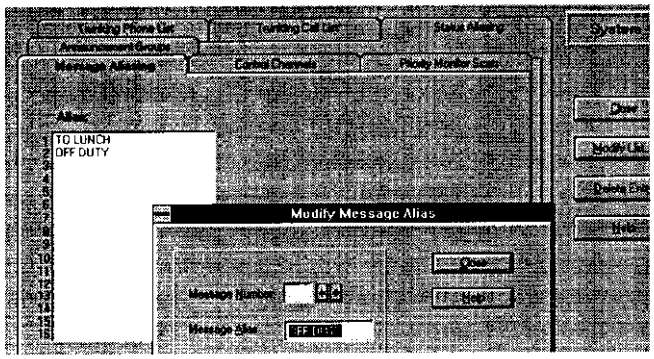
Entry Alias - Up to ten characters can be entered to identify the phone number. This identification is displayed when phone numbers are selected by the user from the list. Only uppercase letters can be entered, so lowercase letters are automatically converted to uppercase by the program.

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



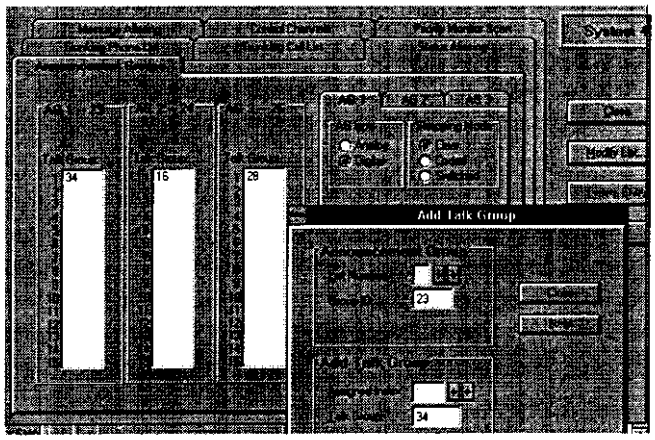
This screen associates an alias (name) with each message number (see Section 3.6.8). To edit this list, click the Message Aliasing tab and then the "Modify List" button on the right side. The following information is then programmed in the dialog box that is displayed:

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 ten 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



SmartNet/SmartZone 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 edit this list, click the Announcement Groups tab and then the "Modify List" button on the right side. The following information is then programmed in the dialog box that is displayed:

Announcement Group

List Number - Selects the announcement group to be programmed (1, 2, or 3).

Group ID - Programs the group ID of that announcement group.

Add Talk Group

Assigned Index - Use the scroll bars to select the talk group to be modified.

Talk Group - Programs the group ID of the selected talk group.

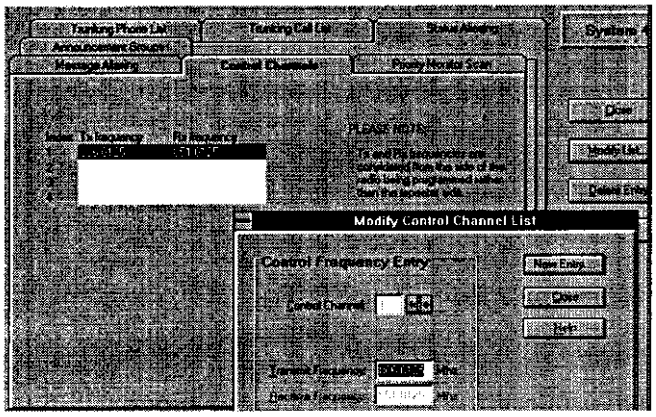
Main Screen Parameters

Talk Group - Read-only list of all talk groups currently in the announcement group.

AG Type - Programs the type of communication associated with the announcement group. Either analog or digital (Project 25) communication can be selected.

Strapping Mode - Defines the type of secure communication used, if any, for the announcement group. Clear, Coded, or Switched can be selected the same as on the Talk Group screen (see Section 4.6.5).

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.

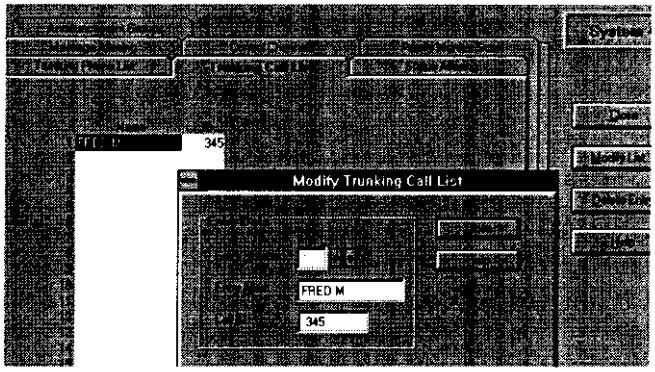
To edit this list, click the Control Channels tab and then the "Modify List" button on the right side. The following information is then programmed in the dialog box that is displayed:

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 Section 3.6.5).

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:

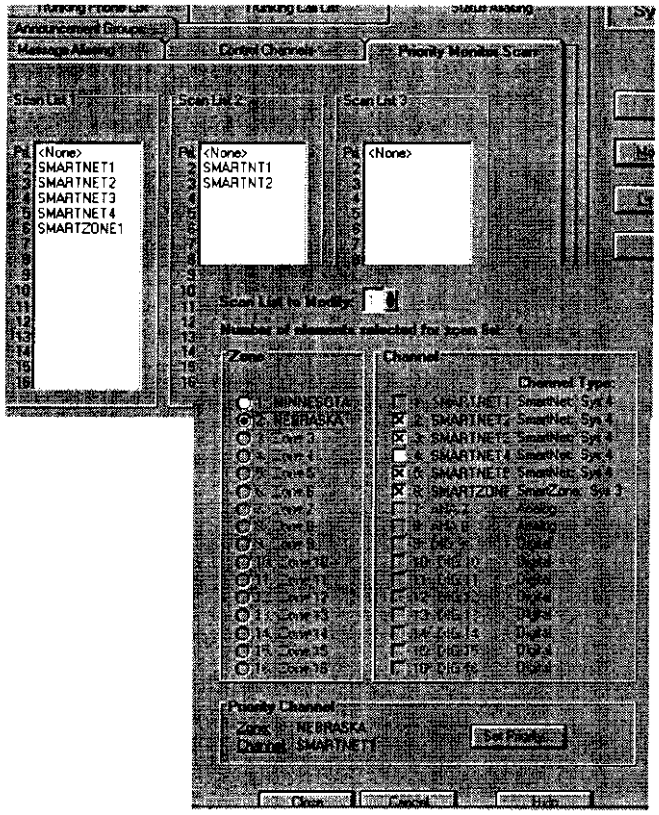
Entry Number - This box selects the entry to be edited. The scroll bars to the right of this box select the desired entry. A phone list can contain up to 16 entries. Selecting a new entry number automatically validates and stores the current entry. If the current entry contains an invalid field, the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

Entry Alias - Up to ten 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 1-49152. 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 3.6.12). 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 top screen shown above is then displayed to select the channels to be included in that scan list. Select channels as follows:

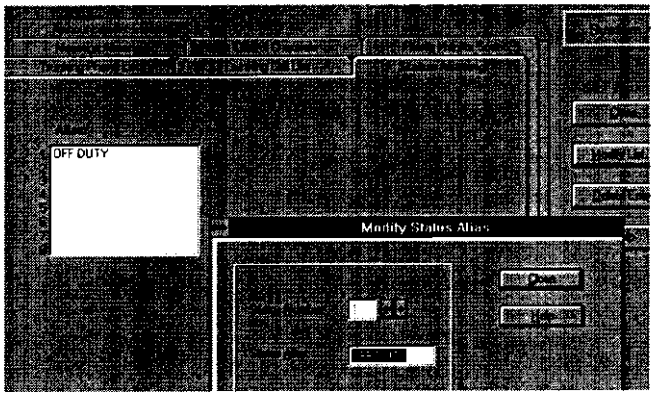
1. Select the scan list to be edited using the scroll bars next to the "Scan List To Modify" box.

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 3.6.9 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 10 characters that identify the status. This identification is displayed when the user selects a status condition.

4.6.8 SETTING UP SMARTNET/SMARTZONE CHANNELS

The SmartNet/SmartZone Channel screen shown in Figure 4-4 is displayed when the SmartNet or SmartZone channel type is selected. The channel 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. This will be the number displayed when the channel is selected.

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 4-4. 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).

4.6.9 SMARTNET/SMARTZONE CHANNEL SCREEN PARAMETERS

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

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 4.4.2.

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 4-4. 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 10 characters can be programmed.

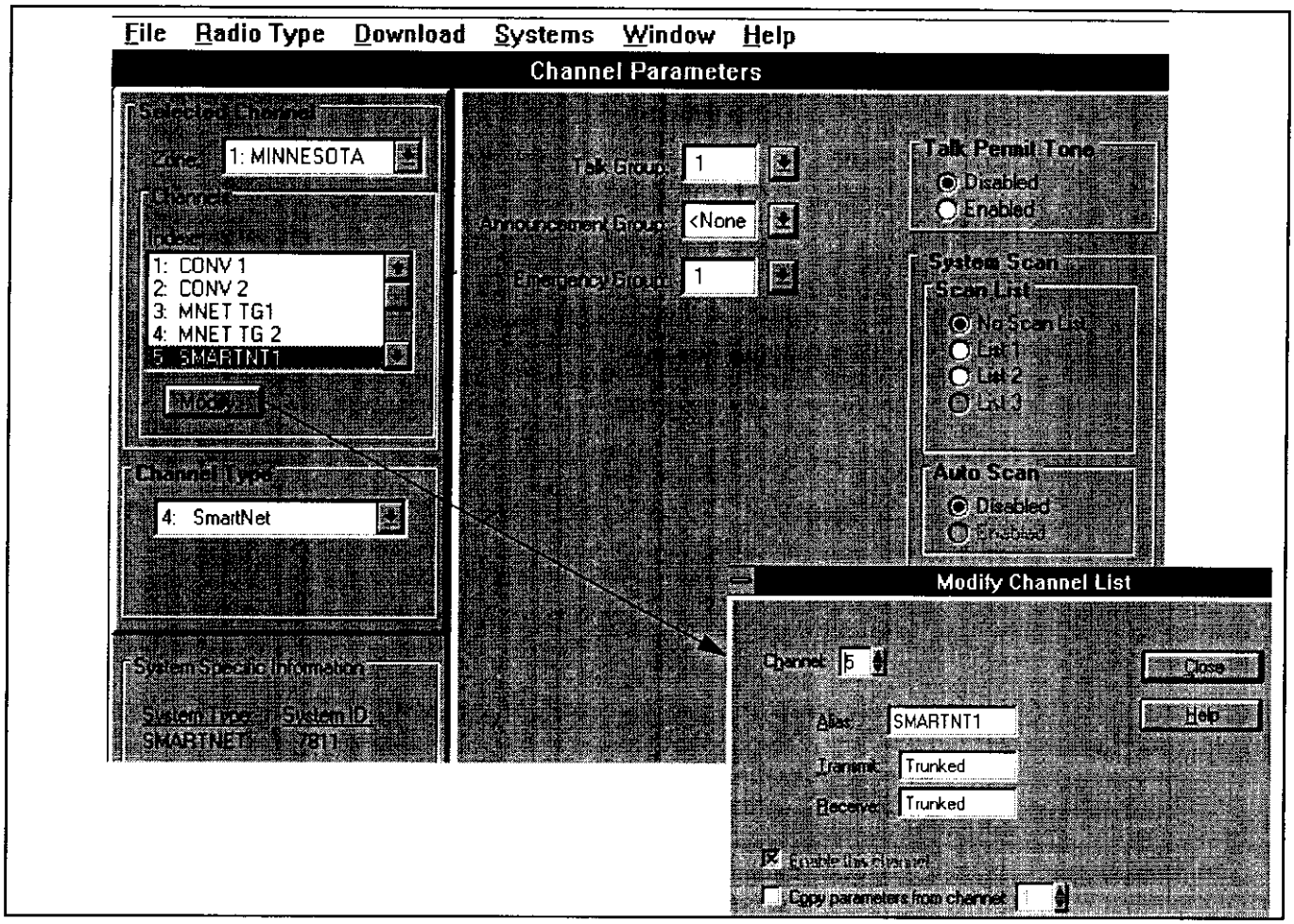


Figure 4-4 SmartNet/SmartZone Channel Screen

Transmit - Not programmable because the transmit frequency is dynamically assigned over the air ("Trunked" is always displayed).

Receive - Dynamically assigned like the preceding transmit frequency.

Enable This Channel - Not used because SmartNet/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 4.6.2).

Talk Group - Selects the talk group selected by that channel. Talk groups are programmed in the Talk Group screen described in Section 4.6.5.

Announcement Group - Selects one of up to three announcement groups selected by the channel. Refer to "Announcement Group Screen" in Section 4.6.7 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 4.6.7). 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 4-1 Call Guard (CTCSS/DCS) Codes and Tones

Recommended Tone Call Guard Codes									
Code	**Freq**	**Code**	**Freq**	**Code**	**Freq**	**Code**	**Freq**	**Code**	**Freq**
00	00.0	09	91.5	18	123.0	27	167.9	37*	241.8
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		
* 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
1	851.0125	806.0125
2	851.0375	806.0375
3	851.0625	806.0625
4	851.0875	806.0875
5	851.1125	806.1125
6	851.1375	806.1375
7	851.1625	806.1625
8	851.1875	806.1875
9	851.2125	806.2125
10	851.2375	806.2375
11	851.2625	806.2625
12	851.2875	806.2875
13	851.3125	806.3125
14	851.3375	806.3375
15	851.3625	806.3625
16	851.3875	806.3875
17	851.4125	806.4125
18	851.4375	806.4375
19	851.4625	806.4625
20	851.4875	806.4875
21	851.5125	806.5125
22	851.5375	806.5375
23	851.5625	806.5625
24	851.5875	806.5875
25	851.6125	806.6125
26	851.6375	806.6375
27	851.6625	806.6625
28	851.6875	806.6875
29	851.7125	806.7125
30	851.7375	806.7375
31	851.7625	806.7625
32	851.7875	806.7875
33	851.8125	806.8125
34	851.8375	806.8375
35	851.8625	806.8625
36	851.8875	806.8875
37	851.9125	806.9125
38	851.9375	806.9375
39	851.9625	806.9625
40	851.9875	806.9875
41	852.0125	807.0125
42	852.0375	807.0375
43	852.0625	807.0625
44	852.0875	807.0875
45	852.1125	807.1125
46	852.1375	807.1375
47	852.1625	807.1625
48	852.1875	807.1875
49	852.2125	807.2125
50	852.2375	807.2375
51	852.2625	807.2625
52	852.2875	807.2875
53	852.3125	807.3125
54	852.3375	807.3375
55	852.3625	807.3625
56	852.3875	807.3875
57	852.4125	807.4125
58	852.4375	807.4375
59	852.4625	807.4625
60	852.4875	807.4875
61	852.5125	807.5125
62	852.5375	807.5375
63	852.5625	807.5625
64	852.5875	807.5875
65	852.6125	807.6125
66	852.6375	807.6375
67	852.6625	807.6625
68	852.6875	807.6875
69	852.7125	807.7125
70	852.7375	807.7375
71	852.7625	807.7625
72	852.7875	807.7875
73	852.8125	807.8125
74	852.8375	807.8375
75	852.8625	807.8625
76	852.8875	807.8875
77	852.9125	807.9125
78	852.9375	807.9375
79	852.9625	807.9625
80	852.9875	807.9875
81	853.0125	808.0125
82	853.0375	808.0375
83	853.0625	808.0625
84	853.0875	808.0875
85	853.1125	808.1125
86	853.1375	808.1375
87	853.1625	808.1625
88	853.1875	808.1875
89	853.2125	808.2125
90	853.2375	808.2375
91	853.2625	808.2625
92	853.2875	808.2875
93	853.3125	808.3125
94	853.3375	808.3375
95	853.3625	808.3625
96	853.3875	808.3875
97	853.4125	808.4125
98	853.4375	808.4375
99	853.4625	808.4625
100	853.4875	808.4875
101	853.5125	808.5125
102	853.5375	808.5375
103	853.5625	808.5625
104	853.5875	808.5875
105	853.6125	808.6125
106	853.6375	808.6375
107	853.6625	808.6625
108	853.6875	808.6875
109	853.7125	808.7125
110	853.7375	808.7375
111	853.7625	808.7625
112	853.7875	808.7875
113	853.8125	808.8125
114	853.8375	808.8375
115	853.8625	808.8625
116	853.8875	808.8875
117	853.9125	808.9125
118	853.9375	808.9375
119	853.9625	808.9625
120	853.9875	808.9875
121	854.0125	809.0125
122	854.0375	809.0375
123	854.0625	809.0625
124	854.0875	809.0875
125	854.1125	809.1125
126	854.1375	809.1375
127	854.1625	809.1625
128	854.1875	809.1875
129	854.2125	809.2125
130	854.2375	809.2375
131	854.2625	809.2625
132	854.2875	809.2875
133	854.3125	809.3125
134	854.3375	809.3375
135	854.3625	809.3625
136	854.3875	809.3875
137	854.4125	809.4125
138	854.4375	809.4375
139	854.4625	809.4625
140	854.4875	809.4875
141	854.5125	809.5125
142	854.5375	809.5375
143	854.5625	809.5625
144	854.5875	809.5875

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
145	854.6125	809.6125	193	855.8125	810.8125	241	857.0125	812.0125
146	854.6375	809.6375	194	855.8375	810.8375	242	857.0375	812.0375
147	854.6625	809.6625	195	855.8625	810.8625	243	857.0625	812.0625
148	854.6875	809.6875	196	855.8875	810.8875	244	857.0875	812.0875
149	854.7125	809.7125	197	855.9125	810.9125	245	857.1125	812.1125
150	854.7375	809.7375	198	855.9375	810.9375	246	857.1375	812.1375
151	854.7625	809.7625	199	855.9625	810.9625	247	857.1625	812.1625
152	854.7875	809.7875	200	855.9875	810.9875	248	857.1875	812.1875
153	854.8125	809.8125	201	856.0125	811.0125	249	857.2125	812.2125
154	854.8375	809.8375	202	856.0375	811.0375	250	857.2375	812.2375
155	854.8625	809.8625	203	856.0625	811.0625	251	857.2625	812.2625
156	854.8875	809.8875	204	856.0875	811.0875	252	857.2875	812.2875
157	854.9125	809.9125	205	856.1125	811.1125	253	857.3125	812.3125
158	854.9375	809.9375	206	856.1375	811.1375	254	857.3375	812.3375
159	854.9625	809.9625	207	856.1625	811.1625	255	857.3625	812.3625
160	854.9875	809.9875	208	856.1875	811.1875	256	857.3875	812.3875
161	855.0125	810.0125	209	856.2125	811.2125	257	857.4125	812.4125
162	855.0375	810.0375	210	856.2375	811.2375	258	857.4375	812.4375
163	855.0625	810.0625	211	856.2625	811.2625	259	857.4625	812.4625
164	855.0875	810.0875	212	856.2875	811.2875	260	857.4875	812.4875
165	855.1125	810.1125	213	856.3125	811.3125	261	857.5125	812.5125
166	855.1375	810.1375	214	856.3375	811.3375	262	857.5375	812.5375
167	855.1625	810.1625	215	856.3625	811.3625	263	857.5625	812.5625
168	855.1875	810.1875	216	856.3875	811.3875	264	857.5875	812.5875
169	855.2125	810.2125	217	856.4125	811.4125	265	857.6125	812.6125
170	855.2375	810.2375	218	856.4375	811.4375	266	857.6375	812.6375
171	855.2625	810.2625	219	856.4625	811.4625	267	857.6625	812.6625
172	855.2875	810.2875	220	856.4875	811.4875	268	857.6875	812.6875
173	855.3125	810.3125	221	856.5125	811.5125	269	857.7125	812.7125
174	855.3375	810.3375	222	856.5375	811.5375	270	857.7375	812.7375
175	855.3625	810.3625	223	856.5625	811.5625	271	857.7625	812.7625
176	855.3875	810.3875	224	856.5875	811.5875	272	857.7875	812.7875
177	855.4125	810.4125	225	856.6125	811.6125	273	857.8125	812.8125
178	855.4375	810.4375	226	856.6375	811.6375	274	857.8375	812.8375
179	855.4625	810.4625	227	856.6625	811.6625	275	857.8625	812.8625
180	855.4875	810.4875	228	856.6875	811.6875	276	857.8875	812.8875
181	855.5125	810.5125	229	856.7125	811.7125	277	857.9125	812.9125
182	855.5375	810.5375	230	856.7375	811.7375	278	857.9375	812.9375
183	855.5625	810.5625	231	856.7625	811.7625	279	857.9625	812.9625
184	855.5875	810.5875	232	856.7875	811.7875	280	857.9875	812.9875
185	855.6125	810.6125	233	856.8125	811.8125	281	858.0125	813.0125
186	855.6375	810.6375	234	856.8375	811.8375	282	858.0375	813.0375
187	855.6625	810.6625	235	856.8625	811.8625	283	858.0625	813.0625
188	855.6875	810.6875	236	856.8875	811.8875	284	858.0875	813.0875
189	855.7125	810.7125	237	856.9125	811.9125	285	858.1125	813.1125
190	855.7375	810.7375	238	856.9375	811.9375	286	858.1375	813.1375
191	855.7625	810.7625	239	856.9625	811.9625	287	858.1625	813.1625
192	855.7875	810.7875	240	856.9875	811.9875	288	858.1875	813.1875

800 MHz Channels

FCC Chan. No.	Mobile Rx Freq.	Mobile Tx Freq
289	858.2125	813.2125
290	858.2375	813.2375
291	858.2625	813.2625
292	858.2875	813.2875
293	858.3125	813.3125
294	858.3375	813.3375
295	858.3625	813.3625
296	858.3875	813.3875
297	858.4125	813.4125
298	858.4375	813.4375
299	858.4625	813.4625
300	858.4875	813.4875
301	858.5125	813.5125
302	858.5375	813.5375
303	858.5625	813.5625
304	858.5875	813.5875
305	858.6125	813.6125
306	858.6375	813.6375
307	858.6625	813.6625
308	858.6875	813.6875
309	858.7125	813.7125
310	858.7375	813.7375
311	858.7625	813.7625
312	858.7875	813.7875
313	858.8125	813.8125
314	858.8375	813.8375
315	858.8625	813.8625
316	858.8875	813.8875
317	858.9125	813.9125
318	858.9375	813.9375
319	858.9625	813.9625
320	858.9875	813.9875
321	859.0125	814.0125
322	859.0375	814.0375
323	859.0625	814.0625
324	859.0875	814.0875
325	859.1125	814.1125
326	859.1375	814.1375
327	859.1625	814.1625
328	859.1875	814.1875
329	859.2125	814.2125
330	859.2375	814.2375
331	859.2625	814.2625
332	859.2875	814.2875
333	859.3125	814.3125
334	859.3375	814.3375
335	859.3625	814.3625
336	859.3875	814.3875

FCC Chan. No.	Mobile Rx Freq.	Mobile Tx Freq
337	859.4125	814.4125
338	859.4375	814.4375
339	859.4625	814.4625
340	859.4875	814.4875
341	859.5125	814.5125
342	859.5375	814.5375
343	859.5625	814.5625
344	859.5875	814.5875
345	859.6125	814.6125
346	859.6375	814.6375
347	859.6625	814.6625
348	859.6875	814.6875
349	859.7125	814.7125
350	859.7375	814.7375
351	859.7625	814.7625
352	859.7875	814.7875
353	859.8125	814.8125
354	859.8375	814.8375
355	859.8625	814.8625
356	859.8875	814.8875
357	859.9125	814.9125
358	859.9375	814.9375
359	859.9625	814.9625
360	859.9875	814.9875
361	860.0125	815.0125
362	860.0375	815.0375
363	860.0625	815.0625
364	860.0875	815.0875
365	860.1125	815.1125
366	860.1375	815.1375
367	860.1625	815.1625
368	860.1875	815.1875
369	860.2125	815.2125
370	860.2375	815.2375
371	860.2625	815.2625
372	860.2875	815.2875
373	860.3125	815.3125
374	860.3375	815.3375
375	860.3625	815.3625
376	860.3875	815.3875
377	860.4125	815.4125
378	860.4375	815.4375
379	860.4625	815.4625
380	860.4875	815.4875
381	860.5125	815.5125
382	860.5375	815.5375
383	860.5625	815.5625
384	860.5875	815.5875

FCC Chan. No.	Mobile Rx Freq	Mobile Tx Freq
385	860.6125	815.6125
386	860.6375	815.6375
387	860.6625	815.6625
388	860.6875	815.6875
389	860.7125	815.7125
390	860.7375	815.7375
391	860.7625	815.7625
392	860.7875	815.7875
393	860.8125	815.8125
394	860.8375	815.8375
395	860.8625	815.8625
396	860.8875	815.8875
397	860.9125	815.9125
398	860.9375	815.9375
399	860.9625	815.9625
400	860.9875	815.9875
401	861.0125	816.0125
402	861.0375	816.0375
403	861.0625	816.0625
404	861.0875	816.0875
405	861.1125	816.1125
406	861.1375	816.1375
407	861.1625	816.1625
408	861.1875	816.1875
409	861.2125	816.2125
410	861.2375	816.2375
411	861.2625	816.2625
412	861.2875	816.2875
413	861.3125	816.3125
414	861.3375	816.3375
415	861.3625	816.3625
416	861.3875	816.3875
417	861.4125	816.4125
418	861.4375	816.4375
419	861.4625	816.4625
420	861.4875	816.4875
421	861.5125	816.5125
422	861.5375	816.5375
423	861.5625	816.5625
424	861.5875	816.5875
425	861.6125	816.6125
426	861.6375	816.6375
427	861.6625	816.6625
428	861.6875	816.6875
429	861.7125	816.7125
430	861.7375	816.7375
431	861.7625	816.7625
432	861.7875	816.7875

800 MHz Channels

FCC Chan. No.	Mobile Rx Freq.	Mobile Tx Freq
433	861.8125	816.8125
434	861.8375	816.8375
435	861.8625	816.8625
436	861.8875	816.8875
437	861.9125	816.9125
438	861.9375	816.9375
439	861.9625	816.9625
440	861.9875	816.9875
441	862.0125	817.0125
442	862.0375	817.0375
443	862.0625	817.0625
444	862.0875	817.0875
445	862.1125	817.1125
446	862.1375	817.1375
447	862.1625	817.1625
448	862.1875	817.1875
449	862.2125	817.2125
450	862.2375	817.2375
451	862.2625	817.2625
452	862.2875	817.2875
453	862.3125	817.3125
454	862.3375	817.3375
455	862.3625	817.3625
456	862.3875	817.3875
457	862.4125	817.4125
458	862.4375	817.4375
459	862.4625	817.4625
460	862.4875	817.4875
461	862.5125	817.5125
462	862.5375	817.5375
463	862.5625	817.5625
464	862.5875	817.5875
465	862.6125	817.6125
466	862.6375	817.6375
467	862.6625	817.6625
468	862.6875	817.6875
469	862.7125	817.7125
470	862.7375	817.7375
471	862.7625	817.7625
472	862.7875	817.7875
473	862.8125	817.8125
474	862.8375	817.8375
475	862.8625	817.8625
476	862.8875	817.8875
477	862.9125	817.9125
478	862.9375	817.9375
479	862.9625	817.9625
480	862.9875	817.9875
481	863.0125	818.0125
482	863.0375	818.0375
483	863.0625	818.0625
484	863.0875	818.0875
485	863.1125	818.1125
486	863.1375	818.1375
487	863.1625	818.1625
488	863.1875	818.1875
489	863.2125	818.2125
490	863.2375	818.2375
491	863.2625	818.2625
492	863.2875	818.2875
493	863.3125	818.3125
494	863.3375	818.3375
495	863.3625	818.3625
496	863.3875	818.3875
497	863.4125	818.4125
498	863.4375	818.4375
499	863.4625	818.4625
500	863.4875	818.4875
501	863.5125	818.5125
502	863.5375	818.5375
503	863.5625	818.5625
504	863.5875	818.5875
505	863.6125	818.6125
506	863.6375	818.6375
507	863.6625	818.6625
508	863.6875	818.6875
509	863.7125	818.7125
510	863.7375	818.7375
511	863.7625	818.7625
512	863.7875	818.7875
513	863.8125	818.8125
514	863.8375	818.8375
515	863.8625	818.8625
516	863.8875	818.8875
517	863.9125	818.9125
518	863.9375	818.9375
519	863.9625	818.9625
520	863.9875	818.9875
521	864.0125	819.0125
522	864.0375	819.0375
523	864.0625	819.0625
524	864.0875	819.0875
525	864.1125	819.1125
526	864.1375	819.1375
527	864.1625	819.1625
528	864.1875	819.1875
529	864.2125	819.2125
530	864.2375	819.2375
531	864.2625	819.2625
532	864.2875	819.2875
533	864.3125	819.3125
534	864.3375	819.3375
535	864.3625	819.3625
536	864.3875	819.3875
537	864.4125	819.4125
538	864.4375	819.4375
539	864.4625	819.4625
540	864.4875	819.4875
541	864.5125	819.5125
542	864.5375	819.5375
543	864.5625	819.5625
544	864.5875	819.5875
545	864.6125	819.6125
546	864.6375	819.6375
547	864.6625	819.6625
548	864.6875	819.6875
549	864.7125	819.7125
550	864.7375	819.7375
551	864.7625	819.7625
552	864.7875	819.7875
553	864.8125	819.8125
554	864.8375	819.8375
555	864.8625	819.8625
556	864.8875	819.8875
557	864.9125	819.9125
558	864.9375	819.9375
559	864.9625	819.9625
560	864.9875	819.9875
561	865.0125	820.0125
562	865.0375	820.0375
563	865.0625	820.0625
564	865.0875	820.0875
565	865.1125	820.1125
566	865.1375	820.1375
567	865.1625	820.1625
568	865.1875	820.1875
569	865.2125	820.2125
570	865.2375	820.2375
571	865.2625	820.2625
572	865.2875	820.2875
573	865.3125	820.3125
574	865.3375	820.3375
575	865.3625	820.3625
576	865.3875	820.3875

800 MHz Channels

FCC Chan. No.	Mobile Rx Freq.	Mobile Tx Freq
577	865.4125	820.4125
578	865.4375	820.4375
579	865.4625	820.4625
580	865.4875	820.4875
581	865.5125	820.5125
582	865.5375	820.5375
583	865.5625	820.5625
584	865.5875	820.5875
585	865.6125	820.6125
586	865.6375	820.6375
587	865.6625	820.6625
588	865.6875	820.6875
589	865.7125	820.7125
590	865.7375	820.7375
591	865.7625	820.7625
592	865.7875	820.7875
593	865.8125	820.8125
594	865.8375	820.8375
595	865.8625	820.8625
596	865.8875	820.8875
597	865.9125	820.9125
598	865.9375	820.9375
599	865.9625	820.9625
600	865.9875	820.9875
-	866.0000	821.0000
601	866.0125	821.0125
-	866.0250	821.0250
602	866.0375	821.0375
603	866.0500	821.0500
604	866.0625	821.0625
605	866.0750	821.0750
606	866.0875	821.0875
607	866.1000	821.1000
608	866.1125	821.1125
609	866.1250	821.1250
610	866.1375	821.1375
611	866.1500	821.1500
612	866.1625	821.1625
613	866.1750	821.1750
614	866.1875	821.1875
615	866.2000	821.2000
616	866.2125	821.2125
617	866.2250	821.2250
618	866.2375	821.2375
619	866.2500	821.2500
620	866.2625	821.2625
621	866.2750	821.2750
622	866.2875	821.2875
623	866.3000	821.3000
624	866.3125	821.3125
625	866.3250	821.3250
626	866.3375	821.3375
627	866.3500	821.3500
628	866.3625	821.3625
629	866.3750	821.3750
630	866.3875	821.3875
631	866.4000	821.4000
632	866.4125	821.4125
633	866.4250	821.4250
634	866.4375	821.4375
635	866.4500	821.4500
636	866.4625	821.4625
637	866.4750	821.4750
638	866.4875	821.4875
-	866.5000	821.5000
639	866.5125	821.5125
-	866.5250	821.5250
640	866.5375	821.5375
641	866.5500	821.5500
642	866.5625	821.5625
643	866.5750	821.5750
644	866.5875	821.5875
645	866.6000	821.6000
646	866.6125	821.6125
647	866.6250	821.6250
648	866.6375	821.6375
649	866.6500	821.6500
650	866.6625	821.6625
651	866.6750	821.6750
652	866.6875	821.6875
653	866.7000	821.7000
654	866.7125	821.7125
655	866.7250	821.7250
656	866.7375	821.7375
657	866.7500	821.7500
658	866.7625	821.7625
659	866.7750	821.7750
660	866.7875	821.7875
661	866.8000	821.8000
662	866.8125	821.8125
663	866.8250	821.8250
664	866.8375	821.8375
665	866.8500	821.8500
666	866.8625	821.8625
667	866.8750	821.8750
668	866.8875	821.8875
669	866.9000	821.9000
670	866.9125	821.9125
671	866.9250	821.9250
672	866.9375	821.9375
673	866.9500	821.9500
674	866.9625	821.9625
675	866.9750	821.9750
676	866.9875	821.9875
-	867.0000	822.0000
677	867.0125	822.0125
-	867.0250	822.0250
678	867.0375	822.0375
679	867.0500	822.0500
680	867.0625	822.0625
681	867.0750	822.0750
682	867.0875	822.0875
683	867.1000	822.1000
684	867.1125	822.1125
685	867.1250	822.1250
686	867.1375	822.1375
687	867.1500	822.1500
688	867.1625	822.1625
689	867.1750	822.1750
690	867.1875	822.1875
691	867.2000	822.2000
692	867.2125	822.2125
693	867.2250	822.2250
694	867.2375	822.2375
695	867.2500	822.2500
696	867.2625	822.2625
697	867.2750	822.2750
698	867.2875	822.2875
699	867.3000	822.3000
700	867.3125	822.3125
701	867.3250	822.3250
702	867.3375	822.3375
703	867.3500	822.3500
704	867.3625	822.3625
705	867.3750	822.3750
706	867.3875	822.3875
707	867.4000	822.4000
708	867.4125	822.4125
709	867.4250	822.4250
710	867.4375	822.4375
711	867.4500	822.4500
712	867.4625	822.4625
713	867.4750	822.4750
714	867.4875	822.4875

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
-	867.5000	822.5000	759	868.1000	823.1000	807	868.7000	823.7000
715	867.5125	822.5125	760	868.1125	823.1125	808	868.7125	823.7125
-	867.5250	822.5250	761	868.1250	823.1250	809	868.7250	823.7250
716	867.5375	822.5375	762	868.1375	823.1375	810	868.7375	823.7375
717	867.5500	822.5500	763	868.1500	823.1500	811	868.7500	823.7500
718	867.5625	822.5625	764	868.1625	823.1625	812	868.7625	823.7625
719	867.5750	822.5750	765	868.1750	823.1750	813	868.7750	823.7750
720	867.5875	822.5875	766	868.1875	823.1875	814	868.7875	823.7875
721	867.6000	822.6000	767	868.2000	823.2000	815	868.8000	823.8000
722	867.6125	822.6125	768	868.2125	823.2125	816	868.8125	823.8125
723	867.6250	822.6250	769	868.2250	823.2250	817	868.8250	823.8250
724	867.6375	822.6375	770	868.2375	823.2375	818	868.8375	823.8375
725	867.6500	822.6500	771	868.2500	823.2500	819	868.8500	823.8500
726	867.6625	822.6625	772	868.2625	823.2625	820	868.8625	823.8625
727	867.6750	822.6750	773	868.2750	823.2750	821	868.8750	823.8750
728	867.6875	822.6875	774	868.2875	823.2875	822	868.8875	823.8875
729	867.7000	822.7000	775	868.3000	823.3000	823	868.9000	823.9000
730	867.7125	822.7125	776	868.3125	823.3125	824	868.9125	823.9125
731	867.7250	822.7250	777	868.3250	823.3250	825	868.9250	823.9250
732	867.7375	822.7375	778	868.3375	823.3375	826	868.9375	823.9375
733	867.7500	822.7500	779	868.3500	823.3500	827	868.9500	823.9500
734	867.7625	822.7625	780	868.3625	823.3625	828	868.9625	823.9625
735	867.7750	822.7750	781	868.3750	823.3750	829	868.9750	823.9750
736	867.7875	822.7875	782	868.3875	823.3875	830	868.9875	823.9875
737	867.8000	822.8000	783	868.4000	823.4000	-	869.0000	824.0000
738	867.8125	822.8125	784	868.4125	823.4125	-	869.0125	824.0125
739	867.8250	822.8250	785	868.4250	823.4250	-	869.0250	824.0250
740	867.8375	822.8375	786	868.4375	823.4375	-	869.0375	824.0375
741	867.8500	822.8500	787	868.4500	823.4500	-	869.0500	824.0500
742	867.8625	822.8625	788	868.4625	823.4625	-	869.0625	824.0625
743	867.8750	822.8750	789	868.4750	823.4750	-	869.0750	824.0750
744	867.8875	822.8875	790	868.4875	823.4875	-	869.0875	824.0875
745	867.9000	822.9000	791	868.5000	823.5000	-	869.1000	824.1000
746	867.9125	822.9125	792	868.5125	823.5125	-	869.1125	824.1125
747	867.9250	822.9250	793	868.5250	823.5250	-	869.1250	824.1250
748	867.9375	822.9375	794	868.5375	823.5375	-	869.1375	824.1375
749	867.9500	822.9500	795	868.5500	823.5500	-	869.1500	824.1500
750	867.9625	822.9625	796	868.5625	823.5625	-	869.1625	824.1625
751	867.9750	822.9750	797	868.5750	823.5750	-	869.1750	824.1750
752	867.9875	822.9875	798	868.5875	823.5875	-	869.1875	824.1875
-	868.0000	823.0000	799	868.6000	823.6000	-	869.2000	824.2000
753	868.0125	823.0125	800	868.6125	823.6125	-	869.2125	824.2125
-	868.0250	823.0250	801	868.6250	823.6250	-	869.2250	824.2250
754	868.0375	823.0375	802	868.6375	823.6375	-	869.2375	824.2375
755	868.0500	823.0500	803	868.6500	823.6500	-	869.2500	824.2500
756	868.0625	823.0625	804	868.6625	823.6625	-	869.2625	824.2625
757	868.0750	823.0750	805	868.6750	823.6750	-	869.2750	824.2750
758	868.0875	823.0875	806	868.6875	823.6875	-	869.2875	824.2875

800 MHz Channels

FCC Chan. No.	Mobile Rx Freq.	Mobile Tx Freq
-	869.3000	824.3000
-	869.3125	824.3125
-	869.3250	824.3250
-	869.3375	824.3375
-	869.3500	824.3500
-	869.3625	824.3625
-	869.3750	824.3750
-	869.3875	824.3875
-	869.4000	824.4000
-	869.4125	824.4125
-	869.4250	824.4250
-	869.4375	824.4375
-	869.4500	824.4500
-	869.4625	824.4625
-	869.4750	824.4750
-	869.4875	824.4875
-	869.5000	824.5000
-	869.5125	824.5125
-	869.5250	824.5250
-	869.5375	824.5375
-	869.5500	824.5500
-	869.5625	824.5625
-	869.5750	824.5750
-	869.5875	824.5875
-	869.6000	824.6000
-	869.6125	824.6125
-	869.6250	824.6250
-	869.6375	824.6375
-	869.6500	824.6500
-	869.6625	824.6625
-	869.6750	824.6750
-	869.6875	824.6875
-	869.7000	824.7000
-	869.7125	824.7125
-	869.7250	824.7250
-	869.7375	824.7375
-	869.7500	824.7500
-	869.7625	824.7625
-	869.7750	824.7750
-	869.7875	824.7875
-	869.8000	824.8000
-	869.8125	824.8125
-	869.8250	824.8250
-	869.8375	824.8375
-	869.8500	824.8500
-	869.8625	824.8625
-	869.8750	824.8750
-	869.8875	824.8875
-	869.9000	824.9000
-	869.9125	824.9125
-	869.9250	824.9250
-	869.9375	824.9375
-	869.9500	824.9500
-	869.9625	824.9625
-	869.9750	824.9750
-	869.9875	824.9875

SECTION 5 CIRCUIT DESCRIPTION

5.1 GENERAL TRANSCEIVER DESRIPTION

5.1.1 INTRODUCTION

The EFJohnson Stealth 25 Digital Radio is a microcontroller-based radio that uses a Digital Signal Processor (DSP) to provide the following modes of operation:

Narrowband Analog - FM modulation with a maximum deviation of 2.5 kHz. This mode is usually used in systems where the channel spacing is 12.5 kHz. Call Guard (CTCSS or DCS) subaudible squelch signaling can be used in this mode.

Wideband Analog - FM modulation with a maximum deviation of 5 kHz. This mode is usually used in systems where the channel spacing is 25 kHz or 30 kHz. Call Guard (CTCSS or DCS) subaudible squelch signaling can be used in this mode.

Project 25 Digital - The voice is digitized, error corrected, optionally encrypted and transmitted using C4FM modulation according to the Project 25 standard. This mode can be used in channel spacings of 12.5 kHz.

DES/DES-XL - This mode is compatible with the Motorola DES and DES-XL protocols. Voice is digitized, encrypted, and transmitted using FSK modulation. This mode can be used in channel spacings of 25 kHz. The DSP processes the received signals and generates the appropriate output signals. The microcontroller controls the hardware and provides an interface between hardware and DSP.

5.1.2 PC BOARDS

The 5300-series mobile contains the following PC board assemblies:

RF Board - Contains the receiver, synthesizer, and exciter sections.

PA Board - Contains the transmitter power amplifier, power control, and main DC power switching sections.

Logic Board - Contains the digital signal processing (DSP), control logic, and audio processing sections.

Interface Board - A small board that provides the electrical connections between the logic and RF/PA boards. It also contains the audio amplifier and volume control circuits for internal and external speakers.

Display Controller - Contains a microcontroller which provides an interface between the controller on the logic board and the front panel display and switches.

Display Board - Contains the liquid crystal display, option switch keypad, and display drivers. In addition, it contains the backlight for the display and keypad.

5.1.3 CIRCUIT PROTECTION (FUSES)

Circuit protection is provided as follows:

- A 15-ampere fuse in the power cable provides overall transceiver protection.
- A 2-ampere fuse on the RF board protects circuits on that board.
- F700 (2-ampere) on the display controller board protects the Sw B+ output of the microphone connector.
- F1 on the logic board protects the Sw B+ output of universal interface connector J5.
- The various voltage regulators provide circuit protection by automatically limiting current.

5.1.4 ANALOG MODE DESCRIPTION

Receive Mode

The RF signal is routed from the antenna connector to the RF Board where it is filtered, amplified, and mixed with the first local oscillator frequency generated by the synthesizer. The resulting IF signal is also filtered and amplified and sent to the ABACUS chip.

The signal is then mixed with the second local oscillator frequency to create a second IF signal of 450 kHz. The second IF signal is then sampled at 14.4 Msps and downconverted to baseband. The baseband

signal is then decimated to a lower sample rate that is selectable at 20 kHz. This signal is then routed via a serial interface using a differential current output to the ADSIC U3 on the logic board.

On the logic board ADSIC U3 digitally filters the input signal, performs frequency discrimination to obtain the message signal, and then routes the message signal to DSP (Digital Signal Processor) U12. The DSP first performs a carrier-detection squelch function on the radio. If a signal is determined to be present, the audio portion of the signal is resampled to an 8 kHz rate and then filtered appropriately. The filtered signal is then routed back to a D/A in the ADSIC to produce an analog signal for output to the audio power amplifier (PA) and then the speaker. Any detected signaling information is decoded and the resulting information is sent to the microcontroller.

Transmit Mode

The signal from the microphone is amplified by the audio PA and is then routed to ADSIC U3 where it is first digitized at a 16 ksps rate and then sent to DSP U12. The DSP performs the required filtering, adds the desired signaling, converts the sample rate to 48 ksps and then sends the resulting signal back to a D/A in the ADSIC to produce the analog modulation signal for the VCO. The modulated VCO signal is then sent to the RF PA for amplification.

5.1.5 PROJECT 25 DIGITAL MODE

Introduction

In Project 25 Digital Mode, the carrier is modulated with four discrete deviation levels of ± 600 Hz and ± 1800 Hz. Digitized voice is created using an IMBE™ vocoder.

Receive Mode

The signal is processed in the same way as an analog mode transmission until after the squelch function is performed. If a signal is detected to be present, DSP U12 resamples the signal from 20 kHz to 24 kHz. This is done so that the sample rate is an integer multiple (5x) of the data rate of the digital modulation which is 4800 symbols/sec (9600 bits/sec).

The resampled signal is then processed by a demodulator routine to extract the digital information. The resulting bit stream (9600 bps) is sent to a routine that performs unframing, error-correction, and voice decoding. The result of these operations is a reconstructed voice signal sampled at 8 kHz. The sampled voice signal is sent to a D/A in ADSIC U3 to produce an analog signal for output to the audio power amplifier and speaker.

Transmit Mode

The microphone signal is processed as in the analog mode until it reaches DSP U12. At this point the audio signal is processed by a voice encoding routine to digitize the information. The resulting samples are then converted to a bit stream that is placed into the proper framing structure and error protected. The resulting bit stream has a bit rate of 9600 Hz.

This bit stream is then encoded, two bits at a time, into a digital level corresponding to one of the four allowable frequency deviations. This produces 16-bit symbols with a rate of 4800 Hz. The symbols are resampled to a rate of 48 kHz and filtered to comply with channel bandwidth requirements. The filtered signal is then sent to a D/A in ADSIC U3 to produce the analog modulation signal for the VCO. The modulated VCO signal is then mixed up to the final transmit frequency and then sent to the RF board power amplifier section.

5.2 RF BOARD

NOTE: The RF Board is not field serviceable. Therefore, it must be replaced if it is defective.

5.2.1 RF BOARD OVERVIEW

The receiver front end consists of a preselector, RF amplifier, second preselector, and mixer (see Figure 5-1). Both preselectors on the VHF board are varactor-tuned, two-pole filters controlled by the microcontroller unit through the D/A IC. The 800 MHz board uses stripline technology for the preselector. The RF amplifier is a dual-gate gallium-arsenide IC. The mixer is a double-balanced, transformer-coupled active mixer. Injection is provided by the VCO through an injection filter. See Table 5-1 for local oscillator (LO) and first IF information.

The frequency generation function is performed by the PLL (Phase-Locked-Loop) consisting of synthesizer U204 and VCO circuit Q202/U201. Reference oscillator U203 generates and supplies a reference signal of 16.8 MHz to synthesizer. The synthesizer contains a programmable reference divider, programmable A and B dividers, a programmable prescaler counter (P), and a programmable fractional N divider with two programmable values (N numerator and N denominator).

All of these dividers are programmed through the serial interface which connects the synthesizer to the controller microprocessor. The 16.8 MHz reference oscillator frequency is divided down to a synthesizer reference frequency of 2.1, 2.4, or 2.225 MHz. This signal is fed to the phase detector which generates the steering voltage for the VCO. The output of the VCO circuit is coupled back and divided by AP+B and then divided by the fractional divider and fed into the second input of the phase detector. The VCO buffer has two outputs. One input goes to the input of Rx mixer chip U2, and the other is applied to the input of power amplifier module U105.

The receiver back end consists of a two-pole crystal filter, IF amplifier, a second two-pole crystal filter, and the ABACUS digital back-end IC. The two

Table 5-1 LO and First IF Frequencies

	VHF	800 MHz
LO Frequency range	181.15 - 219.15 MHz	776.65 - 796.65 MHz
First IF Frequency	45.15 MHz	73.35 MHz

pole filters are wide enough to accommodate 5 kHz modulation. Final IF filtering is done digitally in the ADSIC.

The ABACUS digital back-end chip consists of an amplifier, second mixer, IF analog-to-digital converter, a baseband down-converter, and a 2.4 MHz synthesis circuit to provide a clock to the ADSIC on the logic board. The second LO is generated by discrete components external to the ABACUS. The output of the ABACUS is a digital bit stream that is current driven on a differential pair to reduce noise generation.

The transmitter consists of an RF power amplifier IC that amplifies an injection signal from the VCO. Transmit power is controlled by two custom ICs that monitor the output of a directional coupler and adjust the power amplifier control voltages correspondingly. The signal passes through a Rx/Tx switch that uses

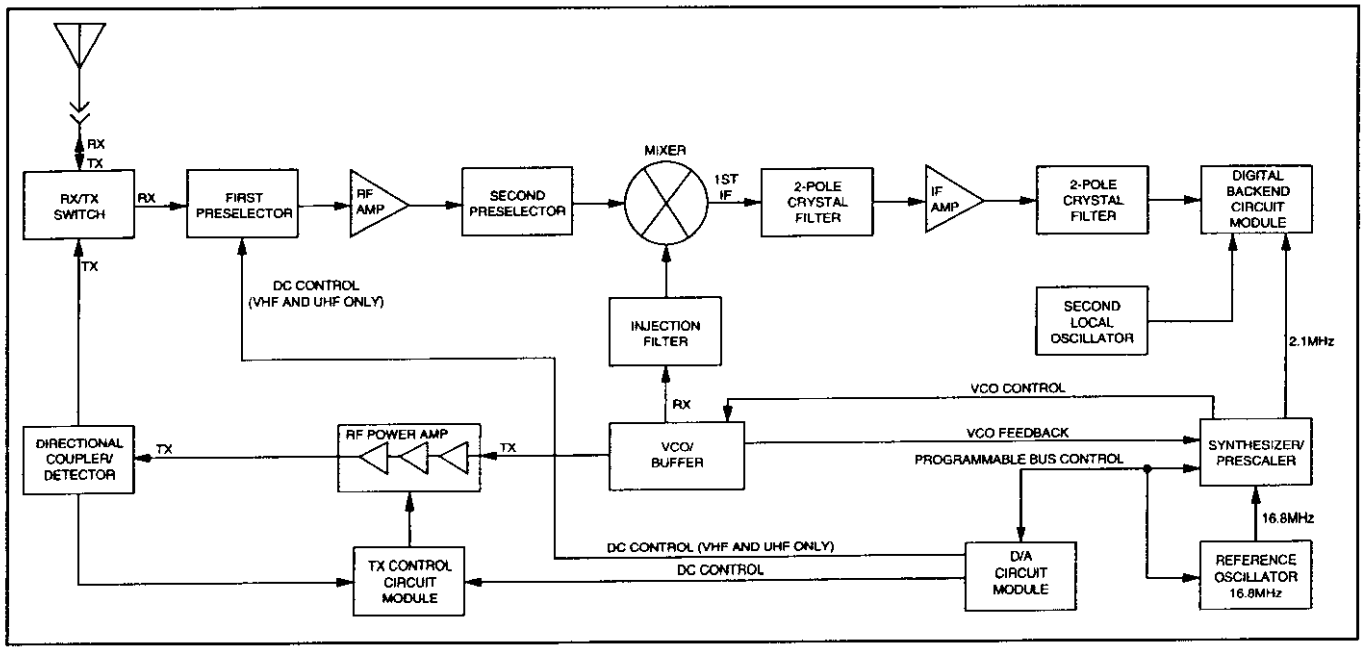


Figure 5-1 RF Board Block Diagram

pin diodes to automatically provide an appropriate interface to transmit or receive signals.

5.2.2 FREQUENCY GENERATION UNIT

The Frequency Generation Unit (FGU) consists of these three major sections: (1) high stability reference oscillator, (2) fractional-N synthesizer, and (3) VCO buffer. A 5-volt regulator supplies power to the FGU. The regulator output voltage is filtered and then distributed to the transmit and receive VCOs and the VCO buffer IC. The mixer LO injection signal and transmit frequency are generated by the receive VCO and transmit VCO, respectively. The receive VCO uses an external active device, and the transmit VCO active device is a transistor inside the VCO buffer.

The receive VCO is a Colpitts-type oscillator. The receive VCO signal is received by the VCO buffer where it is amplified by a buffer inside the IC. The amplified signal is routed through a low-pass filter and injected as the first LO signal into the mixer. In the VCO buffer, the receive VCO signal is also routed to an internal prescaler buffer. The buffered output is applied to a low-pass filter. After filtering, the signal is routed to a prescaler divider in the synthesizer.

The divide ratios for the prescaler circuits are determined from information stored in an EEPROM. The microprocessor extracts data for the division ratio as determined by the position of the channel-select switch and routes the signal to a comparator in the synthesizer. A 16.8 MHz reference oscillator applies the 16.8 MHz signal to the synthesizer. The oscillator signal is divided into one of three pre-determined frequencies. A time-based algorithm is used to generate the fractional-N ratio.

If the two frequencies in the synthesizer's comparator differ, an error voltage is produced. The phase detector error voltage is applied to the loop filter. The filtered voltage alters the VCO frequency until the correct frequency is synthesized.

In the transmit mode, the modulation of the carrier is achieved by using a two-port modulation technique. The modulation for low frequency tones, such as CTCSS and DCS, is achieved by injecting the tones into the A/D section of the fractional-N divider, generating the required deviation. Modulation of the high frequency audio signals is achieved by modulating the varactor through a frequency compensation network.

The transmit VCO signal is amplified by an internal buffer, routed through a low-pass filter, and then sent to the transmit power amplifier module. The reference oscillator supplies a 16.8 MHz clock to the synthesizer where it is divided down to a 2.1 MHz clock. This divided down clock is fed to the ABACUS IC.

5.2.3 ANTENNA SWITCH

A pair of diodes is used to electronically steer the RF signal between the receiver and transmitter. In transmit mode, RF is routed through a transmit switching diode and sent to the antenna. In receive mode, RF is received from the antenna, routed through a receive switching diode and applied to the RF amplifier.

5.2.4 RECEIVER FRONT END

The RF signal from the antenna is sent through a bandpass filter. The bandpass filter is electronically tuned by the microcontroller via the D/A IC by applying a control voltage to the varactor diodes in the filter. The D/A output range is extended through the use of a current mirror. Wideband operation of the filter is achieved by retuning the bandpass filter across the band.

The output of the bandpass filter is applied to a wideband amplifier. After being amplified by the RF amplifier, the RF signal is further filtered by a second broadband, fixed tuned, bandpass filter to improve spurious rejection.

The filtered RF signal is routed via a broadband 50-ohm transformer to the input of a broadband mixer/buffer. The mixer uses GaAs FETs in a double-balanced Gilbert Cell configuration. The RF signal is mixed with a first LO signal of about –10 dBm supplied by the FGU. Mixing of the RF and the first LO results in an output signal which is the first IF frequency according to Figure 5-1. The first IF signal output is routed through a transformer and impedance matching components and is then applied to a two-pole crystal filter. The two-pole crystal filter removes unwanted mixer products.

5.2.5 RECEIVER BACK END

The output of the crystal filter is matched to the input of the IF buffer amplifier transistor. The output of the IF amplifier is applied to a second crystal filter through a matching circuit. This filter supplies further attenuation at the IF sidebands to increase radio selectivity.

In the ABACUS IC the first IF frequency is amplified and then downconverted to 450 kHz, the second IF frequency. At this point, the analog signal is converted into two digital bit streams via a sigma-delta A/D converter. The bit streams are then digitally filtered and mixed down to baseband and filtered again. The differential output data stream is then sent to ADSIC U3 on the logic board where it is processed to produce the recovered audio.

The ABACUS IC on the RF board is electronically programmable, and the amount of filtering, which is dependent on the radio channel spacing and signal type, is controlled by the microcontroller. Additional filtering, which used to be provided externally by a conventional ceramic filter, is replaced by internal digital filters in the ABACUS IC. The ABACUS IC contains a feedback AGC circuit to expand the dynamic range of the sigma-delta converter. The differential output data contains the quadrature (I and Q) information in 16-bit words, the AGC information in a 9-bit word, imbedded word sync information and fill bits dependent on sampling speed. A fractional-N synthesizer is also incorporated on the ABACUS IC for 2nd LO generation.

The 2nd LO/VCO is a Colpitts oscillator. The VCO has a varactor diode to adjust the VCO frequency. The control signal for the varactor is derived from a loop filter.

5.2.6 EXCITER

The exciter consists of three major sections: Harmonic Filter, RF Power Amplifier, and the ALC (Automatic Level Control) circuit.

The RF signal from the PA module is routed through a coupler, then through the harmonic filter, then to the antenna switch. The RF power amplifier module is a wide-band multi-stage amplifier. The nominal input and output impedance of the power amplifier is 50 ohms. The DC bias for the RF power amplifier is controlled by a switching transistor. The microcontroller uses the D/A IC to produce a ready signal for the transmit ALC IC. The synthesizer sends a LOC signal to the transmit ALC IC. When both the ready signal and LOC signal are available to the transmit ALC IC, the switching transistor for the RF power amplifier is turned on.

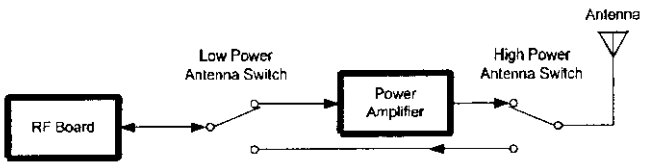
A coupler module samples the forward power and the reverse power of the PA output voltage. Reverse power is present when there is other than 50-ohm impedance at the RF output connector. Sampling is achieved by coupling some of the forward and/or reverse power for rectification and summing. The resulting DC voltage is then applied to the transmit ALC IC as an RF strength indicator.

The transmit ALC circuit is the core of the power control loop. Circuits in the transmit ALC module compare the RF strength indicator to a reference value and generate a bias signal that is applied to the base of a transistor. This transistor varies the DC control voltage applied to the RF PA controlling the RF power.

5.3 VHF PA BOARD

5.3.1 ANTENNA SWITCHES

The RF signal from the RF board is fed by a coaxial cable to the PA board. Since both the receive and transmit signals are present on the input of the PA board, special antenna switching is required on the PA board to route the receive signal around the amplifier section to the antenna. Both a high power and a low power antenna switch are used as shown below.



The low power switch consists of pin diodes* CR512 and CR513 and other components. The Q7 output of shift register U601 is high in the transmit mode and low in the receive mode. Therefore, in the transmit mode, Q507 and Q514 are on and Q508 and Q513 are off. This forward biases CR513 and reverse

* A reverse biased pin diode presents a high impedance to RF signals. Conversely, and a forward biased pin diode presents an variable low impedance that changes inversely to current.

VHF PA BOARD DESCRIPTION (CONT'D)

biases CR512. The transmit signal from the RF board then has a low impedance path through C533 and CR513 to driver Q509, and the high impedance provided by CR512 blocks it from the receive path.

In the receive mode, the opposite occurs, so CR513 is reverse biased and CR512 forward biased. The receive signal from the high power antenna switch (see following) then has a low impedance path through C544, CR512, and C534 to the RF board, and is blocked from the power amplifier by CR513.

The high power antenna switch consists of pin diodes* CR501, CR502, and CR503. This switch effectively switches the antenna between the power amplifier and the receive bypass path to the RF board (see preceding illustration).

Transistor Q501 is on in the transmit mode and off in the receive mode. Therefore, in the transmit mode, all three diodes are forward biased (CR501 and CR502 are biased by voltage applied from the collector of Q510). The transmit signal then has a low impedance path through CR502 to the low-pass filter and is blocked from the bypass path by L504/C511 and L505/C515 which present a high impedance at the transmit frequency. In the receive mode, all three diodes are reverse biased. Therefore, the receive signal from the antenna is blocked from the power amplifier by CR502 and has a low impedance path through L504 and L505 to the RF board.

5.3.2 AMPLIFIERS (Q509, Q510)

Impedance matching between the low power antenna switch and Q509 is provided by L511 and several capacitors and sections of microstrip. Class C biasing is provided by L510 and ferrite bead EP503, and negative feedback for stabilization is provided by R557 and R543. Supply voltage to Q509 is controlled by the power control circuit to regulate the power output of the transmitter. Conditioning and isolation of the DC supply to Q509 is provided by L509, L514, EP501, and C540-C542.

Impedance matching between Q509 and final amplifier Q510 is provided by several capacitors and sections of microstrip. Class C biasing of Q510 is provided by L515, EP502, R559, and R560. The current for this stage flows through L516, R561, and L517. The voltage drop across R561 is sensed by the power control circuit to detect an over-current condition.

From Q510 the transmit signal is fed through another impedance matching network to a directional coupler, to the high power antenna switch (see preceding section), and then to the low-pass filter. This filter attenuates harmonics occurring above the transmit frequency band to prevent adjacent channel interference. The directional coupler detects the forward component of the output power for use by the power control circuit.

5.3.3 POWER CONTROL

Introduction

The power control circuit maintains a constant power output as changes occur in temperature and voltage. It does this by sensing forward power and then varying the drive to Q510 to maintain a constant output power. The drive to Q510 is controlled by varying the supply voltage to driver Q509. The current to final amplifier Q510 is also sensed, but power output is affected by this input only if current becomes excessive. Power output is then cut back to approximately 25% of full power.

The power output level is set in 127 steps by D/A converter U801 which is controlled by the microcontroller. This allows power to be adjusted using the PCTune software and computer and also different power levels to be programmed. In addition, it allows the microcontroller to cut back power if the power amplifier temperature is excessive. Temperature is sensed via thermistor RT501.

U502A, Q500/Q502 Operation

The forward power signal from the directional coupler is applied to pin 2 of amplifier U502A. This is a DC signal that increases proportionally to forward power. The other input to U502A is a DC reference voltage from a D/A converter formed by shift register U801 and several resistors. The voltage from this D/A converter sets the voltage on pin 3 which sets the power output of the transmitter.

* A reverse biased pin diode presents a high impedance to RF signals. Conversely, and a forward biased pin diode presents an variable low impedance that changes inversely to current.

VHF PA BOARD DESCRIPTION (CONT'D)

U502A is a difference amplifier which amplifies the difference between the reference voltage on pin 3 and the forward power signal on pin 2. The turn-on time of U502A is controlled by the time constant of C528 and R534, and negative AC feedback to prevent oscillation is also provided by C528. This circuit operates as follows: Assume the output power attempts to increase. The DC voltage applied to U502A, pin 2 then increases which causes the output voltage on pin 1 to decrease. Transistors Q505 and Q506 then turn off slightly which decreases the supply voltage to driver Q509. The output power then decreases to maintain a constant power output. R541 and R542 limit the voltage gain of Q505 and Q506 to approximately two.

Delayed PTT

Transistor Q504 is used to delay power output for a short time after the transmitter is keyed. This allows the synthesizer and exciter to stabilize so that the transmitter does not transmit off-frequency. The signal which controls Q504 is from microcontroller U9 on the logic board. In the receive mode this output is low, so Q504 is off. Pin 2 of U500A is then pulled high by the 7.2-volt supply applied through R537 and CR506. This causes the output on pin 1 of U502A to go low which shuts off power to Q509. Then when the transmitter is keyed, the Q504 control signal goes high after a short delay. Q504 then turns on and diode CR506 is reverse biased. Only the forward power signal is then applied to pin 2 of U502A.

Over-Current Shutdown

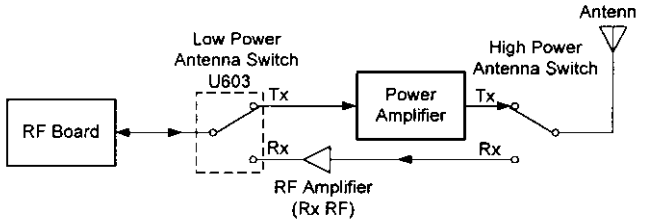
Current to final amplifier Q510 is monitored by sensing the voltage drop across R561. Pins 3 and 6 of U506 are connected across this resistor. As current increases, the output voltage on U506, pin 8 decreases. This causes the output voltage of voltage follower U507A to decrease. This signal is applied to Schmitt trigger U502B. When the voltage on pin 6 rises above the reference on pin 5, the output on pin 7 goes low. This lowers the power control voltage applied to U502A, pin 3 which lowers the power output to approximately 25% of full power.

800 MHz BOARD DESCRIPTION

5.4 800 MHz PA BOARD

5.4.1 LOW POWER ANTENNA SWITCH

The RF signal from the RF board is fed by a coaxial cable to the PA board. Since both the receive and transmit signals are present on the input of the PA board, special antenna switching is required on the PA board to route the receive signal around the power amplifier section to the antenna. Both high power and a low power antenna switches are used as shown below.



Low power antenna switching is provided by electronic antenna switch U603. Pin 5 is effectively connected to pin 1 when pin 6 is high (and pin 4 is low). Conversely, pin 5 is connected to pin 3 when pin 4 is high and pin 6 is low. These control signals are provided by the Q7 output of shift register U501 and inverters Q516/Q517. In the transmit mode, the signal from the RF board is then routed through C532 to the PA module, and blocked from RF amplifier Q503. In the receive mode, the opposite occurs. Refer to Section 5.4.4 for a description of the high power antenna switch.

5.4.2 POWER DETECTOR AND ATTENUATOR

The transmit RF output signal of pin 3 of antenna switch U603 is coupled by C595 to a power detector circuit formed by CR521, R591, and other components. When RF power is detected, the voltage on pin 13 of op amp U502 increases. When it rises above the reference on pin 12, the output on pin 14 goes low and turns off Q507. The base of Q505 is then no longer grounded which allows it to be controlled by the power control circuit. This provides maximum attenuation in the receive mode to minimize the amplification of any low level receive signal that may be present (see following).

800 MHz PA BOARD DESCRIPTION (CONT'D)

A 3-dB pad formed by R541, R542, and R543 provides attenuation of the RF signal and also a 50-ohm impedance. Matching between U603 and this pad is provided by C532 and L514. This pad is then matched by a section of microstrip and L503 to a limiter and variable 50-ohm attenuator formed by pin diodes* C516-C518 and other components. This attenuator provides approximately 0-20 dB attention of the RF signal input to PA module. This controls the power output of the transceiver.

The limiter section formed by CR516, CR517, C535 and biasing resistors R580/R581 attenuates high level input signals that could cause improper operation of the attenuator. The attenuator circuit is formed by CR518 and CR519 and controlled by Q505 and the rest of the power control circuit (see Section 5.4.6). Biasing of these diodes is provided by CR520, R597, R584, R582, R586, and R538 connected to the emitter of Q505. When Q505 is turned off, CR518 is reverse biased by the voltage applied through R537. It then provides maximum attenuation of the RF signal.

A shunt path is provided around CR518 by R583, C537, and R585. Pin diode CR519 is at its maximum forward biased condition when Q505 is off, and connects R583 to AC ground through C538. This maintains a constant 50-ohm impedance. Then as Q505 turns on, CR518 becomes forward biased and provides less attenuation. Likewise, CR519 becomes less forward biased which increases the impedance of the path to ground. From the attenuator the signal is coupled by C542 to a 1 dB, 50-ohm pad formed by R544-R546 and then applied to PA module U504.

5.4.3 POWER AMPLIFIER MODULE (U504), FINAL (Q509)

Power amplifier module U504 provides approximately 19 dB of gain. Pins 2, 3, and 4 are the supply voltage inputs to three separate gain stages. The supply voltage on pin 2 (VS1) is switched by Q508 and limited to 12 volts by CR508 and R549. Switch Q508 is controlled by the same signal used to control the high power antenna switch (see Section 5.4.4).

The supply voltage applied to pins 3 and 4 (VS2/VS3) is the unswitched battery from the power jack fed through R550. Therefore, power is applied to these pins even when transceiver power is turned off. The power control circuit senses transmitter current by monitoring the voltage drop across R550 (see Section 5.4.6).

The output signal on U504, pin 5 is then applied to Q509 (high power models only). With lower power models, Q509 is not used and is replaced by a jumper strap. Amplifier Q509 provides approximately 5 dB of gain. The output impedance on U504, pin 5 is 50 ohms, and it is matched to Q509 by a section of microstrip, C556, C557, and C558. Class C biasing of Q509 is provided by L507. The unswitched battery supply applied to Q509 is isolated from RF by ferrite bead EP503, L508, and several capacitors. Impedance matching is provided on the output by C559, C561, C562, C566, and a section of microstrip.

5.4.4 HIGH POWER ANTENNA SWITCH

The high power antenna switch consists of pin diodes* CR501, CR502, CR503, and other components. This switch effectively switches the antenna to the power amplifier in the transmit mode, and the receive RF amplifier path in the receive mode (see preceding illustration).

Transistors Q506 and Q501 controlled by the Q7 output of shift register U501 after it is double inverted by Q516 and Q517. This signal is high in the transmit mode and low in the receive mode. Therefore, Q506 and Q501 are on in the transmit mode which forward biases CR501, CR502, and CR503. One current path is through Q501, R503, R504, CR501, L508, CR502, and L508, and the other is through Q506, R559, CR503, and R560.

Since a forward biased pin diode has a low impedance, the RF signal passes through CR502 to the low-pass filter. The signal is blocked from the RF amplifier by two discrete grounded quarter-wave lines. One line is formed by L508/C507 and the other by L502/C514. Diode CR501 is effectively AC grounded by C507, and CR503 is AC grounded by C514. When one end of a quarter-wave line is grounded, the other end presents a high impedance to the quarter-wave frequency.

In the receive mode, all three diodes are reverse biased. Therefore, the receive signal from the antenna is blocked from the power amplifier by CR502 and has

* A reverse biased pin diode presents a high impedance to RF signals. Conversely, and a forward biased pin diode presents an variable low impedance that changes inversely to current.

800 MHz PA BOARD DESCRIPTION (CONT'D)

a low impedance path through the quarter-wave lines which are no longer grounded. Resistors R505 and R506 improve the isolation provided by CR501 and CR502 when they are reverse biased in the receive mode.

5.4.5 DIRECTIONAL COUPLER, LOW-PASS FILTER, TEMP SENSE

A directional coupler is formed by adjacent sections of microstrip near C566. The forward component of output power is rectified by CR509 and developed across R557 and then fed to the power control circuit. Reverse power is not detected in this transceiver.

From the directional coupler the transmit RF signal is coupled by C511 to a low-pass harmonic filter formed by C501-C505 and several sections of microstrip. This filter attenuates harmonic frequencies occurring above the transmit band. Resistor R501 dissipates static buildup on the antenna.

The ambient power amplifier temperature is sensed by thermistor RT501. The resistance of a thermistor decreases as temperature increases. The thermistor forms a voltage divider with R147 on the audio/logic board, and the voltage across this divider is monitored by A/D converter U21. If the PA temperature increases above limits set in software, the power is first cut back. Then if it continues to rise, the transmitter is turned off.

5.4.6 POWER CONTROL

Introduction

The power control circuit maintains a constant power output as changes occur in temperature and voltage. It does this by sensing the forward power and then varying the drive to Q505 to maintain a constant output power (see Section 5.4.2). Although current to PA module U504 is also sensed, power output is affected by this input only if current becomes excessive. Power output is then cut back to approximately 25% of full power.

The power output level is set in 127 steps by D/A converter U501 which is controlled by the microcontroller. This allows power to be adjusted using the PCTune software and computer and also different power levels to be programmed. In addition, it allows the microcontroller to cut back power if the power amplifier temperature is excessive. Temperature is sensed via thermistor RT501 (see Section 5.4.5).

U502A Operation

The forward power signal from the directional coupler is applied to pin 2 of amplifier U502A. This is a DC signal that increases proportionally to forward power. The other input to U502A is a DC reference voltage from a D/A converter formed by shift register U501 and several resistors. The voltage from this D/A converter sets the voltage on pin 3 which sets the power output of the transmitter.

U502A is a difference amplifier which amplifies the difference between the reference voltage on pin 3 and the forward power signal on pin 2. The turn-on time of U502A is controlled by the time constant of C525 and R527. This circuit operates as follows: Assume the output power attempts to increase. The DC voltage applied to U502A, pin 2 then increases which causes the output voltage on pin 1 to decrease. Transistor Q505 then turns off slightly which increases the attenuation provided by the attenuation circuit (see Section 5.4.2). The output power then decreases to maintain a constant power output.

Delayed PTT

Transistor Q504 is used to delay power output for a short time after the transmitter is keyed. This allows the synthesizer and exciter to stabilize so that the transmitter does not transmit off-frequency. The signal which controls Q504 is from pin 14 of microcontroller U9 on the logic board. In the receive mode this output is low, so Q504 is off. Pin 2 of U500A is then pulled high by the 7.2-volt supply applied through R530 and CR505. This causes the output on pin 1 of U502A to go low which shuts off Q505 and produces maximum attenuation. Then when the transmitter is keyed, the Q504 control signal goes high after a short delay. Q504 then turns on and diode CR505 is reverse biased. Only the forward power signal is then applied to pin 2 of U502A.

Over-Current Shutdown

Current to the first two amplifier stages of PA module U504 is monitored by sensing the voltage drop across R550. Pins 3 and 6 of U505 are connected across this resistor. As current increases, the output voltage on U505, pin 8 decreases. This causes the output voltage of voltage follower U502 to decrease. This signal is applied to Schmitt trigger U502B. When the voltage on pin 6 rises above the reference on pin 5, the output on pin 7 goes low. This lowers the power control voltage applied to U505 which lowers the power output to approximately 25% of full power.

5.4.7 RF AMPLIFIER (Q503)

The receive signal from the antenna switch is applied to bandpass filter Z501. This is a three-pole filter with a center frequency of 860 MHz and a bandwidth of 18 MHz. This filter attenuates frequencies outside the receive band such as the first injection, image, and half IF frequencies.

The signal is then applied to RF amplifier Q503 which improves and stabilizes receiver sensitivity and also recovers filter losses. A section of microstrip and C515 provide impedance matching on the input. CR504 protects the base-emitter junction of Q503 from damage caused by high level input signals.

The bias current of Q503 is fixed at a constant level by Q502. The collector current of Q503 flows through R511, and the voltage drop across that resistor (and therefore the current) is set by R508 and R509. For example, if current through R2511 attempts to increase, the emitter voltage of Q502 decreases. Q502 then conducts less and turns Q503 off slightly to maintain a constant bias current. This provides a stable bias over changes in temperature. The output signal of Q503 is applied to a 3 dB, 50-ohm pad formed by R587-R589, and then coupled by C531 to antenna switch U603. From U603 it is applied to the RF board.

5.5 DC POWER DISTRIBUTION

5.5.1 POWER ON OPERATION

When the On-Off/Volume knob is pressed to turn power on (this is a push on/push off switch), the following sequence of events occurs:

1. The power switch closes and grounds the emitter of Q8 on the logic board.

2. If ignition switch sense is used, the 13V signal from the ignition switch is applied to the base of Q8 and pin 48 of microcontroller U9. If ignition sense is not used, pull-up resistor R145 is installed.

3. Q8 then turns on which grounds the base of Q512 on the PA board and turns it on. This turns on main power switching transistor Q511 and applies power to the switched portions of the transceiver.

5.5.2 POWER OFF OPERATION

When power is turned off, the following sequence of events occur:

1. If the power switch is pressed, it opens and the base of Q8 is no longer grounded. This also applies a high signal to pin 45 of microcontroller U9 which then detects the power-off condition.

2. If ignition switch control of power is used, turning the ignition switch off causes the signal applied to the base of Q8 to go low. This signal is also inverted by Q5 and applied to pin 48 of microcontroller U9.

3. Q8 then turns off. However, when the controller detects the power-down request, it holds Q2 on to delay power turn-off until all the required save operations are complete.

4. The controller then turns off Q2 and both Q511 and Q512 on the PA board turn off which turns off transceiver power.

5.6 LOGIC BOARD

5.6.1 LOGIC BOARD OVERVIEW

The Logic Board contains ADSIC U3, Digital Signal Processor U12 (TMS320C50), static RAM U5/U6, FLASH memory U2, and a programmable logic IC U1. In addition, it contains microcontroller U9, audio circuits, and a 5V power supply. The logic board connects with the interface board via J9 and the display controller board via J1.

The ADSIC performs the frequency discrimination and receiver filtering functions. It also performs analog-to-digital (A/D) and digital-to-analog (D/A) conversion. Functions previously performed in hardware like filtering and limiting are performed by software running in the DSP chip. The DSP performs demodulation and modulation, voice encoding and decoding, audio filtering, and squelch signaling. The software for the radio is stored in FLASH memory that is loaded in to static RAM at turn-on. The programmable logic IC controls which device (Flash, SRAM, or UART) is connected to the DSP address and data bus.

5.6.2 DIGITAL SIGNAL PROCESSING OVERVIEW

The DSP section consists of a DSP chip (U12), the ADSIC (U3), two 128K x 8-bit Static RAM chips (U5, U6), one 512K x 16-bit FLASH ROM memory chip (U2), a UART chip (U20), a programmable logic IC (U1), and a glue-logic chip (U4). The FLASH ROM contains the program code executed by the DSP. Depending on the operational mode selected for the radio, different sections of the program code in the FLASH ROM are copied into SRAM for faster execution.

The ADSIC is a support chip for the DSP. It provides the interface between the DSP and the analog signal paths, and between the DSP and the ABACUS chip on the RF Board. Configuration of the ADSIC is handled primarily by the microcontroller. The DSP has access to a few memory-mapped registers on the ADSIC.

In receive mode, the ADSIC interfaces the DSP with the ABACUS IC on the RF board. The ADSIC collects the I and Q samples from the ABACUS and performs channel filtering and frequency discrimination on the signals. The resulting demodulated signal is routed to the DSP via the serial port for further processing. After the DSP processing, the signal is sent to the ADSIC Speaker D/A by writing to a memory- mapped register. The ADSIC then converts the processed signal from the DSP to an analog signal and then outputs this signal to the speaker power amplifier on the interface board.

In transmit mode the ADSIC Microphone A/D digitizes the analog signal from the microphone. The DSP reads these values from a memory-mapped register in the ADSIC. After processing, the DSP sends the modulation signal to the ADSIC via the serial port. In the ADSIC, the VCO D/A converts the sampled modulation signal into an analog signal and then routes this signal to the VCO on the RF board.

5.6.3 RECEIVE SIGNAL PATH

The ABACUS IC on the RF board provides a digital back end for the receiver section. It provides a digital output of I (in phase) and Q (quadrature) samples which represent the IF signal at the receiver back end. These samples are routed to the ADSIC where the signal is filtered and frequency discriminated to recover the modulating signal.

The recovered signal is sent to the DSP chip for processing. The ADSIC interface to the ABACUS is comprised of four signals SBI, DIN, DIN*, and ODC. The ODC signal is a clock the ABACUS provides to the ADSIC. Most internal ADSIC functions are clocked by this ODC signal at a rate of 2.4 MHz and are available as soon as the power is supplied to the circuitry. This signal initially may be 2.4 or 4.8 MHz after power-up. It is programmed by the ADSIC through the SBI signal to 2.4 MHz when the ADSIC is initialized by the microcontroller through the SPI bus. For any functionality of the ADSIC to exist, including initial programming, the reference clock must be present.

SBI is a programming data line for the ABACUS. This line is used to configure the operation of the ABACUS and is driven by the ADSIC. The microcontroller programs many of the ADSIC operational features through the SPI interface. There are 36 configuration registers in the ADSIC of which 4 contain configuration data for the ABACUS. When these particular registers are programmed by the microcontroller, the ADSIC in turn sends this data to the ABACUS through the SBI.

DIN and DIN* are the data lines in which the I and Q data words are transferred from the ABACUS. These signals make up a differentially encoded current loop. Instead of sending TTL-type voltage signals, the data is transferred by flowing current one way or the other through the loop. This helps reduce internally generated spurious emissions on the RF board. The

ADSIC contains an internal current loop decoder which translates these signals back to TTL logic and stores the data in internal registers.

The ADSIC performs digital IF filtering and frequency discrimination on the signal, sending the baseband demodulated signal to the DSP. The internal digital IF filter is programmable with up to 24 taps. These taps are programmed by the microcontroller through the SPI interface.

The DSP processes this data through the SSI serial port. This is a six-port synchronous serial bus. The ADSIC transfers the data to the DSP on the TxD line at a rate of 2.4 MHz. This is clocked synchronously by the ADSIC which provides a 2.4 MHz clock on SCKT. In addition, a 20 kHz interrupt is provided on TFS to signal the arrival of a data packet. This means a new I and Q sample data packet is available to the DSP at a 20 kHz rate which represents the sampling rate of the received data. The DSP then processes this data to extract audio, signaling, and other information based on the 20 kHz interrupt.

In addition to the SPI programming bus, the ADSIC also contains a parallel configuration bus. This bus is used to access registers mapped into the DSP memory. Some of these registers are used for additional ADSIC configuration controlled directly by the DSP. Some of the registers are data registers for the speaker D/A. Analog speaker audio is processed through this parallel bus where the DSP outputs the speaker audio digital data words to this speaker D/A. In addition, an analog waveform is generated which is output to SDO (Speaker Data Out).

In conjunction with speaker D/A, ADSIC contains a programmable attenuator to set the rough signal attenuation. However, the fine levels and differences between signal types are adjusted through the DSP software algorithms. The speaker D/A attenuator setting is programmed by the microcontroller through the SPI bus.

The ADSIC provides an 8 kHz interrupt to the DSP on IRQB for processing the speaker data samples. This 8 kHz signal must be enabled through the SPI programming bus by the microcontroller and is necessary for any audio processing to occur.

5.6.4 TRANSMIT SIGNAL PATH

The ADSIC contains an analog-to-digital (ADC) converter for the microphone. The microphone path in the ADSIC also includes an attenuator that is programmed by the microcontroller through the SPI bus. The microphone input in the ADSIC is on pin MAI (U3-19). The microphone ADC converts the analog signal to a series of data words and stores them in internal registers. The DSP accesses this data through the parallel data bus. As with the speaker data samples, the DSP reads the microphone samples from registers mapped into its memory space. The ADSIC provides an 8 kHz interrupt to the DSP on IRQB for processing the microphone data samples.

The DSP processes these microphone samples and generates and mixes the appropriate signaling and filters the resultant data. This data is then transferred to the ADSIC on the DSP SSI port. The ADSIC generates a 48 kHz interrupt so that a new sample data packet is transferred at a 48 kHz rate and sets the transmit data sampling rate at 48 ksps. These samples are then input to a transmit D/A which converts the data to an analog waveform. This waveform is the modulation signal from the ADSIC and is connected to the VCO on the RF Board.

5.6.5 DSP CHIP (U12)

DSP chip U12 has a 16-bit data bus and a 16-bit address bus. It has 10K words of internal SRAM from which 0.5K are used only to store data and 9.5K are used either for data or for program storage. The DSP bus can access through its buses the following external devices:

SRAM U5 and U6 - These two chips are 128K x 8 chips. U5 stores the lower byte of the word while U6 stores the higher byte. Those chips are selected by asserting CE2 high and CE1* low. The programmable logic IC is responsible for controlling the select lines of these ICs.

FLASH ROM U2 - This chip is 512K x 16 words in size. It is selected by asserting CE* low. The programmable logic IC is responsible for controlling the select line of this IC.

ADSIC U3 - The ADSIC contains several registers which can be read from or written to by the DSP. The ADSIC IC has an output which drives a data/address bus enable signal for the programmable logic IC.

UART U7 - This chip converts data from the DSP into serial data. It is used to interface with the optional encryption board.

Programmable Logic U1 - This IC arbitrates access to the DSP's address/data bus between the flash (U2), SRAMs (U5,U6), and UART (U7). The DSP can modify the memory configuration by writing to a series of registers in the programmable logic IC. In order to reduce power consumption, the programmable logic IC can be 'disconnected' from the DSP's address/data bus using the bus enable input on the programmable logic IC (pin 44).

The DSP uses memory as data space, program space, and I/O space as follows. Refer to Figure 5-2 for more information.

Program Space - Internal SRAM, external SRAM, and FLASH memory.
Data Space - Internal SRAM and external SRAM.
I/O Space - Programmable logic IC, ADSIC, and the UART.

The DSP accesses the difference spaces by setting the corresponding lines PS*, DS*, IS* low. Only one of these three signals can be low at a given time. When the DSP accesses internal SRAM, none of these lines is activated.

The programmable logic IC (PLD) acts as the primary arbitrator of the DSP's memory map. The FLASH ROM and the SRAM are both mapped in the program space and cannot both be active at the same time. The DSP may control which type of memory is mapped in program space by enabling the programmable logic IC (PLD), then manipulating a register in the PLD. In addition, the DSP can manipulate other registers to control paging of both the Flash and the SRAM. Paging refers to the swapping of 64K word blocks of Flash or SRAM into or out of the DSP's memory map.

FLASH ROM U2 is used to permanently store the program to be executed in the DSP. However, it is slow to access, so to fully utilize the speed of the DSP, the program stored in the FLASH ROM must be copied into the SRAM. As the size of the SRAM is half the size of the FLASH ROM, only the code required for the current mode of operation is copied in the SRAM. As previously mentioned, the FLASH ROM and the SRAM cannot be active at the same time. Therefore, the internal data memory is used as a temporary buffer to transfer the program from the FLASH ROM to the SRAM.

The following hardware interrupts are used on the DSP:

Interrupt	Description
INT1*	8 kHz interrupt for speaker DAC and microphone ADC from ADSIC
INT2*	125 kHz signal from ADSIC
INT3*	2 kHz timer interrupt from the Controller on the Keypad Board.
INT4*	Interrupt from the UART
NMI*	Not used

Connector J3 allows connection to an emulator for debugging purposes. The emulator connects to some dedicated pins on the DSP.

5.6.6 UART (U20)

UART U20 performs parallel to serial and serial to parallel conversion. The serial format used is a 9-bit format with start and stop bits. The serial transmission speed is 19200 bps. The UART appears as eight registers visible in the I/O space of the DSP starting at every multiple of 0008h from 0000h to 07FFh. U1 performs the address decoding by selecting the UART (pin 39) when both IS* and A15 are low. Crystal Y2 along with the internal oscillator of the UART provides the clock required to generate the correct bit rate on the serial output of the UART.

When the UART receives a new serial word or is ready to accept a new word to send from the DSP, it generates an interrupt on INTRN. This pin is connected to one of the hardware interrupt lines on the DSP. The DSP responds by reading the status register in the UART and by answering accordingly.

5.6.7 ADSIC

The ADSIC is a complex custom IC which performs many analog-to-digital, digital-to-analog, and purely digital functions as previously described. The ADSIC has four internal registers accessible by the DSP. They are selected through the use of address lines A15, A14, A13, A2, A1, A0, IS* (IS* needs to be inverted with U4 to be compatible with the logic level required by the ADSIC), RD*, and WR*. Two of these registers are read-only while the two others are write-only. Therefore, they can be accessed as two locations in the I/O spaces. Due to the decoding performed, those locations appear at the following addresses: Fxx0h, Fxx1h, Fxx8h, Fxx9h, Exx0h, Exx1h, Exx8h, and Exx9h.

Crystal Y1 along with the internal oscillator in the ADSIC provide a 20 MHz clock. This clock signal is used internally by the ADSIC and is also multiplied by two to provide a 40 MHz clock to the DSP. The frequency of the clock can be electronically shifted a small amount by controlling varicap D1 through the OSCW pin (U3-97). This removes interference created on some channels by the clock.

The ADSIC and DSP exchange the sampled receive data and the sampled VCO modulation signal through a serial port. This serial port consists of pins SCKR*, RFS, RxD, TxD, SCKT, and TFS on the ADSIC. U21 and U1 modify the relative phase of TxD and TFS to be compatible with the timing required on the serial port of the DSP.

SDO is the output of the internal speaker DAC. MAI is the input of the internal microphone attenuator and is followed by the microphone ADC.

The ADSIC is configured partially by the DSP through its data and address bus (see preceding). However, most of the configuring is provided through an SPI compatible serial bus. This SPI serial bus consists of pins SEL*, SPD, and SCLK. The other side of this bus is connected to microcontroller U9.

5.6.8 MICROCONTROLLER U9 OVERVIEW

The microcontroller provides an interface between the hardware and DSP U12. When the user presses or rotates a control such as the Select switch, an option button, or the PTT switch, the microcontroller signals the change to the DSP. Conversely, when the DSP needs to change the display or an LED, it signals the microcontroller which then performs the action. The microcontroller also controls peripheral ICs such as the synthesizer, reference oscillator, display processor, and ADSIC.

The microcontroller uses a serial bus to communicate with the DSP and another RS-485 bus to communicate with the front panel/remote control unit. The RS-485 bus is used for external communication with a computer running the programming or tuning software. Finally, the microcontroller maintains certain operating parameters in the associated EEPROM which is controlled via a two-wire serial bus.

5.6.9 MICROCONTROLLER DESCRIPTION

Microcontroller U9 is a Motorola 68HC08XL36 chip. It includes 28K bytes of internal ROM memory and 1K byte of internal SRAM. It does not have an external bus and therefore cannot access any external program memory.

The clock to the microcontroller is provided by Y3 and an internal oscillator. The frequency of the clock can be slightly offset by polarizing the base of Q1 through software control. This prevents RF interference on some channels caused by the clock.

The microcontroller contains an SPI-compatible synchronous serial bus. This bus consists of pins MISO (U1-53), MOSI (U1-52), SPSCK (U1-50), and a chip enable for each device with which it communicates. The devices which communicate with the microcontroller through this bus are as follows:

- PA temperature sense ADC U21
- ADSIC chip U3
- Reference Oscillator (RF Board)
- Front-End DAC (RF Board)
- Synthesizer chip (RF Board)
- Shift register U801 (PA board)
- Optional DES board

The microcontroller communicates with the DSP chip through a custom serial bus. This serial port includes pins PTA3 (U9-8), PTA4 (U9-9), PTA5 (U9-10), PTA6 (U9-11), and PTA7 (U9-12).

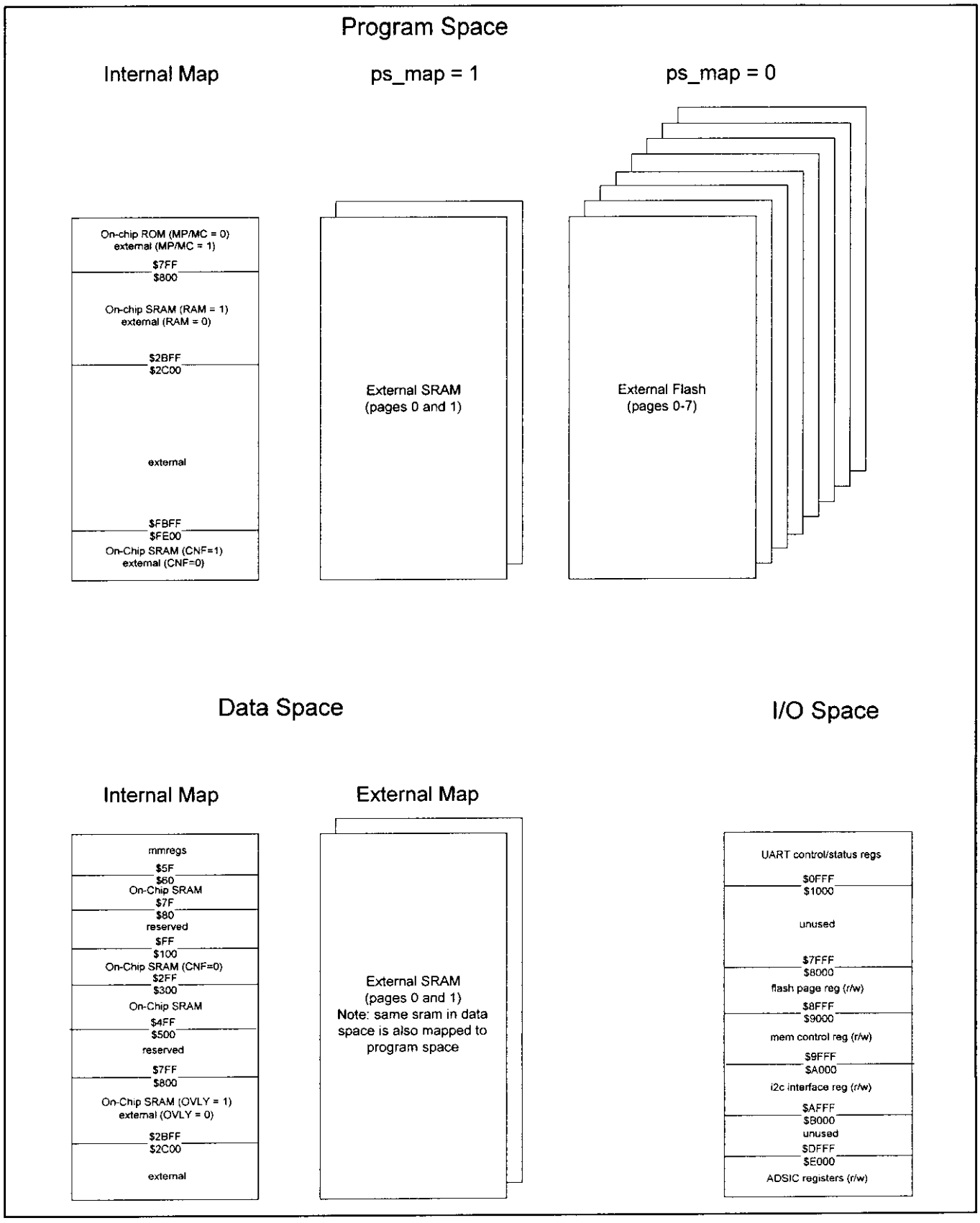


Figure 5-2 Memory Utilization

The microcontroller SCI asynchronous serial bus is converted to an RS-485 bus by U14. The RS-485 bus is then used for communication with the front panel/remote control unit controller and the external computer running the programming or tuning software. The SCI bus consists of RxD (U9-42) and TxD (U9-43). The RS-485 driver (U14) converts U9 signals at a logic level of 0 and 5 V to three-state RS-485 logic levels.

Serial EEPROM U10 is used to store some important radio parameters. The EEPROM is read to or written from using I/O lines PTC6 and PTC7 of the microcontroller. PTC6 is the data line, and PTC7 is the clock line.

5.6.10 RECEIVE AUDIO CIRCUIT

In receive mode, the analog receive waveform created by the ADSIC is fed to summing amplifier U19A. This amplifier sums this signal with the audio tones generated by the microcontroller on pin 46. The output of the summing amplifier is then fed to buffer amplifiers U19B and U18B, and to U17A/U17B which provide a differential output.

The output signal from U19B is fed to volume control IC U4 on the interface board and then to audio amplifier U1. The output signal from U18B provides the External PA output to the accessory cable, and the output signal from U17A/U17B is fed to the display controller board. It is then converted back to a single-ended signal and fed to the Rx Audio pin of the front panel microphone jack. If a remote control unit is used, the U17A/U17B output signal is also routed to the audio amplifier in the remote control unit.

5.6.11 TRANSMIT AUDIO CIRCUIT

In transmit mode, the audio for transmission can be selected from the microphone connected to the front panel microphone jack or the microphone connected to a remote control unit. U15A and U15B convert a differential input to a single-ended output, and analog switch U18A selects the desired microphone signal.

The microphone signal is then buffered by U15C and fed to analog switch U18B and to the microphone output pin of the universal interface connector. U18B which selects either the microphone or universal interface microphone input signal. Additional buffering is provided by U15D and the signal is then fed to the A/D input of the ADSIC.

5.6.12 VOLTAGE REGULATION

The 5-volt supply is produced by switching DC-DC converter U11. This device is powered by the switched 7.2V supply, and the switching frequency is approximately 160 kHz. A switching regulator provides improved efficiency compared to a standard linear regulator. The 5-volt supply power provides a large percentage of the total power consumed by the radio. The peak-to-peak residual ripple on the 5-volt supply is approximately 50 mV.

The DC-DC converter has a soft-start feature (R27, C141) to prevent chattering of the output regulated voltage due to "bouncing" of the on/off switch. The converter has current limiting that limits output current to 1.5 A. The under voltage protection turns the converter off if the input (switched B+) voltage drops below 5.45 V.

SECTION 6 ALIGNMENT PROCEDURE

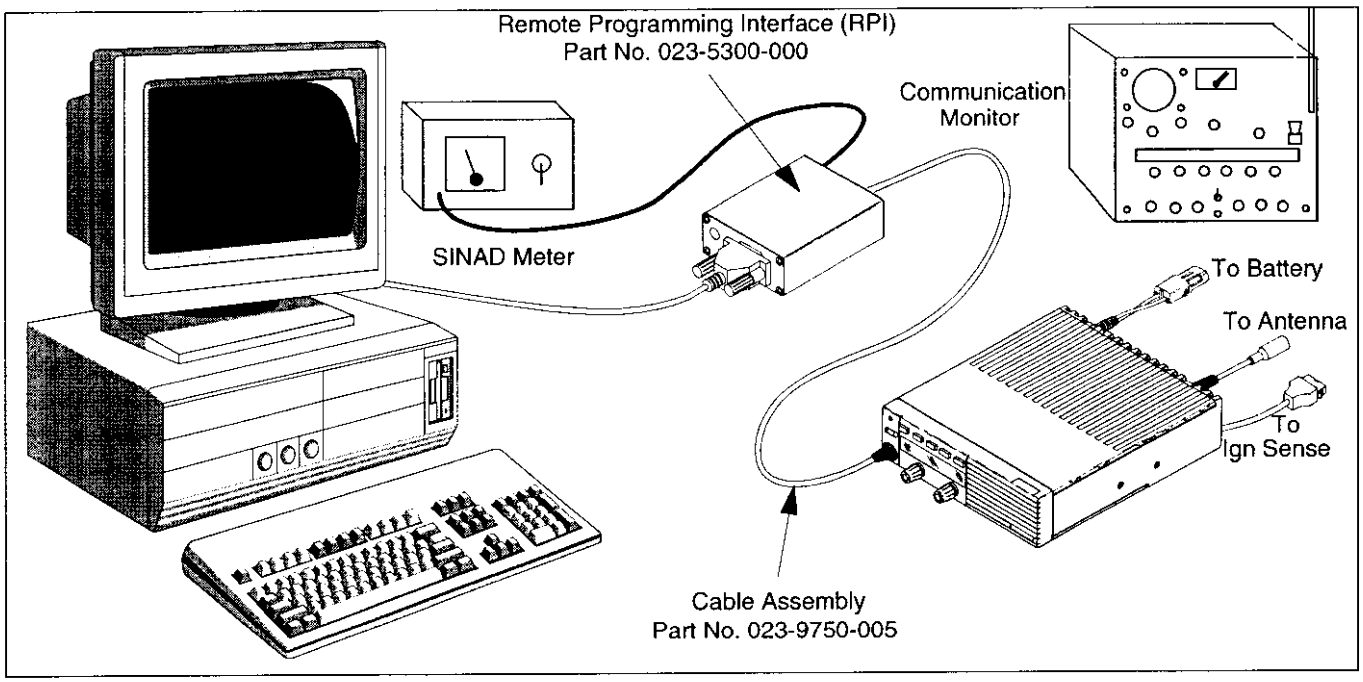


Figure 6-1 Alignment Setup

6.1 GENERAL

6.1.1 INTRODUCTION

The following alignment procedure should be performed if repairs are made that could affect the factory alignment or if adjustments may have changed for some other reason.

To perform transceiver alignment, a PC-compatible computer, Remote Programming Interface (RPI) Part No. 023-5300-000, and PCTune software are required (see Table 1-1). Earlier RPIs, such as Part No. 023-9800-000 or 023-9750-000, cannot be used. Refer to Section 4.1.4 for more RPI information. The programming setup is shown in Figure 6-1.

All adjustments are set digitally using the computer. Therefore, there is no need to disassemble the transceiver to access adjustment points. In addition, audio test signals are generated internally, so an audio generator is not required. The required test equipment is shown in Figure 6-1.

6.1.2 TUNE SOFTWARE

General

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

- Windows® 95 or 3.1
- 386SX 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.

   From the Windows 3.1 Program Manager, choose FILE > RUN and select the SETUP.EXE file on drive A: (or B:).

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

Starting PCTune

From Windows 95 - Select Start in the taskbar, then Programs > PCTune > PCTune.

From Windows 3.1 - From the Program Manager, open the PCTune group and then double click the PCTune icon.

Exiting PCTune

Select FILE > EXIT or press ALT + F4.

On-Line Help

On-line help is not available at this time.

6.1.3 PRELIMINARY

1. With transceiver power turned off, connect the RPI to an unused serial port of the computer using a suitable cable (see Section 4.1.4).

2. Connect the RPI to the microphone jack of the computer using cable Part No. 023-9750-005.

3. If the receiver squelch adjustment will be made, connect the SINAD meter to the Speaker Audio Out jack on the RPI (see Section 6-2). This is a 2.6 mm (3/32") phone jack.

4. Start the program as described in the preceding section. Select Options > Set Com Port and make sure that the correct serial port is selected (see screen in Figure 6-3).

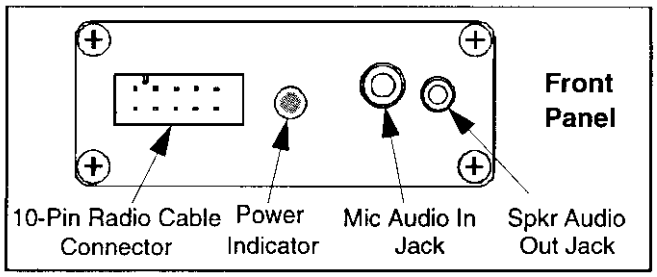


Figure 6-2 RPI Front Panel

5. Turn transceiver power on and make sure that the monitor mode is not selected by the Monitor option switch (the monitor mode is indicated by MON in the display). The power indicator on the RPI should be green. If not, check the cabling and the fuse in the transceiver.

6. On the opening screen select "Mobile Radio" as the radio type. Then on the main screen, select Tuning > Complete Tuning to automatically step through a complete alignment or Partial Tuning to adjust only certain settings or randomly select adjustments.

7. The computer then attempts to establish communication with the transceiver. A message is displayed to indicate success or failure. From this point, prompts are displayed for each step of the programming procedure.

6.2 TRANSMIT FREQUENCY TUNING

The transmit frequency is set by transmitting on the indicated frequency and then adjusting the reference oscillator frequency via the tuning software. Proceed as follows:

1. Connect a 50-ohm load to the antenna jack and monitor the transmit signal with a communication monitor.

2. Set the communication monitor to the indicated frequency and click OK to key the transmitter.

3. Adjust the frequency by clicking the + and – keys. The current setting is indicated in the "Current Value" box. When the frequency is correct, click OK again to complete the adjustment and store the setting.

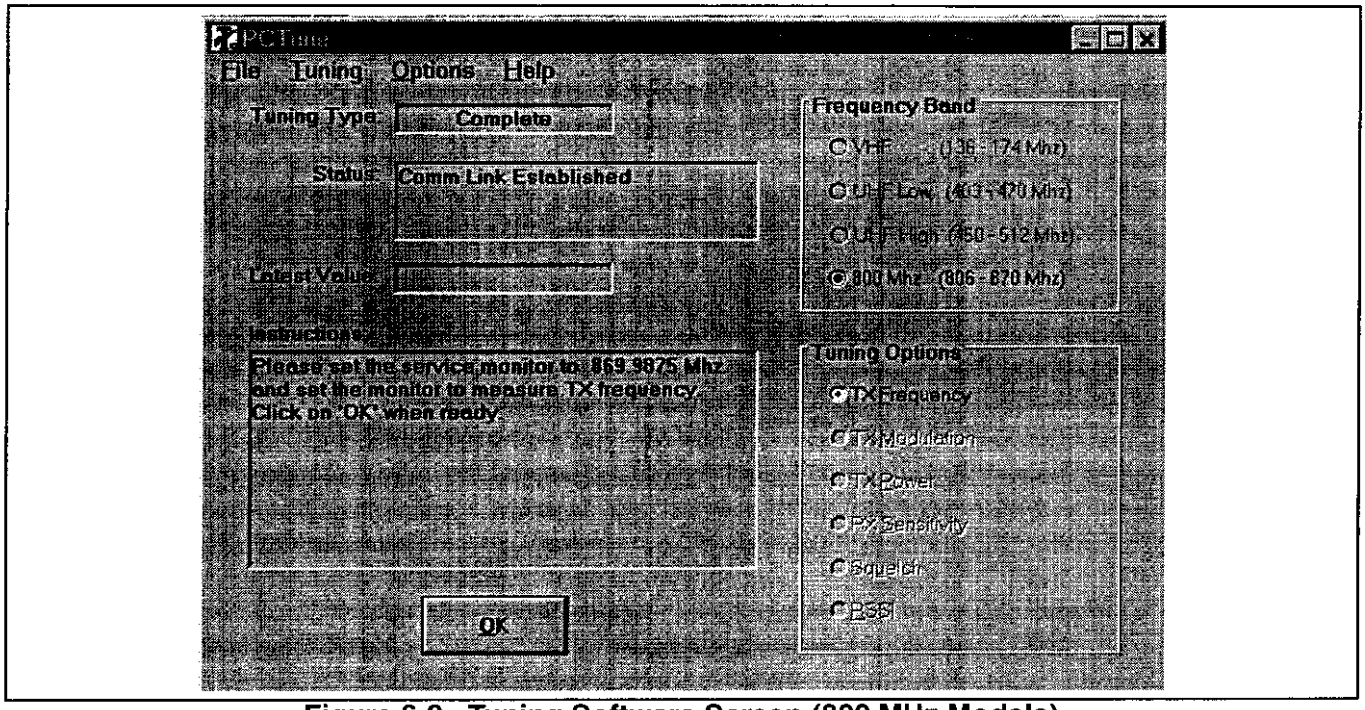


Figure 6-3 Tuning Software Screen (800 MHz Models)

6.3 TRANSMIT MODULATION TUNING

Transmit modulation is set by balancing the modulation produced by 80 Hz and 3 kHz tones and then setting modulation limiting using a 1 kHz tone. All these tones are internally generated by the transceiver, so no external audio generator is required. Proceed as follows:

1. Click OK with "TX Modulation" selected. Set the communication monitor for the displayed frequency.

2. Click OK to transmit a signal modulated with an 80 Hz tone. Enter the resulting deviation (in hertz) in the displayed box and click OK.

3. Continue following the screen instructions to adjust the 3 kHz tone deviation. The + and – buttons are clicked to set the deviation to the indicated level. The 1 kHz tone deviation is then adjusted.

4. The preceding 3 kHz and 1 kHz tone adjustments are then repeated on several other frequencies across the band. After the last adjustment is made, the transmitter unkeys and the settings are stored.

6.4 TRANSMIT POWER ADJUSTMENT

Set transmitter power output as follows:

1. Connect a wattmeter and 50-ohm load to the antenna jack. Click OK with "TX Power" selected.

2. Follow on-screen instructions to adjust for the displayed power output at various frequencies across the band.

3. When the last setting is complete, the transmitter unkeys and the settings are stored.

6.5 RECEIVE SENSITIVITY TUNING

NOTE: This adjustment is not performed with 800 MHz models.

The receiver front end is tuned as follows:

1. Connect an RF signal generator to the antenna jack. Click OK with "RX Sensitivity" selected.

2. Inject the frequencies and signal levels indicated on the computer screen. When tuning is complete, a message is displayed and the settings are saved.

6.6 SQUELCH ADJUSTMENT

Adjust the squelch level as follows:

1. Connect a SINAD meter to the Speaker Audio Output jack of the RPI (see Figure 6-2).

2. Connect an RF signal generator to the antenna jack. Click OK with "Squelch" selected.

3. Set the signal generator for the indicated frequency and modulation. Adjust the generator output level for 12 dB SINAD and click OK.

4. When prompted, adjust the output level for 8 dB SINAD and click OK.

5. Proceed as prompted and when this adjustment is complete, a message is displayed and the settings are stored.

6.7 RSSI ADJUSTMENT

This adjustment calibrates the RSSI signal level. Proceed as follows:

1. Connect an RF signal to the antenna jack. Click OK with "RSSI" selected.

2. Set the generator for the indicated frequency and output level and click OK.

3. Select the other output levels as prompted. When this adjustment is complete, a message is displayed the settings are stored.

SECTION 7 PARTS LIST

Chassis, Hardware, Misc.

Ref No.	Description	Part No.
CHASSIS, HARDWARE, AND MISCELLANEOUS		
A 000	DC power cable assembly, 22 ft (see separate listing on page 7-15)	023-9750-010
A 000	Accessory wire harness kit (extrnl) (see separate listing on page 7-16)	023-9750-011
A 000	Mounting bracket, standard (see separate listing on page 7-16)	023-9750-012
A 102	Front panel assembly (see separate listing on page 7-13)	023-5300-710
A 200	Interface board assembly (see separate listing which follows)	023-5300-201
A 300	Receiver/exciter assembly (VHF) (see separate listing on page 7-2)	023-5317-202
	Receiver/exciter assembly (800 MHz) (see listing on page 7-2)	023-5387-202
A 301	Accessory pigtail cable (internal)	597-2002-230
A 400	Logic board assembly (see separate listing on page 7-8)	023-5300-400
A 500	PA board assembly (VHF) (see separate listing on page 7-3)	023-5315-501
	PA board assembly (800 MHz) (see separate listing on page 7-5)	023-5385-501
CH 101	Chassis, metal	015-0970-001
EP 001	No. 6 terminal lug	586-0005-106
EP 002	Ferrite bead, .375 x .375	517-2002-003
EP 003	Ferrite block, for J200	??????????
HW 001	Captive screw, cover	537-9007-045
HW 002	Screw, 6-32 x 5/16" Torx	575-0006-010
HW 003	Plug, option (in unused chass hole)	032-0792-075
HW 004	Audio amp U1 clip	017-9700-001
HW 005	O-ring, 1/8" x 1/4" cover screw	574-2002-001
HW 006	Nylon washer, cover screw	596-4408-015
HW 007	Split rubber grommet 1/8"ID	574-0002-015
HW 009	Flat washer, cover screw	596-9408-009
HW 010	Screw, 4-40 x 1/4 pan hd	575-1604-008
HW 011	Washer, No 4 shake proof	596-1104-008
HW 012	Washer, No. 4 split lock	596-1304-008
HW 020	1/4" x 1.20" x 1.90" urethane pad	018-1007-250

Interface Board

Ref No.	Description	Part No.
HW 150	Screw, 4-40 x 5/16 phil pan hd	575-0604-010
HW 202	Screw, 4-40 x 1-1/8 mach pan hd	575-1604-036
HW 203	Screw, 2-56 x 1/8 pan hd	575-1602-004
HW 204	Screw, 4-40 x 1/4 pan hd	575-1604-008
J 002	RF – PA board connector	515-9006-110
J 200	Connector, 28-pin inline header	515-7181-038
MP 002	Cover, top black RS-5300	015-0970-007
MP 003	Cover, bottom black	015-0905-031
MP 156	Gasket, top cover	032-0792-060
MP 157	Gasket, bottom cover	032-0792-064
MP 300	Foam tape, dbl side	574-3002-013
MP501	Shield, coax gnd (800 MHz)	017-2226-017
MP 502	Shield, low-pass filter (800 MHz)	017-2226-036
MP 503	Grounding finger (800 MHz)	537-5001-010
MP 504	Grounding clip (800 MHz)	537-5001-004
MP 601	Shield, low-pass filter	017-9700-000
MP 990	Mic gasket	574-3002-121
MP 999	Seal, mic connector	032-0792-129
W 101	Display - logic bd cable assy??	023-5300-025
W 501	Power cable assembly, PA	597-2002-235
W 502	RF cable assembly, PA	597-2002-240
INTERFACE BOARD Part No. 023-5300-201		
C 002	470 µF 25V electrolytic	510-4064-471
C 003	100 µF 25V electrolytic	510-4425-101
C 004	1.0 µF 10V tantalum smd	510-2624-109
C 005	.1 µF ±5% X7R 50V cer smd	510-3609-104
C 006	.1 µF ±5% X7R 50V cer smd	510-3609-104
C 007	.1 µF ±5% X7R 50V cer smd	510-3609-104
C 009	470 pF ±5% NPO cer smd	510-3602-471
C 010	.1 µF ±10% X7R 50V cer smd	510-3606-104
C 011	.1 µF ±10% X7R 50V cer smd	510-3606-104
C 012	.1 µF ±10% X7R 50V cer smd	510-3606-104
C 013	4.7 µF 10V tantalum smd	510-2624-479
C 014	4.7 µF 10V tantalum smd	510-2624-479
C 015	.01 µF ±5% X7R 50V cer smd	510-3609-103

Interface Board Assembly (Cont'd)

Ref No.	Description	Part No.
CR 001	10V zener SOT-23	523-2016-100
CR 002	Switching diode SOT-23	523-1504-002
J 201	Connector, 20-pin	515-7111-230
J 202	Connector, 30-pin	515-7106-430
P 100	Header, 2-pin friction lock	515-9031-201
P 101	Header, 3-pin friction lock	515-9031-202
PC 201	PC board, interface	035-5300-200
Q 001	NPN general purpose	576-0003-658
Q 002	NPN general purpose	576-0003-658
R 002	2.2 ohm ±5% 1W smd	569-0175-229
R 003	10k ohm ±5% 1/8W smd	569-0105-103
R 004	47k ohm ±5% 1/8W smd	569-0105-473
R 005	10k ohm ±5% 1/8W smd	569-0105-103
R 006	7.5k ohm ±5% 1/8W smd	569-0105-752
R 008	1k ohm ±5% 1/8W smd	569-0115-102
R 009	1k ohm ±5% 1/8W smd	569-0115-102
R 010	1k ohm ±5% 1/8W smd	569-0115-102
R 011	10k ohm ±1% 1/8W smd	569-0111-401
R 012	35.7k ohm ±1% 1/8W smd	569-0111-454
R 013	10k ohm ±5% 1/8W smd	569-0115-103
R 014	10k ohm ±5% 1/8W smd	569-0115-103
R 015	Zero ohm jumper	569-0115-001
R 016	10k ohm ±5% 1/8W smd	569-0115-103
R 017	3k ohm ±5% 1/8W smd	569-0115-302
R 018	10k ohm ±5% 1/8W smd	569-0115-103
R 019	Zero ohm jumper	569-0115-001
R 020	10k ohm ±5% 1/8W smd	569-0115-103
R 021	10k ohm ±5% 1/8W smd	569-0115-103
R 022	10k ohm ±5% 1/8W smd	569-0105-103
U 001	Audio amp, 22W TDA1519	544-2004-003
U 002	Voltage regulator, adjust TK11900	544-2603-093
U 003	Op amp, dual LM2904	544-2019-004
U 004	Digital potentiomtr, 2-ch AD8402	544-0004-213

Receiver/Exciter Assembly

Ref No.	Description	Part No.
RECEIVER/EXCITER ASSEMBLY Part No. 023-53x7-202		
A 001	Interconnect board assembly (see separate listing which follows)	023-5300-050
A 002	RF board assembly, VHF	585-0400-003
	RF board assembly, 800 MHz	587-5000-003
HW 001	Screw, 2-56 x 1/8" pan hd	575-1602-004
HW 002	Screw, 4-40 x 1/4" pan hd	575-1604-008
HW 003	Lockwasher, internal	596-2102-006
HW 004	Washer, split lock #4 ZPS	596-1304-008
MP 002	Metal RF board housing	015-0970-003
MP 003	Cover for housing MP2	015-0970-005
MP 004	H-clip for RF board	017-2229-509
P 001	Jumper, flex	515-9500-005
PC 001	PC board, RF connection	035-5300-310
W 001	Coax assy, right angle	597-3008-001
INTERCONNECT BOARD ASSEMBLY Part No. 023-5300-050		
C 001	39 pF ±5% NPO 50V cer smd	510-3674-390
C 002	39 pF ±5% NPO 50V cer smd	510-3674-390
C 003	39 pF ±5% NPO 50V cer smd	510-3674-390
C 004	39 pF ±5% NPO 50V cer smd	510-3674-390
C 005	39 pF ±5% NPO 50V cer smd	510-3674-390
C 007	39 pF ±5% NPO 50V cer smd	510-3674-390
C 008	39 pF ±5% NPO 50V cer smd	510-3674-390
C 009	39 pF ±5% NPO 50V cer smd	510-3674-390
C 010	39 pF ±5% NPO 50V cer smd	510-3674-390
C 011	39 pF ±5% NPO 50V cer smd	510-3674-390
C 012	39 pF ±5% NPO 50V cer smd	510-3674-390
C 014	39 pF ±5% NPO 50V cer smd	510-3674-390
C 016	39 pF ±5% NPO 50V cer smd	510-3674-390
C 017	.1 µF X7R ±10% 50V cer smd	510-3675-104
C 018	39 pF ±5% NPO 50V cer smd	510-3674-390
C 019	39 pF ±5% NPO 50V cer smd	510-3674-390
C 020	39 pF ±5% NPO 50V cer smd	510-3674-390
C 021	39 pF ±5% NPO 50V cer smd	510-3674-390
C 022	39 pF ±5% NPO 50V cer smd	510-3674-390
C 024	39 pF ±5% NPO 50V cer smd	510-3674-390
C 025	39 pF ±5% NPO 50V cer smd	510-3674-390
C 026	39 pF ±5% NPO 50V cer smd	510-3674-390
C 027	39 pF ±5% NPO 50V cer smd	510-3674-390

Receiver/Exciter Assembly (Cont'd)

Ref No.	Description	Part No.
C 028	39 pF ±5% NPO 50V cer smd	510-3674-390
C 029	39 pF ±5% NPO 50V cer smd	510-3674-390
EP 001	Ferrite bead smd	517-2503-002
EP 002	Ferrite bead smd	517-2503-002
J 001	Connector, 2 x 10-pin	515-7113-070
J 002	Connector, 30-pin	515-7111-430
MP 011	Contact, power	013-1724-001
PC 001	PC board, interconnect	035-5300-050
PC 011	Flex circuit, power	035-1800-180
R 001	Zero ohm jumper	569-0155-001
R 002	Zero ohm jumper	569-0155-001
R 003	Zero ohm jumper	569-0155-001
R 004	Zero ohm jumper	569-0155-001
R 005	Zero ohm jumper	569-0155-001

PA BOARD ASSEMBLY (VHF)
Part No. 023-5315-501

C 501	12 pF ±10% 50V high Q smd	510-3663-120
C 502	10 pF 250V mini mica	510-0019-100
C 503	22 pF ±10% 50V high Q smd	510-3663-220
C 504	12 pF 250V mini mica	510-0019-120
C 505	22 pF ±10% 50V high Q smd	510-3663-220
C 506	10 pF 250V mini mica	510-0019-100
C 507	8.2 pF ±10% 50V high Q smd	510-3663-829
C 508	300 pF ±10% 50V high Q smd	510-3663-301
C 509	12 pF ±10% 50V high Q smd	510-3663-120
C 510	300 pF ±5% NPO 50V cer smd	510-3615-301
C 511	300 pF ±10% 50V high Q smd	510-3663-301
C 512	33 pF ±5% NPO 50V cer smd	510-3615-330
C 513	12 pF ±5% NPO 50V cer smd	510-3615-120
C 515	300 pF ±5% NPO 50V cer smd	510-3615-301
C 516	300 pF ±5% NPO 50V cer smd	510-3615-301
C 517	51 pF ±5% NPO 50V cer smd	510-3601-510
C 518	.01 µF ±10% X7R 50V cer smd	510-3605-103
C 519	300 pF ±5% NPO 50V cer smd	510-3615-301
C 520	300 pF ±5% NPO 50V cer smd	510-3615-301
C 521	300 pF ±5% NPO 50V cer smd	510-3615-301
C 522	300 pF ±5% NPO 50V cer smd	510-3615-301
C 523	33 pF ±5% NPO 50V cer smd	510-3615-330
C 524	120 pF ±5% NPO 50V cer smd	510-3601-121
C 526	.01 µF ±10% X7R 50V cer smd	510-3605-103

VHF PA Board Assembly

Ref No.	Description	Part No.
C 527	30 pF ±5% NPO 50V cer smd	510-3615-301
C 528	.01 µF ±10% X7R 50V cer smd	510-3605-103
C 529	300 pF ±5% NPO 50V cer smd	510-3615-301
C 530	.1 µF ±10% X7R 50V cer smd	510-3606-104
C 531	.1 µF ±10% X7R 50V cer smd	510-3606-104
C 532	.01 µF X7R ±10% 50V cer smd	510-3605-103
C 533	300 pF ±5% NPO 50V cer smd	510-3615-301
C 534	300 pF ±5% NPO 50V cer smd	510-3615-301
C 535	240 pF ±5% NPO 50V cer smd	510-3615-241
C 536	51 pF ±5% NPO 50V cer smd	510-3601-510
C 537	100 pF ±5% NPO 50V cer smd	510-3601-101
C 538	150 pF ±5% NPO 50V cer smd	510-3601-151
C 540	4.7 µF 20V tantalum smd	510-2626-479
C 541	300 pF ±5% NPO 50V cer smd	510-3615-301
C 542	.01 µF X7R ±10% 50V cer smd	510-3605-103
C 543	.01 µF X7R ±10% 50V cer smd	510-3605-103
C 544	300 pF ±5% NPO 50V cer smd	510-3615-301
C 545	120 pF ±10% 50V high Q smd	510-3663-121
C 546	120 pF ±10% 50V high Q smd	510-3663-121
C 547	4.7 pF ±10% 50V high Q smd	510-3663-479
C 548	300 pF ±10% 50V high Q smd	510-3663-301
C 549	220 pF ±10% 50V high Q smd	510-3663-221
C 550	120 pF ±10% 50V high Q smd	510-3663-121
C 551	150 pF ±10% 50V high Q smd	510-3663-151
C 552	220 pF ±10% 50V high Q smd	510-3663-221
C 553	220 pF ±10% 50V high Q smd	510-3663-221
C 554	300 pF 250V mini mica	510-0019-301
C 555	300 pF 250V mini mica	510-0019-301
C 556	240 pF 250V mini mica	510-0019-241
C 557	270 pF 250V mini mica	510-0019-271
C 558	100 pF 250V mini mica	510-0019-101
C 559	100 pF 250V mini mica	510-0019-101
C 560	47 pF 250V mini mica	510-0019-470
C 561	.01 µF X7R ±10% 50V cer smd	510-3605-103
C 562	300 pF ±10% 50V high Q smd	510-3663-301
C 563	1 µF ±10% X7R 16V cer smd	510-3606-105
C 564	.01 µF X7R ±10% 50V cer smd	510-3605-103
C 565	300 pF ±5% NPO 50V cer smd	510-3615-301
C 567	.018 µF ±10% X7R 50V cer smd	510-3605-183
C 568	300 pF ±5% NPO 50V cer smd	510-3615-301
C 569	300 pF ±5% NPO 50V cer smd	510-3615-301
C 570	.018 µF ±10% X7R 50V cer smdl	510-3605-183
C 571	300 pF ±5% NPO 50V cer smd	510-3615-301
C 572	.018 µF ±10% X7R 50V cer smd	510-3605-183
C 573	300 pF ±5% NPO 50V cer smd	510-3615-301

VHF PA Board Assembly (Cont'd)

Ref No.	Description	Part No.
C 574	1500 µF 25V electrolytic	510-4055-152
C 577	.1 µF ±10% X7R 50V cer smd	510-3606-104
C 579	10 µF 25V tantalum smd	510-2627-100
C 580	1 µF ±10% X7R 16V cer smd	510-3606-105
C 581	.01 µF ±5% X7R 50V cer smd	510-3609-103
C 582	1 µF ±10% X7R 16V cer smd	510-3606-105
C 583	1 µF ±10% X7R 16V cer smd	510-3606-105
C 585	470 µF 16V electrolytic	510-4056-471
C 588	1 µF ±10% X7R 16V cer smd	510-3606-105
C 589	470 µF 16V electrolytic	510-4056-471
C 590	1500 µF 25V electrolytic	510-4055-152
C 591	.01 µF ±10% X7R 50V cer smd	510-3605-103
C 593	.001 µF X7R ±10% 50V cer smd	510-3605-102
C 594	.001 µF X7R ±10% 50V cer smd	510-3605-102
C 597	100 pF ±5% NPO 50V cer smd	510-3601-101
C 598	100 pF ±5% NPO 50V cer smd	510-3601-101
C 599	100 pF ±5% NPO 50V cer smd	510-3601-101
C 600	100 pF ±5% NPO 50V cer smd	510-3601-101
C 608	100 pF ±5% NPO 50V cer smd	510-3601-101
C 609	100 pF ±5% NPO 50V cer smd	510-3601-101
C 611	27 pF ±10% 50V high Q smd	510-3663-270
C 612	47 pF ±10% 50V high Q smd	510-3663-470
C 613	1 µF ±10% X7R 16V cer smd	510-3606-105
CR 501	Pin diode	523-1504-032
CR 502	Pin diode	523-1504-032
CR 503	Pin switching diode	523-1504-001
CR 506	Switching diode SOT-23	523-1504-002
CR 508	Switching diode SOT-23	523-1504-002
CR 509	Switching diode SOT-23	523-1504-002
CR 510	HC diode	523-1504-016
CR 512	Pin switching diode	523-1504-001
CR 513	Pin switching diode	523-1504-001
CR 514	Transient suppressor	523-2906-001
CR 515	Schottky power 3A,40V	523-0519-032
EP 501	Ferrite bead smd	517-2503-010
EP 502	Ferrite bead smd	517-2503-010
EP 503	Ferrite bead smd	517-2503-002
J 501	Connector, 20-pin	515-7111-230
J 502	Connector, SMT receptacle	515-7111-470
L 501	2T inductor	016-0020-082
L 502	2T inductor	016-0020-082

Ref No.	Description	Part No.
L 503	2T inductor	016-0020-082
L 504	8T inductor	016-0020-058
L 505	10T inductor	542-0030-010
L 506	1.0 µH ±5% smd	542-9000-109
L 507	1.0 µH ±5% smd	542-9000-109
L 509	10T 43 nH smd	542-0030-010
L 510	10T 43 nH smd	542-0030-010
L 511	6T 17.5 nH	542-0030-006
L 514	10T 43 nH smd	542-0030-010
L 515	10T 43 nH smd	542-0030-010
L 516	8T inductor	016-0020-058
L 517	4T inductor	542-0020-044
L 518	4T inductor	542-0020-034
L 519	70 µH DC line filter	542-5010-003
L 520	100 µH 3A toroid inductor	542-5010-016
L 521	50 µH 3A toroid inductor	542-5010-013
PC 501	PA board, VHF	035-5315-500
Q 501	NPN general purpose	576-0003-658
Q 504	NPN general purpose	576-0003-658
Q 505	NPN general purpose	576-0003-658
Q 506	PNP power Darlington amp	576-0007-013
Q 507	NPN general purpose	576-0003-658
Q 508	NPN general purpose	576-0003-658
Q 509	NPN RF power	576-0004-111
Q 510	NPN RF power 75W, 175 MHz	576-0004-053
Q 511	PNP power Darlington	576-0007-013
Q 512	PNP switching	576-0003-612
Q 513	NPN general purpose	576-0003-658
Q 514	NPN general purpose	576-0003-658
R 501	220k ohm ±5% 1/8W smd	569-0105-224
R 502	220k ohm ±5% 1/8W smd	569-0105-224
R 503	220 ohm ±5% 1/8W smd	569-0105-221
R 505	100 ohm ±5% 1W smd	569-0175-101
R 506	100 ohm ±5% 1W smd	569-0175-101
R 507	220k ohm ±5% 1/8W smd	569-0105-224
R 508	4.7k ohm ±5% 1/8W smd	569-0105-472
R 509	68k ohm ±5% 1/8W smd	569-0105-683
R 510	2.0k ohm ±5% 1/8W smd	569-0105-202
R 519	47k ohm ±5% 1/8W smd	569-0105-473
R 520	20k ohm ±5% 1/8W smd	569-0105-203
R 521	20k ohm ±5% 1/8W smd	569-0105-203
R 522	10k ohm ±5% 1/8W smd	569-0105-103

VHF PA Board Assembly (Cont'd)

Ref No.	Description	Part No.
R 523	20k ohm ±5% 1/8W smd	569-0105-203
R 524	10k ohm ±5% 1/8W smd	569-0105-103
R 525	20k ohm ±5% 1/8W smd	569-0105-203
R 526	10k ohm ±5% 1/8W smd	569-0105-103
R 527	20k ohm ±5% 1/8W smd	569-0105-203
R 528	10k ohm ±5% 1/8W smd	569-0105-103
R 529	20k ohm ±5% 1/8W smd	569-0105-203
R 530	10k ohm ±5% 1/8W smd	569-0105-103
R 531	20k ohm ±5% 1/8W smd	569-0105-203
R 532	10k ohm ±5% 1/8W smd	569-0105-103
R 533	20k ohm ±5% 1/8W smd	569-0105-203
R 534	220k ohm ±5% 1/8W smd	569-0105-224
R 535	10k ohm ±5% 1/8W smd	569-0105-103
R 536	2.2k ohm ±5% 1/8W smd	569-0105-222
R 537	10k ohm ±5% 1/8W smd	569-0105-103
R 538	18k ohm ±5% 1/8W smd	569-0105-183
R 539	47k ohm ±5% 1/8W smd	569-0105-473
R 540	10k ohm ±5% 1/8W smd	569-0105-103
R 541	1.8k ohm ±5% 1/8W smd	569-0105-182
R 542	1.0k ohm ±5% 1/8W smd	569-0105-102
R 543	4.3k ohm ±5% 1/8W smd	569-0105-432
R 544	4.3k ohm ±5% 1/8W smd	569-0105-432
R 545	6.2k ohm ±5% 1/8W smd	569-0105-622
R 546	330 ohm ±5% 1/8W smd	569-0105-331
R 547	470k ohm ±5% 1/8W smd	569-0105-474
R 548	10k ohm ±5% 1/8W smd	569-0105-103
R 549	20k ohm ±5% 1/8W smd	569-0105-203
R 551	18k ohm ±5% 1/8W smd	569-0105-183
R 552	68k ohm ±5% 1/8W smd	569-0105-683
R 553	1.0k ohm ±5% 1/8W smd	569-0105-102
R 555	4.7k ohm ±5% 1/8W smd	569-0105-472
R 556	10 ohm ±5% 1W smd	569-0175-100
R 557	100 ohm ±5% 1W smd	569-0175-101
R 558	18k ohm ±5% 1/8W smd	569-0105-183
R 559	100 ohm ±5% 1W smd	569-0175-101
R 560	100 ohm ±5% 1W smd	569-0175-101
R 561	.015 ohm ±5% 2W smd	569-2019-157
R 562	200 ohm ±5% 1/8W smd	569-0115-201
R 563	200 ohm ±5% 1/8W smd	569-0115-201
R 564	4.7k ohm ±5% 1/8W smd	569-0115-472
R 565	330 ohm ±5% 1/8W smd	569-0105-331
R 566	100 ohm ±5% 0.75W smd	569-0135-101
R 567	68k ohm ±5% 1/8W smd	569-0105-683
R 568	100k ohm ±5% 1/8W smd	569-0105-104
R 569	68k ohm ±5% 1/8W smd	569-0105-683

800 MHz PA Board Assembly

Ref No.	Description	Part No.
R 570	470 ohm ±5% 1/8W smd	569-0105-471
R 571	100 ohm ±5% 1/8W smd	569-0105-101
R 572	1.2k ohm ±5% 1/8W smd	569-0115-122
R 573	1.2k ohm ±5% 1/8W smd	569-0115-122
R 574	100k ohm ±5% 1/8W smd	569-0105-104
R 575	560 ohm ±5% 1/8W smd	569-0105-561
R 576	1.2k ohm ±5% 1/8W smd	569-0115-122
R 577	47k ohm ±5% 1/8W smd	569-0105-473
R 578	3.01k ±1% 1/8W smd	569-0111-347
R 579	1.27k ohm 1% 1/8W smd	569-0111-311
R 580	1.0k ohm ±5% 1/8W smd	569-0105-102
R 581	18k ohm ±5% 1/8W smd	569-0105-183
R 582	68k ohm ±5% 1/8W smd	569-0105-683
R 583	10k ohm ±5% 1/8W smd	569-0105-103
R 584	20k ohm ±5% 1/8W smd	569-0105-203
R 585	1.0k ohm ±5% 1/8W smd	569-0105-102
R 586	1.0k ohm ±5% 1/8W smd	569-0105-102
R 587	1.0k ohm ±5% 1/8W smd	569-0105-102
R 588	1.0k ohm ±5% 1/8W smd	569-0105-102
RT 501	Thermistor, 10k ohm ±5% smd	569-3013-007
U 501	Shift reg, 8-stage MC4094	544-3016-094
U 502	Op amp, dual LM2904	544-2019-004
U 505	Current sense amp MAX472ESA	544-2039-002
U 506	Switching regulator, 3A MC33166	544-2003-102
U 507	Op amp, dual LM2904	544-2019-004

PA BOARD ASSEMBLY (800 MHz)
Part No. 023-5385-501

C 501	3.9 pF ±10% 50V high Q smd	510-3653-399
C 502	7.5 pF ±10% 50V high Q smd	510-3663-759
C 503	1.0 pF ±5% NPO 50V cer smd	510-3615-109
C 504	7.5 pF ±10% 50V high Q smd	510-3663-759
C 505	3.9 pF ±10% 50V high Q smd	510-3653-399
C 506	39 pF ±5% NPO 50V cer smd	510-3615-390
C 507	9.1 pF ±5% NPO 50V cer smd	510-3615-919
C 508	1.8 pF ±5% NPO 50V cer smd	510-3615-189
C 509	39 pF ±5% NPO 50V cer smd	510-3615-390
C 510	2.2 pF ±5% NPO 50V cer smd	510-3615-229
C 511	56 pF ±10% 50V high Q smd	510-3653-560
C 512	1.8 pF ±5% NPO 50V cer smd	510-3615-189
C 513	1.8 pF ±5% NPO 50V cer smd	510-3615-189

800 MHz PA Board Assembly (Cont'd)

Ref No.	Description	Part No.
C 514	12 pF ±5% NPO 50V cer smd	510-3601-120
C 515	8.2 pF ±5% NPO 50V cer smd	510-3615-829
C 516	.01 µF X7R ±10% 50V cer smd	510-3605-103
C 517	.01 µF X7R ±10% 50V cer smd	510-3605-103
C 518	.01 µF X7R ±10% 50V cer smd	510-3605-103
C 519	39 pF ±5% NPO 50V cer smd	510-3615-390
C 521	39 pF ±5% NPO 50V cer smd	510-3615-390
C 522	2.2 pF ±5% NPO 50V cer smd	510-3615-229
C 524	39 pF ±5% NPO 50V cer smd	510-3601-390
C 525	.01 µF X7R ±10% 50V cer smd	510-3605-103
C 526	.01 µF X7R ±10% 50V cer smd	510-3605-103
C 527	.1 µF X7R ±10% 50V cer smd	510-3606-104
C 528	39 pF ±5% NPO 50V cer smd	510-3601-390
C 529	.1 µF X7R ±10% 50V cer smd	510-3606-104
C 530	39 pF ±5% NPO 50V cer smd	510-3601-390
C 531	39 pF ±5% NPO 50V cer smd	510-3601-390
C 532	39 pF ±5% NPO 50V cer smd	510-3601-390
C 533	39 pF ±5% NPO 50V cer smd	510-3601-390
C 534	39 pF ±5% NPO 50V cer smd	510-3601-390
C 535	12 pF ±5% NPO 50V cer smd	510-3601-120
C 536	39 pF ±5% NPO 50V cer smd	510-3601-390
C 537	39 pF ±5% NPO 50V cer smd	510-3601-390
C 538	5.6 pF ±5% NPO 50V cer smd	510-3601-569
C 539	39 pF ±5% NPO 50V cer smd	510-3601-390
C 540	39 pF ±5% NPO 50V cer smd	510-3601-390
C 541	1 µF ±10% X7R 16V cer smd	510-3606-105
C 542	39 pF ±5% NPO 50V cer smd	510-3601-390
C 543	1 µF ±10% X7R 16V cer smd	510-3606-105
C 544	1 µF ±10% X7R 16V cer smd	510-3606-105
C 545	39 pF ±5% NPO 50V cer smd	510-3615-390
C 546	.018 µF ±10% X7R 50V cer smd	510-3605-183
C 547	1 µF ±10% X7R 16V cer smd	510-3606-105
C 548	39 pF ±5% NPO 50V cer smd	510-3615-390
C 549	.018 µF ±10% X7R 50V cer smd	510-3605-183
C 550	39 pF ±5% NPO 50V cer smd	510-3615-390
C 551	.018 µF ±10% X7R 50V cer smd	510-3605-183
C 552	1 µF ±10% X7R 16V cer smd	510-3606-105
C 553	.018 µF ±10% X7R 50V cer smd	510-3605-183
C 554	39 pF ±5% NPO 50V cer smd	510-3615-390
C 555	.018 µF ±10% X7R 50V cer smd	510-3605-183
C 556	3.0 pF ±5% NPO 50V cer smd	510-3615-309
C 563	1 µF ±10% X7R 16V cer smd	510-3606-105
C 564	.01 µF X7R ±10% 50V cer smd	510-3605-103
C 565	56 pF ±10% 50V hi Q smd	510-3653-560
C 566	1.0 to 4.5 pF smd variable	512-1008-001

Ref No.	Description	Part No.
C 567	12 pF ±5% NPO 50V cer smd	510-3615-120
C 568	39 pF ±5% NPO 50V cer smd	510-3615-390
C 569	.018 µF ±10% X7R 50V cer smd	510-3605-183
C 570	39 pF ±5% NPO 50V cer smd	510-3615-390
C 571	1500 µF 25V electrolytic	510-4055-152
C 572	100 pF NPO ±5% 50V cer smd	510-3601-101
C 573	39 pF ±5% NPO 50V cer smd	510-3615-390
C 577	.1 µF ±10% X7R 50V cer smd	510-3606-104
C 579	10 µF 25V tantalum smd	510-2627-100
C 580	1 µF ±10% X7R 16V cer smd	510-3606-105
C 581	.01 µF X7R ±5% 50V cer smd	510-3609-103
C 582	1 µF ±10% X7R 16V cer smd	510-3606-105
C 583	1 µF ±10% X7R 16V cer smd	510-3606-105
C 585	470 µF 16V electrolytic	510-4056-471
C 586	470 µF 16V electrolytic	510-4056-471
C 589	1 µF ±10% X7R 16V cer smd	510-3606-105
C 590	.018 µF ±10% X7R 50V cer smd	510-3605-183
C 591	.018 µF ±10% X7R 50V cer smd	510-3605-183
C 592	39 pF ±5% NPO 50V cer smd	510-3615-390
C 593	.01 µF X7R ±10% 50V cer smd	510-3605-103
C 595	39 pF ±5% NPO 50V cer smd	510-3601-390
C 596	39 pF ±5% NPO 50V cer smd	510-3601-390
C 597	39 pF ±5% NPO 50V cer smd	510-3601-390
C 598	5.1 pF ±5% NPO 50V cer smd	510-3601-519
C 599	39 pF ±5% NPO 50V cer smd	510-3601-390
C 601	39 pF ±5% NPO 50V cer smd	510-3601-390
C 602	39 pF ±5% NPO 50V cer smd	510-3601-390
C 604	39 pF ±5% NPO 50V cer smd	510-3601-390
C 605	39 pF ±5% NPO 50V cer smd	510-3601-390
C 606	39 pF ±5% NPO 50V cer smd	510-3601-390
C 607	39 pF ±5% NPO 50V cer smd	510-3601-390
C 608	39 pF ±5% NPO 50V cer smd	510-3601-390
C 609	.018 µF ±10% X7R 50V cer smd	510-3605-183
C 610	39 pF ±5% NPO 50V cer smd	510-3601-390
C 611	39 pF ±5% NPO 50V cer smd	510-3601-390
C 612	39 pF ±5% NPO 50V cer smd	510-3601-390
C 613	39 pF ±5% NPO 50V cer smd	510-3601-390
C 614	39 pF ±5% NPO 50V cer smd	510-3601-390
C 615	39 pF ±5% NPO 50V cer smd	510-3601-390
C 616	39 pF ±5% NPO 50V cer smd	510-3601-390
C 617	39 pF ±5% NPO 50V cer smd	510-3601-390
C 618	39 pF ±5% NPO 50V cer smd	510-3601-390
C 619	39 pF ±5% NPO 50V cer smd	510-3601-390
C 620	39 pF ±5% NPO 50V cer smd	510-3601-390
C 621	39 pF ±5% NPO 50V cer smd	510-3601-390

800 MHz PA Board Assembly (Cont'd)

Ref No.	Description	Part No.
C 622	39 pF ±5% NPO 50V cer smd	510-3601-390
C 623	1 µF ±10% X7R 16V cer smd	510-3606-105
C 624	39 pF ±5% NPO 50V cer smd	510-3601-390
CR 501	Pin diode	523-1504-032
CR 502	Pin diode	523-1504-032
CR 503	Pin switching diode	523-1504-001
CR 504	Switching diode SOT-23	523-1504-002
CR 505	Switching diode SOT-23	523-1504-002
CR 506	5.1V zener SOT-23	523-2016-519
CR 507	Switching diode SOT-23	523-1504-002
CR 508	12V zener diode SOT-23	523-2016-120
CR 509	HC diode SOT-23	523-1504-016
CR 510	Transient suppressor, axial	523-2906-001
CR 515	Schottky power, 3A, 40V SMT	523-0519-032
CR 516	Pin diode	523-1504-032
CR 517	Hc diode SOT-23	523-1504-016
CR 518	Pin diode	523-1504-032
CR 519	Pin diode	523-1504-032
CR 520	3.3V zener SOT-23	523-2016-339
CR 521	HC diode SOT-23	523-1504-016
CR 522	Switching diode SOT-23	523-1504-002
EP 501	Ferrite bead smd	517-2503-010
EP 502	Ferrite bead smd	517-2503-010
EP 503	Ferrite bead smd	517-2503-010
J 501	Connector, 20-pin	515-7111-230
L 501	8.0nH smd air core	542-0030-003
L 502	8.0nH smd air core	542-0030-003
L 503	12 nH smd	542-9003-127
L 504	15 nH smd	542-9003-157
L 505	15 nH smd	542-9003-157
L 506	9T, 35.5 nH smd	542-0030-009
L 507	8T 22 AWG. 090 ID smd	542-0016-008
L 508	8T 22 AWG. 090 ID smd	542-0016-008
L 509	DC line filter	542-5010-003
L 511	12 nH smd	542-9003-127
L 512	100 µH 3A toroid	542-5010-016
L 513	50 µH 3A toroid	542-5010-013
L 514	15 nH smd	542-9003-157
Q 501	NPN general purpose sw/amp	576-0001-300
Q 502	PNP switching	576-0003-612

Ref No.	Description	Part No.
Q 503	NPN low noise amp	576-0003-618
Q 504	NPN general purpose SOT-23	576-0003-658
Q 505	NPN general purpose SOT-23	576-0003-658
Q 506	NPN general purpose SOT-23	576-0003-658
Q 507	NPN general purpose SOT-23	576-0003-658
Q 508	PNP low noise amp	576-0003-657
Q 509	NPN 800 MHz high power amp	
Q 513	PNP pwr Darlington	576-0007-013
Q 515	PNP switching	576-0003-612
Q 516	NPN general purpose SOT-23	576-0003-658
Q 517	NPN general purpose SOT-23	576-0003-658
R 501	220k ohm ±5% 1/8W smd	569-0105-224
R 502	560 ohm ±5% 1/8W smd	569-0105-561
R 503	100 ohm ±5% 3/4W smd	569-0135-101
R 504	100 ohm ±5% 3/4W smd	569-0135-101
R 505	220k ohm ±5% 1/8W smd	569-0105-224
R 506	220k ohm ±5% 1/8W smd	569-0105-224
R 507	68k ohm ±5% 1/8W smd	569-0105-683
R 508	4.7k ohm ±5% 1/8W smd	569-0105-472
R 509	10k ohm ±5% 1/8W smd	569-0105-103
R 510	4.7k ohm ±5% 1/8W smd	569-0105-472
R 511	100 ohm ±5% 1/8W smd	569-0105-101
R 512	220 ohm ±5% 1/8W smd	569-0105-221
R 513	20k ohm ±5% 1/8W smd	569-0105-203
R 514	20k ohm ±5% 1/8W smd	569-0105-203
R 515	10k ohm ±5% 1/8W smd	569-0105-103
R 516	20k ohm ±5% 1/8W smd	569-0105-203
R 517	10k ohm ±5% 1/8W smd	569-0105-103
R 518	20k ohm ±5% 1/8W smd	569-0105-203
R 519	10k ohm ±5% 1/8W smd	569-0105-103
R 520	20k ohm ±5% 1/8W smd	569-0105-203
R 521	10k ohm ±5% 1/8W smd	569-0105-103
R 522	20k ohm ±5% 1/8W smd	569-0105-203
R 523	10k ohm ±5% 1/8W smd	569-0105-103
R 524	20k ohm ±5% 1/8W smd	569-0105-203
R 525	10k ohm ±5% 1/8W smd	569-0105-103
R 526	20k ohm ±5% 1/8W smd	569-0105-203
R 527	220k ohm ±5% 1/8W smd	569-0105-224
R 528	10k ohm ±5% 1/8W smd	569-0105-103
R 529	2.2k ohm ±5% 1/8W smd	569-0105-222
R 530	10k ohm ±5% 1/8W smd	569-0105-103
R 531	47k ohm ±5% 1/8W smd	569-0105-473
R 532	47k ohm ±5% 1/8W smd	569-0105-473
R 533	1.15k ohm ±1% 1/8W smd	569-0101-307

800 MHz PA Board Assembly (Cont'd)

Ref No.	Description	Part No.
R 534	4.3k ohm ±5% 1/8W smd	569-0105-432
R 535	7.5k ohm ±5% 1/8W smd	569-0105-752
R 536	100k ohm ±1% 1/8W smd	569-0101-501
R 537	10k ohm ±5% 1/8W smd	569-0105-103
R 538	330 ohm ±5% 1/8W smd	569-0105-331
R 539	Zero ohm ±5% 1/8W smd	569-0105-001
R 540	10k ohm ±5% 1/8W smd	569-0105-103
R 541	300 ohm ±5% .425W smd	569-0116-301
R 542	18 ohm ±5% .425W smd	569-0116-180
R 543	300 ohm ±5% .425W smd	569-0116-301
R 544	270 ohm ±5% 1/8W smd	569-0115-271
R 545	18 ohm ±5% 1/8W smd	569-0115-180
R 546	270 ohm ±5% 1/8W smd	569-0115-271
R 547	10k ohm ±5% 1/8W smd	569-0115-103
R 548	5.1k ohm ±5% 1/8W smd	569-0115-512
R 549	1k ohm ±5% 1/8W smd	569-0115-102
R 550	.015 ohm ±5% 2W smd	569-2019-157
R 551	200 ohm ±5% 1/8W smd	569-0115-201
R 552	200 ohm ±5% 1/8W smd	569-0115-201
R 553	6.8k ohm ±5% 1/8W smd	569-0115-682
R 554	100 ohm ±5% 1/8W smd	569-0105-101
R 555	100 ohm ±5% 1/8W smd	569-0115-101
R 556	100k ohm ±5% 1/8W smd	569-0105-104
R 557	220k ohm ±5% 1/8W smd	569-0105-224
R 558	47k ohm ±5% 1/8W smd	569-0105-473
R 559	510 ohm ±5% 1/8W smd	569-0105-511
R 560	510 ohm ±5% 1/8W smd	569-0105-511
R 561	560 ohm ±5% 1/8W smd	569-0105-561
R 562	100k ohm ±5% 1/8W smd	569-0105-104
R 563	100 ohm ±5% 1/8W smd	569-0105-101
R 564	1.2k ohm ±5% 1/8W smd	569-0115-122
R 565	1.2k ohm ±5% 1/8W smd	569-0115-122
R 566	47k ohm ±5% 1/8W smd	569-0105-473
R 567	3.01k ohm ±1% 1/8W smd	569-0111-347
R 568	1.27k ohm ±1% 1/8W smd	569-0111-311
R 569	91k ohm ±5% 1/8W smd	569-0105-913
R 570	220k ohm ±5% 1/8W smd	569-0105-224
R 571	75k ohm ±5% 1/8W smd	569-0105-753
R 572	47k ohm ±5% 1/8W smd	569-0105-473
R 573	47k ohm ±5% 1/8W smd	569-0105-473
R 574	47k ohm ±5% 1/8W smd	569-0105-473
R 575	1.8k ohm ±5% 1/8W smd	569-0105-182
R 576	47k ohm ±5% 1/8W smd	569-0105-473
R 577	47k ohm ±5% 1/8W smd	569-0105-473
R 578	1.8k ohm ±5% 1/8W smd	569-0105-182

Logic Board Assembly

Ref No.	Description	Part No.
R 579	120 ohm ±5% 1/8W smd	569-0105-121
R 580	10k ohm ±5% 1/8W smd	569-0105-103
R 581	1.0k ohm ±5% 1/8W smd	569-0105-102
R 582	680 ohm ±5% 1/8W smd	569-0105-681
R 583	51 ohm ±5% 1/8W smd	569-0115-510
R 584	3.9k ohm ±5% 1/8W smd	569-0105-392
R 585	51 ohm ±5% 1/8W smd	569-0115-510
R 586	1.0k ohm ±5% 1/8W smd	569-0105-102
R 587	300 ohm ±5% 1/8W smd	569-0105-301
R 588	18 ohm ±5% 1/8W smd	569-0105-180
R 589	300 ohm ±5% 1/8W smd	569-0105-301
R 590	100 ohm ±5% 1/8W smd	569-0105-101
R 591	100k ohm ±5% 1/8W smd	569-0105-104
R 592	47k ohm ±5% 1/8W smd	569-0105-473
R 593	47k ohm ±5% 1/8W smd	569-0105-473
R 595	510 ohm ±5% 1/8W smd	569-0105-511
R 596	10k ohm ±5% 1/8W smd	569-0105-103
R 597	3.9k ohm ±5% 1/8W smd	569-0105-392
R 598	1.2k ohm ±5% 1/8W smd	569-0115-122
R 601	Zero ohm jumper	569-0105-001
R 631	5.1k ohm ±5% 1/8W smd	569-0105-512
U 501	Shift register, 8-bit MC14094	544-3016-094
U 502	Op amp, low pwr quad LM2902	544-2020-011
U 503	RF switch, DC-2 GHz AS139-73	544-9015-100
U 505	Current sense amp MAX472ESA	544-2039-002
U 506	Regulator, 3A switching MC33166	544-2003-102
U 507	Regulator, 8V low cur 78L08	544-2603-042
Z 501	Filter, 860 MHz 20 MHz 3-pole	532-2007-011

LOGIC BOARD ASSEMBLY
Part No. 023-5300-400

C 001	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 002	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 003	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 004	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 005	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 006	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 007	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 008	220 pF ±5% NPO 50V cer smd	510-3674-221
C 009	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 010	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104

Logic Board Assembly (Cont'd)

Ref No.	Description	Part No.
C 011	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 012	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 013	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 014	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 015	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 016	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 017	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 018	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 019	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 020	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 021	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 022	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 023	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 024	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 025	10 pF ±.1 pF NPO 50V cer smd	510-3673-100
C 026	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 027	10 pF ±.1 pF NPO 50V cer smd	510-3673-100
C 028	6.2 pF ±.1 pF NPO 50V cer smd	510-3673-629
C 029	5.1 pF ±.1 pF NPO 50V cer smd	510-3673-519
C 030	470 pF ±5% NPO 50V cer smd	510-3674-471
C 031	470 pF ±5% NPO 50V cer smd	510-3674-471
C 032	.22 µF ±10% Z5U 25V cer smd	510-3686-224
C 033	220 pF ±5% NPO 50V cer smd	510-3674-221
C 034	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 035	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 036	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 037	220 pF ±5% NPO 50V cer smd	510-3674-221
C 038	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 039	220 pF ±5% NPO 50V cer smd	510-3674-221
C 040	330 pF ±10% X7R 25V cer smd	510-3675-331
C 041	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 042	.01 µF ±10% X7R 50V cer smd	510-3675-103
C 043	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 044	1 µF +80/–20% Z5U 25V cer smd	510-3631-105
C 045	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 046	220 pF ±5% NPO 50V cer smd	510-3674-221
C 047	220 pF ±5% NPO 50V cer smd	510-3674-221
C 048	10 pF ±.1 pF NPO 50V cer smd	510-3673-100
C 049	10 pF ±.1 pF NPO 50V cer smd	510-3673-100
C 050	68 µF ±10% 16V tantalum	510-2625-680
C 051	33 pF ±10% X7R 25V cer smd	510-3675-330
C 053	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 054	33 pF ±10% X7R 25V cer smd	510-3675-330
C 055	68 µF ±10% 16V tantalum	510-2625-680
C 056	220 pF ±5% NPO 50V cer smd	510-3674-221

Ref No.	Description	Part No.
C 057	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 058	100 µF 10V tantalum smd	510-2624-101
C 059	4.7 µF 10V tantalum smd	510-2624-479
C 060	4.7 µF 10V tantalum smd	510-2624-479
C 061	220 pF ±5% NPO 50V cer smd	510-3674-221
C 062	220 pF ±5% NPO 50V cer smd	510-3674-221
C 063	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 064	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 065	220 pF ±5% NPO 50V cer smd	510-3674-221
C 066	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 067	3900 pF ±10% X7R 25V cer smd	510-3675-392
C 068	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 069	470 pF ±5% NPO 50V cer smd	510-3674-471
C 070	220 pF ±5% NPO 50V cer smd	510-3674-221
C 071	220 pF ±5% NPO 50V cer smd	510-3674-221
C 072	470 pF ±5% NPO 50V cer smd	510-3674-471
C 073	1 µF ±20% Z5U 25V cer smd	510-3636-105
C 074	1 µF ±20% Z5U 25V cer smd	510-3636-105
C 075	1 µF ±20% Z5U 25V cer smd	510-3636-105
C 076	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 077	1 µF ±20% Z5U 25V cer smd	510-3636-105
C 078	470 pF ±5% NPO 50V cer smd	510-3674-471
C 079	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 080	220 pF ±5% NPO 50V cer smd	510-3674-221
C 081	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 082	.1 µF +80/–20% Z5U 50V cer smd	510-3636-104
C 083	.001 µF ±10% X7R 50V cer smd	510-3675-102
C 084	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 085	1 µF ±20% Z5U 25V cer smd	510-3636-105
C 086	220 pF ±5% NPO 50V cer smd	510-3674-221
C 087	100 pF ±5% NPO 50V cer smd	510-3674-101
C 088	1 µF ±20% Z5U 25V cer smd	510-3636-105
C 089	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 090	4700 pF ±10% X7R 25V cer smd	510-3675-472
C 091	220 pF ±5% NPO 50V cer smd	510-3674-221
C 092	220 pF ±5% NPO 50V cer smd	510-3674-221
C 093	220 pF ±5% NPO 50V cer smd	510-3674-221
C 094	220 pF ±5% NPO 50V cer smd	510-3674-221
C 095	220 pF ±5% NPO 50V cer smd	510-3674-221
C 096	220 pF ±5% NPO 50V cer smd	510-3674-221
C 097	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 098	220 pF ±5% NPO 50V cer smd	510-3674-221
C 099	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 100	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 101	.1 µF +80/–20% Z5U 50V cer smd	510-3636-104

Logic Board Assembly (Cont'd)

Ref No.	Description	Part No.
C 102	10 µF 10V tantalum smd	510-2624-100
C 103	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 105	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 106	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 107	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 108	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 109	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 110	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 111	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 112	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 113	220 pF ±5% NPO 50V cer smd	510-3674-221
C 114	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 115	470 pF ±5% NPO 50V cer smd	510-3674-471
C 116	470 pF ±5% NPO 50V cer smd	510-3674-471
C 117	470 pF ±5% NPO 50V cer smd	510-3674-471
C 118	470 pF ±5% NPO 50V cer smd	510-3674-471
C 119	470 pF ±5% NPO 50V cer smd	510-3674-471
C 120	470 pF ±5% NPO 50V cer smd	510-3674-471
C 121	470 pF ±5% NPO 50V cer smd	510-3674-471
C 122	470 pF ±5% NPO 50V cer smd	510-3674-471
C 123	470 pF ±5% NPO 50V cer smd	510-3674-471
C 124	470 pF ±5% NPO 50V cer smd	510-3674-471
C 125	470 pF ±5% NPO 50V cer smd	510-3674-471
C 126	470 pF ±5% NPO 50V cer smd	510-3674-471
C 127	470 pF ±5% NPO 50V cer smd	510-3674-471
C 128	470 pF ±5% NPO 50V cer smd	510-3674-471
C 129	470 pF ±5% NPO 50V cer smd	510-3674-471
C 130	470 pF ±5% NPO 50V cer smd	510-3674-471
C 131	470 pF ±5% NPO 50V cer smd	510-3674-471
C 132	470 pF ±5% NPO 50V cer smd	510-3674-471
C 133	470 pF ±5% NPO 50V cer smd	510-3674-471
C 134	470 pF ±5% NPO 50V cer smd	510-3674-471
C 135	470 pF ±5% NPO 50V cer smd	510-3674-471
C 136	470 pF ±5% NPO 50V cer smd	510-3674-471
C 137	470 pF ±5% NPO 50V cer smd	510-3674-471
C 138	470 pF ±5% NPO 50V cer smd	510-3674-471
C 139	470 pF ±5% NPO 50V cer smd	510-3674-471
C 140	470 pF ±5% NPO 50V cer smd	510-3674-471
C 141	470 pF ±5% NPO 50V cer smd	510-3674-471
C 142	470 pF ±5% NPO 50V cer smd	510-3674-471
C 143	470 pF ±5% NPO 50V cer smd	510-3674-471
C 144	470 pF ±5% NPO 50V cer smd	510-3674-471
C 145	470 pF ±5% NPO 50V cer smd	510-3674-471
C 146	470 pF ±5% NPO 50V cer smd	510-3674-471
C 147	470 pF ±5% NPO 50V cer smd	510-3674-471

Ref No.	Description	Part No.
C 148	470 pF ±5% NPO 50V cer smd	510-3674-471
C 149	470 pF ±5% NPO 50V cer smd	510-3674-471
C 150	470 pF ±5% NPO 50V cer smd	510-3674-471
C 151	470 pF ±5% NPO 50V cer smd	510-3674-471
C 152	470 pF ±5% NPO 50V cer smd	510-3674-471
C 153	470 pF ±5% NPO 50V cer smd	510-3674-471
C 154	470 pF ±5% NPO 50V cer smd	510-3674-471
C 155	470 pF ±5% NPO 50V cer smd	510-3674-471
C 157	220 pF ±5% NPO 50V cer smd	510-3674-221
C 158	33 pF ±10% X7R 25V cer smd	510-3675-330
C 159	33 pF ±10% X7R 25V cer smd	510-3675-330
C 160	33 pF ±10% X7R 25V cer smd	510-3675-330
C 161	220 pF ±5% NPO 50V cer smd	510-3674-221
C 162	220 pF ±5% NPO 50V cer smd	510-3674-221
C 163	33 pF ±10% X7R 25V cer smd	510-3675-330
C 164	33 pF ±10% X7R 25V cer smd	510-3675-330
C 165	33 pF ±10% X7R 25V cer smd	510-3675-330
C 166	33 pF ±10% X7R 25V cer smd	510-3675-330
C 167	33 pF ±10% X7R 25V cer smd	510-3675-330
C 168	33 pF ±10% X7R 25V cer smd	510-3675-330
C 169	33 pF ±10% X7R 25V cer smd	510-3675-330
C 170	33 pF ±10% X7R 25V cer smd	510-3675-330
C 171	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 172	.1 µF +80/–20% Z5U 25V cer smd	510-3680-104
C 173	.22 µF electrolytic	510-9510-055
D 001	Switching diode	523-1504-029
D 002	Dual switch-com cath	523-1504-022
D 003	Dual switch-com cath	523-1504-022
D 004	18V zener	523-2601-180
D 005	Diode, Schottky rect	523-0519-034
D 006	Dual switch-com cath	523-1504-022
D 007	Dual switch-com cath	523-1504-022
D 008	18V zener	523-2601-180
D 009	Dual switch-com cath	523-1504-022
D 010	18V zener	523-2601-180
D 011	5.1V zener SOT-23	523-2601-519
D 012	Dual switch-com cath	523-1504-022
F 001	Fuse 0.5A smd	534-5002-009
J 001	Connector, 16-pin	515-7000-668
J 002	Connector, 18-pin	515-7010-438
J 003	Connector, 18-pin .	515-7010-438
J 004	Connector, 25-pin	515-7113-071

Logic Board Assembly (Cont'd)

Ref No.	Description	Part No.
J 005	Connector, 13-pin	515-7111-262
J 006	Connector, 13-pin	515-7111-262
J 007	Connector, 5-pin	515-7111-254
J 008	Connector, 12-pin	515-7111-261
J 009	Connector, 2 x 14-pin	515-9500-045
L 001	1.8 uH 350 ma smd	542-9230-027
L 002	1.8 uH 350 ma smd	542-9230-027
L 003	33 uH 1.2A smd	542-9230-025
L 004	Ferrite bead smd	542-9230-005
L 005	Ferrite inductor	542-9230-021
L 006	Ferrite bead smd	542-9230-005
L 007	1.8 uH 350 ma smd	542-9230-027
L 008	Ferrite inductor	542-9230-021
L 009	Ferrite inductor	542-9230-021
L 010	33 uH 70 ma smd	542-9230-029
L 011	Ferrite inductor	542-9230-021
L 012	Ferrite inductor	542-9230-021
PC 000	PC board, logic	035-1800-400
Q 001	NPN general purpose	576-0003-658
Q 002	NPN switching	576-0003-714
Q 003	NPN general purpose	576-0003-658
Q 004	NPN general purpose	576-0003-658
Q 005	NPN general purpose	576-0003-658
Q 006	Transistor	576-0003-725
Q 007	NPN general purpose	576-0003-658
Q 008	NPN Darlington SOT-23	576-0003-700
Q 009	NPN general purpose	576-0003-658
Q 010	NPN general purpose	576-0003-658
Q 011	NPN general purpose	576-0003-658
Q 012	NPN general purpose	576-0003-658
R 001	4.7k ohm ±5% 1/16W smd	569-0155-472
R 002	4.7k ohm ±5% 1/16W smd	569-0155-472
R 003	10k ohm ±5% 1/16W smd	569-0155-103
R 004	4.7k ohm ±5% 1/16W smd	569-0155-472
R 005	10k ohm ±5% 1/16W smd	569-0155-103
R 006	10k ohm ±5% 1/16W smd	569-0155-103
R 007	390k ohm ±5% 1/16W smd	569-0155-394
R 008	10k ohm ±5% 1/16W smd	569-0155-103
R 009	4.7k ohm ±5% 1/16W smd	569-0155-472
R 010	Zero ohm jumper	569-0155-001
R 011	10k ohm ±5% 1/16W smd	569-0155-103

Ref No.	Description	Part No.
R 012	100 ohm ±5% 1/16W smd	569-0155-101
R 013	4.7k ohm ±5% 1/16W smd	569-0155-472
R 014	10k ohm ±5% 1/16W smd	569-0155-103
R 015	47k ohm ±5% 1/16W smd	569-0155-473
R 016	100 ohm ±5% 1/16W smd	569-0155-101
R 017	1k ohm ±5% 1/16W smd	569-0155-102
R 018	10k ohm ±5% 1/16W smd	569-0155-103
R 019	10k ohm ±5% 1/16W smd	569-0155-103
R 020	6.8k ohm ±5% 1/16W smd	569-0155-682
R 021	1.0m ohm ±5% 063W smd	569-0155-105
R 022	15K ohm ±5% 1/16W smd	569-0155-153
R 023	6.8k ohm ±5% 1/16W smd	569-0155-682
R 024	1k ohm ±5% 1/16W smd	569-0155-102
R 025	Zero ohm jumper	569-0155-001
R 026	47k ohm ±5% 1/16W smd	569-0155-473
R 027	510k ohm ±5% 1/16W smd	569-0155-514
R 028	Zero ohm jumper	569-0155-001
R 029	10k ohm ±5% 1/16W smd	569-0155-103
R 030	10k ohm ±5% 1/16W smd	569-0155-103
R 031	10 ohm ±5% 1/16W smd	569-0155-100
R 032	10 ohm ±5% 1/16W smd	569-0155-100
R 033	Zero ohm jumper	569-0155-001
R 034	22k ohm ±5% 1/16W smd	569-0155-223
R 035	22k ohm ±5% 1/16W smd	569-0155-223
R 036	22k ohm ±5% 1/16W smd	569-0155-223
R 037	Zero ohm jumper	569-0155-001
R 038	10k ohm ±5% 1/16W smd	569-0155-103
R 040	10k ohm ±5% 1/16W smd	569-0155-103
R 041	47k ohm ±5% 1/16W smd	569-0155-473
R 042	Zero ohm jumper	569-0155-001
R 043	1.0M ohm ±5% 063W smd	569-0155-105
R 044	100k ohm ±5% 1/6W smd	569-0155-104
R 045	22k ohm ±5% 1/16W smd	569-0155-223
R 046	22k ohm ±5% 1/16W smd	569-0155-223
R 047	22k ohm ±5% 1/16W smd	569-0155-223
R 048	22k ohm ±5% 1/16W smd	569-0155-223
R 049	22k ohm ±5% 1/16W smd	569-0155-223
R 050	22k ohm ±5% 1/16W smd	569-0155-223
R 051	22k ohm ±5% 1/16W smd	569-0155-223
R 052	22k ohm ±5% 1/16W smd	569-0155-223
R 053	22k ohm ±5% 1/16W smd	569-0155-223
R 054	22k ohm ±5% 1/16W smd	569-0155-223
R 055	22k ohm ±5% 1/16W smd	569-0155-223
R 056	22k ohm ±5% 1/16W smd	569-0155-223
R 057	22k ohm ±5% 1/16W smd	569-0155-223

Logic Board Assembly (Cont'd)

Ref No.	Description	Part No.
R 058	22k ohm ±5% 1/16W smd	569-0155-223
R 059	22k ohm ±5% 1/16W smd	569-0155-223
R 060	22k ohm ±5% 1/16W smd	569-0155-223
R 061	22k ohm ±5% 1/16W smd	569-0155-223
R 062	22k ohm ±5% 1/16W smd	569-0155-223
R 063	22k ohm ±5% 1/16W smd	569-0155-223
R 064	Zero ohm jumper	569-0155-001
R 065	1k ohm ±5% 1/16W smd	569-0155-102
R 066	10k ohm ±5% 1/16W smd	569-0155-103
R 067	10k ohm ±5% 1/16W smd	569-0155-103
R 068	10k ohm ±5% 1/16W smd	569-0155-103
R 069	10k ohm ±5% 1/16W smd	569-0155-103
R 070	100k ohm ±5% 1/6W smd	569-0155-104
R 071	10k ohm ±5% 1/16W smd	569-0155-103
R 072	10k ohm ±5% 1/16W smd	569-0155-103
R 073	10k ohm ±5% 1/16W smd	569-0155-103
R 074	10k ohm ±5% 1/16W smd	569-0155-103
R 075	10k ohm ±5% 1/16W smd	569-0155-103
R 076	560 ohm ±5% 1/8W smd	569-0105-561
R 077	100k ohm ±5% 1/6W smd	569-0155-104
R 078	47k ohm ±5% 1/16W smd	569-0155-473
R 079	10k ohm ±5% 1/16W smd	569-0155-103
R 080	10k ohm ±5% 1/16W smd	569-0155-103
R 081	47k ohm ±5% 1/16W smd	569-0155-473
R 082	10k ohm ±5% 1/8W smd	569-0105-103
R 083	10k ohm ±5% 1/8W smd	569-0105-103
R 084	47k ohm ±5% 1/16W smd	569-0155-473
R 085	100k ohm ±5% 1/6W smd	569-0155-104
R 086	100k ohm ±5% 1/6W smd	569-0155-104
R 087	Zero ohm jumper	569-0155-001
R 088	47k ohm ±5% 1/16W smd	569-0155-473
R 089	330 ohm ±5% 1/16W smd	569-0155-331
R 090	10k ohm ±5% 1/16W smd	569-0155-103
R 092	100k ohm ±5% 1/6W smd	569-0155-104
R 093	47k ohm ±5% 1/16W smd	569-0155-473
R 094	100k ohm ±5% 1/6W smd	569-0155-104
R 095	330 ohm ±5% 1/16W smd	569-0155-331
R 096	6.8k ohm ±5% 1/16W smd	569-0155-682
R 097	6.8k ohm ±5% 1/16W smd	569-0155-682
R 098	47k ohm ±5% 1/16W smd	569-0155-473
R 099	47k ohm ±5% 1/16W smd	569-0155-473
R 100	6.8k ohm ±5% 1/16W smd	569-0155-682
R 101	390k ohm ±5% 1/16W smd	569-0155-394
R 102	47k ohm ±5% 1/16W smd	569-0155-473
R 103	47k ohm ±5% 1/16W smd	569-0155-473

Ref No.	Description	Part No.
R 104	6.8k ohm ±5% 1/16W smd	569-0155-682
R 105	100k ohm ±5% 1/6W smd	569-0155-104
R 106	100k ohm ±5% 1/6W smd	569-0155-104
R 107	100k ohm ±5% 1/6W smd	569-0155-104
R 108	6.8k ohm ±5% 1/8W smd	569-0105-682
R 109	6.8k ohm ±5% 1/16W smd	569-0155-682
R 110	150 ohm ±5% 1/16W smd	569-0155-151
R 111	150 ohm ±5% 1/16W smd	569-0155-151
R 112	100k ohm ±5% 1/6W smd	569-0155-104
R 113	100k ohm ±5% 1/6W smd	569-0155-104
R 114	10 ohm ±5% 1/16W smd	569-0155-100
R 115	100k ohm ±5% 1/6W smd	569-0155-104
R 116	100 ohm ±5% 1/16W smd	569-0155-101
R 117	100k ohm ±5% 1/6W smd	569-0155-104
R 118	180k ohm ±5% 1/6W smd	569-0155-184
R 119	68k ohm ±5% 1/16W smd	569-0155-683
R 120	390k ohm ±5% 1/16W smd	569-0155-394
R 121	6.8k ohm ±5% 1/16W smd	569-0155-682
R 122	56k ohm ±5% 1/16W smd	569-0155-563
R 123	47k ohm ±5% 1/16W smd	569-0155-473
R 124	47k ohm ±5% 1/16W smd	569-0155-473
R 125	6.8k ohm ±5% 1/16W smd	569-0155-682
R 126	100k ohm ±5% 1/6W smd	569-0155-104
R 127	68k ohm ±5% 1/16W smd	569-0155-683
R 128	10k ohm ±5% 1/16W smd	569-0155-103
R 129	10k ohm ±5% 1/16W smd	569-0155-103
R 130	Zero ohm jumper	569-0155-001
R 131	47k ohm ±5% 1/16W smd	569-0155-473
R 132	47k ohm ±5% 1/16W smd	569-0155-473
R 133	10k ohm ±5% 1/16W smd	569-0155-103
R 134	10k ohm ±5% 1/16W smd	569-0155-103
R 135	10k ohm ±5% 1/16W smd	569-0155-103
R 136	10k ohm ±5% 1/16W smd	569-0155-103
R 137	10k ohm ±5% 1/16W smd	569-0155-103
R 138	10k ohm ±5% 1/16W smd	569-0155-103
R 139	47k ohm ±5% 1/16W smd	569-0155-473
R 140	47k ohm ±5% 1/16W smd	569-0155-473
R 141	100k ohm ±5% 1/6W smd	569-0155-104
R 142	100 ohm ±5% 1/16W smd	569-0155-101
R 144	10 ohm ±5% 1/16W smd	569-0155-100
R 145	Zero ohm jumper	569-0105-001
R 146	4.7k ohm ±5% 1/16W smd	569-0155-472
R 147	1k ohm ±5% 1/16W smd	569-0155-102
R 148	10k ohm ±5% 1/16W smd	569-0155-103
R 149	10k ohm ±5% 1/16W smd	569-0155-103

Logic Board Assembly (Cont'd)

Ref No.	Description	Part No.
R 150	10k ohm ±5% 1/16W smd	569-0155-103
R 151	10k ohm ±5% 1/16W smd	569-0155-103
R 152	330 ohm ±5% 1/16W smd	569-0155-331
R 153	330 ohm ±5% 1/16W smd	569-0155-331
R 154	100k ohm ±5% 1/6W smd	569-0155-104
R 155	100k ohm ±5% 1/6W smd	569-0155-104
R 156	10k ohm ±5% 1/16W smd	569-0155-103
R 157	47k ohm ±5% 1/16W smd	569-0155-473
R 158	100 ohm ±5% 1/16W smd	569-0155-101
R 159	10k ohm ±5% 1/16W smd	569-0155-103
R 160	4.7k ohm ±5% 1/16W smd	569-0155-472
R 161	Zero ohm jumper	569-0155-001
R 162	Zero ohm jumper	569-0155-001
R 163	100k ohm ±1% 1/16W smd	569-0156-104
R 164	33.2k ohm ±1% 1/16W smd	569-0103-332
R 165	10k ohm ±5% 1/16W smd	569-0155-103
R 166	Zero ohm jumper	569-0155-001
R 167	4.7k ohm ±5% 1/16W smd	569-0155-472
R 168	Zero ohm jumper	569-0155-001
R 169	Zero ohm jumper	569-0105-001
S 001	Switch, detector mom norm-on	583-9512-002
U 001	Programmable logic	023-1870-043
U 002	Flash CMOS 512k x 16 AT49F	544-1028-192
U 003	ADSIC, DSP support BGA106	544-1010-015
U 004	NAND, 2-input TC7SH00	544-1010-012
U 005	RAM, static 128k x 8 CY7C1009-15VC	544-1011-028
U 006	RAM, static 128k x 8 CY7C1009-15VC	544-1011-028
U 007	RS-232 driver LTC1338IG	544-1015-706
U 008	EEPROM,32k x 8 AT24C256W	544-1020-256
U 009	Microprocessor MC68HC708	544-1030-007
U 010	EEPROM 1k 2.5V 24LC02B	544-1012-402
U 011	DC-DC converter, 5V MAX744AE	544-1010-744
U 012	Dig sign proc TMS320C50PGEA	544-1010-018
U 013	Regulator, 5V LT1121IST-5	544-1011-121
U 014	RS-485 driver SN65176	544-2023-027
U 015	Op amp, quad 324	544-1020-324
U 016	Multiplexer, triple 4053	544-1014-053
U 017	Op amp, dual 358	544-1020-385
U 018	Op amp, dual 358	544-1020-385
U 019	Op amp, dual 358	544-1020-385
U 020	UART, dual SCC2692	544-1010-038

Front Panel Assembly

Ref No.	Description	Part No.
U 021	A/D converter, serial 8-bit AD7823	544-1010-041
U 022	Multiplexer, triple 4053	544-1014-053
Y 001	Crystal, 20.0000 MHz smd	521-3060-037
Y 002	Crystal, 3.6864 MHz smd	521-3060-053
Front Panel Assembly Part No. 023-5300-710		
A 151	Plastic front panel assembly	587-9650-002
A 713	Display board assembly	023-5300-713
C 701	4.7 µF 20V tantalum smd	510-2626-479
C 702	.1 µF ±10% X7R 50V cer smd	510-3606-104
C 703	.1 µF ±10% X7R 50V cer smd	510-3606-104
C 704	4.7 µF 20V tantalum smd	510-2626-479
C 705	.1 µF ±10% X7R 50V cer smd	510-3606-104
C 706	.1 µF ±10% X7R 50V cer smd	510-3606-104
C 707	4.7 µF 20V tantalum smd	510-2626-479
C 708	20 pF NPO ±5% cer smd	510-3601-200
C 709	20 pF NPO ±5% cer smd	510-3601-200
C 710	.1 µF ±10% X7R 50V cer smd	510-3606-104
C 711	.1 µF ±10% X7R 50V cer smd	510-3606-104
C 712	.047 µF ±10% X7R 50V cer smd	510-3605-473
C 713	4.7 µF 6.3V tantalum smd	510-2623-479
C 714	.1 µF ±10% X7R 50V cer smd	510-3606-104
C 715	.1 µF ±10% X7R 50V cer smd	510-3606-104
C 716	.1 µF ±10% X7R 50V cer smd	510-3606-104
C 717	.1 µF ±10% X7R 50V cer smd	510-3606-104
C 750	4.7 µF 10V tantalum smd	510-2624-479
C 751	.01 µF ±10% X7R 50V cer smd	510-3606-103
C 752	.01 µF ±10% X7R 50V cer smd	510-3606-103
C 753	.01 µF ±10% X7R 50V cer smd	510-3606-103
C 754	1.0 µF 35V tantalum smd	510-2628-109
C 755	4.7 µF 10V tantalum smd	510-2624-479
C 756	.01 µF ±10% X7R 50V cer smd	510-3606-103
CR 701	HC diode SOT-23	523-1504-016
DS 700	Dual color, red/grn LED	549-4001-215
DS 701-DS706	LED, green smd	549-4001-145
DS 707-DS726	LED, green smd	549-4003-011
DS 727	LCD assembly	549-4501-010

Front Panel Assembly (Cont'd)

Ref No.	Description	Part No.
EP 101	Key cap kit (see Section 2.5)	587-5300-001
F 700	Fuse, 2.0 A smd	534-5001-009
HW 010	Washer, .438 x .274 x .030	596-9410-010
HW 011	Nut, spanner 3/8 x 7mm	013-1313-018
HW 012	Screw, 2-56 x 1/4"	575-1602-008
HW 013	Lockwasher, internal No. 2	596-2102-006
J 101	Connector, 2-pin	515-9031-281
J 102	Connector, elastomeric	515-9900-002
J 700	Connector, 16-pin	515-7000-668
J 701	Connector, micro-miniature	515-7113-073
J 702	Connector, 9-pin ZIF flex	515-7111-321
J 703	Connector, 13-pin circular recept	515-1009-025
J 704	Connector, 3-pin	515-7000-643
J 705	Connector, 31-pin	515-7109-130
LS 001	Speaker, 2 x 3 in 16-ohm	589-1015-006
MP 101	Display bezel	017-2226-046
MP 102	Display gasket	018-1136-120
MP 103	Light pipe	032-0792-032
MP 108	Support-keypad	017-2226-090
MP 151	Gasket front lens	018-1136-108
MP 152	Control knob	032-0792-010
MP 153	Control knob	032-0792-010
MP 154	Speaker membrane	018-1136-112
MP 155	Pad, display board	018-1136-122
MP 158	Front panel lens	032-0792-034
MP 160	Spacer (between boards)	014-1188-053
MP 161	Keypad, standard	032-0792-030
MP 162	Speaker retainer	016-2187-250
NP 001	Johnson label raised	559-9001-310
PC 010	Flex circuit	035-5300-010
PC 710	PC board, display/controller	035-5300-710
Q 701	NPN general purpose	576-0003-658
Q 702	NPN general purpose	576-0003-658
Q 710	PNP general purpose	576-0003-650
Q 711	NPN general purpose	576-0003-658
Q 712	NPN general purpose	576-0003-658

Ref No.	Description	Part No.
R 701	620 ohm ±5% 1/8W smd	569-0105-621
R 702	47k ohm ±5% 1/8W smd	569-0105-473
R 703	47k ohm ±5% 1/8W smd	569-0105-473
R 704	47k ohm ±5% 1/8W smd	569-0105-473
R 705	47k ohm ±5% 1/8W smd	569-0105-473
R 706	47k ohm ±5% 1/8W smd	569-0105-473
R 707	47k ohm ±5% 1/8W smd	569-0105-473
R 708	47k ohm ±5% 1/8W smd	569-0105-473
R 709	47k ohm ±5% 1/8W smd	569-0105-473
R 710	620 ohm ±5% 1/8W smd	569-0105-621
R 711	47k ohm ±5% 1/8W smd	569-0105-473
R 712	47k ohm ±5% 1/8W smd	569-0105-473
R 713	47k ohm ±5% 1/8W smd	569-0105-473
R 714	10k ohm ±5% 1/8W smd	569-0105-103
R 715	47k ohm ±5% 1/8W smd	569-0105-473
R 716	47k ohm ±5% 1/8W smd	569-0105-473
R 717	47k ohm ±5% 1/8W smd	569-0105-473
R 718	47k ohm ±5% 1/8W smd	569-0105-473
R 720	47k ohm ±5% 1/8W smd	569-0105-473
R 721	47k ohm ±5% 1/8W smd	569-0105-473
R 722	10k ohm ±5% 1/8W smd	569-0105-103
R 723	47k ohm ±5% 1/8W smd	569-0105-473
R 724	47k ohm ±5% 1/8W smd	569-0105-473
R 725	10k ohm ±5% 1/8W smd	569-0105-103
R 726	47k ohm ±5% 1/8W smd	569-0105-473
R 727	10k ohm ±5% 1/8W smd	569-0105-103
R 728	1M ohm ±5% 1/8W smd	569-0105-105
R 729	10k ohm ±5% 1/8W smd	569-0105-103
R 730	4.7k ohm ±5% 1/8W smd	569-0105-472
R 731	3.3k ohm ±5% 1/8W smd	569-0105-332
R 732	10k ohm ±5% 1/8W smd	569-0105-103
R 733	10k ohm ±5% 1/8W smd	569-0105-103
R 734	10k ohm ±5% 1/8W smd	569-0105-103
R 735	4.7k ohm ±5% 1/8W smd	569-0105-472
R 736	10k ohm ±5% 1/8W smd	569-0105-103
R 737	4.7k ohm ±5% 1/8W smd	569-0105-472
R 738	10k ohm ±5% 1/8W smd	569-0105-103
R 739	3.3k ohm ±5% 1/8W smd	569-0105-332
R 740	47k ohm ±5% 1/8W smd	569-0105-473
R 741	300 ohm ±5% 1/8W smd	569-0105-301
R 742	47k ohm ±5% 1/8W smd	569-0105-473
R 743	47k ohm ±5% 1/8W smd	569-0105-473
R 744	47k ohm ±5% 1/8W smd	569-0105-473
R 745	10k ohm ±5% 1/8W smd	569-0105-103
R 746	3.3k ohm ±5% 1/8W smd	569-0105-332

Front Panel Assembly (Cont'd)

Ref No.	Description	Part No.
R 747	47k ohm ±5% 1/8W smd	569-0105-473
R 748	10k ohm ±5% 1/8W smd	569-0105-103
R 749	470 ohm ±5% 1/8W smdl	569-0105-471
R 750	470 ohm ±5% 1/8W smdl	569-0105-471
R 751	470 ohm ±5% 1/8W smdl	569-0105-471
R 752	Zero ohm jumper	569-0105-001
R 753	47k ohm ±5% 1/8W smd	569-0105-473
R 754	47k ohm ±5% 1/8W smd	569-0105-473
R 755	47k ohm ±5% 1/8W smd	569-0105-473
R 756	Zero ohm jumper	569-0105-001
R 757	100k ohm ±5% 1/8W smd	569-0105-104
R 758	Zero ohm jumper	569-0105-001
R 761	2.2ohm ±5% 2512smd 1W	569-0175-229
R 762	10k ohm ±5% 1/8W smd	569-0105-103
R 763	47k ohm ±5% 1/8W smd	569-0105-473
R 764	10k ohm ±5% 1/8W smd	569-0105-103
R 765	47k ohm ±5% 1/8W smd	569-0105-473
R 766	47k ohm ±5% 1/8W smd	569-0105-473
R 767	300 ohm ±5% 1/8W smd	569-0105-301
R 768	47k ohm ±5% 1/8W smd	569-0105-473
R 769	10k ohm ±5% 1/8W smd	569-0105-103
R 770	47k ohm ±5% 1/8W smd	569-0105-473
R 771	100k ohm ±5% 1/8W smd	569-0105-104
R 772	200k ohm ±5% 1/8W smd	569-0105-204
R 774	300 ohm ±5% 1/8W smd	569-0105-301
R 775	200k ohm ±5% 1/8W smd	569-0105-204
R 776	51 ohm ±5% 1/8W smd	569-0105-510
R 777	47k ohm ±5% 1/8W smd	569-0105-473
R 778	100k ohm ±5% 1/8W smd	569-0105-104
R 779	100k ohm ±5% 1/8W smd	569-0105-104
R 780	300 ohm ±5% 1/8W smd	569-0105-301
R 781	300 ohm ±5% 1/8W smd	569-0105-301
R 800	180k ohm ±5% 1/8W smd	569-0105-184
R 801	100k ohm ±5% 1/8W smd	569-0105-104
R 802	100k ohm ±5% 1/8W smd	569-0105-104
R 803	62 ohm ±5% 2010 .75W smd	569-0135-620
R 804	62 ohm ±5% 2010 .75W smd	569-0135-620
R 805	62 ohm ±5% 2010 .75W smd	569-0135-620
R 806	62 ohm ±5% 2010 .75W smd	569-0135-620
R 807	510 ohm ±5% 1/8W smd	569-0105-511
R 808	62 ohm ±5% 2010 .75W smd	569-0135-620
R 809	62 ohm ±5% 2010 .75W smd	569-0135-620
R 810	510 ohm ±5% 1/8W smd	569-0105-511
R 811	10k ohm ±5% 1/8W smd	569-0105-103
R 812	10k ohm ±5% 1/8W smd	569-0105-103

DC Power Cable Assembly

Ref No.	Description	Part No.
R 813	47k ohm ±5% 1/8W smd	569-0105-473
R 814	47k ohm ±5% 1/8W smd	569-0105-473
R 815	1.0k ohm ±5% 1/8W smd	569-0105-102
S 001	DIP switch, 10-position	583-5100-210
S 154	On-off/Vol push on w/50k pot	562-0018-075
S 155	Switch rotary and push	583-2042-001
U 700	Op amp, quad MC3303	544-2020-008
U 701	RS-485 driver SN65176	544-2023-027
U 702	Regulator, 5V LP2951	544-2003-067
U 703	Microprocessor, MC	023-9998-450
U 704	Buffer, open drain MM74C906	544-3716-906
U 710	LCD driver, PCF8576TD	544-2027-010
U 711	LCD driver, PCF8576TD	544-2027-010
U 712	Regulator, 8V 0.5A 78M08	544-2003-081
W 103	Cable assembly, display	597-2002-265
Y 700	3.6864 MHz crystal fundamental	521-0003-685

DC Power Cable Assembly
Part No. 023-9750-010

A 001	Fused DC power cable (see separate listing)	023-9650-008
A 002	Mic clip ground wire	023-7171-911
EP 002	Ring terminal, 3/4" 10-12 AWG	586-0001-036
EP 003	Ring terminal, 3/8" 10-12 AWG	586-0001-019
F 101	Fuse, 15 amp 32V	534-0003-038
HW 000	Key extraction tool	017-2226-000
HW 001	Butt splice insulated (2)	586-9008-061
HW 002	Screw, 4-40 x 3/8" pan head (1)	575-0604-012
HW 003	Screw, 4-24 x 1/4" phil (3)	575-3604-008
HW 004	Screw, 4-20 x 5/8" phil (3)	575-5604-020
MP 001	Heavy-duty mic clip	023-3514-001

Fused DC Power Cable
Part No. 023-9650-008

EP 101	Female crimp pin	515-9032-540
FH 001	Fuse holder in-line includes:	
	Contact	534-1004-037
	Body	534-1004-031
	Knob	534-1004-032
	Spring	534-1004-035

Ref No.	Description	Part No.
HW 101	Wire seal	574-9025-035
ML 001	Negative ground warning tag	559-4014-001
ML 002	Jump start warning label	559-4057-010
P 101	2-pin female power connector	515-9032-535
W 101	Wire, 12 AWG stranded blue	597-7021-206
W 102	Wire, 12 AWG stranded red	597-7021-202
Accessory Wire Harness Kit Part No. 023-9750-011		
	Fuseholder components:	
EP 001	Contact	586-9004-001
F 001	Fuse, 1A 250V FB AGC	534-0003-020
MP001	Fuseholder body	534-1004-031
MP002	Fuseholder knob	534-1004-032
MP003	Fuseholder spring	534-1004-035
HW 001	Pin contact, crimp type	515-1501-055
P 101	8-pin receptacle housing	515-1501-050
Mounting Bracket Assembly Part No. 023-9750-012		
HW 001	Self-drilling screw 1/4" (4)	575-9077-565
HW 002	Self-drilling screw #10 (4)	575-9077-545
MP 101	Knob 10-32 1/2"	547-0016-007
MP 201	Transceiver mounting bracket	017-2226-034
Amplified Dynamic Microphone Part No. 250-0740-310		
C 001	3.3 µF 16V tantalum chip	510-2625-339
C 002	220 pF ±5% NPO 50V cer chip	510-3602-221
EP001	Contact .038" diameter	586-9008-100
EP002	Mic cord w/Hirose connector	597-2002-255
EP004	Terminal (on hanger)	022-0069-011
HW001	Screw 4-20 x 3/8	575-5604-012
HW004	Screw 2-56 x 3/8	575-1602-012

Ref No.	Description	Part No.
MK001	Dynamic mic cartridge	589-1011-003
MP001	Case front black	032-0426-100
MP002	Case back black	032-0427-100
MP003	Actuator black	032-0428-050
MP004	Cartridge gasket	032-0429-075
MP005	Blast filter	018-1033-002
MP006	Switch bracket	017-1885-030
MP007	Hanger button	013-1216-005
MP008	Crimp retainer	017-2222-006
MP009	Rubber bumper	018-0798-009
MP010	Backing plate	015-0876-026
MP011	Strain relief, mic cord	032-0429-086*
MP012	Shim support, rubber bumper	017-2222-007
MP020	Foam support	018-0798-012
NP001	Nameplate	559-0039-026
PC001	PC board, amplifier	035-0441-020
Q 001	NPN amplifier SOT-23	576-0003-658
R 001	51k ohm ±5% 1/8W chip	569-0115-513
R 002	18 ohm ±5% 1/8W chip	569-0115-180
S 001	Leaf switch SPST	583-1004-031
15 Watt, 4.0-ohm Speaker (Black) Part No. 250-0151-006		
HW001	Strain relief (in case back)	574-0003-008
HW002	Screw, self drilling	574-9077-543
HW003	Screw, 4-20 x 1/2 pan head	575-5604-016
HW005	Foam gasket	018-1126-001
HW006	Urethane foam, 1/16" thick	042-0361-318
LS001	Speaker, 5" 15W 4.0 ohm	589-1016-003
MP001	Case front (black)	032-0758-004
MP002	Case back (black)	032-0759-004
MP003	Mounting bracket (black)	032-0760-004
MP004	Tri knob 10-32	547-0016-004
NP001	Overlay, speaker front	559-0072-010
P 001	Crimp wire contact	515-5010-055
W 001	Speaker wire, 22 AWG (6 ft used)	597-2006-002