



Model 70-1545

Mobile Transceiver

SERVICE MANUAL

6KEN SOFTWARE VERSION
Manual # KW208SM-6KEN

SCOPE OF THIS MANUAL

This manual covers the KG208 Series for the following bands:

KG208-08A....	66-88 MHz.
KG208-15A....	134-162 MHz.
KG208-15B....	146-174 MHz.
KG208-20A....	176-208 MHz
KG208-20B....	208-245 MHz.
KG208-20C....	240-276 MHz.
KG208-40SA....	300-335 MHz
KG208-40A....	335-365 MHz
KG208-40B....	365-400 MHz
KG208-40C....	400-435 MHz.
KG208-40DS....	420-455 MHz
KG208-40D....	440-475 MHz
KG208-40E....	465-500 MHz
KG208-40F....	485-520 MHz

The KG208-03, 30 –50 MHz band will be covered in an addendum to this manual.

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SPECIFICATIONS

KG208 Mobile Transceiver

GENERAL

Frequency Range	30 MHz Band (1) Designated 03	80 MHz Band Designated 08	VHF Band Designated 15	200 MHz Band Designated 20	UHF Band Designated 40
	A: 30 - 40 MHz B: 40 - 50 MHz C: 45 - 55 MHz*	A: 66 - 88 MHz	A: 134-162 MHz B: 146-174 MHz	A: 176-208MHz B: 208-245 MHz C: 240-276 MHz	SA: 300-335 MHz A: 335-370 MHz B: 365-400 MHz C: 400-435 MHz DS: 420-455 MHz D: 440-475 MHz E: 465-500 MHz F: 485-520 MHz
	* Special Order				
(1) This band will be covered in an addendum)					

Number of Channels	200 channels or 100 channels with channel name
Channel Spacing	12.5, 20, 25, 30 kHz programmable by channel
Mode of Operation	Simplex or Semi duplex, Push To Talk
Antenna Impedance	50 Ohms unbalanced
Power Supply	13.6 V DC +/- 20% negative ground
Power Consumption	TX: <3 A @ 10 W, <5 A @ 25 W, <8A @ 40 W, RX: 330 mA standby, 370mA receive-mid volume, 525 mA receive-max volume
Environmental Conditions	Ambient temperature: -30 C to +60 C (-22 F to +140 F) Relative humidity: 95% at 35 C

Construction	Die cast aluminum chassis and control unit, stamped steel covers	
Dimensions	High power model 166 mm (6.54" width) 50 mm (1.97") high 195 mm ((7.7") long	Standard model 166 mm (6.54" width) 50 mm (1.97") high 173 mm (6.81") long
Weight	1.7 kg (3.74 lb.)	
Color	Dark gray, textured	

TRANSMITTER

RF Power Output	30 MHz Band	80 MHz Band	VHF Band	200 MHz Band	UHF Band
Models are available at 10 W, 25 W & 40 W in VHF and UHF bands	40 W	25 W	5-10 W (10 W) 10-25 W (25W) 20-40 W (40W)	25 W	5-10 W (10W) 10-25 W (25W) 20-40 W (40W)

All powers are programmable high or low (two levels) by channel and selectable at front panel
Low power levels are adjustable down to 2 W.

Max. Frequency Deviation	Wide band: +/- 5 kHz, Narrow band, +/- 2.5 kHz
Frequency Stability	±0.0003%
Frequency Response	Within +1, -3dB of 6 dB/octave pre-emphasis from 300 to 3000 Hz, 1 kHz ref.
Signal To Noise Ratio	Wide band: more than 50dB at 1 kHz 70% modulation Narrow band: more than 45 dB at 1 kHz 70% modulation
Modulation Distortion	Less than 3% at 1kHz 70% modulation
Spurious and Harmonics	More than 70 dB below rated power

RECEIVER

Intermediate Frequency	1 st IF: 48.5 MHz, 2 nd IF: 455 kHz
Frequency Stability	±0.0003%
Sensitivity	Less than 0.4 μV for 20 dB quieting, Less than 0.25μV for 12 dB SINAD
Squelch Sensitivity	Less than 0.25 μV
Selectivity	More than 70 dB at 25 kHz point
Blocking	More than 90 dB
Intermodulation	More than 70 dB
Spurious Response	More than 70 dB
AF Response	Within +1, -3 dB of 6 dB/octave de-emphasis from .3 to 3 kHz, 1 kHz Ref.
AF Output	Internal speaker: 4 W max, 2.5 W @ < 5% distortion into 4 Ohms, 1 kHz, 70% modulation External Speaker: 6 W max, 4 W @ <5% distortion into 4 Ohms, 1 kHz, 70% modulation
Signal to Noise Ratio	Wide band, 25 KHz: more than 50 dB at 1 kHz 70% modulation Narrow band, 12.5 KHz: more than 45 dB at 1kHz 70% modulation

Due to constant technological developments and changes, specifications may vary without notice. Options and specifications may vary slightly in different countries to suit local requirements.

SECTION 1. INTRODUCTION

1.1 INTRODUCTION

1.1.1 APPLICATIONS

The KG208 Series mobile radio transceivers provide professional communications for a wide variety of applications. Government agencies, police departments, security and public safety agencies, courier and freight companies, construction, airport ground services, petroleum and utility industries may use the radio for reliable communications.

KG208 radios use sophisticated technology and microprocessor control to allow the installer to quickly change the radio's characteristics. Any computer-equipped dealer or service shop with the necessary software and programming manual can easily program your radio to your specific operating requirements. The radio's many advanced features will add to the usefulness, safety and efficiency of any communications system.

1.1.2 RADIO FEATURES

- Simplex or semi-duplex operation
- High performance specifications
- Wide non-tuning bandwidth
- Wide range of standard bands for use in many countries
- Wide-band/Narrow band by channel
- IBM-PC™ compatible field-programmable features.
- Emergency alert
- Direct input of channel number
- Up to 200 channels or
- Up to 100 channels with 8-digit alphanumeric "Channel Name" feature
- Kill Mode (disable from another radio).
- ANI, Unit ID
- CTCSS by channel, DCS optional
- DTMF or 5-Tone select-call encoder / decoder
- Memory storage of frequently called numbers
- Caller ID
- Voice Scrambling
- Single-tone encoder
- Transmitter high or low power selectable from panel or assigned by channel
- Readout of programmed frequencies and tones
- Transmit time limiter.
- Multiple scanning modes.
- Large alphanumeric LCD display with back-light
- User friendly
- Self diagnostics
- Small, rugged die-cast construction
- State of the art technology

1.1.3 IMPORTANT SAFETY INFORMATION

The Federal Communications Commission (FCC) of the United States in General Docket 79-144 adopted a safety standard for human exposure to radio frequency energy. Proper operation of this FCC regulated equipment will result in exposure significantly below FCC recommended limits.

DO NOT transmit if someone is within .6 meters of the radio antenna.

DO NOT press the transmit switch unless you actually want to transmit.

DO NOT allow children to play with any radio equipment containing a transmitter.

DO NOT operate the radio near unshielded electrical blasting caps.

DO NOT operate the radio in an explosive atmosphere unless the radio is specifically approved for such use.

DO NOT operate the radio in a vehicle while refueling.

1.1.4 MODEL NUMBER CODING

The radio model number contains information about the radio.

Typical model number: **KG208 - 15 B 25 K**

KG208 = model series

15 = 150 MHz band

B = band segment (see specifications)

25 = power output maximum

K = manufacturers code.

Example: Model KG208-40C40K is a KG208 mobile radio, UHF 400-435 MHz band, 40 W.

1.1.5 INITIAL INSPECTION

When you receive your radio, inspect the carton for any signs of shipping damage. Report any damage to the carrier immediately. Then remove and check the contents to be sure all items have been included.

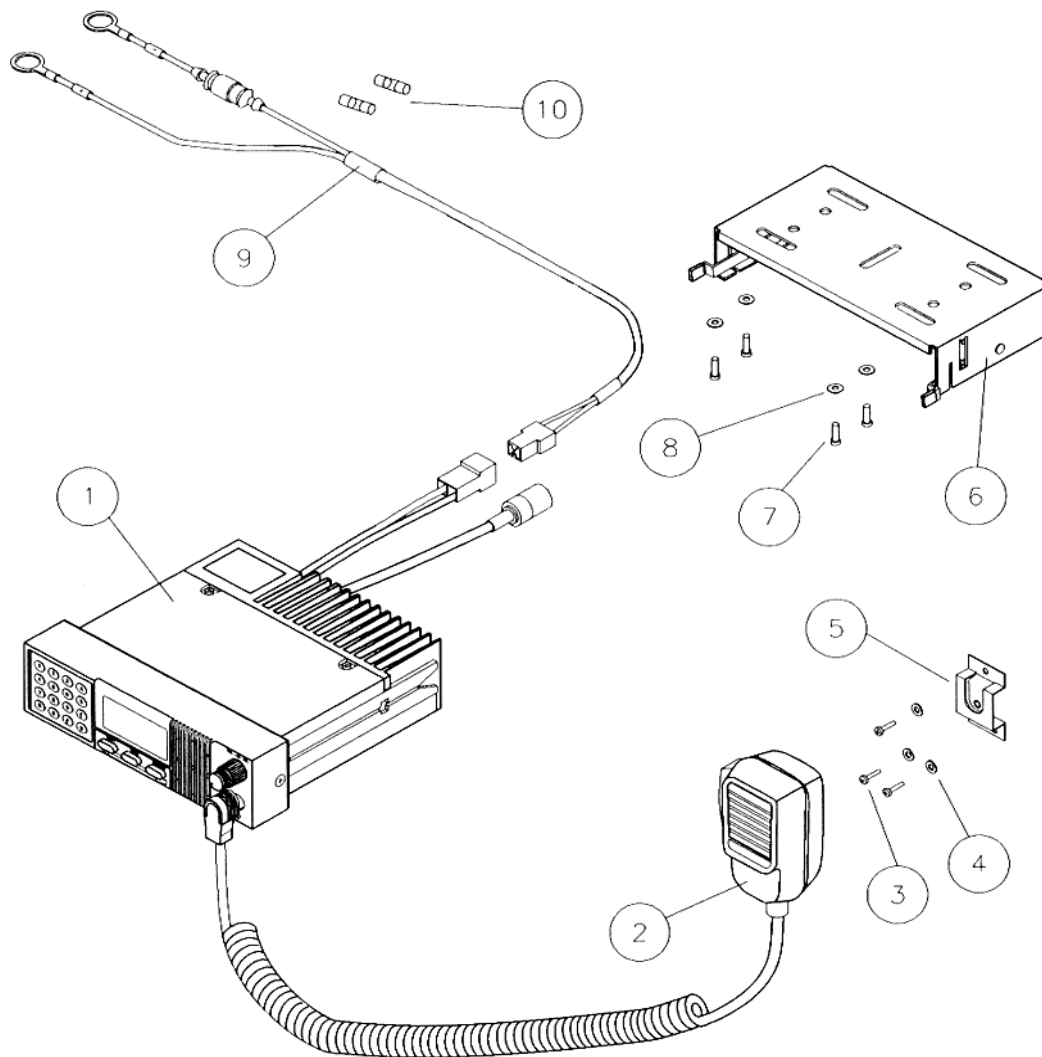
1.1.6 STANDARD PACKAGE

See listing at right and drawing below.

TAG	Part name	Part No.	Qty.
1	Transceiver	KG208-xxxxxx	1
2	Hand Microphone	KD-559	1
3	Hang-up clip screw	99-40-0204-1214	3
4	Hang-up clip washer	99-47-1104-23	3
5	Hang-up clip	14-11-64-01	1
6	Mounting bracket	2A10-0164	1
7	Mounting screw	STB-5 x 15	4
8	Flat washer	FW-5PAI	4
9	Battery cable	SCN-14-BC	1
10	Spare fuses	MINI-12.5A	2

1.1.7 OPTIONAL ITEMS

Check your order or packing list for the items to be supplied.



STANDARD PACKAGE CONTENTS

SECTION 2. INSTALLATION

2.1 RADIO INSTALLATION

Note: It is highly recommended that a qualified technician or engineer perform installation. Special equipment is required to properly install and tune the antenna.

2.1.1 LOCATION

The recommended location is under the dash or near the console area within reach of the operator. Do not mount the radio near heat vents or where it will be exposed to direct sunlight. Leave space behind the radio for proper ventilation and for access to the connectors and cables at the rear of the radio. Note that the bracket is designed to permit mounting on surfaces above or below the radio.

2.1.2 TRANSCEIVER INSTALLATION [Tag # from drawing above]

Mount the radio as follows:

1. Use the mounting bracket, tag # 6, to mark the location of the mounting holes.
2. Drill four 3mm (1/8") holes for the mounting screws.
3. Attach the bracket using 4 black self-tapping screws and flat washers, tag # 7 & 8. Make certain that the release tabs are facing forward.
4. Slide the radio into the bracket, aligning the slots on each side. Press in until it snaps into place.

2.1.3 BATTERY CABLE INSTALLATION

The KG208 operates from a 12 V negative ground vehicle system.

1. For 12 V positive ground systems, use an Astron 1212 polarity converter.
2. For 20 - 50 V negative ground systems use a NewMar model 32-12-10 converter.
3. For 20 - 56 V negative, positive or floating systems, use NewMar model 48-12-12-I isolated converter.
4. Install the cable into the vehicle. The cable terminals should be placed near the battery or converter. The white connector should be near the radio.
5. Avoid hot parts in the engine compartment.
6. Tie cable to the vehicle body at several points to avoid movement.
7. Use rubber grommets or tape when passing through holes in the chassis.
8. Connect blue lead to the or the negative terminal of the battery or converter.
9. Connect the red lead to the positive terminal of the battery or converter.
10. Connect the white connector to the matching connector on the radio cable.
11. **Do not turn on the radio until installation is complete.**

2.1.4 MICROPHONE INSTALLATION

It is very important that the microphone be installed in a convenient location to avoid distracting the driver when he wants to use it. Select a location near the radio to avoid stretching the microphone cable.

1. Connect the microphone to the radio.
2. Using the hang-up clip, mark the location for the three mounting holes.
3. Drill three 2.5 mm (3/32") holes. Be very careful that you do not drill into wires or other components.
4. Mount the hang-up clip using three self-tapping screws and flat washers.
5. Hang the microphone on the clip.

2.1.5 OPTIONAL EXTERNAL SPEAKER INSTALLATION

The external speaker is highly recommended for noisy vehicles or where multiple radios are in use. It provides an increase in power over the internal speaker and it may be positioned to provide better clarity for the operator.

1. Remove the two large mounting knobs and remove the speaker from the mounting bracket.
2. Use the mounting bracket to mark the location of the mounting holes.
3. Drill two 3 mm (1/8") holes.

4. Mount the bracket using two self-tapping screws and flat washers.
5. Mount the speaker into the bracket using the mounting knobs removed in step 1.
6. Remove the white connector on the rear of the radio. Note that this is a jumper to connect the internal speaker. Use tape or a nylon strap to attach this connector to one of the cables on the radio to avoid losing it. It is required to reconnect the internal speaker if the radio is removed for testing.

2.1.6 ANTENNA INSTALLATION

The recommended location for the antenna is on the roof or trunk (boot) lid.

1. Follow the instructions supplied with the antenna for installation.
2. Install the cable and route it to the rear of the radio.
3. Connect the cable to the antenna connector of the radio.
4. When installation is complete, use a thru-line wattmeter to adjust the antenna for best SWR.

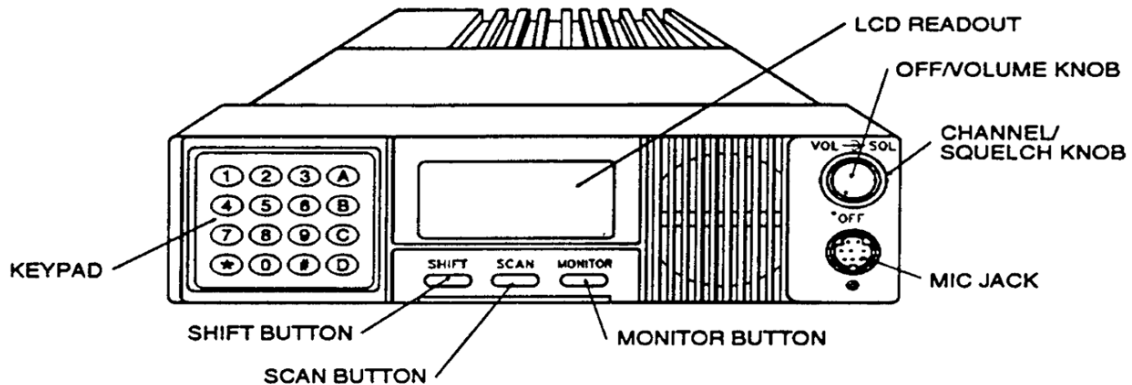
2.1.7 PROGRAMMING

Programming instructions are too extensive to be included in this manual. Please refer to the separate Programming Manual supplied with the program kit. Programming is done using a PC (Personal Computer). A portable lap-top computer is recommended so that the radio may be programmed in the vehicle.

A KG208 6KEN programming kit is available from your dealer. It consists of a detailed manual, software and an interface cable.

SECTION 3. OPERATION

3.1 CONTROL FUNCTIONS



CONTROL PANEL

3.1.1 OFF/VOLUME

Switch the radio on by rotating the VOLUME knob clockwise $\frac{1}{2}$ turn. The volume may be adjusted later when you receive a message.

3.1.2 CHANNEL/SQUELCH KNOB

Select the desired channel by rotating the CHANNEL knob. The channel number will appear in the display. Either **1** or **CH-1** may appear depending on other program features used. If using the Channel Name feature, the name will appear after a short time.

The channel may also be selected by pressing **C** on the keypad and entering the channel number, then **C** again (see OPERATION section).

To adjust the SQUELCH, press the **SHIFT** button. The CHANNEL knob will now become the squelch control. Normal setting is SQ-4.

3.1.3 SHIFT BUTTON

Assigns alternate functions to Channel Knob and the keypad. Stays active for four seconds after being pressed.

3.1.4 SCAN BUTTON

Controls the All Scan mode.

3.1.5 MONITOR BUTTON

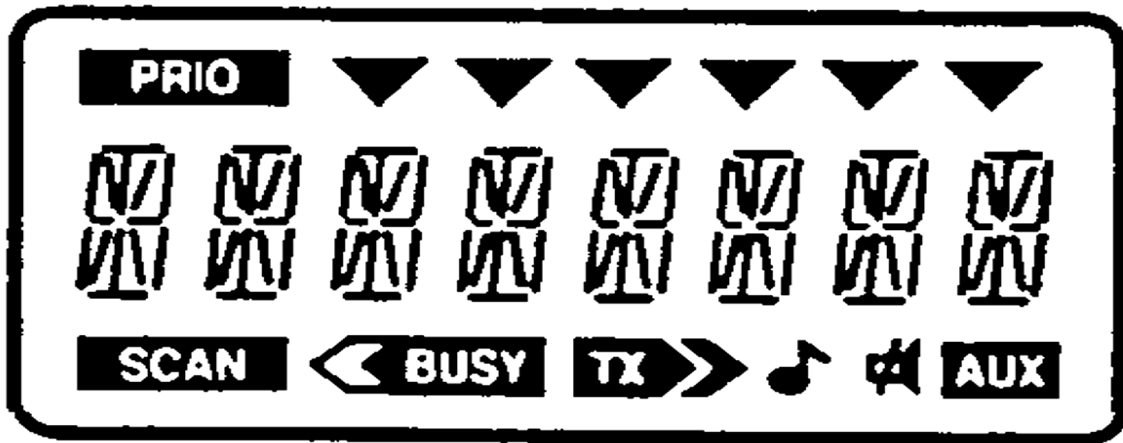
Sets and resets the decoder (mutes and unmutes speaker).

3.1.6 KEYPAD

Enters selective call digits and controls radio functions with use of the SHIFT button.

3.2 DISPLAY ICONS

The drawing below shows all of the ICONS and characters that are used to indicate radio operation. The function of each icon will be discussed here, and again as we cover the operation and features.



LCD DISPLAY

Top row

3.2.1 PRIO

Indicates that the radio is in one of the priority scan modes.

3.2.2 6 ARROWS ▼

There are six (6) arrows along the top of the display. The first indicates that the shift button has been pressed. The remaining arrows indicate the active field for entering 5-Tone digits.

Center row

3.2.3 ALPHANUMERIC CHARACTERS

There are eight alphanumeric characters across the center that display channel number, channel name, tone format, call numbers, caller ANI and other information required by the program.

Bottom Row

3.2.3 SCAN

Indicates that the radio is in one of the scan modes.

3.2.3 BUSY

Indicates that the channel is in use.

3.2.4 TX

Indicates that the radio is in the transmit mode.

3.2.5 >

Indicates that the radio is in the high power mode. If this icon is not present, the radio is in the low power mode.

3.2.6 🎵

Indicates that DTMF or 5Tone data is being transmitted.

3.2.7 🔇

Indicates that the decoder is set and the speaker is muted.

3.2.8 AUX

Indicates an auxiliary function (future application).

3.3 OPERATING THE RADIO

This section discusses the actual use of all controls while operating the radio.

3.3.1 POWER ON/OFF, VOLUME

Rotate the OFF/VOLUME knob $\frac{1}{2}$ turn to the right. Volume may be adjusted when a signal is received.



3.3.2 SQUELCH ADJUSTMENT


Press the **SHIFT** on the radio panel. The first arrow will appear at the top of the display. The CHANNEL knob now becomes the SQUELCH control. While turning the knob, the display will show **SQ-0** through **SQ-7**. At **SQ-0**, the squelch will be open and the **BUSY** icon will be displayed. If the radio is not equipped with a decoder, noise will be heard in the speaker. Rotate the CHANNEL knob clockwise until the **BUSY** icon goes away (usually between SQ-2 and SQ-4). This is the most sensitive setting for the squelch. If the squelch is set to a higher number, you may miss weaker messages. If you hear occasional noise bursts in the speaker, set the squelch to a higher number. A few seconds after the desired setting is made, the radio will return to normal operation. A default squelch setting is programmed into the radio. The radio will return to this setting if the power is removed.

Note that the radio may be programmed with a fixed squelch setting during programming. If this is the case, external adjustment is not possible.


3.3.3 MONITORING THE CHANNEL

If the channel is in use, the **BUSY** icon will be displayed. If you are not using any type of decoder, you will be able to hear any messages on the channel. You should not transmit until the channel is clear except when you are communicating through a repeater. In this case, the repeater will remain on the air for several seconds after the other party has finished speaking. You should begin speaking immediately even though the **BUSY** icon is still displayed.

If a CTCSS or DCS decoder is in use, a  icon will appear in the lower right of the display and the audio will remain muted when another person (outside of your system) is using the channel (indicated by the **BUSY** icon). If you wish to listen to this message, you may disable your decoder by pressing the MONITOR button. This will toggle the decoder and speaker ON/OFF causing the  icon to switch on and off.

If a selective call decoder is used, the  icon will appear and speaker will only turn on when the specific decode number is received. The operator may or may not be able to monitor other calls on the channel depending on the programming of the radio.

3.3.4 TRANSMIT

To transmit, press the PTT button on the left side of the microphone. The **TX** icon will appear in the display. Note that the  icon indicates high power. Hold the microphone near your lips and speak in a normal voice. When finished speaking, release the PTT button.

A common mistake is to begin speaking before pressing the PTT button. This may cause the first word of your message to be cut off. It is recommended that you press the button, then wait one second before speaking. This is especially important when using a repeater or ANI tone signaling.


Please review the safety information at the beginning of this manual to avoid endangering yourself or others.

3.3.5 USING SCAN

The radio has two types of scanning, "All Scan" and "Program Scan". Each of these has a "Busy" mode and a "Priority" mode of operation.

In each of the scan modes, when a call is received, the radio will pause on the busy channel for the duration of the message and for a few seconds after the end of the message before resuming scan. This allows you to hear any reply to the message before the radio resumes scanning. During this pause, you may transmit to answer a call on that channel without leaving the scan mode. If you wait until the radio

resumes scanning, you cannot transmit without first exiting the scan mode and selecting the proper channel.

If the radio is programmed for selective call, scan capability is limited. The radio will not scan unless the decoder is set ( icon is present). Then, the scan will stop only when the correct decode select call number is received.

3.3.5.1 Deleting channels from scan list: To temporarily delete a channel from the scan list, wait for the radio to stop on that channel, press **SHIFT**, then press * for two seconds until you hear a beep. To restore all deleted channels, press **SHIFT**, then press **A** for two seconds until you hear a beep. All deleted channels are restored each time you exit the scan mode.

3.3.5.2 Priority Channels: During programming, a HIGH and LOW priority channel is entered for both the All Scan and Program Scan modes. These may be a different pair of channels for each mode.

3.3.5.3 All Scan: In this mode, the radio will scan all channels and stop on any that is busy. Select All Scan by pressing **SCAN**. The display will show **BY--AL--SC** (Busy All Scan). The **SCAN** icon will be displayed. To exit this mode, press **SCAN**.

3.3.5.4 Priority All Scan: While in the All Scan mode, press **SHIFT**, then **9** (note that it is not necessary to hold the SHIFT button in). The display will show **PR--AL--SC** (Priority All Scan). The **PRIO** and the **SCAN** icons will be displayed. The radio will now scan all channels and stop on any that is busy. While listening to this channel, it will also monitor the All Scan HIGH and LOW priority channels selected during programming.

If a signal appears on the LOW priority channel, the radio will immediately switch to that channel. Also, while listening to the LOW priority channel, the radio will continue to monitor the HIGH priority channel. If a signal appears there, it will immediately switch to that channel. When the priority channel messages are ended, the radio will resume scan. To exit this mode, press **SCAN**.

3.3.5.5 Priority Transmit: When the radio is in the All Scan mode, if you press the PTT, the radio will switch to the All Scan HIGH priority channel and remain there during the transmission and for several seconds after. This allows the operator to send a message on the priority channel and receive a reply without exiting the scan mode.

3.3.5.6 Program Scan: In this mode, the radio will scan all channels that were selected for scan during programming and stop on any channel that is busy. Select Program Scan by pressing the # (no **SHIFT**). The display will show **BY--PG--SC** (Busy Program Scan). The **SCAN** icon will be displayed. To exit this mode, press **SCAN**.

3.3.5.7 Priority Program Scan: While in the Program Scan mode, press **SHIFT**, then **9**. The display will show **PR--PG--SC** (Priority Program Scan). The **PRIO** and the **SCAN** icons will be displayed. The radio will now scan all channels that were selected for scanning during programming and stop on any that are busy. While listening to this channel, it will also monitor the Program Scan HIGH and LOW priority channels selected during programming. If a signal appears on the LOW priority channel, the radio will immediately switch to that channel. Also, while listening to the LOW priority channel, the radio will continue to monitor the HIGH priority channel. If a HIGH priority signal appears, it will immediately switch to that channel. When the priority channel messages are ended, the radio will resume scan. To exit this mode, press **SCAN**.

3.3.5.8 Priority Transmit: When the radio is in the Program Scan mode, if you press the PTT the radio will switch to the Program Scan HIGH priority channel and remain there during the transmission and for several seconds after. This allows the operator to send a message on the priority channel and receive a reply without exiting the scan mode.

3.3.5.9 Priority Channel Instant Select: When in normal non-scan operation, the user may immediately switch to the All Scan HIGH Priority channel by pressing **SHIFT**, then **B**. Pressing **SHIFT**, **B** again will select the All Scan LOW Priority channel. Repeated pressing will toggle between the two channels.

To switch to the Program Scan HIGH Priority channel, press **B** (no SHIFT). Pressing **B** again will select the Program Scan LOW Priority channel. Repeated pressing will toggle between the two channels.

3.4 ADVANCED FEATURES

Your new Model KG208 contains many advanced features that may be used to suit your individual system needs. Some are available at all times while others may be programmed as needed. Your system engineer may provide additional instructions about specific features used in your system.

3.4.1 CHANNEL NAME

During programming, each channel may be assigned a name to assist you in channel selection. For example, channel 1 may be REPEAT, channel 2 may be POLICE, channel 3 may be PRIVATE, etc. When the channel is selected, the actual channel number will appear in the display. After a short time, the channel name will appear. Up to 8 alphanumeric characters may be used.

Note that the radio normally is capable of up to 200 channels. If the Channel Name feature is used, only 100 channels may be programmed due to the additional memory requirements.

3.4.2 TRANSMIT TIME LIMITER (TTL)

This feature limits the length of each transmission to a pre-programmed time (5 to 255 sec.). This prevents long transmissions, either accidental or intentional. If the time limit is exceeded, the radio will stop transmitting and return to the receive mode. You must release the PTT button for five seconds before you can resume transmitting.

3.4.3 ALERT TONES

The radio may be programmed to emit a beep from the speaker at the beginning of each transmission, at the end, or both (This beep is not sent over the air). This will alert the operator that he has begun and/or ended his transmission. Tones may also be programmed to beep when keypad buttons are pressed.

3.4.4 POWER-OFF TIMER

If this feature is programmed, the radio will automatically turn off after a period of time with no activity (1 to 15 hours). This will prevent the vehicle battery from going dead when the radio is not in use. When the radio turns off, the display will show **PW OFF**. To return to normal operation, turn the radio OFF, then ON.

3.4.5 TRANSMIT INHIBIT

During programming, different conditions may be selected to prevent transmitting, such as channel is busy, improper CTCSS tone, etc. If the selected condition exists, the radio will not transmit and you may hear a beep when you press the PTT button.

3.4.6 VOICE SCRAMBLER (Voice Inversion)

This feature may be programmed for any channel or channels. It scrambles the voice so that it cannot be understood by another radio unless it also has the scramble feature. This feature may be programmed into a several radios to permit private communications between those radios. Others in the group will not understand the messages. This feature is useful for police and military operations.

An optional digital encryption module is available for use when very high security is required. This feature is activated from the keypad.

3.4.7 ANI (Automatic Number Identification)

If this feature is programmed, the radio will transmit a unique ANI number each time the PTT button is pressed. This number may be sent at the beginning of the transmission, at the end of the transmission, or both. When the number is being sent, a small 🎵 icon will appear in the lower right of the display. If this appears at the beginning of your message, your voice may be covered by the tones and will not be heard by others. You should practice pressing the PTT and waiting for one second before beginning to speak.

If the control point is using a KG208 or KG510, it may be programmed to display the ANI of any radio on the channel. With another type of base station, equipment is available to display the ANI. In either case, the operator at the control point will know which radio is transmitting.

3.4.8 KILL MODE

If this feature is programmed, the radio may be disabled or “killed” by another operator in the system if he knows the proper kill code and kill password. This feature may be used if the radio or vehicle is stolen or lost. The radio must be turned on and the kill code must be sent on the selected channel. When the kill code is properly received, the radio will answer back (transpond) with its ANI number, then become disabled and the display will show **F**. If the radio is turned off, out of range or on a different channel, the Kill feature will not operate and the transpond will not be heard. After entering the kill mode, the radio is totally disabled and must be returned to a service center for reprogramming. Information regarding kill procedures may not be made available to all users.

3.4.9 EMERGENCY ALARM

If this feature is programmed, the radio will be capable of sending an alarm when the user is in danger or injured. To activate the alarm, press SHIFT, PTT and any keypad button, all at the same time. Also, the radio may be equipped with a momentary ALARM switch on the floor of the vehicle. The radio will switch to an emergency channel, transmit the radio Emergency ANI, then stay in the transmit mode for 10 or 20 seconds to alert others. The display will show **E**. During the time the transmitter is activated, the microphone is active so that other users may monitor activity in the vehicle. This is followed by a period of silence (no transmit). If programmed to do so, the radio will send a beep—beep—beep sound as an audible alert during the transmit period. A timer is also programmed which turns off the alarm after 1 to 15 hours. The radio may be silenced by sending its kill code from another radio during the period when it is not transmitting (see Kill Mode on previous page).

With proper display equipment, the operator at the control point will know which radio is transmitting and that an emergency exists.

3.4.10 USER PASSWORD (PIN Number)

When this feature is programmed, you must enter the proper **Personal Identification Number** (up to 6 digits) before the radio will operate. This prevents unauthorized use of the radio. When the radio is turned on, the display will show **PLS PIN** (please enter PIN). The operator must press * to clear the display, then enter his password. If the correct number is not entered in a certain number of attempts, the radio will enter the kill mode (see above) and must be returned to a service center for reprogramming.

3.4.11 SELECTIVE CALL OPERATION (sel call)

If this feature is programmed, selective call may be used to call individual or groups of users within the system. Each radio is assigned a specific “phone number”. The radios are normally muted until their specific number is called. The radio supports DTMF and 5Tone, encode and decode formats. Before using selective call you must first select the desired tone format using **SHIFT, 0** for 2 seconds.

A memory is included to store up to 10 frequently called numbers (see SHIFT 3 below). These numbers may contain any of the 16 keypad digits in any sequence.

3.4.12 PLACING A CALL, DTMF Mode

In DTMF mode, digits are transmitted as they are entered. Only digits 1 through 9, 0 and A may be used as the first digit. Keys B, C & D have specific functions when entered alone. After the first digit, any of the 16 digits may be used. Up to 16 total digits may be entered. If the digits are entered quickly, the other radio may transpond (send an acknowledge tone) after the last digit is entered. However, it may be necessary to send the number again. Press **SHIFT**, then **D**. A 📞 icon will appear in the display indicating that the tones are being transmitted. To redial, press **D**. If the call is received, the other radio will answer back (transpond) with a short tone, then “ring” several times to signal the operator. That operator may then answer the call. After a number is sent, a new number may be entered. It is not necessary to clear the display.

3.4.13 PLACING A CALL, 5Tone Mode

In 5Tone mode, enter the digits in the field indicated by the arrow at the top of the display. To clear the display, hold the SHIFT key and press the PTT. However, it is not necessary to clear the display. New numbers entered will replace existing digits. Only digits 1 through 9, 0 and A may be used. Other keys have specific functions when entered alone or with the SHIFT key. Due to the four-second delay of the SHIFT function, entry of B, C, or D will cause undesired results. When entering digits, the pointer will advance automatically as numbers are entered or it may be advanced during entry using the CHANNEL knob.

After the complete number is entered, press **D** (no SHIFT) to send the number. A 🎵 icon will appear in the display indicating that the tones are being sent. If the other radio receives the call, it will automatically answer back (transpond) with a short tone, then “ring” several times to signal the operator. That operator may then answer the call. If the other radio receives the call (transponds) but does not answer, you may redial by pressing **D**.

3.4.14 RECEIVING A CALL

If another party calls you, your decoder will unmute the speaker and the radio will “ring” several times. To answer, press the PTT button and speak. The decoder will automatically reset after a short time.

In 5Tone systems, the radio may be programmed to display the identity of the caller.

3.5 SPECIAL KEYPAD FUNCTIONS

The main function of the keypad is to enter digits for selective calling. However, the keypad is also used to control many radio functions by pressing keypad buttons within four seconds after pressing the SHIFT key. For some functions, the SHIFT is not required.

SHIFT, POWER ON Firmware and Software Identification

If the SHIFT is held when the radio is turned on, the display will indicate the firmware version and the software required for programming the radio. For example **PRG 6KEN** indicates that firmware version 6KEN is installed in the radio and that 6KEN software must be used for programming. This version contains the features covered by this manual. If another version is indicated, that software must be available for programming.

NOTE: In all cases where the SHIFT key is used to control another function, it is not necessary to hold the SHIFT key. Press it and you have four seconds to press the next button. The first arrow will appear at the top of the display during this time.

SHIFT, 1 Display Brightness

Toggles the display backlight from bright to dim.

SHIFT, 2 HIGH/LOW Power Selection

If enabled during programming, selects HIGH or LOW) power. When on HIGH power, a > icon will appear in the display.

SHIFT, 3 Select Call Number Memory

Selects one of the 10 Encode Memory Registers M0 to M9 that are used to store frequently called numbers for selective calling. Numbers are entered during programming. To recall a number, press **SHIFT**, then **3** and rotate the CHANNEL knob. Each number will be displayed in sequence. To send the displayed number, press **D**. A 🎵 will appear in the lower edge of the display while the tones are being sent.

SHIFT, 4 Single Tone Function

Turns the SINGLE TONE function ON or OFF.

SHIFT, 5 Transfer Mode (Call Forwarding)

Toggles the Transfer Mode ON or OFF. Upon receipt and decoding of a valid number, this feature allows the radio to retransmit (forward) a number on the same or different channel.

SHIFT, 6 Kill Password

Permits entry of a password to use the Kill function. This function allows you to disable (kill) another radio by sending that radio its proper kill code. Details of this feature may not be made available to every user.

SHIFT, 7 Information Display

If enabled during programming, sequentially displays programmed data such as channel frequencies, CTCSS / DCS codes, select call and ANI numbers. Press SHIFT and hold 7 while the radio displays the information.

SHIFT, 8 Keypad Lock

Turns the KEY LOCK feature on or off. When locked, certain keypad and control functions are locked out. This may be used to prevent accidentally sending tones or switching channels. Variations of operation may be selected during programming.

SHIFT, 9 Scan Mode Select

If the radio is in one of the scan modes, **SHIFT 9** will select the PRIORITY scan mode. **PRIO** will appear in the upper left of the display and the radio will monitor the HIGH and LOW priority channels selected during programming (see "Using Scan").

SHIFT, * Digital Encryption

If the radio is fitted with an optional Digital Encryption module, SHIFT * switches the module from the clear to the encrypt mode.

***** (no SHIFT) PIN entry

If the radio has been programmed to require a Personal Identification Number (PIN) for operation, the operator must press * to clear the display before entering the PIN. This will be requested upon turning on the radio. The display will show **PLS PIN**. The operator must press * then enter the correct PIN number.

SHIFT, 0 DTMF / 5Tone format select

If enabled during programming, when SHIFT is pressed and 0 is held for two seconds, the tone format toggles from DTMF to 5Tone or from 5 Tone to DTMF.

SHIFT, # All Scan Select

Turns on the All Scan mode. This mode scans all channels in the radio. The display will show **BY--AL--SC** (Busy All Scan) indicating that the radio is scanning all channels (see "Using Scan").

(no SHIFT) Program Scan Select

Turns on the Program Scan mode. The display will show **BY--PG--SC** (Busy Program Scan) indicating that the radio is scanning all channels that were selected for scan during programming (see "Using Scan").

SHIFT, B All Scan Priority Channel Select

Instantly selects one of the All Scan Priority Channels specified during programming. Repeated pressing toggles between HIGH and LOW priority.

B (no SHIFT) Program Scan Priority Channel Select

Instantly selects one of the Program Scan Priority Channels specified during programming. Repeated pressing toggles between HIGH and LOW priority.

SHIFT, C DTMF Clear

Clears any new DTMF entry that may have been entered in error. Example, if the desired number is 12345 and you have entered 13345, press SHIFT, C to erase 13345, then enter the correct number 12345.

C (no SHIFT) Instant Channel Selection

C, followed by keypad entry of a channel number followed by **C** again will instantly select that channel. Example: **C 1 2 C** will select channel 12. The display will flash the new channel several times before switching. If an unprogrammed channel is selected, the radio will BEEP and return to the original channel. If the final **C** is not entered, the radio will wait for two seconds, then switch to the selected channel. This feature is helpful if you are using a large number of channels.

SHIFT, D Sends Call

In DTMF Mode, sends sequence of DTMF digits immediately after entry. Example: The operator enters sequence 1 2 3 4 5 then pressed D to send the call.

In 5Tone mode, sends R (repeat) 5Tone sequence.

D (no SHIFT) Send 5Tone) or Redial (DTMF)

In 5Tone mode, sends or redials displayed sequence entered by keypad. If sequence is selected from memory (see SHIFT 3), it is sent only one time, then the radio reverts to the previously displayed digits.

In DTMF mode, redials the previously sent digits after first sending with SHIFT D (see above). If D is pressed while entering a sequence, the radio accepts it as a digit in the sequence. If sequence is selected from memory (see SHIFT 3), it replaces the previous entry and is sent each time the D is pressed.

SECTION 4

CIRCUIT DESCRIPTION

4.1 OPERATING VOLTAGE CONTROL

There is a programmable, Power-Off Feature which turns off the radio after a preset time of non-activity to prevent discharging of the vehicle battery. This feature is mentioned in the discussion of each circuit under its control.

Battery voltage enters the radio on the RED/BLUE battery cable. Fuses are located in this cable. D22 protects the radio from reverse voltage by causing the fuses to blow. LF1 filters noises existing on the automobile supply.

The power switch on the control unit lowers the bias on Q16 which turns on Q23 and Q15 supplying power to the radio. The switched battery voltage is regulated to 5 Volts by IC10 and supplied to all circuits which are not under control of the power-off timer.

Regulator IC13 removes impulse noise from the 12 V line and is used to switch off the power to many circuits upon input from the TIMER IN signal from the logic board at CN6-2.

Q24 filters the 12 V supply to the audio power amplifier.

Q13 and Q14 control operating voltage to an external relay at CN10-5, DECODE HORN for signaling that a call has been received. Q14 is turned on by an active high DECODE HORN input from the logic board on CN6-19. Q14-C pulls Q13-B low turning it on and supplying a voltage to the relay.

IC12 supplies a regulated 7 Volts to the circuits under control of the power-off timer. During transmit, the top half of Q12 turns off B+ to the receiver upon receiving an active high transmit command on the TX1 IN input at CN6-11. The lower half of Q12 provides an inverted active low PTT signal to the VCO at CN2-3.

IC14 provides protection from wide variations in the power supply voltage. If the voltage drops below 8 V or rises above 18 V, a STOP OUT signal is output to the logic board on CN6-3 to stop the CPU and shut down the radio.

4.2 RECEIVER

4.2.1 RF SECTION

The received signal enters the antenna connector and passes through Low-Pass Filter made up of L20, 21, 22, 23 and C134 through C 140. The Antenna Switch, D27 and D29, directs the signal to the receiver input at L1. L1 and L2, along with Varactors D1 and D2 tune the RF section to the selected frequency using a tuning voltage from IC4 derived from the PLL circuit. Q1 amplifies the RF and feeds the signal through a bandpass filter to TP1 and on to the mixer made up of T1, T2, D5& D6. The bandpass filter eliminates signals outside the desired band. A signal from the VCO local oscillator is also input to the mixer at CN1-4 to produce the 1st IF signal, 48.5 MHz. (refer to VCO UNIT).

4.2.2 VCO UNIT, RX

Q301 is the receive oscillator. It is tuned by varactors D301 and D311 using the control voltage from the PLL circuit at CN4-6. L301 is adjusted to center the oscillator range in the desired band of frequencies. The oscillator output is amplified by IC301 and Q306 and sent to the receiver mixer on *CN5-4 RX LOCAL*.

Operating voltage for the oscillators is filtered by Q308. Q304 switches voltage to the oscillator and gates Q306 amplifier on and off depending on the state of the Q305-C and the PTT line. Q303 supplies regulated voltage to IC301 in both the receive and transmit modes.

4.2.3 HIGH IF (48.5 MHz)

The IF passes through Crystal Filter XF1, IF Amplifier Q3, IF Transformer T3, Crystal Filter XF2, Amplifier Q4 and on to the input of IC1 -20. IC1 uses crystal X1 to generate 45.045 MHz to convert the 1st IF of 48.5 MHz to the 2nd IF of 455 kHz.

4.2.4 LOW IF (455 kHz)

The 455 kHz IF is filtered by Ceramic Filters CF1 & CF2. IC1 also limits, detects the audio and provides a squelch (BUSY) signal, an RSSI signal (Receive Signal Strength Indication) for use in other circuits of the radio. Discriminator audio leaves IC1-11 to the Audio Processor IC8-40 (see Audio Processing).

4.2.5 SQUELCH

The high frequency noise from the audio is passed through FVR1 and C34 to IC1-13. FVR1 provides an internal adjustment of the squelch range. The high frequency noise present in the audio is reduced when a signal is received. IC1 amplifies and detects the noise and compares it to the squelch threshold set by the operator to produce a squelch logic (BUSY) signal at pin 17. This is buffered by IC2 and used to control the Squelch Gate IC9 which breaks the audio path when no signal is present.

Squelch control data originates in microprocessor, IC203 on the logic unit. Under control of impulses from the channel/squelch switch on the control unit, squelch data is generated by IC203 and appears on pins 41, 42, 43. These are combined to provide eight steps of squelch threshold voltage (SQ-0 thru SQ-7) which enters the main unit on CN6-13, is buffered by IC4 and goes on to the squelch circuit R26, R24, D7 to IC1-15. This voltage is compared to the detected noise level to generate the squelch logic (BUSY) signal mentioned in the last paragraph.

In the transmit mode, the voltage is removed from the receiver which causes a loss of voltage on the anode of D7. This immediately mutes the receiver.

4.2.6 RECEIVER MUTE

Operating voltage for the receiver circuits described above comes from IC12, 5 Volt Regulator. Q12 switches the voltage off during PTT to mute the receiver. Also, all voltage is removed upon activation of the power-off timer.

4.2.7 AUDIO PROCESSING

Discriminator audio from IC1-11 goes to the Audio Processor IC8-40. IC8, contains the audio bandpass filter, 300 to 3000 Hz, de-emphasis @ 6 dB/octave, voice inversion scrambler and CTCSS. The audio leaves on pin 12 and passes to Volume Control chip IC9-6. The volume control on the control unit changes the gain of IC9 by changing the bias on pins 3 and 5. Audio leaves IC9-7 and goes through the Squelch Gate Q10 which is controlled by the BUSY signal from the squelch circuit, the CTCSS decode from the audio processor and the DECODE signal from the logic unit. From the Squelch Gate, the audio goes to the Audio PA IC11-1. Operating voltage for the Audio PA is filtered by Q24 to minimize noise from the automobile 12 volt system. Speaker audio leaves IC11, pin 4 and is fed to CN7-3 and to the rear connector CN10-3. An external speaker may be connected between pins 3 and 1 (ground). To use the internal speaker, a jumper plug connects pins 3 and 4 allowing the audio to pass to CN4-2 & 3 and on to the Control Unit speaker through R414 and CN401 to the speaker. R414 limits the power applied to the internal speaker. Audio is also supplied to the microphone connector through R415 and CN402-12. This permits the use of a handset or another audio accessory. R415 reduces the audio level applied to the external accessory to match the volume of the speaker.

4.3 TRANSMITTER

4.3.1 TRANSMITTER AUDIO

Microphone audio enters the control unit at the microphone connector, pin 1, passes through preamplifier IC403 and out to the main board on CN4-5.

Transmit audio from an external device may be input to the interface connector on the back of the radio, CN10-6. Resistor R103 provides microphone bias if required. External audio is combined with the mic audio and enters the Audio Processor IC8-2 TX IN. Q8 mutes the microphone audio upon input from the logic board on CN6-14, MIC OFF IN. This occurs when signaling tones are being sent.

The Audio Processor contains an input amplifier, pre-emphasis, 6dB/octave, bandpass filter, amplitude limiter, splatter filter, voice inversion scrambler, output amplifier and CTCSS tone generator. The processed audio leaves on IC8-8 MOD and goes to the VCO modulation input on CN2-5. FVR2 controls the level of modulation. The gain of the internal modulation amplifier is controlled by R65 and R62. R62 is bypassed by Q26 to decrease the gain for narrow band operation. Q26 is controlled by a W/N (Wide/Narrow) input at CN5-19.

CTCSS tone from IC8-33 TX TONE is adjusted by FVR5 and combined with the voice audio. Q9 is also controlled by the W/N input and controls the tone level for Wide and Narrow band operation.

Within the VCO, the combined audio is applied to varactor diodes to modulate the transmit signal.

4.3.2 VCO UNIT, TX

Q302 is the transmit oscillator, It is tuned by varactors D302 (also D310 and D312, some bands) using the control voltage from the PLL circuit at CN4-6. L305 is adjusted to center the oscillator range in the desired band of frequencies. The oscillator output is amplified by IC301, Q307 and sent to the transmitter on CN5-1 TX OUT.

Audio enters the VCO at *CN4-5 MOD* and is applied to varactors D303 and D304 to FM modulate the oscillator. For widely spaced transmit channels, FVR301 is used to balance the modulation at low and high channels

Operating voltage for the TX oscillator is filtered by Q308. Q305 switches the voltage to the oscillator and gates Q307 amplifier on and off depending on the state of the PTT line. Q303 supplies regulated voltage to IC301 in both the receive and transmit modes.

A sample of the RF frequency is supplied to the PLL on CN4-4 RF.

4.3.3 TRANSMITTER RF

The modulated transmitter signal originates at carrier frequency in the VCO (refer to VCO UNIT) and appears on CN1-1. It is amplified by Q17, Q18 and Power Output Module PM-I, passes through the antenna switch D29 and the low pass filter to the antenna connector.

A directional coupler in the output path senses both output power (D26) and reflected power (D28). The forward power sense voltage from D26 is amplified by IC15 and is used to control series pass regulator Q19 which supplies B+ to amplifiers Q17 and Q18 and the driver section of PM-I. If the power output tends to drop due to low supply voltage or other reason, Q19 will increase the drive and maintain power. The opposite is true for an increase in power. FVR8 adjusts the high power level by adjusting the static bias on IC15. In the low power mode, Q22 is turned on by a signal (P. CONTROL) from the logic board. This connects Low Power adjustment FVR7 to IC15 to reduce the power output.

If the antenna becomes damaged or disconnected, a reverse power sense voltage appears at D28. This is applied to IC15 through Power Protect adjustment FVR9. High reflected power will reduce the output to protect the power amplifier without completely shutting the transmitter.

Operating voltage for IC15 is controlled as follows. During transmit, an active high signal from the logic board, TX2 IN, CN6-6, turns on the top half of Q11 which turns on Q21 applying voltage to IC15. An UNLOCK active high signal from the PLL circuit Q7-C controls the lower half of Q11. When the PLLNCO is out of lock, the top half is prevented from turning on. This disables the transmitter.

The power output section of PM-1 operates directly from un-switched battery voltage. Voltage is present here even if the radio is switched OFF. DISCONNECT THE BATTERY CABLE WHEN SERVICING THIS SECTION. All earlier amplifier stages operate from switched, controlled voltage which is under control of the power-off timer switch IC13.

4.4 PLL CIRCUIT

The PLL function is performed by IC3. Reference Oscillator OSC1 sends a 12.0 MHz signal to IC3-1 where it is divided to a reference frequency of 5.0, 10, or 12.5 kHz by counters under control of data from the logic board on pins 9, 10, and 11. A sample of the RF signal from the VCO from CN2-4 RF is applied to IC3-8. This is divided by 64 in a pre-scaler and further divided to the same 5, 10 or 12.5 kHz reference, also under control of data from the logic board. This data changes depending on the selected channel and PTT line. The two references are compared by a phase detector to produce a phase difference voltage on pin 5. Q5 and Q6 are charge pumps which are used in developing the phase difference voltage. This passes through a loop filter composed of D9, D10 and associated components and becomes the control voltage applied to the VCO at CN2-6 where it is used to vary the capacity of varactors used in tuning the oscillator frequency. This control voltage is also buffered by IC4 and is used as a tuning voltage for the receiver RF section. Switch IC5 speeds up the loop filter to allow rapid frequency shifts in the scan mode.

If the VCO is out of lock, a logic low appears at pin 7. This is inverted by Q7 and is applied to Q11 to disable the transmitter.

4.5 LOGIC UNIT

The radio operating firmware is programmed into the CPU, IC203, at time of manufacture. The Logic Unit provides most of the control for the radio as indicated in the various sections discussed above, using firmware stored in IC203 and data stored in memory IC201. Regulator IC205 provides 5 V to power the board. IC204 resets the Microprocessor on "power up." A manual reset may be done by shorting the two points marked RESET. These are located near IC201.

IC202 is the DTMF encoder/decoder. FVR201 adjusts the tone output level to the audio processor IC8. Tone input at CN6-16 TONE IN goes to the decoder IC202-2. This signal comes from the Audio Processor IC8-48. A successful decode is sent to the CPU and to the main unit on CN6-4 to open the Squelch Gate.

IC201 is a memory chip which stores data programmed into the radio. This includes frequencies, channel names, CTCSS/DCS, ANI, encode/decode numbers and all timer data entered during initial programming.

4.6 CONTROL UNIT

Please refer to the Radio Operation section for complete information on use of the various controls. The Control Unit connects at CN4. This unit contains the channel/squelch switch, volume control, keypad speaker, display, control switches for scan, monitor and shift and the microphone connector. The channel/squelch switch sends pulses to the Logic Unit to select channels or adjust the squelch. This switch is also used to select call numbers stored in memory.

Q401 supplies reduced voltage to the LCD backlight LED's. Q404 changes the brightness of the backlight under control of LED control signal from the logic board on CN4-11 LED.

IC402 supplies regulated 5 V to mic preamplifier IC403. If the radio is in the transmit mode, Q403 and Q402 hold the radio power on until the PTT is released in the event the power switch is turned off.

The keypad permits entry of DTMF or 5-Tone encode messages and various control functions. Other controls include the SHIFT which is used to change the function of various buttons, SCAN which activates the scan function and MUTE (MONITOR) which controls the decoder.

IC401 controls the LCD display using serial data from the logic board at CN3-11, 12, 13, 14.

SECTION 5.

SERVICING INFORMATION

CAUTION: This radio uses surface mount construction. It is recommended that servicing may be limited to replacement of complete modules and non-surface mount components. Component level servicing should not be attempted unless the engineer or technician is very familiar with surface mount repair techniques and has all of the necessary specialized tools and equipment.

5.1 TEST EQUIPMENT AND TOOLS

ITEM	DESCRIPTION
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1. DMM (Digital Multi-meter)
2. Audio Generator 10 Hz To 10,000 Hz
3. Regulated DC Power Supply with Volt and Amp meters, adjustable up to 15 V @ 15 Minimum
4. AC Voltmeter Analog Type preferred
5. Test Set With Signal Generator, Frequency Counter, Watt-Meter/Load, Deviation Meter, CTCSS/DCS. If test set is not available, separate equipment may be used for these functions,
6. Complete Set Of Small Hand Tools.
7. Temperature Controlled Soldering Iron.
8. Desoldering Braid Or Vacuum Type Desoldering Iron.

5.2 TUNING AND ADJUSTMENTS

5.2.1 GENERAL

All adjustments have been properly set at the factory and should not require readjustment in the field. If a module has been replaced, refer to the section which covers the adjustment or tuning of that module.

Tuning tools should fit exactly. Use insulated, nonmetallic tools for all RF adjustments.

Always use an antenna or 50 Ohm dummy load for transmitter tests.

Do not key transmitter when connected to signal generator.

Connect the radio to a regulated DC power. Adjust for 13.8 volts at the power supply terminals.

Adjustments are to be made with the top and bottom covers removed. *Refer to section 5.3 DISASSEMBLY PROCEDURES.*

5.2.2 VCO ADJUSTMENTS

Note: Adjustment should not be required unless parts or the entire module have been replaced.

If replacement and readjustment of the VCO, after repair is made, program wide band low and high power test channels near the low end, center and high end of the band (six channels in all) with CTCSS of 100 Hz on all channels. Example, for VHF Band, 146-174 MHz, program channels at 146.1 high and low power, 160.1 high and low power, and 173.9 high and low power.. Remove these channels after testing

is completed and program customer frequencies. Use the low power channels for all VCO tests to minimize overheating of the radio.

The VCO must be adjusted so that the phase detector voltage remains between 1V and 5 V over the entire range of frequencies used.

1. To access the VCO, remove the top cover, 2 black screws, and the VCO shield, 5 brass screws.
2. Select the center channel which was programmed for tuning adjustments. Connect DMM to TP2 located on the left edge of the main board.
3. Adjust L301 located on the lower left, for 3 V in the RX mode.
4. Adjust L305 located on the lower right, for 3 V in the TX mode.
5. Check both RX and TX VCO at highest and lowest frequency to make certain that voltage remains between 1 V and 5 V. Make minor readjustments as required.
6. For frequency spread of less than 10 MHz, re-install VCO shield and top cover. For spread over 10 MHz, leave covers off for later adjustment of FVR3O1 Modulation Balance control.

5.2.2 RECEIVER TUNING ADJUSTMENTS

Note: If no repairs have been made to the radio, the sensitivity may be easily checked by testing the squelch sensitivity. Set the squelch to threshold and apply an on-frequency signal of .25 uV. If the Squelch opens, the sensitivity is OK. Typical squelch sensitivity is usually <.2uV,

1. Connect one lead of the Analog AC voltmeter to the high side of the speaker at the rear connector, pin 3 or 4 (jumper wire). Connect the other lead to the radio chassis. Remove bottom cover, 2 black screws.
2. Connect signal generator to antenna connector, select center channel frequency.
3. Check that RX VCO voltage at TP2 is near 3 V (+/- .5 V). Recheck VCO adjustment if necessary.
4. Select the center channel and adjust L1, L2 and L5, L6 or BPF1 (depends on band) and T3 for best sensitivity. Check sensitivity at the highest and lowest frequency and make minor adjustments if needed. Note that there may be a slight difference in sensitivity on these channels but it should not be outside of the sensitivity specifications.
5. After tuning is completed, sensitivity should be less than 0.4 uV for 20 dB quieting and less than .3 uV for 12 dB SINAD. Squelch sensitivity should be less than .25 uV at threshold.

5.2.3 FREQUENCY ADJUSTMENT

1. Connect frequency counter to the transmitter using proper attenuation.
2. Key the transmitter on a low power channel and adjust the trimmer on the reference oscillator OSC1 for correct frequency within 1 PPM. OSC1 is located on the front left side of the radio. This adjustment controls both the TX and RX frequencies.

5.2.4 TRANSMITTER POWER AMPLIFIER ADJUSTMENT

Note: The mobile transmitter is designed for 20% duty cycle. Key the transmitter only long enough to make the adjustments. The transmitter contains internal protection against overheating which may reduce the power output if it is keyed for a long time. This may cause improper setting of the power output and possible damage to the radio..

1. Connect wattmeter and load to antenna connector.
2. Select high power center channel and adjust the PWR HIGH (FVR8) for 25 Watts (40 Watts on high power models) or other desired power below maximum rated power.
3. Adjust FVC1 (FVC3) for maximum power and repeat step 2.
4. Check power at highest and lowest frequency and readjust FVC1 to balance the power. Power may be slightly lower at band extremes but should not exceed -1 dB.
5. Select low power center channel and adjust PWR LOW (FVR7) for ½ power or other low power setting.
6. The Reverse Protect feature protects the power amplifier from damage due to reflected power if the antenna becomes open or shorted. Select any high power channel. Key transmitter and adjust REVERSE PROTECT (FVR9) until power supply current just begins to drop. Slowly adjust in the other direction until current returns to normal. Repeat if necessary to make sure you have the correct adjustment.

5.2.5 TRANSMITTER DEVIATION ADJUSTMENT

1. Select the low power, low frequency channel.
2. Connect dummy load or antenna to the transmitter.
3. Connect deviation meter using proper attenuation.
4. Connect microphone to the connector on the control unit.
5. While speaking loudly and very close to the microphone, key the transmitter and adjust FVR2 for 4.8 kHz deviation.
6. Adjust FVR5 for 700 Hz deviation of the CTCSS tone (note that any background noise in the area will be picked up by the microphone and cause an error in adjustment. Recheck step 5 if necessary.
7. If DTMF tones will be used, adjust FVR201 located on logic unit for 3 kHz deviation while holding the 5 key on the keypad.
8. Select the highest frequency channel and recheck deviation. Adjust Modulation Balance control FVR301 in the VCO to balance the modulation on the highest and lowest frequency, if required.
9. Reassemble all covers.

5.3 DISASSEMBLY PROCEDURES

Note the positioning of the cables for reassembly later. Perform only the steps necessary for service required. *Refer to EXPLODED VIEW for tag numbers (nn).*

5.3.1 TOP COVER REMOVAL

1. Remove two black screws (36) from top cover (35).
2. Remove top cover (35).

5.3.2 BOTTOM COVER REMOVAL

1. Remove two black screws (36) from bottom cover (73).
2. Remove bottom cover (73).

5.3.3 LOGIC UNIT REMOVAL

1. Remove top cover (35).
2. Remove two screws (32) from left side of logic unit (33).
3. Gently lift up on logic unit (33) and unplug from main unit (58).
4. Unplug CN9S socket (45) from CN9P on logic unit (33).
5. Remove logic unit (33)
6. Install logic unit and reverse the steps above to reassemble.

5.3.4 VCO UNIT REMOVAL

1. Remove top cover (35).
2. Remove five bind screws (32) from VCO cover (37).
3. Gently lift up on edges of VCO cover (37) to remove.
4. Remove five studs (40) from VCO unit (42).
5. Gently lift up on edges of VCO unit (42) and unplug from main unit (58).
6. Install new VCO unit and reverse the steps above to reassemble.

5.3.5 DC CORD REMOVAL

1. Remove bottom cover (73).
2. Desolder red and blue wires (47) from main unit (58).
3. Use pliers to squeeze grommet together.
4. Push DC cord (47) and grommet (46) outward through opening in rear of main chassis (29).
5. Open grommet (46) and remove DC cord (47).
6. Bend new DC cord in the same place that the old cord is bent.
7. Install grommet (46) on new DC cord.
8. Install new DC cord assembly and reverse the steps above to reassemble.

5.3.6 ANTENNA CABLE REPLACEMENT

1. Remove bottom cover (73).
2. Remove one black screw (67) from rear of main chassis (29).
3. Remove power amplifier cover (70) by removing 6 screws (71).
4. Remove screw (32) from antenna clamp (50).
5. Desolder antenna cable (48) and clamp (50) from main unit (58).
6. Lift up on antenna cable (48), bushing (49), and clamp (50) to remove from main chassis (29).
7. Remove clamp (50) from antenna cable (48).
8. Remove bushing (49) from antenna cable (48).

9. Install bushing (49) on new antenna cable.
10. Install clamp (50) on new antenna cable.
11. Slide new antenna cable, bushing (49), and clamp (50) into place using screw (32).
12. Attach bushing (49) to main chassis (29) with one black screw (67).
13. Solder new antenna cable to main unit (58).
14. Solder clamp (50) to main unit (58).
15. Reverse the steps above to reassemble.

5.3.7 MAIN UNIT REPLACEMENT

1. Remove bottom cover (73).
2. Remove six screws (71) from TX/PA cover (70).
3. Remove TX/PA cover (70).
4. Remove one flat screw (60) from side of main chassis (29).
5. Remove plate nut (62).
6. Remove four bind screws (32) from main unit (58).
7. Remove two bind screws (59) from main unit (58).
8. Remove one bind screw (67) from rear of main chassis (29).
9. Remove one bind screw (32) from antenna cable clamp (50).
10. Disconnect CN7S socket (45) from CN7P plug on main unit (58).
11. Disconnect CN8S socket (45) from CN8P plug on main unit (58).
12. Desolder DC cord assembly (47) and Antenna Cable (48) from main unit (58).
13. Remove top cover (35).
14. Remove logic unit (33).
15. Remove four bind screws (32) from logic shield (31).
16. Remove logic shield (31).
17. Disconnect microphone cable assembly (56) from CN3S socket on main unit (58).
18. Disconnect keypad cable assembly (57) from CN4S socket on main unit (58).
19. Remove VCO unit (42).
20. Remove main unit (58) from main chassis (29).
21. Install new main unit and reverse the steps above to reassemble.

5.3.8 EXT SPKR (ACCESSORY) CONNECTOR AND CABLE REPLACEMENT

1. Disconnect jumper plug (44) from cable assembly (45).
2. Remove main unit (58).
3. Hold clips in on both sides of cable assembly (45).
4. Push cable assembly (45) inside main chassis (29) to remove.
5. Install new cable assembly and reverse the steps above to reassemble.

5.3.9 CONTROL UNIT REMOVAL

1. Remove two oval screws (7) from each side of control unit (8).
2. Separate control unit (8) from main chassis (29).
3. Disconnect red keypad cable assembly (57) from CN3P plug on control unit (14).
4. Disconnect blue microphone cable assembly (56) from CN4P plug on control unit (14).

5.3.10 CONTROL UNIT CIRCUIT BOARD REPLACEMENT

1. Remove control unit (8).
2. Disconnect volume cable assembly (16) from CN4O2P plug on control unit (14).
3. Disconnect speaker cable assembly (23) from CN4OIP plug on control unit (14).
4. Disconnect keypad (1) from CN12P socket on control unit (14).
5. Remove five bind screws (15) from control unit (14).
6. Remove board (14).
7. Install new control board and reverse the steps above to reassemble.

5.3.11 LCD AND BACKLIGHT REPLACEMENT

1. Remove control unit (14).
2. Straighten four metal tabs on the LCD cover (10) which are twisted on the opposite side of the control unit (14).
3. Remove LCD cover (10).
4. Remove LCD conductive pad (12).
5. Remove LCD display (11).
6. Desolder four tabs on the control unit (14) and remove LCD backlight (13).
7. The LCD display (11) makes contact by mechanical pressure against contacts on the control unit circuit board (14) and LCD conductive pad (12). Clean all contact surfaces with rubbing alcohol.
8. Install new backlight and solder into place. (This part is symmetrical so it cannot be inserted wrong)
9. Install new LCD display and conductive pad, press firmly against the control unit (14) and twist the tabs on the LCD cover (10) 1/4 turn. (Arrows on the control module show which way the tabs should be turned).

5.3.12 KEYPAD REPLACEMENT

1. Remove control unit (14).
2. Use a heat gun or hair dryer to warm the casting behind the keypad. Do not overheat.
3. Using a blunt tool, apply steady pressure to the rear of the keypad (1) through the cable slot and separate the keypad (1) from the control panel (8).
4. Clean the surface of control panel (8) with rubbing alcohol.
5. Remove paper cover on the tape on the back of new keypad.
6. Install new keypad and reverse the steps above to reassemble.

5.3.13 SPEAKER REPLACEMENT

1. Remove control panel (8).
2. Disconnect speaker cable assembly (23) from CN401P plug on control unit (14).
3. Disconnect volume cable assembly (16) from CN402P plug on control unit (14).
4. Remove two screws (27) from speaker housing (26).
5. Remove speaker housing (26).
6. Pull speaker cap (24) off of speaker (22).
7. Desolder speaker cable assembly (23) from speaker (22).
8. Remove speaker (22).
9. Install new speaker and reverse the steps above to reassemble.

5.3.14 VOLUME/SQUELCH CONTROL AND MIC SOCKET REPLACEMENT

1. Remove control panel (8).
2. Disconnect volume assembly (16) from CN402P plug on control unit (14).
3. Pull volume knob (3) off.
4. Pull squelch knob (4) off.
5. Remove nut (6) from V/S switch (18).
6. Remove one bind screw (5) from front of control panel (8).
7. Remove two sems screws (27) from speaker housing (26).
8. Remove speaker housing (26).
9. Remove Volume/Squelch control and microphone socket assembly (16,17,18,19,20,41).
10. Install new V/S switch and microphone socket assembly and reverse the steps above to reassemble.

