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Apelco

VHF8500

Instruction Manual

TABLE OF CONTENTS

GLOSSARY OF TERMS

VHF	Very High Frequency (30 MHz to 300 MHz)
FM	Frequency Modulation.
MODULATION	To vary a carrier wave.
CARRIER WAVE	A radio frequency on which intelligence is superimposed.
DUAL WATCH	Monitors channel 16 while working on another channel.
U.S.A. CHANNELS	Channel designations as defined by the FCC.
INTERNATIONAL CHANNELS	Channel designations as defined by the International Telecommunication Union.
CANADIAN CHANNELS	Channel designations as defined by the ISC.
WEATHER CHANNELS	Channels for routine and emergency weather informati broadcast by NOAA.
SIMPLEX	Transmit and receive on the same frequency.
DUPLEX	Transmit and receive on different frequencies.
SQUELCH	To suppress totally.
LCD	Liquid crystal display.
TX	Transmit.
RX	Receive.
RF	Radio Frequency.
CPU	Control Processor Unit.
PLL	Phase Lock Loop (A type of Frequency Synthesizer).
VCO	Voltage Controlled Oscillator.
PTT SWITCH	Microphone push-to-talk switch.

SECTION 1

GENERAL DESCRIPTION

1.1 INTRODUCTION

Congratulations on your purchase of Apelco's VHF8500 marine radiotelephone.

The VHF 8500 is a CPU-controlled, digitally synthesized, compact transceiver, which provides reliable simplex and duplex (two-frequency) communications between ships and from ships at sea to public or private shore stations. The VHF 8500 provides two-way communications on the International and US channels, reception on 10 separate weather channels, and two-way communications on the international calling and safety channel (16).
This manual describes the physical and functional characteristics of the radiotelephone.

1.2 EQUIPMENT FEATURES

The VHF 8500 is designed and manufactured to provide ease of operation with excellent reliability. The important built-in features of the equipment are listed below:

- Waterproof to U.S.C.G. standard CFR-46.
- All solid-state circuitry for low current drain and maximum reliability.
- Series diode protection on input power circuits to prevent reverse polarity damage.
- High-performance receiver section with optimum selectivity.
- 53 channel transmit and 93 channel receive capability within the assigned VHF-FM maritime band. All US and International channels are included.
- Exclusive circuit that automatically selects 16 PLUS (priority) channel when the radio is turned on.
- Exclusive weather alert feature (when in Monitor Mode).
- Up to 10 memory channels available for scan and seek operations.
- Selected channel number indicated on the LCD digital display.
- Aluminum die cast housings to prevent interference of offending noises.
- Key entries for "Quick" 16 PLUS, and 10 weather channels WX0 through WX9.

SECTION 2

INSTALLATION

2.1 UNPACKING AND INSPECTION

Use care when unpacking the unit from the shipping carton to prevent damage to the contents. It is also good practice to save the carton and the interior packing material. The original packing material should be used in the unlikely event it is necessary to return the unit to the factory.

2.2 EQUIPMENT SUPPLIED

The following is a list of materials supplied with the VHF 8500.

Description	Part No.
Radiotelephone	M56790
Instruction Manual	G263722-1A
Microphone Bracket w/hardware	G263720-2
Power/External Speaker Cable	G263720-6
FCC Instructions	FCC Form 506
Mounting Yoke	G263720-14
Yoke Knob	G263720-15
Yoke Knob Spacer	G263720-16

Table 2-1 Equipment Supplied

2.2.1 Optional Accessories

Item #	Description	Part No.
1	Flush Mounting Kit	M99-113
2	Flush Mounting Face Cover	M99-124

Table 2-2 Optional Accessories

These optional accessories may be ordered by calling our Customer Service Department directly at (603)647-7530 ext. 2120 Monday through Friday 8:30 am - 5:00 pm E.S.T.

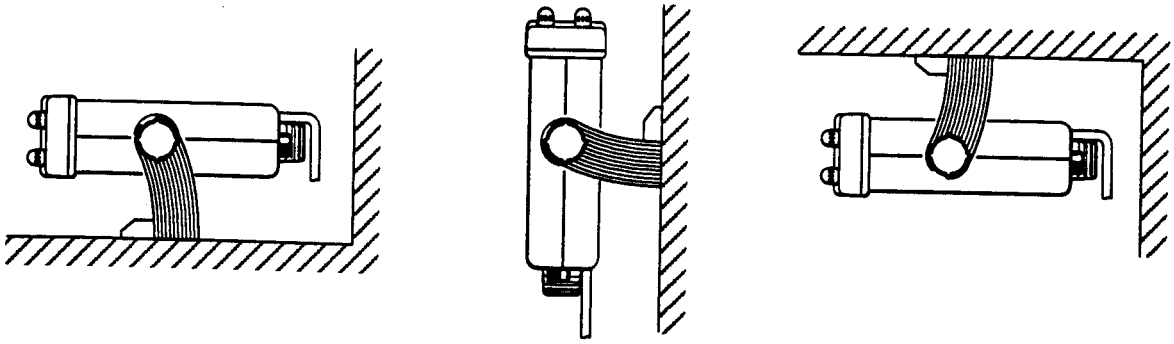
2.3 PLANNING THE INSTALLATION

When planning the installation for your VHF 8500, the following conditions should be considered insure dependable and trouble-free operation.

- The mounting location should be easily accessible to allow operation of the front panel.
- There should be adequate ventilation for the control unit.
- A sufficient space should be secured behind the transceiver to allow enough space for proper cable connections to the rear panel connectors.
- The transceiver should be located as near to the power source as possible.
- The selected location should be as far apart as is possible from any devices that may cause interference such as motors, generators, and other onboard electronics.
- Generally speaking, the transceiver should be protected from prolonged direct exposure to rain and salt spray. It is always a good practice to protect your valuable electronic equipment as much as possible.
- Use adequate sized wire for all DC power connections and make sure to solder all inline connectors or splices.

2.3.1 Typical Mounting Methods

The 8500 can be conveniently mounted on a chart table, bulkhead, overhead or any other desired location. (Refer to Figure 2-1 for typical mounting methods).



(table top mount) (bulkhead mount) (overhead mount)

Fig. 2-1 TYPICAL MOUNTING METHODS

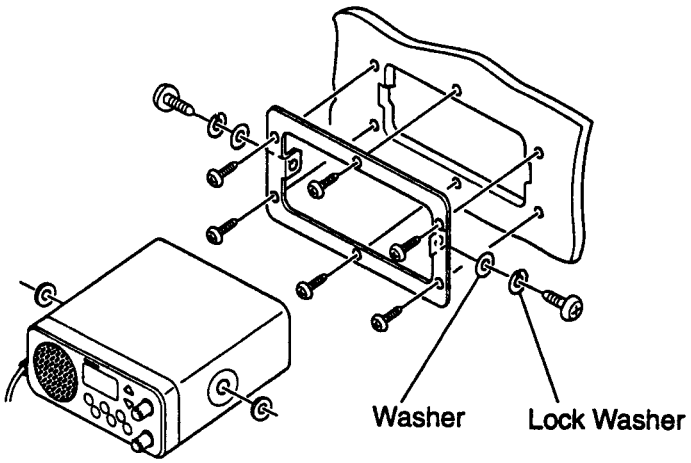
2.3.2 Flush Mounting

In addition to the Typical Mounting Methods, the 8500 may also be flush mounted using the optional Flush Mount kit (#M99-113).
These kits are available from our Customer Service Department.

1) Select the location for the VHF. A clear flat area, high having at least 8" of clear depth behind the panel is required.
2) Unpack the Flush Mounting kit and confirm that all hardware is present.
3) Place the ring at the desired location on the panel. Using the inside of the trim ring, trace a cutout guide. Remove the trim ring.
4) Drill a pilot hole inside of the cut-out guide area.
5) Using an appropriate saw, cut along the outside of the cut-out line.
6) Remove the yoke knobs and the bracket from the VHF cabinet, Check that the VHF will fit into the cut-out area.
7) Install the power and antenna cables in the console.
8) Slip the trim ring onto the VHF from the rear.
9) Install the VHF using the clamps and hardware supplied in the kit. A suitable scalant may be used between the trim ring and console to prevent moisture entry. The trim ring should be secured to the console with the countersunk flathead screws.
10) Connect the power/external speaker and antenna cables.

CAUTION

Make sure there are no hidden electrical wires of other items behind the desired location before proceeding. Check that free access for mounting and cabling is available.



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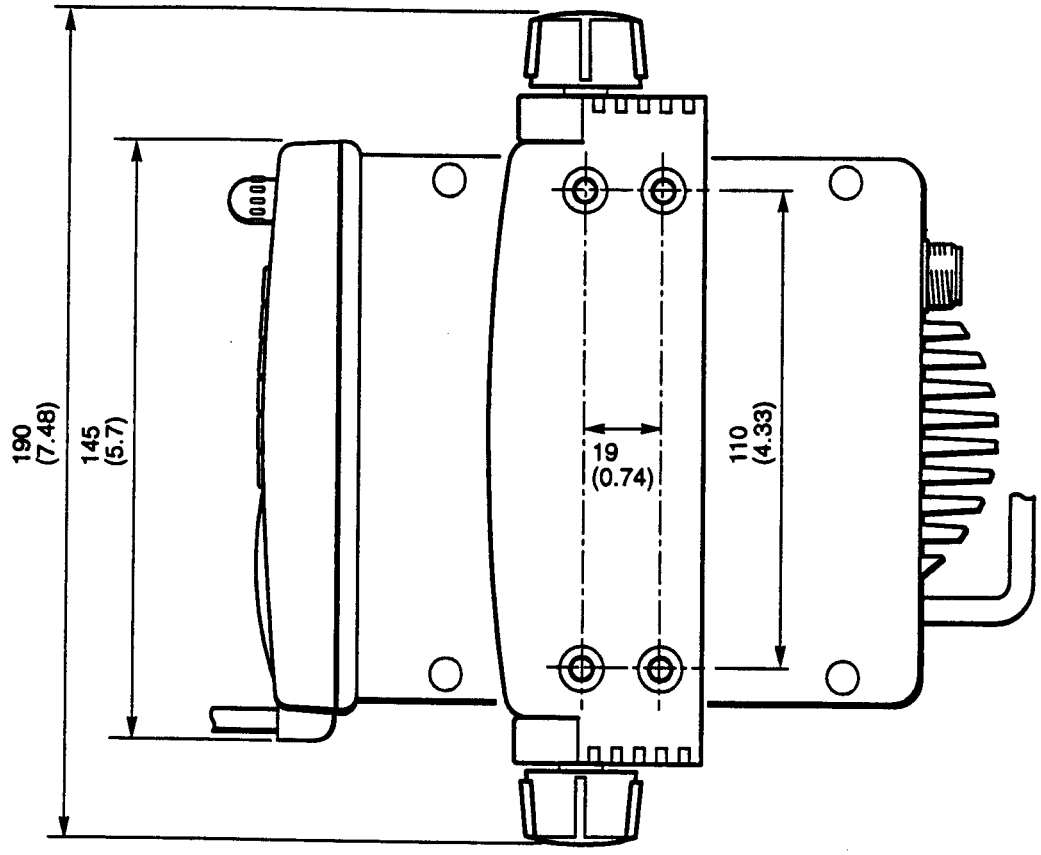

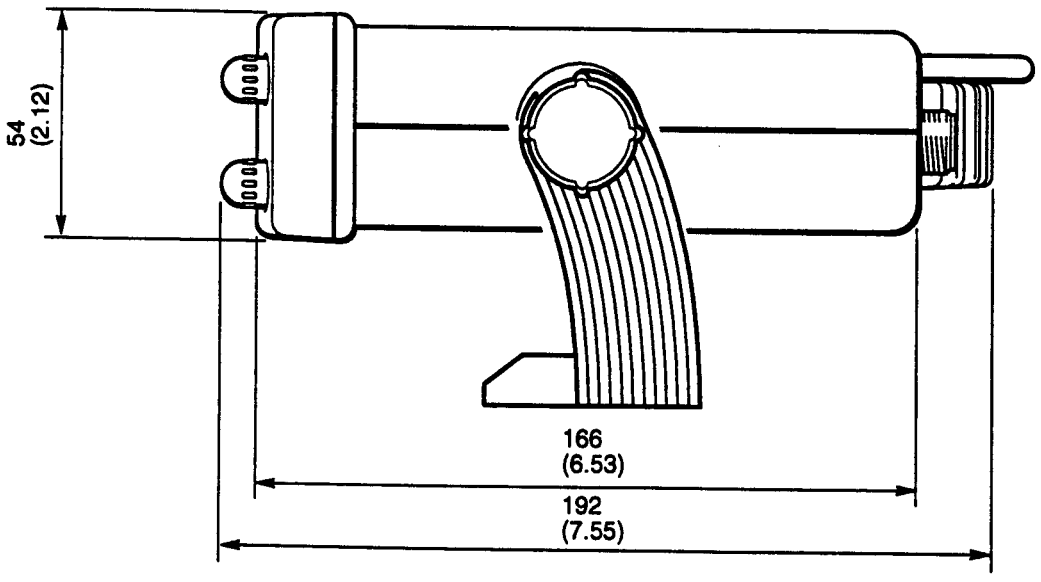

Fig. 2-2 OUTLINE AND MOUNTING DIMENSIONS

All dimensions are shown in inches and millimeters

Unit: mm
(inch)

2.4 ELECTRICAL CONNECTIONS

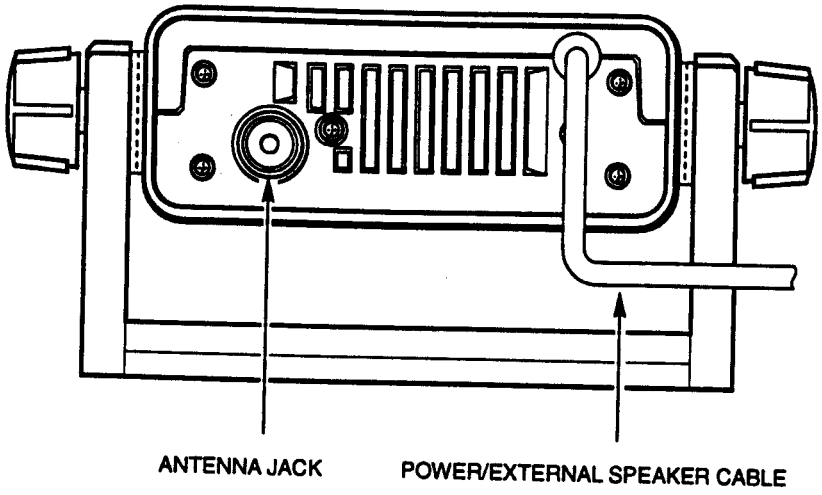

Fig. 2-3 REAR VIEW

CAUTION
DO NOT INSTALL THIS RADIO ON VESSELS WITH **POSITIVE** GROUND BATTERY SYSTEMS.

2.4.1 DC Power Connections

The power cable comes with external speaker attachments. The power/external speaker cable which is provided is 6 feet long and plugs into the 4P connector cable at the rear panel of the radio. The RED(+) wire with an in-line fuse (10 amps.) and the BLACK (–) wire of the 4P connector cable are used for connecting the VHF 8500 to the ship's 12 Vdc power system. (Refer to Fig. 2-4.)

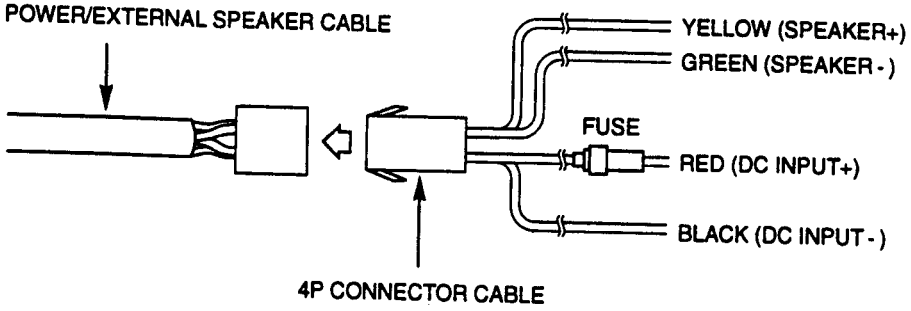

Fig. 2-4 POWER/EXTERNAL SPEAKER CABLE AND 4P CONNECTOR CABLE

In most cases the length should be adequate enough to reach the dc power source. If additional wire length is required, the cable can be extended by adding more cable as necessary. However, for power cable runs longer than 15 feet, larger wire diameter size should be used to prevent voltage line loss. Fig. 2-5 provides recommended wire sizes to use for various cable run distances.

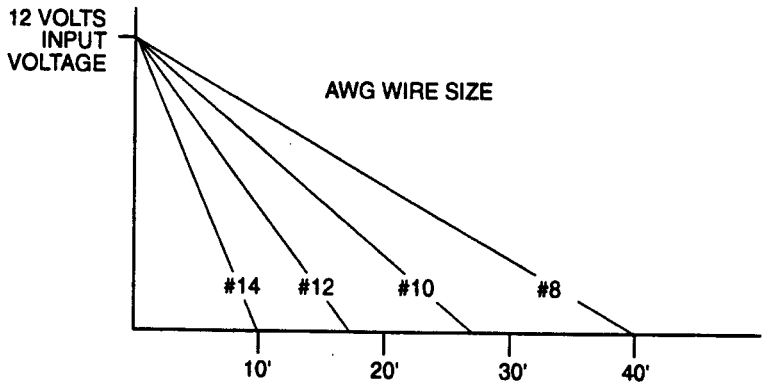

Fig. 2-5 POWER CABLE LENGTH

RY SYSTEMS.

Your VHF radio should be connected to the nearest primary source of ship's dc power. A typical source may be a circuit breaker on the power panel or a fuse block located near the unit. When connecting to either of these sources, the circuit breaker or other in-line fuse should be rated at 10 amps.

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It is recommended that terminal lugs be used to connect the power cable to the dc supply and that the lugs should be both **crimped and soldered**. This is very important in order to insure adequate current draw to the equipment. Intermittent operation may result if an insufficient connection is made to the power source. The connection terminals should be clean, with no sign of corrosion.

:R+)
?-)

The **RED**(+) wire is connected to the positive terminal of the power source or battery. The **BLACK**(–) wire is connected to the negative (ground) of the power source or battery. Should the power connector be inadvertently reversed, the 10 amp. in-line fuse located in the RED(+) wire will blow. Check the input power leads for correct polarity with a VOM, reconnect the leads observing correct polarity, and replace the fuse. Use the same rate and type fuse.

-)

2.4.2 External Speaker Connections

The YELLOW(+) wire and GREEN(–) wire are used for connecting the VHF 8500 to an external speaker. (Refer to Fig. 2-4.)

3 watts of audio output is provided for an external 4 ohm speaker. A suitable speaker can be purchased from your local marine dealer.

Connect the YELLOW(+) wire and GREEN(–) wire with the speaker. The internal speaker and the external speaker when connected will sound simultaneously.

CABLE

2.4.3 Antenna Connections

The coaxial cable to your VHF antenna is intended to be connected to the antenna jack on the rear panel using a PL259 VHF type connector. The antenna cable may be cut to the required length at installation. If a longer cable length is required, RG-58 50-ohm coaxial or equivalent cable may be used for antenna runs up to a maximum of 50 feet. If the distance required is even greater, then we recommend using low loss RG-213 or equivalent cable for the entire run in order to avoid excessive losses in power output.

If the antenna connector is likely to be continuously exposed to the marine environment, a protective coating of silicon grease (similar to Dow Corning DC-4) can always be applied to the connector before mating it to the radio to help prevent poor contact. Any other extensions or adapters in the cable run should also be protected by silicon grease and then wrapped with a weatherproofing tape.

2.4.4 Antenna Mounting Suggestions

The best radio in the world is useless without a good antenna location. Mounting the VHF antenna properly is very important because it will directly affect the performance of your VHF radio. A standard VHF antenna which is designed for use aboard boats should be used.
There are several factors to consider so as to maximize the effective communication range of the radio.

- Since VHF transmissions are essentially Line-Of-Sight, mount the antenna at the highest possible location on the vessel and free of obstructions in order to obtain maximum range.
- Use an antenna with the highest possible gain characteristics.
- If you must extend the length of the coaxial cable between the antenna and the radio, use a cable designed for the least amount of power loss over the entire cable length.
- Keep the coaxial cable between the radio and antenna as short as possible.

2.4.5 Grounding

While special grounding is not generally required for VHF radiotelephone installations, it is a good marine practice to properly ground all electronic equipment to the ship's ground system. The 8500 can be connected to ground by attaching a wire to one of the RF connector screws on the unit's rear panel and then to the nearest ship's ground connection point. The recommended wire to be used for such grounding is #10 AWG.

The 8500's cabinet was specifically designed and die cast from aluminum, this alone will do an outstanding job of rejecting noise.

3.3 OPERATING PROCEDURES

Specific operating procedures for the 8500 are prsented in this section. General information regarding correct marine channel usage may be found in the Appendix section. Refer to the Controls section 3.2.1 beginning on page 8 for a thorough description of all 8500 functions.

3.3.1 Turning the Power on

1) Rotate the ON/OFF/Volume control to turn the radio on. Rotate the knob clockwise and set it at approximately the midpoint of it"s range.

NOTE

When the Power is turned on, the synthesizer automatically programs for USA channel frequencies and selects the calling channel 16. (Refer to 16 PLUS operation to change this channel)

Setting the Volume

1) Rotate the SQUELCH control fully counterclockwise, background noise will be heard.
2) Rotate the VOLUME control clockwise for the desired listening level out of the speaker.

Setting the Squelch

1) Rotate the SQUELCH control slowly clockwise until the background noise in the speaker ceases.

Setting the Power Output

1) Press the "1/25" key to select 1 watt ("1W" will be displayed.) or 25 watts ("1W" disappears.) power output. This will be dependent on the distance the message is to be transmitted, and transmitting conditions. In certain US harbors and on certain channels, the FCC requires the power to be limited to 1 watt. On these "required" channels, the radio automatically selects the 1 watt power output when the channel is selected.

Selecting a Channel

1) To select the appropriate channel you will be using press the [▲] or [▼] channel select keys. Refer to Table 3-1 to select your "working" channel.

⑤ [WX] Key
When pressed puts the radio into the Weather channel receiving mode. A "WX" will be displayed on the LCD along with the weather channel number (0-9). When in this mode, the transmitter is always disabled.

⑥ [MON INT] Key
When pressed, puts the radio into the MONITOR mode and "MON" is displayed on the LCD. In this mode the radio will scan (monitor) 16 PLUS (priority) channel automatically, a selected working channel, and a weather channel for the weather alert tone.
When pressed and held for 2 seconds you will hear a beep and "INT" will appear on the display.
This causes the synthesizer to program International channel frequencies. When pressed and held again for 2 seconds you will again hear a beep and the synthesizer programs US frequencies. ("INT" indication disappears.) (US channels are selected in the initial setting.)

⑦ [1/25] Key
When pressed, alternately changes the transmitter output power from 1 watt ("1W" will be displayed.) to 25 watts. ("1W" disappears.)

⑧ [MEM] Key
This key is used to program channels into memory, or to clear channels from memory.
The radio will beep to confirm when channels are being stored into memory.

⑨ [SCAN] Key
When pressed, puts the radio into the All Scan mode or the Memory Scan mode.
In this mode the radio will scan channels and stop on channels receiving transmissions and monitor that channel until the transmission ceases. Simply press the Scan key to continue the scanning.

⑩ [SEEK] key
When pressed, puts the radio into the all seek mode or memory seek mode.
In this mode the radio will seek channels and stop on channels receiving transmissions and monitor for 7 seconds then continue the seek function.

⑪ [PTT] (Push-To-Talk) Switch
When pressed puts the radio into the transmit mode, and a character "TX" will be displayed on the LCD.

All of the above keys will produce an audible beep when pressed.

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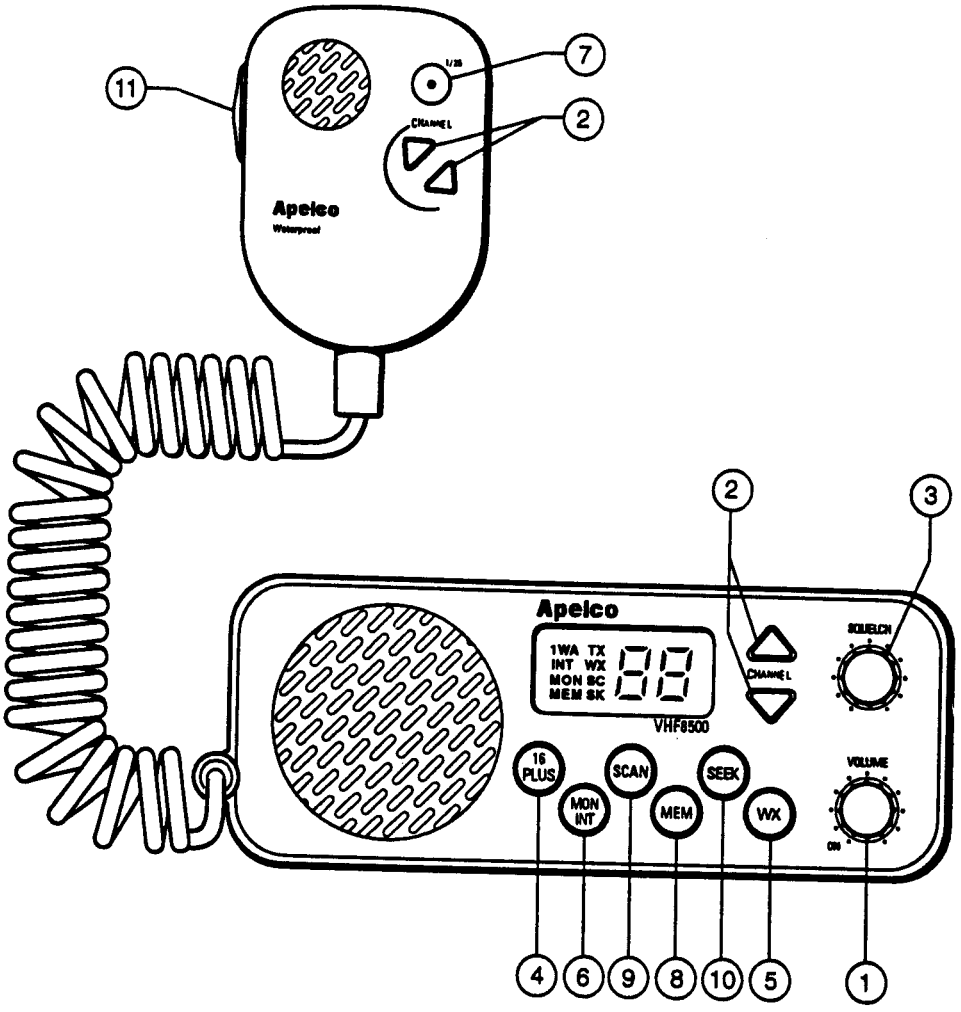

Fig. 3-1 LAYOUT OF CONTROLS AND CONNECTORS

3.2.2 LCD Display

A number of characters appear on the LCD display in different locations. The following list describes the characters and when and where they will appear.

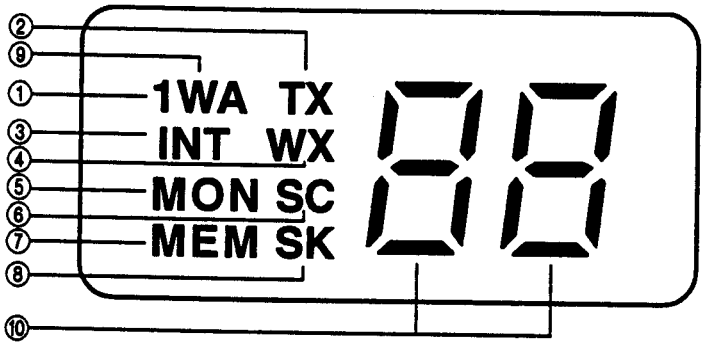

Fig. 3-2 LCD DISPLAY

① 1W (High/Low Power) : will be displayed when the transmitter circuits are providing 1 watt of power to the antenna, and will disappear when the transmitter circuits are providing 25 watts of power to the antenna.

② TX (Transmit) : will be displayed on the LCD when the Push-To-Talk switch on the radio has been pressed and the transmitter circuits are providing a signal to the antenna.

③ INT (International/USA) : will be displayed when International channels are programmed for use, and will disappear when US channels are programmed for use.

④ WX (Weather) : will be displayed when the channel selected to be monitored is a weather channel.

⑤ MON (Monitor) : will be displayed when the MON/INT key is pressed and the radio is in the monitor mode.

⑥ SC (All Channel Scan / Memory Scan) : will be displayed when the SCAN key is pressed and the radio is in the All Scan mode or memory Scan mode.

⑦ MEM (Memory) : will blink when the MEM key is pressed and the radio is in the Memory Standby mode for two seconds.

⑧ SK (All Channel Seek / Memory Channel Seek) : will be displayed when the SEEK key is pressed and the radio is in the All Seek mode or Memory Seek mode.

⑨ WA (Weather Alert) : will blink when a Weather Alert tone has been received.

⑩ LCD Segments: will display channel number in use.

3.3 OPERATING PROCEDURES

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3.3.1 Turning the Power on

1) Rotate the ON/OFF/Volume control to turn the radio on. Rotate the knob clockwise and set it at approximately the midpoint of it"s range.

NOTE

When the Power is turned on, the synthesizer automatically programs for USA channel frequencies and selects the calling channel 16. (Refer to 16 PLUS operation to change this channel)

Setting the Volume

1) Rotate the SQUELCH control fully counterclockwise, background noise will be heard.
2) Rotate the VOLUME control clockwise for the desired listening level out of the speaker.

Setting the Squelch

1) Rotate the SQUELCH control slowly clockwise until the background noise in the speaker ceases.

Setting the Power Output

1) Press the "1/25" key to select 1 watt ("1W" will be displayed.) or 25 watts ("1W" disappears.) power output. This will be dependent on the distance the message is to be transmitted, and transmitting conditions. In certain US harbors and on certain channels, the FCC requires the power to be limited to 1 watt. On these "required" channels, the radio automatically selects the 1 watt power output when the channel is selected.

Selecting a Channel

1) To select the appropriate channel you will be using press the [▲] or [▼] channel select keys. Refer to Table 3-1 to select your "working" channel.

To Transmit

- Select the desired mode (INT or USA) by pressing the MON INT key. Then simply press the Push-To-Talk switch and speak into the microphone using a clear normal voice.
- When the power is initially turned on, simply press the Push-To-Talk switch, the radio will be ready for transmission on CH 16 or a user selected priority channel (16 PLUS).

The 8500 is designed to meet the new FCC Rules Part 80.203. Which states, if the Push-To-Talk switch is pressed for over five minutes continuously, transmission is forcibly inhibited. If this occurs audible beeps will sound until the Push-To-Talk switch is released. While, "TO (time out)" blinks on the LCD. After releasing the Push-To-Talk switch, the radio is ready for reception.

NOTES

Initial communication contacts are usually made over channel 16 as all ships and shore stations monitor this channel, then a shift to a working channel will be necessary.

To Select a Weather Channel

1) Press the WX key, then the up [▲] or down [▼] key to select the desired weather channel from 0 to 9. When this mode is selected, the transmitter is always inhibited.
2) If a weather alert signal is received on your selected WX channel (**when in the Monitor Mode**) there is a five-second audible alarm generated. To cancel the audible alarm, simply press any key.

3.3.2 The 16 PLUS (priority) Channel

The 16 PLUS channel has been preset to the CH 16 prior to shipment from the factory. But the 16 PLUS channel can be changed freely, with the exception of all weather channels.

1) Press the Up [▲] or Down [▼] key to select the desired channel. Then press and hold the 16 PLUS key for three seconds. An audible beep tone will confirm that the selected channels is stored in memory as the 16 PLUS channel.
2) To set CH 16 as the 16 PLUS channel again, repeat step 1 for CH 16.

3.3.3 Channel Memory

The VHF 8500 has the capability of memorizing and scanning up to a maximum of 10 channels in the INT/US mode.

1) Channel Memory: To put a channel into memory simply select the channel to be stored in memory with the up & down arrows to show on the display. Push and hold the MEM key down until a beep is heard (approx. 2 seconds), the beep tone confirms that the channel has been entered into memory. This procedure can be repeated for a total of 10 channels. If channel memory is full, FL will appear on the display when you attempt to memorize a channel. To program more channels you must first clear some of the existing channels from memory.
2) Memory Clear: To clear a memorized channel, simply select the channel to be cleared on the display, then press and hold down the MEM key until a beep tone is heard (approx. 2 seconds) and MEM disappears from the display. This procedure may be repeated to clear all or selected channels from memory.

3) Memory Recall: To review the memorized channels, simply press the MEM key and then press the MEM key again while the "MEM" indicator is blinking. This will sequentially display the memorized channels at 0.5 second intervals.

3.3.4 Master Reset

If you hold down the MEM key when turning the power on, all channels will be cleared from memory and the 16 PLUS channel will be automatically programmed back to channel 16.

3.3.5 Scan Mode

1) All Channel Scan
When the SCAN key is pressed, the radio will start scanning all channels from the one displayed in an upward direction. If a signal is received, scanning will stop (will hold on displayed channel) until signal is no longer received, then, after five seconds it will continue to scan. While the scanning has stopped on a received signal you may simply press the SCAN key to continue the scanning. To cancel the scanning, press and hold the SCAN key for two seconds or simply press any key except the "1/25" key.

2) Memory Scan
To scan only the memorized channels, press the MEM key and then press the SCAN key while "MEM" is blinking for two seconds. Other operation is identical to all scan.

3.3.6 Seek Mode

1) All Channel Seek
When the SEEK key is pressed, the radio will start seeking all channels from the one displayed in an upward direction. If a signal is received, seeking will stop (will hold on displayed channel for seven seconds), then continue seeking. Press any key except the TX PWR key to cancel the seek operation.

2) Memory Channel Seek
To seek the memorized channels, press the MEM key and then press the SEEK key while "MEM" is blinking for two seconds. Other operation is identical to all seek.

3.3.7 Monitor Mode

Before entering the Monitor Mode you must first select the WX channel you wish to monitor for the weather alert tone. Next, you must also select a working channel to be monitored for traffic. Then, simply press the MON/INT key and the radio will begin to scan channel 16 PLUS, 83, WX2, repetitively. In this example, we used channel 83 as our working channel and WX2 as our weather channel. The 16 PLUS channel programmed into the radio is automatically selected as one of the monitored channels. To cancel the Monitor mode, press any key except "1/25" key.

Working Channel

If a signal is received on CH 83, the scan will stop on CH 83, but will continue to monitor 16 PLUS and the selected weather channel every five seconds.

16 PLUS (priority) Channel

If while scanning a signal is received on 16 PLUS, the scanning will stop on 16 PLUS for as long as the signals being received. If the signal ceases for more than five seconds, the scanning will continue.

Weather Channel

Until a weather alert tone signal is received on WX2, the scan will stop on WX2 briefly, but will not give any audio output. When a weather alert tone (1050 Hz) is received, the monitor will stop and an audible alarm will sound for five seconds. To silence the alarm, simply push any key.

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3.3.8 VHF 8500 Marine Channels and Their Usage

CAUTION

* The transmitter of the VHF 8500 is disabled when channel 15 or WX0 - WX9 is displayed.

CHANNEL DESIGN.	FREQUENCY (MHz)			TYPE OF TRAFFIC	FUNCTION	
	TX	RX (USA)	RX (INT'L)		SHIP TO SHIP	SHIP TO SHORE
01#	156.050	156.050	160.650	–	–	–
02#	156.100	156.100	160.700	–	–	–
03#	156.150	156.150	160.750	–	–	–
04#	156.200	156.200	160.800	–	–	–
05	156.250	156.250	160.850	Port Operations	Yes	Yes
06	156.300	156.300	156.300	Intership Safety	Yes	No
07	156.350	156.350	160.950	Com'l	Yes	Yes
08	156.400	156.400	156.400	Com'l	Yes	No
09	156.450	156.450	156.450	Call & Ship/Ship	Yes	Yes
10	156.500	156.500	156.500	Com'l & Ship/Ship	Yes	Yes
11	156.550	156.550	156.550	Com'l & Ship/Ship	Yes	Yes
12	156.600	156.600	156.600	Port Operations	Yes	Yes
13**	156.650	156.650	156.650	Nav. Ship/Bridge	Yes	Yes
14	156.700	156.700	156.700	Port Operations	Yes	Yes
15#	–	156.750	156.750	Environmental	–	–
16	156.800	156.800	156.800	Emerg/Calling	Yes	Yes
17*	156.850	156.850	156.850	State Controlled	Yes	Yes
18	156.900	156.900	161.500	Com'l	Yes	Yes
19	156.950	156.950	161.550	Com'l	Yes	Yes
20	157.000	157.600	161.600	Port Operations	Yes	Yes
21 (CG)	157.050	157.050	161.650	Coast Guard	Yes	Yes
22 (CG)	157.100	157.100	161.700	Coast Guard	Yes	Yes
23 (CG)	157.150	157.150	161.750	Coast Guard	Yes	Yes
24	157.200	161.800	161.800	Public Corresp	No	Yes
25	157.250	161.850	161.850	Public Corresp	No	Yes
26	157.300	161.900	161.900	Public Corresp	No	Yes
27	157.350	161.950	161.950	Public Corresp	No	Yes
28	157.400	162.000	162.000	Public Corresp	No	Yes
60+	156.025	156.025	160.625	–	–	–
61+	156.075	156.075	160.675	–	–	–
62+	156.125	156.125	160.725	–	–	–
63	156.175	156.175	160.775	Com'l	Yes	Yes
64+	156.225	156.225	160.825	–	–	–

Table 3-1

* 1 watt only

**1 watt initially. User can override to high power (25 watts) via microphone controls.

The transmitter is automatically disabled when channels 1, 2, 3, and 4, for USA; and 15 for USA and International are selected.

+ Assigned by Canadian Government, proper authorization must be ensured prior to use.

Caution

* Operation on channels not designated for use by your classification or craft or on International Channels within the US territorial waters is a violation of FCC Rules and Regulations and may result in severe penalties.

CHANNEL DESIGN.	FREQUENCY (MHz)			TYPE TRAFFIC	FUNCTION	
	TX	RX (USA)	RX (INT'L)		SHIP TO SHIP	SHIP TO SHORE
65	156.275	156.275	160.875	Port Operations	Yes	Yes
66	156.325	156.325	160.925	Port Operations	Yes	Yes
67**	156.375	156.375	156.375	Com'l	Yes	No
68	156.425	156.425	156.425	Non Com'l	Yes	Yes
69	156.475	156.475	156.475	Non Com'l	Yes	Yes
70#	–	156.525	156.525	DSC	Yes	Yes
71	156.575	156.575	156.575	Non Com'l	Yes	Yes
72	156.625	156.625	156.625	Non Com'l	Yes	No
73	156.675	156.675	156.675	Port Operations	Yes	Yes
74	156.725	156.725	156.725	Port Operations	Yes	Yes
75#	–	156.775	156.775	–	–	–
76#	–	156.825	156.825	–	–	–
77*	156.875	156.875	156.875	Port Operations	Yes	No
78	156.925	156.925	161.525	Non Com'l	Yes	Yes
79	156.975	156.975	161.575	Com'l	Yes	Yes
80	157.025	157.025	161.625	Com'l	Yes	Yes
81	157.075	157.075	161.675	Coast Guard	Yes	Yes
82	157.125	157.125	161.725	Coast Guard	Yes	Yes
83	157.175	157.175	161.775	Coast Guard	Yes	Yes
84	157.225	161.825	161.825	Public Corresp.	No	Yes
85	157.275	161.875	161.875	Public Corresp.	No	Yes
86	157.325	161.925	161.925	Public Corresp.	No	Yes
87	157.375	161.975	161.975	Public Corresp.	No	Yes
88	157.425	157.425	162.025	Com'l	Yes	No

Table 3-1 (Continued)

* 1 watt only

**1 watt initially. User can override to high power (25 watts) via front panel controls.

The transmitter is disabled when channels 75 and 76 are selected. Channel 70 is now used for DSC calling only, therefore transmission is disabled on channel 70 in this radio.

Caution

* Operation on channels not designated for use by your classification of craft or on International Channels within US territorial waters is a violation of FCC Rules and Regulations and may result in severe penalties.

8500 VHF Weather Channels and Frequencies

Channel	Frequency (MHz)	Type Traffic	Function-Ship to Shore
WX0	163.275	NOAA Weather	Receive Only
WX1	162.550	NOAA Weather	Receive Only
WX2	162.400	NOAA Weather	Receive Only
WX3	162.475	NOAA Weather	Receive Only
WX4	162.425	NOAA Weather	Receive Only
WX5	162.450	NOAA Weather	Receive Only
WX6	162.500	NOAA Weather	Receive Only
WX7	162.525	NOAA Weather	Receive Only
WX8	161.650	Canadian Weath.	Receive Only
WX9	161.775	Canadian Weath.	Receive Only

ON	HIP TO SHORE
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SECTION 4

TECHNICAL DESCRIPTION

4.1 GENERAL

The VHF 8500 can be considered as consisting of two major sections. They are :

- The Control Circuitry (consisting of the front panel controls, the LCD display, control CPU).
- The Transmitter/Receiver/PLL circuits.

4.2 THE CONTROL SECTION

The heart of the control section is the CPU, which is IC201 located on the main PCB. The CPU controls all of the following items :

- controls the Squelch circuit by detecting a busy signal from the 2nd IF circuit IC5.
- generates a beep tone when a key is activated on the keyboard.
- mutes the transmitter modulation circuit when receiving.
- controls the output power of the transmitter High/Low.
- controls the dividing ratio N of the PLL circuit.
- switches On/Off the transmitter power.
- mutes AF audio.
- detects a weather alert signal (when in Monitor Mode).
- controls the LCD display.

4.3 THE TRANSMITTER/RECEIVER/PLL SECTION

In reading through the following circuit descriptions, it may be helpful to refer to Figure 4-1 Block Diagram of the TX/RX/PLL circuits.

4.3.1 PLL (Phase Lock Loop) Circuit

The PLL circuit is the frequency synthesizer in the VHF 8500.
The reference frequency of 12.8 MHz is provided by crystal XTL1 and IC4 IC4 contains the reference oscillator (12.8 MHz) circuit, the phase comparator, the program counter and the phase detector.
The 12.8 MHz reference signal is divided by 512 in the program counter in IC4 to obtain a 25 KHz reference signal. The dividing ratio is determined by CPU IC201. The VCO output from oscillator Q4 is amplified by buffer amplifier Q3, and returned to IC4 and is divided by the dividing ratio N to ob-

tain a 25 KHz signal. N for 1/N in IC 4 is determined by CPU IC201. Both of these 25 KHz signals are fed into the phase comparator circuit of IC4.
The phase detected signal, obtained by comparing the phase difference between these two signals, is applied to LPF between pins 11 and 12 of IC 4 to get a DC voltage correlated with the phase difference.
This DC voltage acts on the VCO to make the two 25 KHz signals the same phase. When this condition is met, the PLL circuit is locked. If the two signals have a large phase difference, the PLL is unlocked. In this condition, the unlocked signal is fed to CPU IC201 from IC 4 and the transmitter is compelled to stop.
The VCO output from Q 4 is fed to the TX amplifier Q 2 and the first RX mixer Q19 through buffer amplifier Q 3.

4.3.2 Transmitter Circuit

A signal from the microphone is fed to a pre-emphasis operational amplifier IC 3, and modulates VCO (Q 4) through active LPF IC 3.
The VCO output signal from Q 4 is sent to the RF power amplifiers IC1, Q1 and Q2 through buffer amplifier Q 3. The RF signal from IC1 is fed to the antenna through a low pass filter.
The DC voltage correlative to the RF output is detected by D2 and Q9, amplified by IC 2 and fed to IC 1. The output voltage from IC 1 controls the RF power to keep the RF output at a constant level.

4.3.3 Receiver Circuit

1) RF Circuit
The signal from the antenna passes through the single tuned band pass filter, and is amplified by RF amplifier Q17, and is fed into a triple tuned band pass filter. The signal is then mixed Q 3 (lock freq.) by Q19 (first mixer) and produces the first IF signal of 21.6 MHz. This signal is sent to a crystal filter (21.6 MHz) and 1st IF amplifier Q 20, mixed by IC 5, the 2nd mixer, and becomes an audio signal after detection.

2) AF Circuit
The AF signal from IC 5 is amplified by IC 6 to drive the speaker while the receiver is in the squelched condition. Muting control of IC 6 is carried out by the CPU IC201.

3) Weather Alert Tone Detecting Circuit
If a weather alert tone is included in the AF signal from IC 5 while receiving the weather service broadcast, IC 7 detects it and notify an alert condition to CPU IC201.

4) IF Circuit
The output of the 1st IF amplifier Q 20 is fed into IC 5. IC 5 contains the second mixer, second local oscillator, 455 KHz amplifier, quadrature detector and DC switching amplifier.
A 455 KHz ceramic filter is installed between pins 3 and 5 of IC 5 to examine the selectivity of this unit.
The detector output is separated into audio and noise components by an RC filter. The noise component is fed back to the noise amplifier section of IC 5. Its output is rectified by a diode in IC 5, and then fed to the switching amplifier in IC 5.

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BLOCK DIAGRAM

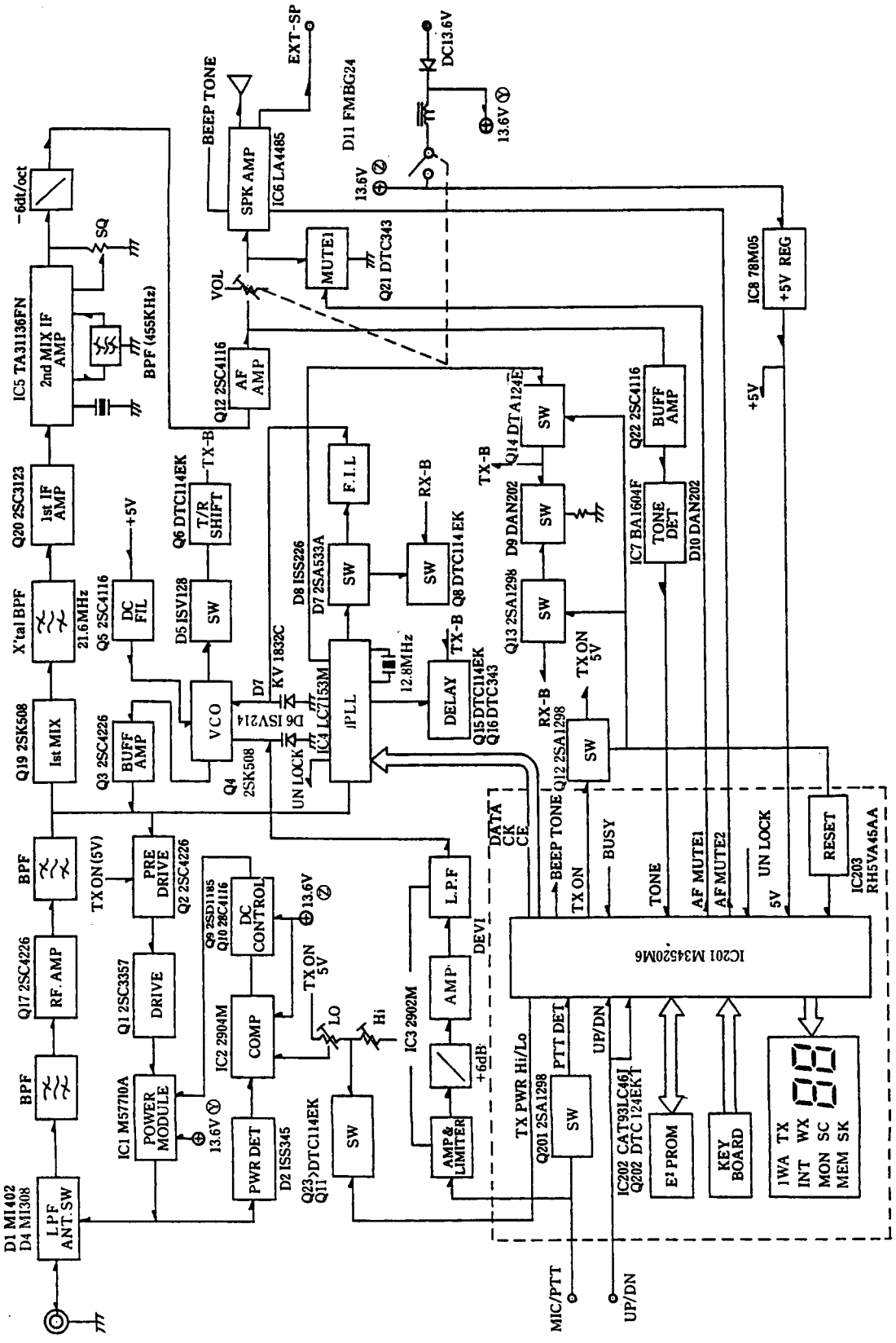

Fig. 4-1 VHF 8500 BLOCK DIAGRAM

4.4 SPECIFICATIONS

Transmitter

Channels	53 US/International
Frequency Stability	10 PPM (±0.001%) (–20˚C to +50˚C)
Frequency Range	156.025 to 157.425 MHz
Channel Spacing	25 KHz increments
Power Output	25 Watts switchable to 1 Watt into 50 Ohms at 13.6 Vdc
Modulation	Frequency modulated 16F3 (±4.5 KHz at 1000 Hz)
Modulation Audio Response	Shall not vary +1/–3 dB from true 6 dB pre-emphasis from 300 to 2500 Hz, reference 1000 Hz. Audio frequencies 3-20 KHz shall be attenuated (at 1 KHz by 60 log f/3 dB. Above 20 KHz by 50 dB)
FM Hum & Noise Level	Greater than –40 dB below audio
Audio Distortion	Less than 10% at 1 KHz for ±3 KHz deviation
Spurious & Harmonic Emissions	Attenuated at least 43 +10 log Po (below rated radiated carrier power) per FCC Rules Parts 2 & 80
Antenna Impedance	50 Ohms
Transmitter Protection	Shall survive open or short circuit of antenna system without damage (10 min. test)

Receiver

Channels	93 (includes 10 weather channels)
Frequency Range	156.025 to 163.275 MHz in 25 KHz increments
Frequency Stability	±10 PPM (0.001%) from –20˚C to +50˚C
Usable Sensitivity	0.3 µV for 12 dB (SINAD)
Squelch Sensitivity Threshold	0.2 µV or better 0.8 µV full squelch
Adjacent Chl Rejection	Greater than 70 dB
Spurious Image Rejection	Greater than 70 dB
Intermodulation Rejection	Greater than 70 dB

Audio Output	3 Watt or more at 10% or less distortion into 4 Ohm load
Hum & Noise in Audio	Less than –40 dB
Operating Requirements	
Input Voltage	13.6 Vdc ±15% (11.6 to 15.6 Vdc)
Current Required Transmit	Less than 5.8 amp at 25 Watts Less than 1.5 amp at 1 Watt
Operating Temperature	–20˚C to +50˚C
Duty Cycle	Continuous, 80% receive, 20% transmit (max 10 min. @ 25˚C)
Humidity	100% at 50˚C for 8 hours
Radio Dimensions	
Height	54 mm (2.2 inches)
Width	137 mm (5.4 inches)
Depth	166 mm (6.6 inches)
Weight	Approx. 1.3kg. (2.8 lb)

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SECTION 5

MAINTENANCE AND ALIGNMENT

5.1 GENERAL

The purpose of this section is to provide maintenance and servicing instructions for the service technician. The equipment is designed to provide long periods of trouble-free operation. It is recognized however, that environmental and other factors will result in a need for occasional service.

5.1.1 Product Support and Customer Service

In the event that your 8500 is in need of service, the dealer from whom the radio was purchased, or an authorized Apelco dealer should be contacted first for assistance. The authorized Apelco dealer is best equipped to handle your inquiries. If, after contacting your dealer, you have further questions and require further assistance, you may contact Apelco Marine Company directly at the following numbers:

Customer Service: (603) 647-7530 ext. 2120
Phone calls to this department should deal primarily with questions regarding: Purchasing Parts and accessories, authorized Apelco dealer locations, basic product information, and brochure/literature requests.

Product Support: (603) 647-7530 ext. 2444
Phone calls made to this department should deal primarily with the operation and technical aspects of Apelco Marine equipment. Please contact your dealer in advance.

When calling the above numbers, your phone call will be placed in a queue and will be answered in the order in which it was received. The normal operating hours for this system are from 8:30am-5:00pm Eastern Standard Time.

5.2 PREVENTIVE MAINTENANCE

The VHF 8500 has been constructed to be virtually maintenance free. Your attention to a few basic points should assure many years of service.

1) Although the unit is waterproof, always keep the unit as dry as possible.
2) Clean the exterior of the unit with a tissue or soft non-abrasive cloth.

CAUTION
Do not use solvents or other chemicals for cleaning this equipment.

3) Inspect the radio case and antenna for any physical damage.

4) Check the antenna connector and external speaker connections for any dirt or corrosion.

NOTE

The following alignment procedures have been provided in this manual to aid FCC licensed technicians and service personnel **only!**

5.3 ALIGNMENTS AND SERVICE

This transceiver is completely aligned at the factory and does not require any adjustments at installation.

The test equipment listed below are used for the test setup shown in Fig.5-1. This test setup is used either in part or in total during the following adjustments.

TEST EQUIPMENT

1. DC Power Supply (20V, 10A) set at 13.6 Vdc
2. RF Power Meter (40 W, 50 ohm, 150 - 200 MHz)
3. RF Signal Generator (50 ohm Output, 150 - 200 MHz)
4. FM Linear Detector (FMLD) or Deviation Monitor 150-200MHz
5. Frequency Counter
6. Digital Voltmeter (DC Voltmeter)
7. Oscilloscope (any oscilloscope accurate for audio signal tracing)
8. SINAD Meter
9. Distortion Meter
10. Toggle Switch (for use as a PTT switch)
11. Coaxial Switch for TX/RX antenna switching

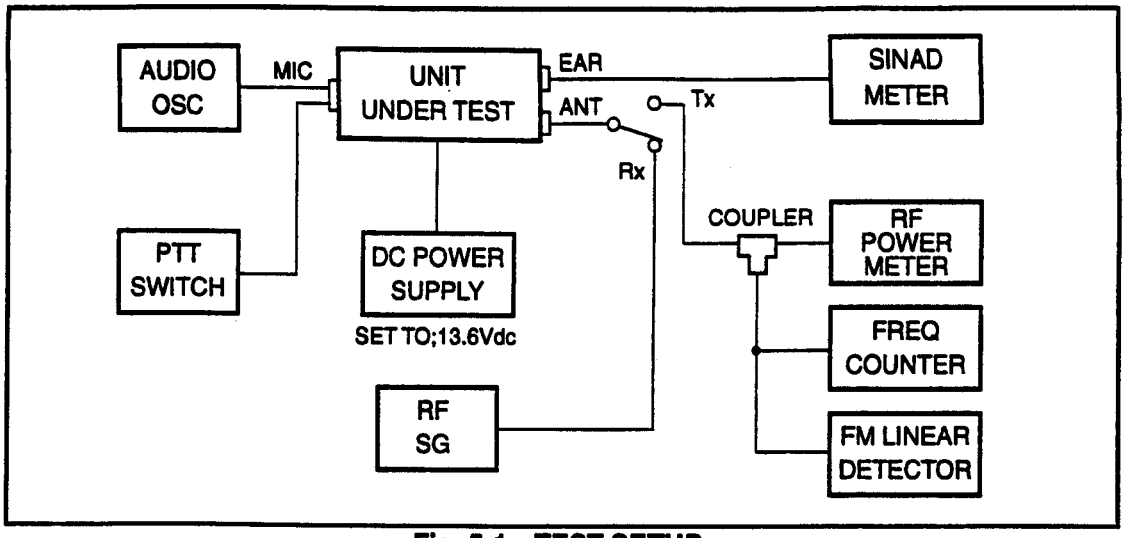


Fig. 5-1 TEST SETUP

5.3.1 PLL Adjustment (TRANSMITTER/RECEIVER)

1) Connect the power supply (13.6 V, 10 A) to the power line and the PTT switch to the microphone terminal.
2) Connect a digital voltmeter or high impedance tester (positive lead to TP1, negative to ground) and adjust T1 on the RF module as shown in Table 5-1. (See Fig. 5-2.)

Sequence	Item	Condition	Adj. point	Adj. volt.
1	TX	transmit CH.60 USA	T1	3.5 ± 0.1 Vdc
2	RX	receive CH.60	---	check for 1.65±0.3Vdc
3	RX	receive CH.WX0	---	check for 3.4±0.3Vdc

Table 5-1

5.3.2 Frequency Adjustment (TRANSMITTER)

1) Connect the coupler output to a frequency counter, set the radio on CH16 (156.800 MHz), key to transmit, and read the indication on the frequency counter.
2) Adjust trimmer capacitor CV1 on the RF module for the desired frequency (156.800 MHz) ± 200 Hz on the frequency counter. (Refer to Fig. 5-2.)

5.3.3 Modulation Adjustment (TRANSMITTER)

1) Connect the coupler output to an FM linear detector.
   Connect an audio oscillator to the microphone connector and key to transmit.
2) Set the audio oscillator output to –20 dBm, 300 Hz and adjust RV3 on the RF module for a deviation of 4.5 KHz ± 300 Hz. (See Fig. 5-2.)
3) Set the audio oscillator output to –43 dBm, 1 KHz and read the deviation meter (± 2.8 KHz — ± 3.2 KHz).

5.3.4 Power Output Adjustment (TRANSMITTER)

1) Connect an RF power meter to the antenna connector through the coupler. Key to transmit and adjust RV1 and RV2 on the main PCB as shown in Table 5-2. (See Fig. 5-2.)

Sequence	Condition	Adj. point	Target power
1	13.6 Vdc H/L: L	RV1 low power	0.9 W ± 0.05 W (limit 1.0 W)
2	13.6 Vdc H/L: H	RV2 high power	24 W ± 0.5 W (limit 25 W)

Table 5-2

5.3.5 RF Sensitivity Adjustment (RECEIVER)

1) Connect an RF signal generator to the antenna connector and a SINAD meter to the external speaker line.
   Set the deviation of the RF signal generator to 1 KHz ± 3 KHz.
2) Set the output level of the RF signal generator and adjust T2—T6 on the RF module as shown in Table 5-3. (See Fig. 5-2.)

Sequence	Condition	Adj. point	Target level
1	CH.88 (157.425 MHz) SG output: 60 dBμ	T2-T6	Max. sensitivity
2	CH.WX0 SG output: –6 dBμ	T2-T6	Over 12 dB SINAD

Table 5-3

5.3.6 Weather Alert Frequency Adjustment (RECEIVER)

1) Connect an RF signal generator to the antenna connector.
   Set the RF signal generator as follows:
   - Frequency: 162.550 MHz with no modulation
   - Output level: 60 dBμ
2) Select the weather channel WX1.
3) Connect a frequency counter to TP2 on the MAIN PCB and adjust VR4 to obtain 1050 kHz ± 5 Hz on the frequency counter. (See Fig. 5-2.)

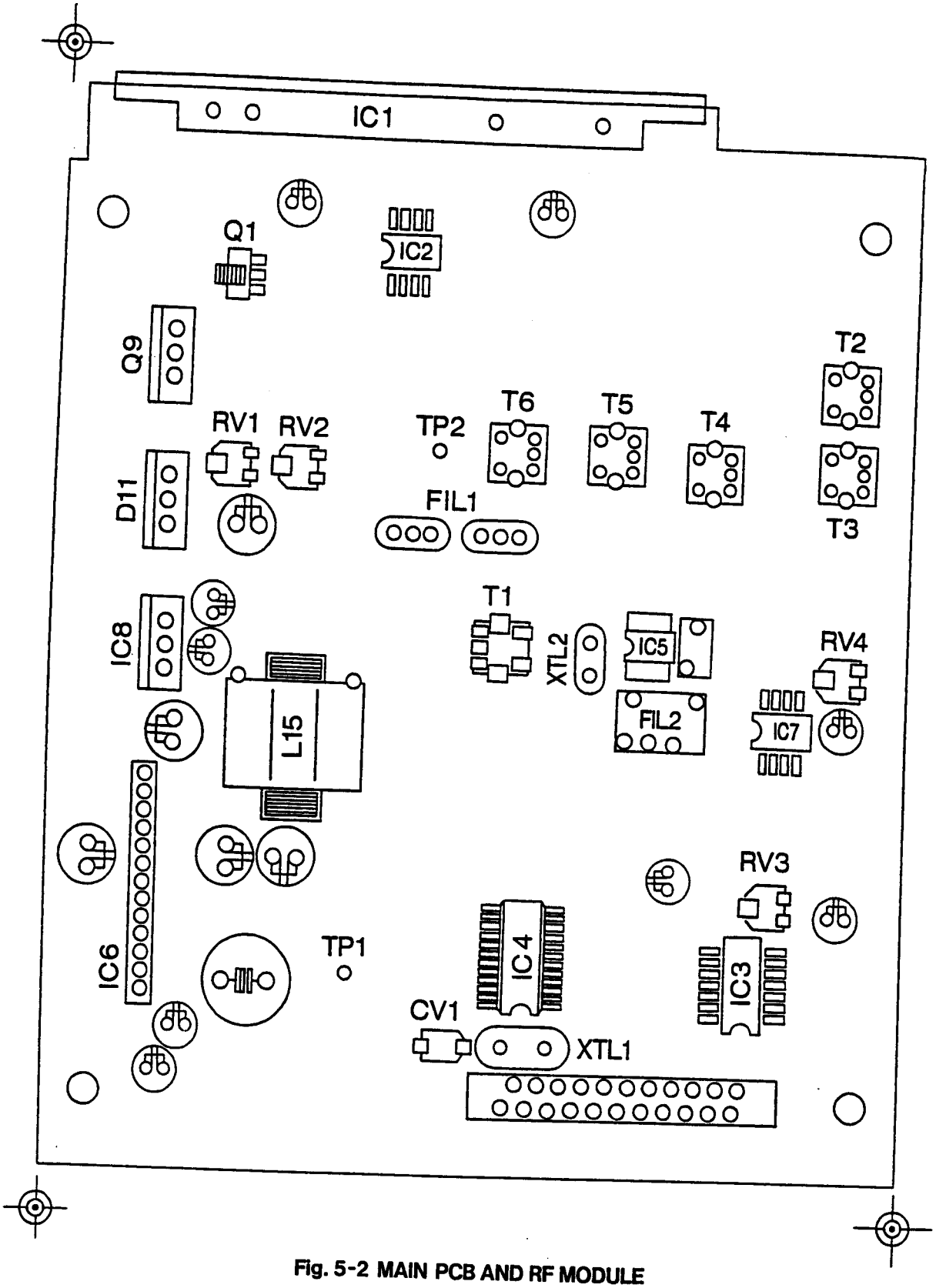


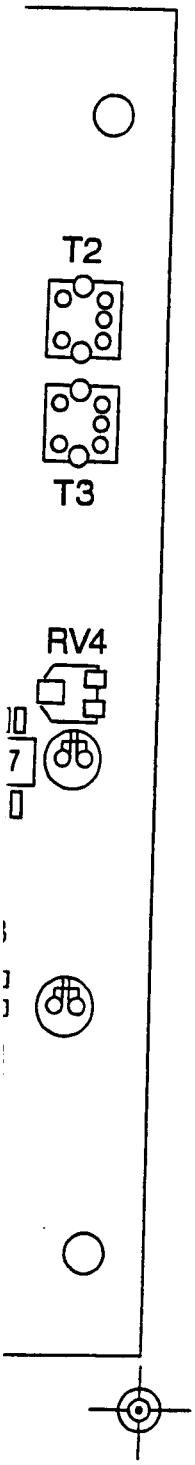
Fig. 5-2 MAIN PCB AND RF MODULE

5.4 TROUBLESHOOTING GUIDE

Table 5-4 provides a general troubleshooting chart for use by a technician to isolate circuitry failures to specific functional areas within the VHF radio.

NOTE

Micro-components within the radio are generally not field replaceable, therefore, repairs to the radio typically go down to the PC board level only. A replacement parts list for the VHF 8500 can be found in Section 6.



Item Number	Symptom	Possible Cause
1	Unit does not turn on.	a. Defective power switch. b. 10 amp. fuse in power line blown. c. Diode D11 open. d. Noise filter L15 open. e. Capacitor C119 and C120 shorted. f. Defective regulator IC8 (5V).
2	No sound with AF signal applied to pins 1 and 2 of IC6.	a. Defective internal speaker. b. Defective IC6 and/or associated components (C108, C109)
3	No sound with AF signal applied to volume control	a. Defective volume control. b. Defective mute circuitry (IC201).
4	Squelch circuit inoperative	a. Check squelch control. b. Defective IC5 and/or associated circuitry between pins7 and 9.
5	No receive (RX)	a. Defective regulators IC8 (5V). b. Defective Q13 (RX+B). c. Check IC5)audio output voltage at pin 9. d. Defective AF amplifier Q21. e. Defective mute circuitry IC201. f. Check XTL2 output for 21.145 MHz signal. g. Check 21.6 MHz output of first mixer Q19. h. Check 21.6 MHz output of ceramic filters FIL1. i. Check 21.6 MHz output of first IF amplifier Q20. j. Check 455 KHz signal from ceramic filter FIL2. k. Failue of VCO circuit (Q4, Q3, and/or PLL IC4). l. Defective CPU. (IC201).
6	Low receiver sensitivity	a. Check antenna and connector for possible corrosion or bad connection. b. Failure of the output from Q17, Q19, Q20, and/or IC5. c. Check the output level of VCO per para. 5.3.1.

Table 5-4 TROUBLESHOOTING CHART

Item Number	Symptom	Possible Cause
7	CPU inoperative	a. Turn off the power once, and try again. b. Check CPU clock frequencies (pins 22 and 23, and pins 26 and 27 of IC201). c. If clock frequency is not present, check for +5 Vdc line.
8	Display mulfunction	a. Check the interconnection to the LCD display. b. Inoperative CPU.
9	No transmit (TX)	a. Defective PTT switch. b. Defective regulators IC8 (5V). c. Defective Q12(TX+B). d. Check power transmit circuit (Q1, Q2, and/or IC1). e. Failure of VCO circuit (Q4, and/or Q3) or PLL IC4. or f. Check PLL control voltage for 3.5 V at TP1 on channel 60. g. Failure of talk detection circuit (IC201).
10	Low RF power output	a. Check RF power output from IC1. If it checks good, then check the triple Pi type network components (C2-6, L1-3, etc.) and antenna switching diode (D4). If not good, then check the voltage level outputs of the drive amplifiers Q1 and Q2 as well as the associated circuitry. b. Check power control circuit (IC2, Q9, Q10).104, and/
11	Poor or no modulation	a. Defective microphone. b. Defective IC3 and/or their associated components.
12	Deviation of transmit frequency	a. Check VCO output frequency at pin 14 of PLL IC4, PLL phase detector output at pin 12 of PLL IC4, and associated circuitry. b. Check 12.8 MHz crystal (XTL1).
13	PLL output frequency or level incorrect	a. Check frequency of 12.8 MHz crystal (XTL1). b. Check the frequency input at pin 14 of IC4 and verify the transmit frequency.

Table 5-4 (Continued)

SECTION 6

PARTS LIST AND DRAWINGS

6.1 PARTS LOCATION LIST

MAIN PCB ASSEMBLY SECTION

CKT, SYMBOL	DESCRIPTION	PART NO.
	MAIN PCB ASSEMBLY	G263720-3A
D1,4	ANT SW, MI308	
D2	RF POWER DET, ISS345	
D3	---------	
D5	RF SW, ISV128	
D6	MOD/VARI/CAP, ISV214	
D7	VCO/VARI/CAP, KV1832C	
D8	SW, ISS226	
D9	SW, DAN202	
D10	ISOLATOR, DAN202	
D11	ISOLATOR, FMBG24	
FL101	XTAL, 32.768KHZ	G263720-15
F901, F907	XTAL, MF21.6-RB	G263479-11
F905	XTAL, 21.145KHZ	G263479-17
F906	XTAL, 12.8MHZ	G263479-55
IC1	TX POWER MODULE, M57710A (or S-AV6)	1032698-85
IC2	OP AMP, 2904M	
IC3	OP AMP, 2902M	
IC4	PLL IC, LC7153M	
IC5	FN IC, TA31136FN	
IC6	AF POWER AMP, LA4485	G263720-10
IC7	TONE DETECTOR, BA1604	
IC8	+5V REGULATOR, 78M05	
Q1	TX DRIVER, 2SC3357	
Q2	TX PRE-DRIVER, 2SC4226	
Q3	BUFF AMP, 2SC4226	
Q4	VCO, 2SK508	
Q5	DC FIL, 2SC4116	
Q6,8,11,15,23,	SW, DTC114EK	
Q7	SW, 2SA811A	

Q9	DC CONTROL, 2SB1185
Q10	DC CONTROL, 2SC4116
Q12,13	SW, 2SA1298
Q14	SW, DTA124EK
Q16,21	AF SW, DTC343
Q17	RF AMP, 2SC4226
Q18,22	AF AMP, 2SC4116
Q19	1ST MIXER, 2SK508
Q20	1ST IF AMP, 2SC3123

CPU PCB ASSEMBLY SECTION

CKT, SYMBOL	DESCRIPTION	PART NO.
	CPU PCB ASSEMBLY	G263720-7A
H200	LCD, 211	
IC201	CPU, M34520M6	
IC202	EEPROM, CAT93LC46J	
IC203	RESET, RH5VA45AA	
PL-201, 202 203, 204	PILOT LAMP, 17	
PL-205	PILOT LAMP, 93(14V)	
Q201	SW, 2SA1298	
Q202	SW, DTC124EKT	

VOLUME/SQUELCH PCB ASSEMBLY

	VOLUME/SQUELCH PCB ASSEMBLY	G263720-5A