

RAY 210VHF

VHF RADIOTELEPHONE OPERATION MANUAL



PURPOSE

This contains very important information on the installation, operation, and maintenance of your new equipment. To get the best results in operation and performance, please take the time to read this manual thoroughly.

IMPORTANT NOTICE

This device is only an aid to navigation. Its accuracy can be affected by many factors including equipment failure or defects, environmental conditions, and improper handling or use. It is the user's responsibility to exercise common prudence and navigational judgment, and this device should not be relied upon as a substitute for such prudence and judgment.

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GLOSSARY OF TERMS

VHF	Very High Frequency: 30MHz to 300MHz
FM	Frequency Modulation
Carrier Wave	A Radio Frequency on which Intelligence is superimposed
Dual Watch	Monitor channel 16 while working on another channel
All Scan	Scans all channels
Select Scan	Scans only user selected memory channels
U.S.A. Channels	Channel designations as defined by the FCC
International Channels	Channel designations as defined by International Telecommunication Union
Canadian Channels	Channel designations as defined by the DOC
Weather Channels	Channels for routine and emergency weather information 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	Central Processing Unit
PLL	Phase Lock Loop (A type of frequency Synthesizer)
VCO	Voltage Control Oscillator
PTT switch	Microphone push-to-talk switch

SECTION 1

INTRODUCTION

1.1 GENERAL

Congratulations on your purchase of Raymarine's RAY210 marine radiotelephone.

Your RAY210 VHF-FM marine radiotelephone provides reliable simplex and duplex (two-frequency) communications between ships and from ships at sea to public or private shore stations. The RAY210 is programmed for two-way communication on all the International, US and Canadian channels plus reception on ten separate weather channels, and the international calling and safety channels (16/9). Simple installation requires attaching the mounting yoke and microphone bracket, connection to a 13.6 Vdc power source, and to a proper VHF antenna.

This manual describes the physical and functional characteristics of the radiotelephone.

1.2 EQUIPMENT FEATURES

The RAY210 is designed and manufactured to provide ease of installation and operation with excellent reliability. The important built-in features of the equipment are listed below;

1) 51 transmitting channels and 93 receiving channels within the assigned VHF/FM maritime band. All U.S. and International channels are included.

2) Automatically scans four modes;

- ALL channels
- Any selected channels
- Dual watch plus weather: channel 16/9 and any other selected weather channel
- Dual Watch: channel 16/9 and any other selected channel.

3) All solid-state circuitry for low current drain and maximum reliability.

4) Exclusive circuit that automatically selects USA channel 16 and 25 watts output power when radio turned on.

5) High-performance receiver section with optimum selectivity for operation in "noisy" or "high traffic" areas.

6) Four watts audio output power to speaker provide adequate volume even in a noisy environment.

- 7) Large speaker cavity designed to provide superior audio quality.
- 8) Selected channel number indicated on the LCD digital display.
- 9) "Quick" channel 16 or 9 key to instantly switch to emergency channel 16/9.
- 10) Full 25 watts RF output power to the antenna port with protective circuitry to prevent damage to the radio if operating into a faulty antenna system.

1.3 SPECIFICATIONS

Appendix 1 : Design Specification Model RAY210

General : FCC Part 80, ITU Radio Regulations Appendix 18.

DOC CAT V RSS-18 Issue 2.

1.3.1 Electrical Specifications;

Transmitter

Channel	51 USA /International
Frequency Stability	+/-5ppm(+/-0.0005%)
Channel Spacing	25KHz Increment
Power Output	25Watts Switchable to 1 Watt into 50 ohm at 13.6 Vdc.
Modulation	Frequency Modulated 16F3 (+/-4.5KHz at 1000Hz)
Modulation Audio	within the limit of +/-3dB at 6dB/oct freq. curve (300-2.5KHz)
Hum & Noise Level	Greater than 40dB below audio
Audio distortion	less than 10% at 1KHz for +/- 3KHz deviation
Spurious & Harmonic	greater than 70dB below carrier power.
Antenna Impedance	50 ohms

Receiver

Channel	93 (Includes 10 WX Channels)
Frequency Range	156.025 to 163.275MHz in 25KHz increments
Frequency Stability	± 5 ppm (± 0.0005 %) -20degree C to +50degree C
Sensitivity	0.3 μ V for 12dB SINAD
Squelch Sens. Threshold	0.2 μ V or better
Tight Squelch Sens.	1 μ V
Adjacent CH Rejection	greater than 70dB
Spurious Image Rejection	greater than 70dB
Intermodulation Rejection	greater than 70dB
Audio Output	4 Watts @ 4 ohms with Less than 10% distortion
Hum & Noise	greater than 40dB
Operating Requirement	
Input Voltage	13.6 Vdc ± 15 % (11.6 to 15.6Vdc)
Current Required for Transmit	Less than 5.5 A at 25 Watts
Operating Temperature	Less than 1.3 A at 25 Watts -20° C to +50° C

1.3.2 Mechanical Specifications

Waterproofness:

CFR 46 Parts 110,111

Mechanical Requirement

(1) Cabinet

Front : ABS

Rear : Die-Cast

(2) Keyboard

Silicon Rubber

(3) Display

Custom LCD (EL Backlit LCD)

(4) External Hardware

Non Corrosive and porous metal shall be used

(5) External connections

Antenna M-Type power/External
Speaker 4- Pin Jack

SECTION 2

INSTALLATION

2.1 UNPACKING AND INSPECTION

Use care when unpacking your new RAY210 from the shipping carton to prevent damage to the contents. It is also a good practice to save the carton and the interior packing material. The original packing material should be used in the unlikely event that it becomes necessary in the future to return the unit for service.

2.2 EQUIPMENT SUPPLIED

The following is a list of the standard equipment include with your RAY210 model.

Description	Part No.
Radiotelephone	M56798
Microphone Bracket w/hardware	G623759-3
Mounting Yoke	G623760-7
Yoke Knob	G623760-8
Yoke Rubber Spacer	G623760-9
Microphone	G623759-2
Power Cable	G623760-6
Instruction manual	G623759-5
Bridge Card	G623759-6
Fuse (s) Kit	
FCC Instructions	FCC FORM506
Sun Cover	G623759-4

2.3 PLANNING THE INSTALLATION

When planning the installation for your RAY210, the following conditions should be considered to insure dependable and trouble-free operation.

- 1) The mounting location should be easily accessible to allow operation of the front panel.
- 2) There should be adequate ventilation.
- 3) A sufficient space should be secured behind the transceiver to allow cable connections to the rear panel connectors.
- 4) The transceiver should be located near a power source.
- 5) The selected location should be far enough away from devices that may cause interference, such as motors and generators.
- 6) Generally speaking, the transceiver should be protected from prolonged direct exposure to rain and salt spray. It is a good practice to protect your valuable electronic equipment as much as possible.

The RAY210 can be conveniently mounted on a chart table, bulkhead, overhead or any other desired location.

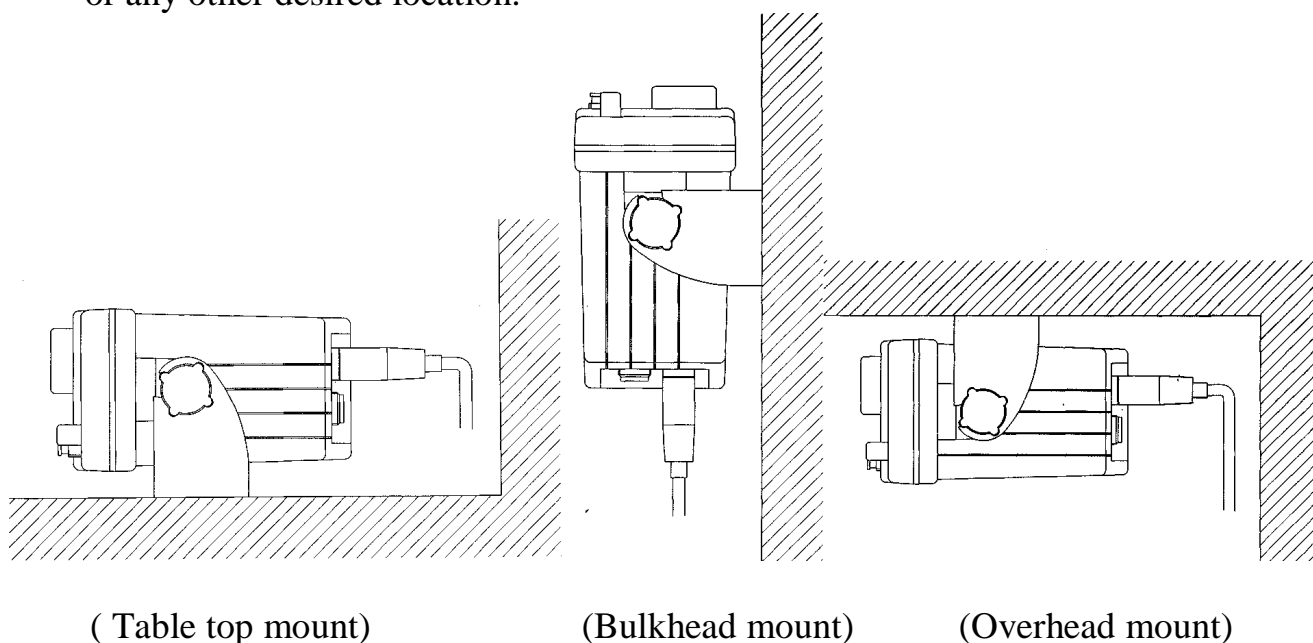


Figure 2-1 Typical Mounting Methods

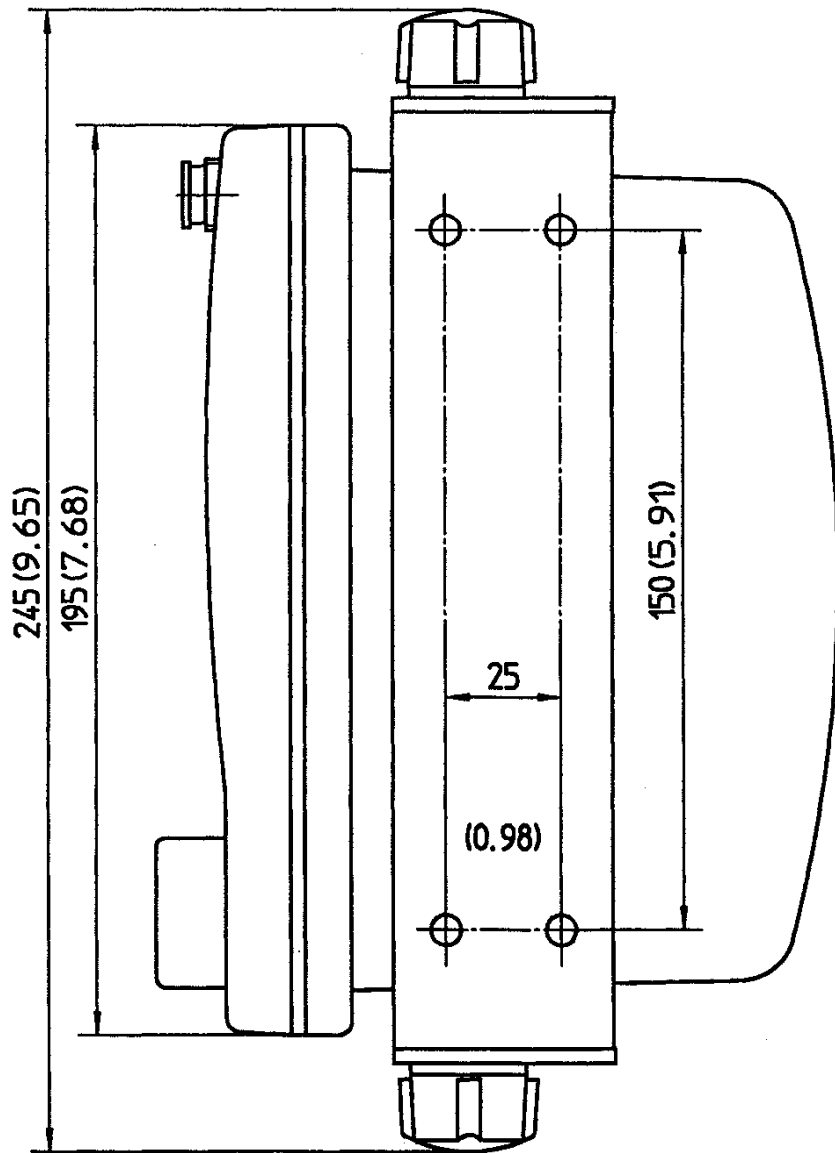
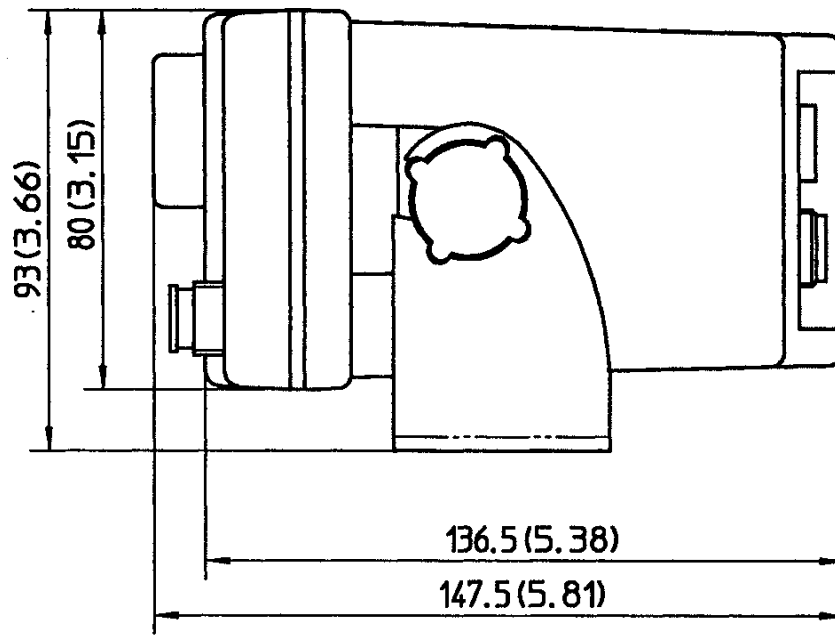


Figure 2-2 Outline and Mounting Dimensions

2.3.1 Mounting Options

The RAY210 may be given a professional appearance when mounting the radio into a console when ordering and using the optional RAY 210 Console Mounting Kit-Product Code M92803. The Console Mounting kit is available from your Raymarine dealer.

2.4 ELECTRICAL CONNECTIONS

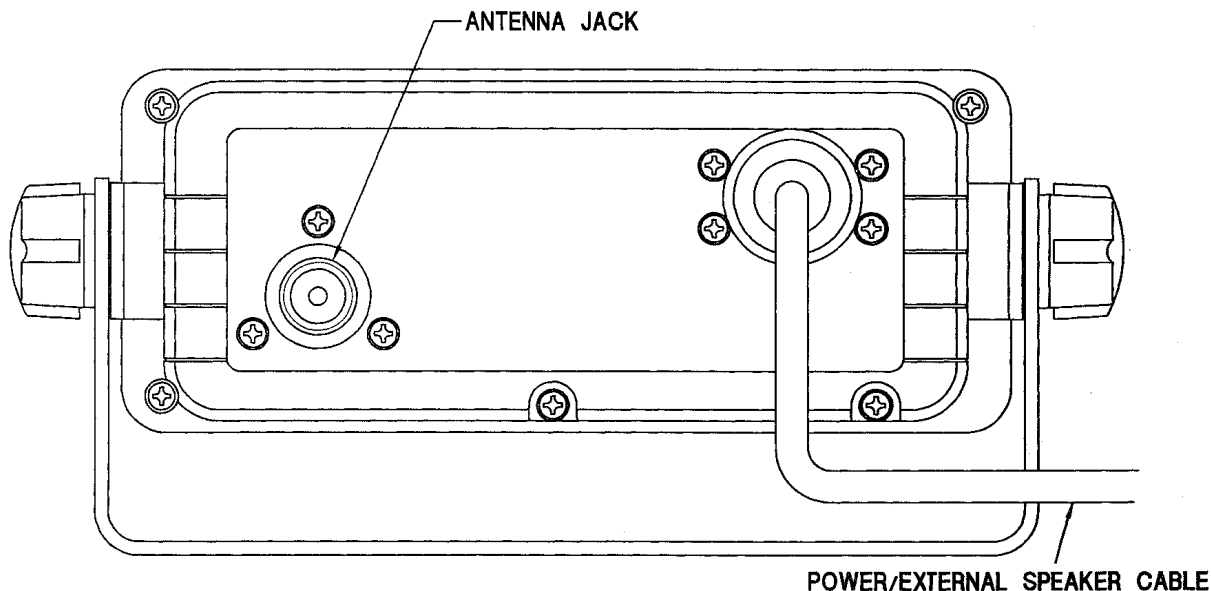


Figure 2-3 Rear View

CAUTION

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

2.4.1 DC Power and External Speaker Connections

The 6 foot long power cable assembly consists of the DC power and the external speaker cable. The DC power cable is composed of RED (+) and BLACK (-) wires, and the external speaker cable has YELLOW (+) and GREEN (-) wires. The RED (+) wire with an in-line fuse (10 amps.) and the BLACK (-) wire of the 4 pin connector cable are used for connecting the RAY210 to the ship's 12 VDC power system. (refer to fig 2-4)

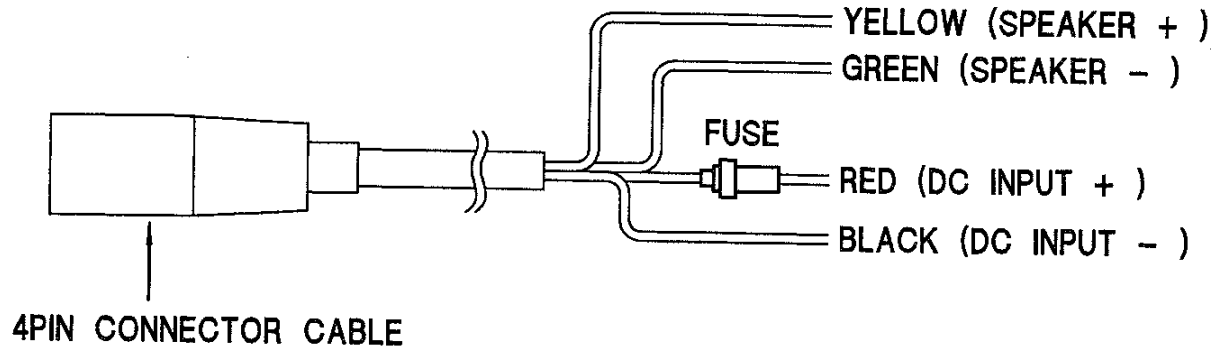


Fig 2-4 POWER / EXTERNAL SPEAKER CABLE AND 4PIN CONNECTOR CABLE

In most cases this 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 distance.

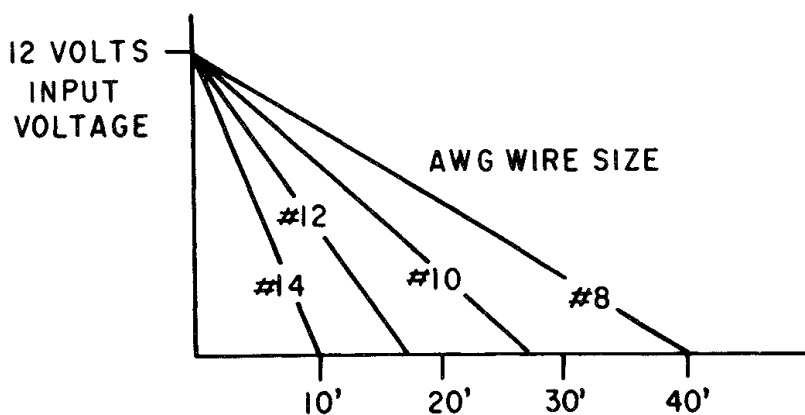


Fig 2-5 POWER CABLE LENGTH

Your RAY210 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 near the unit. When connecting to either of these sources, the circuit breaker or other in-line fuse should be rated at 10 amps.

It is recommended that lugs be used to connect the power cable to the DC supply and that 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.

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 open. Check the input power leads for correct polarity with a VOM (volt /ohm meter), 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 RAY210 to the external speaker. (Refer to Fig 2-4)

Four 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 will sound simultaneously.

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 cable or equivalent cable may be used for 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 exposed to the marine environment, a protective coating of grease (similar to Dow Corning DC-4) can be applied to the connector before connecting it to the radio. Any other extensions or adapters in the cable run should also be protected by silicon grease and then wrapped with a waterproofing 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 that is designed for use aboard boats should be used.

There are several factors to consider in order 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 obstruction 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 coaxial 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 to VHF radiotelephone installations, it is a good marine practice to properly ground all electronic equipment to the ship's ground system. The RAY210 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 RAY210's cabinet was specifically designed and die-cast from aluminum to insure maximum noise rejection from external sources.

SECTION 3

OPERATIONS

3.1 INTRODUCTION

Your RAY210 has the capability to transmit on 51 and receive on 93 Marine VHF radiotelephone channels. There are channels that are FCC approved but may only be used by authorized stations for specific purposes, depending on the type of vessel (commercial or non-commercial). Take a look at Table 3-1 and 2 on page 22-24 which lists all of the marine VHF channels available in your RAY210 for International and U.S. radiotelephone use. Full familiarization with this table is essential when selecting your channels. The international frequencies were agreed upon by the attending countries at the 1968 International Telecommunication Union Meeting in Geneva and are in active use around the world. The U.S. channels are those channels authorized for use in the U.S.A. by the FCC.

3.2 CONTROLS AND LCD DISPLAY

Refer to Figure 3-1 for familiarization with the controls and mode display.

3.2.1 Controls

1) On / Off and Volume Control:

This control switches the RAY210 on and off and controls the volume level of the internal speaker. Turning the radio On will apply power to the radio circuitry. When the radio is on, rotating this control clockwise will increase volume to the internal speaker and rotating this control counterclockwise will decrease volume.

2) CHANNEL Selector Control

This control selects the desired operating channel. When the control is turned in a clockwise direction, the channel number increases. When the control is turned in a counterclockwise direction the channel number decreases.

3) SQUELCH Control

Provides an adjustable input signal threshold to eliminate random RF background noise during “no signal” conditions. This control sets the signal-to-noise ratio at which a signal will become audible.

4) [16/9] Key

Used to select channel 16 or 9 immediately. This Key enables the following operating mode;

At the time of shipment	:	n	16	9	n
Press for more than 3 sec	:	n	16	n	
Press for more than 6 sec	:	n	9	n	
Press for more than 9 sec	:	n	16	9	n

(n = The Previously Monitored Channel)

This key is operative any time and will stop All Scan or Select Scan when pressed.

5) [FUNC] (Function) Key:

When the [FUNC] key is pressed, an F will appear on the LCD to let the operator know that a Secondary Function can be selected. To operate a secondary function, first press the [FUNC] key, then press the desired front panel key. To cancel a secondary function and return to the previous operating mode, repeat the same procedure.

The function key enables the following operating modes and operations when the associated keys are depressed:

- All Scan Mode - press [FUNC] then [SCAN] : SCAN will be displayed on the LCD.
- TX Power setting mode - press [FUNC] then [1/25] :1W will be displayed on the LCD.
- DWX mode - press [FUNC] then [DWX] : DWX will be displayed on the LCD.
- MEM mode - press [FUNC] then [MEM] : MEM will be displayed on the LCD.
- International mode - press [FUNC] then [INTL] : INTL will be displayed the LCD.

6) [SCAN] (All Scan) Key:

This key is used as a secondary function to activate the all scan mode. To activate the all scan mode, press the [FUNC] key, then [SCAN]. SCAN will be displayed on the LCD and the RAY210 will sequentially scan all USA or INTL channels (CH 01- CH 88, See Table 3-2 page 23 and 24) except weather channels. To cancel the scan function, press the [FUNC] key then [SCAN].

- If signal is present on the channel that is being scanned, the scanning will stop until the station clears. After the station clears and no signal is received for five seconds, the scanning will resume. Pressing [SC] (scan continue) will reactivate the scanning if the radio has stopped on a particular channel and the operator wants to continue.

- If the radio has stopped on a channel, and the operator wants to transmit on that channel, pressing the PTT switch will cancel the scan function and the RAY210 will remain on that channel.
- If the radio stops on a channel during the scan mode due to a received signal, the operator can cancel the scan function and the RAY210 will remain on that channel. If no signal was present when the All Scan is deactivated, the radio will revert to the channel in use prior to the selection of All Scan.

When the radio is in the All Scan mode, the keyboard is inoperative except for the following keys: [SC], [DIM], [VOLT], and [16]. The transmitter is inhibited in the All Scan mode.

NOTE: During scanning operations, a VHF radio will sometimes stop on a particular channel for no obvious reason. This can be caused by electrical noise and interference that may be common to a particular port or harbour area.

7) [1/25] (high / low power) key:

This secondary function is used to toggle the transmit power setting between 25 watts and 1 watt. To set the transmitter to low power setting (1 watt), press the [FUNC] key, then [1/25]. 1W will then be displayed on the LCD and your RAY210 will apply approximately 1 watt of power to the antenna during transmit operation. When 1W is not displayed on the LCD, the radio is set to provide 25 watts of power to the antenna. The low power setting is provided for situations where the parties communicating are close to each other. This reduces radio channel congestion in distant areas, allowing more individuals to use the same channel at a given time.

Some VHF channels are required by the FCC to be automatically set to transmit on low power (Refer to Table 3-2 on pages 23 and 24). The operator may override this automatic setting on some of these channels. To override the automatic low power setting on authorized channels, press the [FUNC] key then [1/25] key and hold.

8) [DWX] (Dual Watch Plus Weather) Key:

This secondary function key activates Dual Watch plus Weather Mode and illuminates the DWX symbol on the LCD. In this mode, the RAY210 will scan (monitor) priority channel 16, a user selected channel, and selected weather channel (monitor weather alert warnings). To operate this mode, first select a working channel, then select a weather channel by pressing the [WX] key and set to desired channel. Pressing [FUNC] key and then the [DWX] key will activate the DWX mode. Pressing the [FUNC] and then the [DWX] key again cancels the DWX mode.

- If a signal is received on either channel 16 or the selected working station while in the DWX mode, the operator can communicate with the calling party and still remain in this mode.
- If a weather warning is received on the weather station being monitored, the RAY210 will emit a series of tones. The radio will then automatically switch to the WX mode in order to monitor the emergency broadcast. The radio will no longer be in the DWX mode.

9) [MEM] (Memory) key:

This secondary function key stores channels into memory for select scan functions. To store a channel using the memory, select the desired channel using the selector knob, press the [FUNC] key, then [MEM]. The MEM symbol will illuminate on the LCD and the displayed channel will be stored into memory. The same procedure is used to remove a channel from memory. To view all channels that are stored in memory, press the [RCL] key. RAY210 will display each channel in memory, then return to the previously selected channel.

10) [INTL] (International) key:

This key causes the synthesizer to program international frequencies and illuminates the INTL symbol on the LCD. To change to international frequencies, press [FUNC] key, then [INTL]. To return to U.S. channel frequencies, repeat this same procedure.

11) [WX] (Weather) key:

When pressed, puts the radio into the weather receiving mode. A WX indicator will be displayed on the LCD along with the weather channel number (0-9). Rotate the channel selector knob until the desired WX channel is displayed. Refer to Table 3-1 (page 22) for weather channel frequencies. Pressing the [WX] key a second time returns the RAY210 to the operating channel previously used.

12) [DW] (Dual Watch) key:

Pressing this key puts the radio into the Dual Watch mode and DW is illuminated on the LCD. The RAY210 will then monitor the current selected channel and channel 16. If a signal breaks squelch on either channel, the radio will change to that channel. After the channel clears, and no transmission is received for five seconds, the radio will return to the Dual Watch operation.

13) [SC] (Scan Continue) key:

During scanning mode, if a signal breaks squelch on a certain channel, the scanning will stop on that channel. Pressing the Scan Continue [SC] key will resume the scan operation.

14) [SS] (Select Scan) key:

Pressing this key puts the radio into the Select Scan Mode, and MEM SCAN will be illuminated on the LCD. In this mode the RAY210 will scan only those channels which have been stored into memory by the operator.

- If a signal breaks squelch during the scan operation, the radio will stop on that channel and will resume scanning only after a signal is no longer received and the channel remains clear for five seconds.
- If a signal breaks squelch during the scan operation and you wish to communicate with the other party, when the PTT switch is depressed, the scan mode will deactivate and the radio will operate normally on the channel.

If a signal is present when the Select Scan is deactivated, the radio will remain on that channel. If no signal is present when the Select Scan is deactivated, the radio will revert to the channel in use prior to the selection of the Select Scan Mode.

When the radio is in the Select Scan mode, the only keyboard buttons that preempt the scan are [SS] and [16]. Note that two separate sets of programmed memory channels are possible, one set of International channels and one set of USA channels. The transmitter is inhibited in the SS mode.

15) [M1] through [M5] "quick" memory keys:

Using these keys, the operator can store up to five channels in memory for quick and convenient access any time. To store a channel in the M1 through M5 quick memory:

- Select the desired channel with channel selector knob.
- Press and hold the desired quick memory key for approximately three seconds until two beeps are heard.
- The memory location number will then be displayed on the LCD.

16) [RCL] (Memory Recall) key:

When this key is pressed, the RAY210 will display each of the channels that are currently stored in memory for the Select Scan mode.

Upon completion, the radio will return to the previously selected channel.

17) [DIM] (Dimmer) key :

The [DIM] key changes backlighting level for the front panel. The backlighting is in the off condition when the RAY210 is first turned on. There are four levels for front panel illumination (high, medium, low, and off), Pressing the [DIM] key one time turns the backlight to its brightest setting (high). Each subsequent press of the backlight key decreases the level of illumination. Once the backlight is decreased to the "off" condition, the next press of the [DIM] key returns the backlight to high.

18) [VOLT] (voltmeter) key :

Pressing this key will activate the unique digital voltmeter feature for fast verification of input DC voltage to your RAY210.

To activate the voltmeter, press [VOLT] key. The display will then show the input DC voltage for five seconds, then will return to previous operation.

19) [D/L] (sensitivity) key :

The receiving sensitivity is changed by pressing this key. When the RAY210 is turned on, sensitivity is set high. To reduce receiving sensitivity, press [D/L] key. When at low sensitivity setting "DESENS11 is displayed on the LCD.

Note: When your radio is interfered with by pagers, land mobile and TV signals, your RAY210 can eliminate the interference by utilizing the desensitising function.

20) Microphone PTT (Push-To-Talk) Switch :

When pressed puts the radio into the transmit mode, and a "TX" is displayed on the LCD. Bar segments of 1 through 3 will illuminate when the PTT switch is depressed at 1 Watt. Bar segment 4 will illuminate when modulation is detected. At 25 Watts, segments 1 through 6 will illuminate when PTT is depressed and 7 will display when modulation is detected.

21) Microphone 16/9 switch :

This switch has the same function as that of the main unit.

22) Microphone Up/Down Channel Switches :

These keys located on the right side of the microphone (labelled CH) allow the operator to switch radio channel by simply pressing the appropriate arrow. The channel number can be increased or decreased one with each press, or if held will continue to increase or decrease the number as long as the key is held.

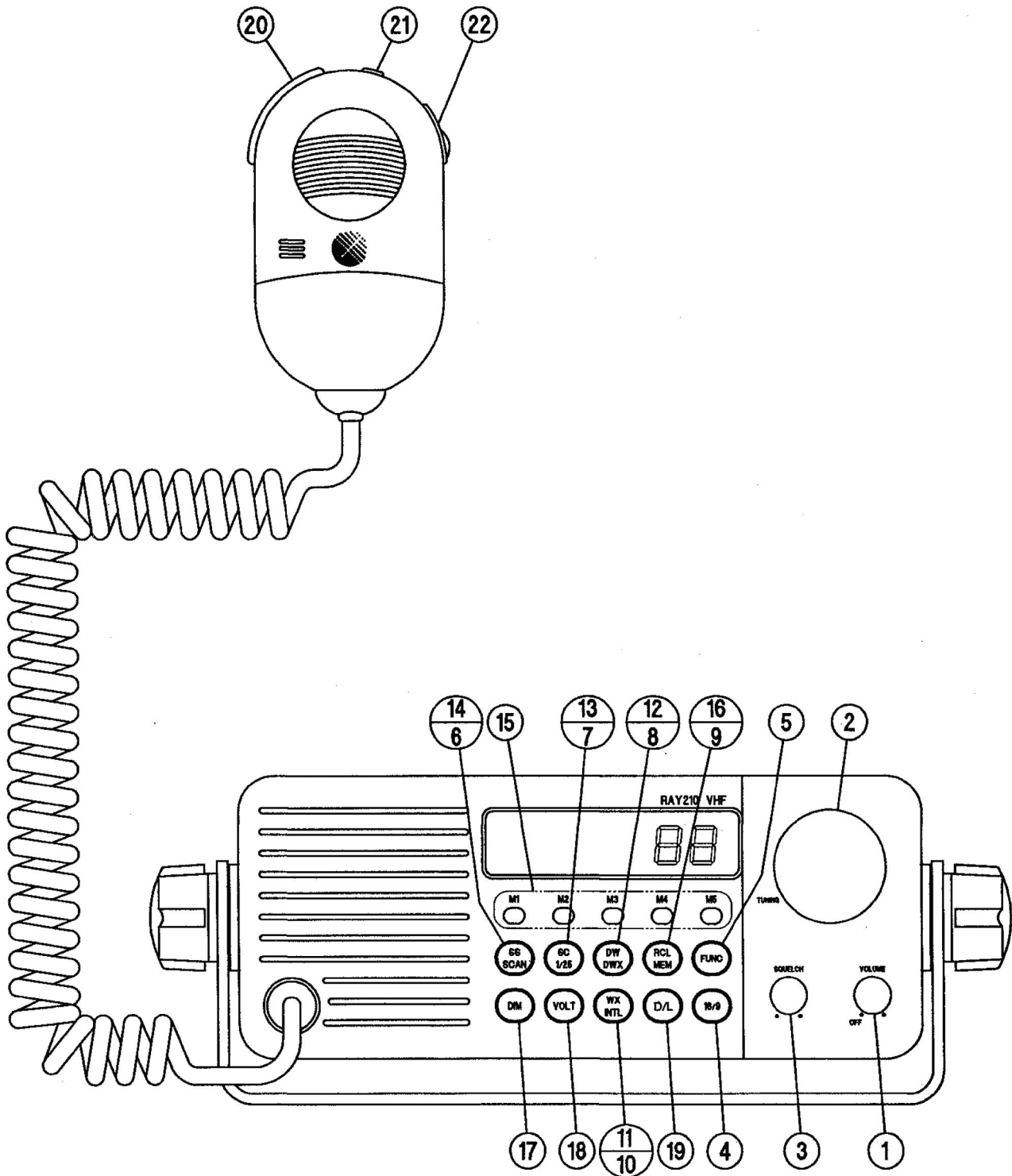


Figure 3-1 Layout of Controls and Connectors

MEM (Memory): will appear on the LCD display to show the operator that the displayed channel has been programmed into the Select Scan memory.

SCAN (All Scan): will appear on the LCD display when the radio is in the All Scan mode.

WX (Weather): will appear on the LCD display when the radio is in the Weather mode.

TX (Transmit): will appear on the LCD display when the microphone push-to-talk switch has been pressed and the transmitter circuits are providing a signal to the antenna.

1W (1 Watt, Low Power Setting): will appear on the LCD display when the transmitter output power has been set to Low Power (1 Watt), or when a low power channel has been selected using the channel selector knob.

F (Function): will appear on the LCD display when the [FUNC] key has been pressed to operate a secondary key function. The secondary key functions are as follows : SCAN, 1/25, DWX, MEM, and INTL.

LCD Bar Indicator: In the transmit mode, the 7 bars indicate transmitter conditions. During low power transmit (1W), 3 bars will be displayed continuously and a fourth bar will indicate modulation. During high power transmit (25 W), 6 bars will be lit continuously and seventh bar will indicate transmit modulation.

V (volt) : The DC supply voltage to the RAY210 will appear on the LCD display for 5 seconds when the [VOLT] key is pressed.

CHANNEL #: The selected channel number will appear on the LCD display when a communication, distress, or weather channel is selected by the operator.

Channel numbers will be displayed in two digits (01-88) for U.S A and INTL channels as follows:

01

88

Weather channels WO to W9 are displayed in a single digit (0-9) on the LCD display as follows:

0

9

3.3 OPERATING PROCEDURES

Specific operating procedures for the RAY 210 are presented on 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!2 for a thorough description of all functions.

3.3.1 Turning the power on (Transmit/Receive)

Turn the ON/OFF/Volume control to switch the radio on. Rotate the knob clockwise and set it at approximately the mid point of it's range.

3.3.2 Setting the volume

Rotate the Squelch control fully counterclockwise, and set the ON/OFF/Volume control to the desired listening level.

3.3.3 Setting the Squelch

Rotate the Squelch control clockwise until the receiver becomes "quiet" and the audible noise coming from the internal speaker ceases.

3.3.4 Selecting a Channel

Rotate the channel selector switch to the desired channel. See Table 3-2 (Page 23 and 24) for available U.S.A. and International channels and their frequencies. To transmit and receive on channel 16/9, press the "quick" 16/9 key. If the [16/9] is pressed again, the RAY 210 will return to the previous channel.

NOTE: Initial communication contacts are usually made on channel 16 as all ships and shore stations monitor this channel. Then switch to a working frequency for general communications.

3.3.5 Setting the Power Output

Press the [FUNC] and then the [1/25] key to select the power output. Power setting is dependent on the distance the message is to be transmitted, and transmitting conditions. In certain U.S. harbours and on certain channels, the FCC requires the power to be limited to 1W. On these "required" channels, the RAY 210 automatically selects 1 watt operation when the channel is selected 1W will appear beside the channel number.

3.3.6 To Transmit

To transmit, press the Push-To-Talk switch on the side of the RAY 210 microphone. Speak into the microphone using a clear, normal voice.

The RAY 210 is designed to meet the FCC Rules Part 80.203. This rule requires transmitter time out circuitry which will automatically disable the transmitter after 5 minutes of continuous transmit.

After 4 minutes of continuous transmit, the RAY 210 will emit two warning tones. If the transmitter remains engaged for an additional minute, or 5 minutes total, the RAY 210 will automatically disable the transmit operation.

At this time, the RAY 210 will cease transmitting, emit an alarm, and “ot” will be displayed on the LCD. To return to normal operation, the microphone FIT switch must be disengaged.

3.3.7 To Transmit and Receive on INTL Frequencies

To transmit and receive on International frequencies, press the [FUNC] and then the [INTL] key, then select the desired channel. INTL will appear on the display to indicate International operation.

3.3.8 Selecting a Weather Channel

To select and receive a weather channel, press the [WX] key and then rotate the channel selector switch to the desired channel (0-9). Refer to the below Table 3-1 for specific weather channel frequencies. When in the weather mode, the transmitter is disabled.

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

Table 3-1 RAY 210 VHF WEATHER CHANNELS AND FREQUENCIES

RAY 210 VHF RADIOTELEPHONE CHANNELS

Channel Design.	Frequency (MHz)			TYPE OF TRAFFIC	FUNCTION	
	TX	RX (U.S.A.)	RX (INTL)		SHIP TO SHIP	SHIP TO SHORE
01	156.050	156.050	160.650	VTS/Portops	Yes	Yes
02 #		156.100	160.700	Port Operations	Yes	Yes
03 #		156.150	160.750	Port Operations	Yes	Yes
04+	156.200	156.200	160.800	Can. SAR/Port Ops	No	Yes
05	156.250	156.250	160.850	Port Operations	No	Yes
06	156.300	156.300	156.300	Safety; Ship/Ship	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. Bridge/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	157.000	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

Table 3-2

*1 Watt only

**1 Watt initially. May override to full transmit power via front panel operations.

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

The transmitter is automatically disabled when channels 2 and 3 for USA channels and channel 15 for USA and International channels is selected.

Channel Design.	Frequency (MHz)			TYPE OF TRAFFIC	FUNCTION	
	TX	RX (U.S.A.)	RX (INT'L)		SHIP TO SHIP	SHIP TO SHORE
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	~	-	-
64+-	156.225	156.225	160.825	-	-	-
65	156.275	156.275	160.875	Port Operations	No	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	DSC Code only	
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	Non Com'l	Yes	Yes
80	157.025	157.025	161.625	Non 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 3-2 (Continued)

*1 Watt only

**1 Watt initially. May override to full transmit power via front panel operations

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

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.

SECTION 4

TECHNICAL

4.1 RECEIVING CIRCUIT OPERATION:

4.1.1 Antenna Switching Circuit:

A signal received at the antenna connector J1 goes to the antenna switching circuit composed of pin diode D1 and D2 via the low pass filter.

4.1.2 High Frequency Amplifier Circuit:

After being amplified by transistors RF AMP1 (Q21) and RF AMP2 (Q22), the high frequency signal which is sent from the antenna switching circuit goes through BPF to suppress the undesired signals. Then the high frequency signal is added to the 1st mixer of the next step diode (D15, D16).

A local oscillating signal from PLL unit (134MHz range) is input to this 1st mixer, mixed with the receiving signal to make the 1st intermediate frequency (21.6MHz).

4.1.3 1st Intermediate Frequency Amplifier Circuit

After undesired signals have been removed by a pair of crystal filters (FIL101), the 1st intermediate frequency signal generated in the 1st mixer is amplified at the 1st IF AMP (Q30).

4.1.4 2nd Intermediate Frequency Circuit:

The 1st intermediate frequency signal is added to IC307, which is composed of a local oscillating circuit, a mixer circuit, a limiter amplifier circuit, a remodulation circuit and a squelch circuit.

The 1st intermediate frequency signal is converted to 455KHz 2nd intermediate frequency signal after being mixed with 21.145MHz signal which is output from the local oscillating circuit in IC307 and a crystal oscillator (XTAL4). Undesired signals are removed from this signal by a ceramic filter (FIL3), and the signal is subjected to amplification in the limiter amplifier circuit.

The amplified 2nd intermediate frequency signal is re-modulated by the re-modulation circuit composed of a circuit in the IC307 and a ceramic discriminate element (FIL4).

Then it is output as a low frequency signal.

4.1.5 Low Frequency Circuit:

The low frequency signal re-modulated by IC307 obtains -6dB/oct characteristic by going through the de-emphasis circuit which contains BUFF (IC13A) and LPF (Q25). Then the signal is input to the low frequency section of CPU AF board.

4.1.6 Squelch Circuit:

If no signal is input to the antenna, noise signal is amplified by the amplifier (IC 13B), As the result of receiving the amplified noise signal, the squelch circuit of IC307 outputs BUSY signal. Squelch level is controlled by VR101.

4.1.7 Low Frequency Treatment Circuit (CPU AF Board):

The re-modulated low frequency signal is amplified in AMP (Q7). Its volume can be adjusted by the tone volume (VR 102).

BUSY signal, output from the squelch circuit (6), becomes a MUTE signal after being conditioned in CPU circuit. The low frequency signal is turned on and off by the transistor switch (Q6) which is driven by this MUTE signal.

The low frequency signal further undergoes power-amplification in the low-frequency-power-amplifier (IC 305) to drive the speaker. With the amplifier circuit (IC6, Q8, Q10), which drives the microphone speaker, it is possible to monitor the receiving tone heard from the microphone speaker. This driving circuit can be turned on and off by key operation.

4.1.8 WX Alert Detection:

The tone selector (IC10 RF Board) detects the 1050Hz alert tone if it is contained in the re-modulated receiving signal. The operating mode is changed to WX receiving mode when CPU confirms that the alert tone has been detected.

4.2 TRANSMITTING CIRCUIT OPERATION

4.2.1 Microphone Amplifier Circuit:

Voice signal from the microphone is amplified by TX MIC AMP (IC5AJC5B) in the CPU AF Board. At the same time, the voice signal obtains pre-emphasis characteristic of 6 dB/oct in the range from 300Hz to 3KHz. The oscillation width of this signal is limited by LIMITER circuit (D5) of the RF board. The harmonic wave distortion generated by this oscillation width limitation is removed by TX MOD LPF (IC31). Then the voice signal is input to VCO section of PLL circuit as a modulation signal. This modulation signal frequency is modulated directly by the variable capacity diode D11 of VCO.

4.2.2 High Frequency Power Amplifier Circuit:

When the mode turns to be in a state of transmitting by turning the PTT switch of the microphone, frequency of PLL is set up to the transmitting frequency. The range of oscillation frequency of VCO is shifted by this transmitting/receiving shift circuit (Q31). This high frequency signal of VCO undergoes the amplification in the buffer amplifier Q17 and driving amplifiers Q4, Q3. After being power-amplified to a maximum output power of 25W by the power module (IC1), it is transmitted as a transmitting output power from the antenna connector J1) via the antenna switching circuit

4.2.3 APC Circuit:

The output power is detected as a direct current signal by APC detecting circuit (D3). APC control circuit composed of Q1, Q2 and IC2 controls the transmitting output power, together with 25W/1W switching circuit (Q5).

4.2.4 Antenna Monitoring Circuit:

After passing through LPE which depresses harmonic waves, the amplified transmitting output power is outputted as an antenna output power via a split line on the PC board pattern and an antenna monitoring circuit composed of D311 and D312. After being detected at D311 and D312, the direct current signals are amplified at SWR REF AMP (IC30B) and SWR FWD AMP (IC30A) respectively. Then they are converted to digital signals by the A/D converter in CPU. The antenna monitoring circuit always watches the condition of the antenna by observing these digital signals.

If the antenna is normal:

$$VSWR - R < VSWR - F$$

If the antenna is open or short:

$$VSWR - R \geq VSWR - F$$

4.3. PLL CIRCUIT OPERATION

The oscillation circuit of PLL IC (IC9) oscillates 12.8MHz frequency by the crystal oscillator (XTAL1) attached to it. This 12.8MHz frequency is divided into 1/512 by the divider inside the IC to make 25KHz frequency, which is the reference frequency of PLL. Frequencies are set up at the time of transmitting and receiving respectively by data from CPU (DATA, CLK, STB). Error signals from PLL pass through the loop filter (LPF). Frequencies of these error signals are controlled by variable capacity diode (DIG) of VCO (Q15).

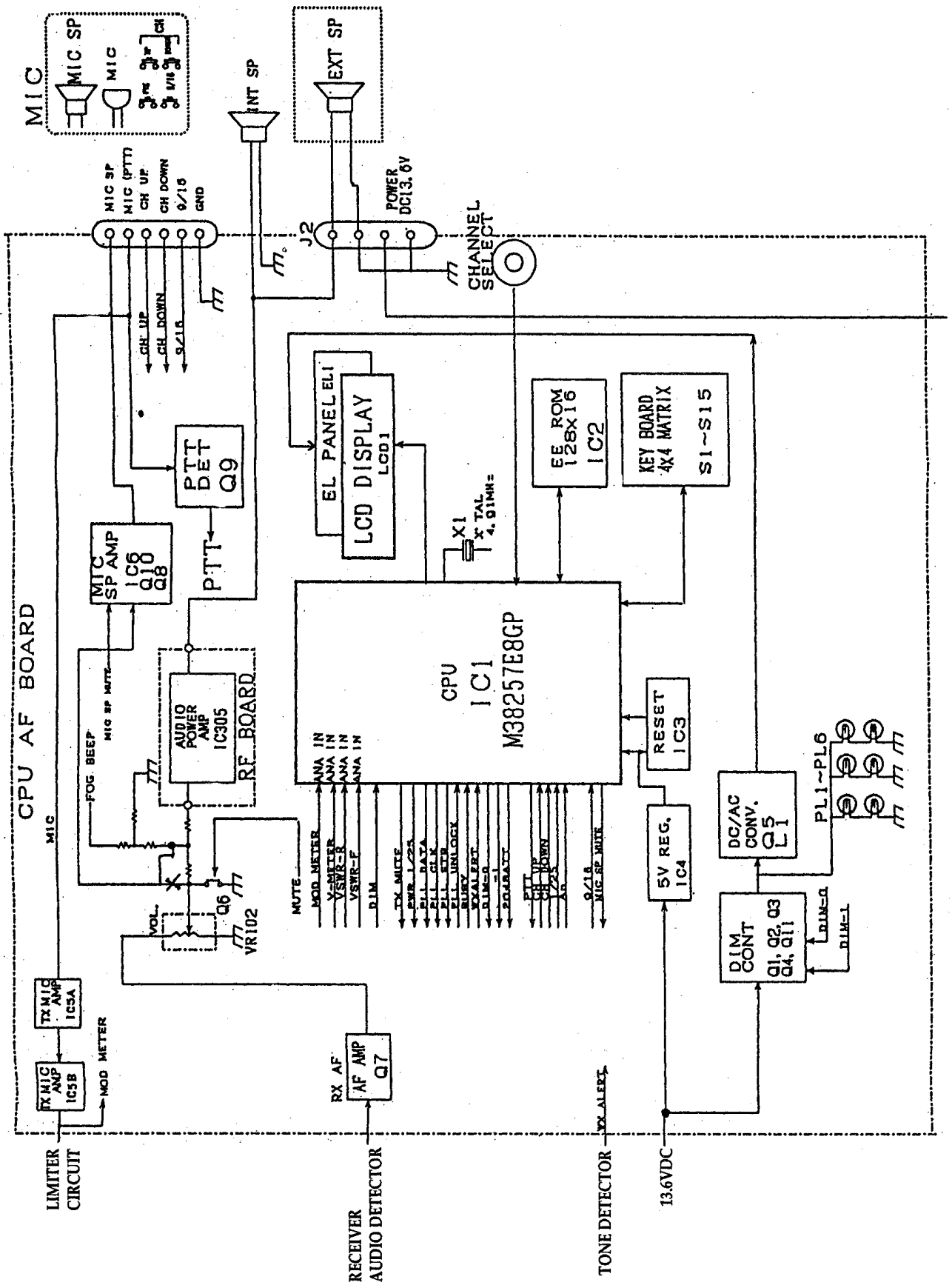


Fig.4-2 Block Diagram / CPU PCB

SECTION 5

MAINTENANCE

5.1 GENERAL

The purpose of this section is to provide servicing instructions to the service technician. The RAY 210 is designed to provide long periods of trouble-free operation. It is recognized, however, that environmental and other factors may result in a need for occasional service.

5.1.1 How to contact Raymarine Technical Support

The Americas: +1 800 539-5539 ext.2444 or +1 603 881-5200 ext.2444

UK, Rest of the World: +44 23 6971 4713

Our Technical Support Specialists are available to answer installation, operation, and trouble-shooting questions about your Raymarine unit. Our Technical Support Department may also be reached via the Internet, where a comprehensive library of frequently asked questions and solutions is available.

<http://www.raymarine.com/support>

Accessories and Parts

The Americas: 1-800-539-5539 ext.2333 or (603) 647-7530 ext.2333

UK, Rest of the World: +44 23 9269 3611 ext. 2029,
service.admin@raymarine.com

Many Raymarine accessory items and parts are available through your authorized Raymarine dealer. However, if you are in need of an item not available through your retailer feel free to contact our Customer Service department. If you are uncertain about what item to choose for your Raymarine unit please contact our Technical Support Department prior to placing your order.

Product Repair and Service: +1 800 539 5539 ext. 2118

In the unlikely event your Raymarine unit should develop a problem please contact the Raymarine dealer from where the unit was purchased. Your Raymarine dealer is best equipped to handle your service needs. Service may also be obtained by returning your unit to Raymarine's Product Repair Centres at the addresses below:

The Americas:
Service Department,
Raymarine Inc.,
22 Cotton Road, Unit H
Nashua
NH 03063-4219

UK, Rest of the World:
Service Department,
Raymarine Ltd.,
Anchorage Park
Portsmouth, Hampshire
PO3 5TD

We will do everything possible to return your unit as quickly as possible. To inquire about the status of your unit our Product Repair Centre may be reached by calling 1-800-539 5539 ext.2118.

Please keep a record of the serial number of your unit and have this number ready when you call.

5.2 PREVENTATIVE MAINTENANCE

The procedures listed below for the RAY 210 should be performed at monthly intervals to minimize the possibility of an equipment failure and assure optimum performance.

1. Inspect the antenna system. Pay particular attention to the cleanliness of the antenna connectors and the condition of any soldered connections.
2. Fuse holders and their connections may be subject to corrosion which can increase circuit resistance. The in-line fuse should be removed from its holder, inspected and cleaned of any accumulation of dirt or corrosion.
3. The radio front panel should be cleaned with a tissue or a soft non-abrasive cloth. Care should be exercised when cleaning any plastic surface to prevent scratching, especially the LCD window area. Mild soap and water may be used in stubborn cases. The radio case should be cleaned of any salt spray or dust as often as necessary.

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

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

The RAY 210 is completely aligned at the factory and normally does not require any readjustment at installation. However, it is considered good a practice to verify the power output, modulation, and receiver performance on occasion.

The test equipment listed in paragraph 5.3.1 is used for the test setup shown in Figure 5-1. This test setup may be used either in part or completely to perform the following adjustments should any alignments be required.

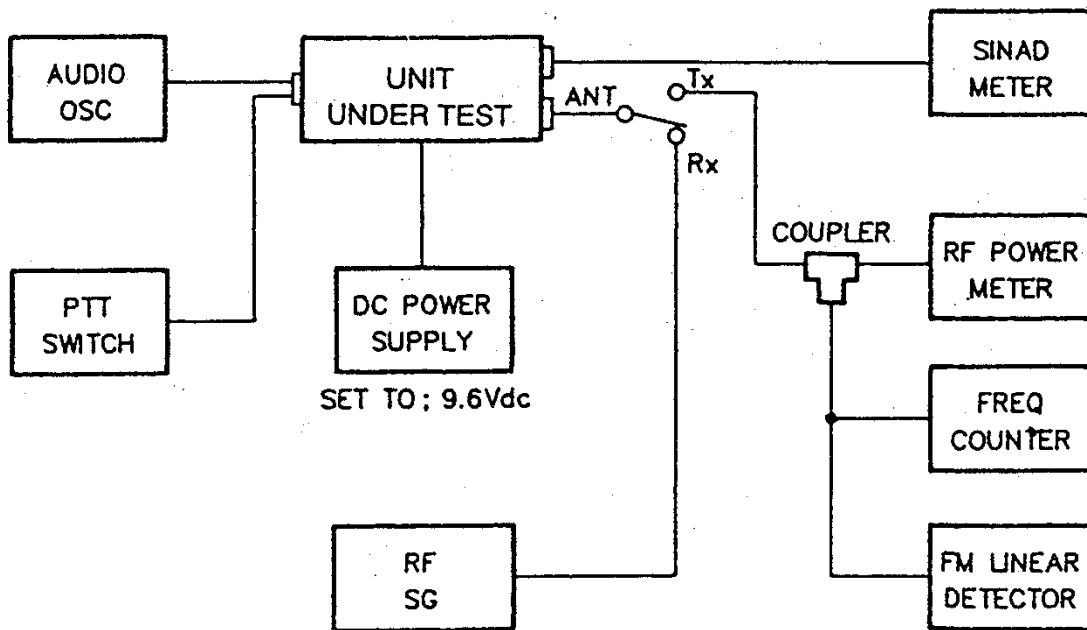


Figure 5-1 Test Setup

5.3.1 Test Equipment

1. DC Power Supply (20V.10A) set at 13.6Vdc
2. RF Power Meter (40W.50 ohm, 150-200MHz)
3. RF signal Generator (50 ohm Output, 150-200MHz)
4. FM Linear Detector (FMLD) or Deviation Monitor 150-200 MHz
5. Frequency Counter
6. Digital 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

5.3.2 PLL Adjustment (TRANSMITTER/RECEIVER)

1. Connect the power supply (13.6V, 10A) to the power line and the PTT switch to the microphone terminal.
2. Connect digital voltmeter or high impedance tester (positive lead to TP2, negative to ground) and adjust CV2, CV3 on the RF module as shown in Table 5-1.

Sequence	Item	Condition	Adj. point	Adj. volt.
1	TX	transmit CH1 6	CVS	3.5±0.1Vdc
2	RX	receive CH1 6	CV2	2.5±0.1Vdc
3	RX	receive CH WXO	-----	check for 5.5 ±0.3Vdc

Table 5-1

5.3.3 Frequency Adjustment (TRANSMITTER)

- 1) Connect the coupler output to a frequency counter, set the radio on CH16 (156.800MHz), key to transmit, and read the indication on the frequency counter.
- 2) Adjust trimmer capacitor CV1 on the RF module for the desired frequency (156.800MHz) $\pm 200\text{Hz}$ on the frequency counter.

5.3.4 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 -20dBm , 300Hz and adjust RV5 on the RF module for a deviation on 4.5 kHz $\pm 300\text{Hz}$.
- 3) Set the audio oscillator output to -43dBm , 1kHz and read the deviation meter ($\pm 2.8\text{ kHz} \sim \pm 3.2\text{ kHz}$).

5.3.5 Power Output Adjustment

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

Sequence	Condition	Adj. Point	Target Power
1	13.6VDC H/L:L	RV1 Low Power	0.9W $\pm 0.05\text{W}$ (limit 1.0W)
2	13.6VDC H/L:H	RV2 High Power	24W $\pm 0.5\text{W}$ (limit 25W)

Table 5-2

5.3.6 RF Sensitivity Adjustment (RECEIVER)

- 1) Connect an RF signal generator to the antenna connector and a SINAD meter to the external speaker line.
- 2) Set the deviation of the RF signal generator to 1kHz $\pm 3\text{Hz}$.
- 3) Set the output level of the RF signal generator and adjust T1 ~ T7, T9 and T10 on the RF module, as shown in Table 5-3.

Sequence	Condition	Adj. Point	Target Level
1	CH.88(157.425 MHz) SG. output: 60dB μ	T2 ~ T7 T9,T10	Max. Sensitivity
2	CH.WXO SG. output: $-6\text{dB } \mu$	T2 ~ T7 T9,T10	Over 12dB SINAD

Table 5-3

5.3.7 Weather Alert Frequency Adjustment (RECEIVER)

1) Connect an RF signal generator to the antenna connector. Set the RF signal generator as follows:

Frequency: 162.550MHz with no modulation

Output level: 60dB μ

2) Select the weather channel WX1.

3) Connect a frequency counter to TP1 on the RF Board and adjust RV6 to obtain 1050kHz +/-5Hz on the frequency counter.

5.4 TROUBLE SHOOTING GUIDE

Table 5-4 provides a general trouble-shooting chart for use by a technician to isolate circuitry failures to specific functional areas within the RAY 210.

5.4.1 Master Reset

The first step in attempting to clear a problem associated with the general operation of this radio is to perform a MASTER RESET. This can be done by pressing the [FUNC] and [16] keys simultaneously, and while holding, turning the power on. This should be performed anytime a component or PCB within the radio is replaced. This function will clear the RAY210 memory and will return it to its factory settings.

It should be noted that micro-components within the radio are generally not field replaceable, therefore, repairs to the radio typically go down to the board level only. A replacement parts list for the RAY210 can be found in Section 6.

Table 5-4 TROUBLESHOOTING CHART

Item Number	Symptom	Possible Cause
1	Unit does not turn on	a. Defective power switch b. 10 amp. fuse in power line open c. Diode D24 open d. Noise filter L309 open e. Capacitor C358 and C369 shorted f. Defective regulator IC15 (5V)
2	No sound with AF signal applied to pin 1 of IC305	a. Defective internal speaker b. Defective IC305 and/or associated components
3	No sound with AF signal applied to volume control	a. Defective volume control b. Defective mute circuitry (Q6 IC1) [CPU AF Board]

Table 5-4 (Continued)

Item Number	Symptom	Possible cause
4	Squelch circuit inoperative	a. Check squelch control b. Defective IC307 and/or associated circuitry between pins 7 and 9
5	No receive (RX)	a. Defective regulators 1C 15(5V) and 1C 17 (8V) b. Defective Q33 (KXB+) c. Check IC 307 audio output voltage at pin9 d. Defective AF amplifier IC 305 e. Defective mute circuitry (Q6 IC1) [CPU AF Board] f. Check XTAL4 output for 21.145MHz signal g. Check 21.6MHz output of first mixer Q23, D15, DIG h. Check 21.6MHz output of ceramic filter FIL101 i. Check 21.6MHz output of first IF amplifier Q30 j. Check 455 kHz signal from ceramic filter FIL3 k. Failure of VCO circuit (Q13, Q15, Q17 and/or PLL IC9) l. Defective CPU (IC1) [CPU AF Board]
6	Low receiver frequency	a. Check antenna and connector for possible corrosion or bad connection b. Failure of the output from Q21, Q22, Q30 and/or IC307 c. Check the output level of VCO per para.5.3.1
7	CPU inoperative [CPU AF Board]	a. Turn off the power once, and try again b. Check CPU clock frequencies (pins 36 and 37 of IC1) c. If clock frequency is not present, check for +5VDCline(IC4)
8	Display malfunction [CPU AF Board]	a. Check the interconnection to the LCD display b. Inoperative CPU

Table 54 (Continued)

Item Number	Symptom	Possible cause
9	No transmit(TX)	a. Defective PTT switch b. Defective regulators IC15 (5V), IC17 (8V) c. Defective Q32 (TX +B) d. Check power transmit circuit (Q3, Q4, IC1) e. Failure of VCO circuit (Q15 and/or Q17) or PLL (IC9) f. Check PLL control voltage for 3.5 VDC at TP1 or channel 16 g. Failure of talk detection circuit (Q9) [CPU AF Board]
10	Low RF power output	a. Check RF power output from IC1. If it checks good, check the triple P type network component (L1, L2, C3, etc.) and antenna switching diode (D2). If not good then check the voltage level outputs of the drive amplifiers Q3 and Q4 as well the associated circuitry b. Check power control circuit (Q1, Q2, Q5) and IC2
11	Poor or no modulation	a. Check VCO output frequency at pin8 of PLL10. PLL phase detector output at pin 5 of PLL IC9a associated circuitry b. Check 12.8MHz crystal (XTAL1)
12	PLL output frequency or incorrect	a. Check frequency of 12.8MHz crystal (XTAL1) b. Check the frequency input at pin 8 or IC9 and verify the transmit frequency

SECTION 6

6.1 PARTS LIST

*****PF PCB Assembly Section*****

DESCRIPTION	Q'ty	Symbol	Parts No.
<u>Capacitor</u>			
Ceramic, 15pF (2125)	2	C7,361	
Ceramic, 33pF (2125)	2	C4,5	
Ceramic, 1000pF (3216)	4	C6,12,18,20	
Ceramic, 1000pF	61	C9,21,22,23,24,25,26,27,30,31,32,33,35,36,40,8 0,97,106,107,111,115,118,119,502,121,122,124, 126,127,131,133,134,140,141,143,147,149,151, 170,245,246,250,105,362,363,368,377,378,379, 501,381,383,11,14,16,359,360,336,401,403	
Ceramic, 0.5pF	3	C137,402,404	
Ceramic, 1pF	1	C109	
Ceramic, 2pF	3	C13,108,117	
Ceramic, 5pF	4	C123,129,132,139	
Ceramic, 6pF	1	C136	
Ceramic, 7pF (UJ)	1	C113	
Ceramic, 8pF	3	C130,138,145	
Ceramic, 10pF	1	C110	
Ceramic, 15pF	2	C10.34	
Ceramic, 10pF (UJ)	1	C114	
Ceramic, 18pF	1	C142	
Ceramic, 33pF	4	C28,95,144,146	
Ceramic, 27pF	1	C29	
Ceramic, 39pF	1	C156	
Ceramic, 47pF	1	C37	
Ceramic, 51pF	1	C94	
Ceramic, 56pF	1	C157	
Ceramic, 68pF	1	C104	
Ceramic, 91pF	1	C153	
Ceramic, 220pF	3	C38,159,160	
Ceramic, 6800pF	2	C39.102	
Ceramic, 2200pF	2	C41.103	
Ceramic, 0.1μF	18	C96,150,152,155,158,161,225,228,232,234,334, 364,365,369,382,343,344,384	
Ceramic, 0.01μF	6	C167,168,148,172,407,406	
Ceramic, 0.022uF	2	C164.101	
Tant., 0.1μF /25V	4	C15,99,226,349	
Tant., 1μF/16V	7	C42,98,162,169,227,229,332	
Tant., 2.2μF/10V	2	C100.223	
Tant., 4.7μF/10V	2	C163,222	
Tant., 10μF / 16V	8	C45,154,166,224,231,236,116,385	
Elec., 4.7μF/25V	1	C335	
Elec., 22μF / 16V	1	C44	
Elec., 47μF / 16V	1	C337	

DESCRIPTION	Q'ty	Symbol	Parts No.
Elec.,47uF/25V	2	C17.19	
Elec., 100μF / 25V	4	C358,338,340,346	
Elec., 1000μF / 25V	2	C333,370	
<u>Diode</u>			
Diode M1402	1	D1	
Diode M1308	1	D2	
Diode 1SS345	3	D3,311,312	
Diode 1SS226	2	D9,25	
Diode 1SS184	1	D303	
Diode 1SS239	2	D15,16	
Diode 1SV166	1	D10	
Diode 1SV214	1	D11	
Diode 1SV128	2	D12,14	
Diode DAP202K	2	D5.317	
Diode DAN202K	4	04,19,304,316	
Diode DA204K	1	D310	
Diode FMB-G24H	1	D24	
<u>Transistor</u>			
Transistor 2SB1185	1	Q1	
Transistor 2SC4116	2	Q2,16	
Transistor 2SC3357	1	Q3	
Transistor 2SC4226	6	Q4,13,17,21,22,23	
Transistor 2SA1298	2	Q11,33	
Transistor 2SC1623	1	Q25	
Transistor 2SC3123	1	Q30	
Transistor 2SB798	1	Q32	
Transistor 2SK508	1	Q15	
Transistor DTC114EKA	5	Q5,12,20,31,34	
Transistor DTA143EKA	1	Q6	
<u>Resistor</u>			
Resistor 1 ohm 1/4W	1	R463	
Resistor 10k ohm 1/4W	1	R1	
Resistor 150 ohm 1/4W	1	R2	
Resistor 10 ohm	3	R6,15,19	
Resistor 22 ohm	3	R67,114,351	
Resistor 33 ohm	4	R7,18,20,107	
Resistor 47 ohm	2	R182.203	
Resistor 51 ohm	2	R436.442	
Resistor 68 ohm	1	R104	
Resistor 100 ohm	10	R16,55,64,105,109,111,115,117,118,99	
Resistor 330 ohm	2	R5,62	
Resistor 470 ohm	5	R14,23,119,349,430	
Resistor 680 ohm	4	R68,98,202,480	
Resistor 820 ohm	1	R128	
Resistor 1k ohm	9	R9,13,17,60,63,183,434,350,473	
Resistor 1.2k ohm	1	R51	
Resistor 1.5k ohm	3	R127,440,451	
Resistor 2.2k ohm	6	R32,58,110,125,138,472	
Resistor 3.3k ohm	4	R3,8,123,431	

DESCRIPTION	Q'ty	Symbol	Parts No.
Resistor 4.7k ohm	7	R22,52,180,453,454,464,471	
Resistor 5.6k ohm	2	R30,113	
Resistor 6.8k ohm	1	R129	
Resistor 8.2k ohm	3	R103,134,179	
Resistor 10k ohm	21	R4,11,12,21,31,46,47,48,53,61,112,108,124,133,181,437,438,439,441,456,467	
Resistor 22k ohm	1	R54	
Resistor 33k ohm	7	R100,106,131,136,432,433,121	
Resistor 39k ohm	2	R24,25	
Resistor 47k ohm	5	R49,50,56,130,201	
Resistor 56k ohm	4	R26,27,28,29	
Resistor 68k ohm	1	R204	
Resistor 100k ohm	2	R59,120	
Resistor 150k ohm	5	R122,132,468,126,137	
Resistor 220k ohm	2	R10.102	
<u>Coils & Transformer</u>			
Coil, 3T	2	L6,7	
Coil, 5T	4	L1,2,3,5	
Coil, 1ST	2	L38,39	
Coil, LK2125R12K	1	L8	
Coil, LK21251ROK	1	L19	
Coil, LK21252R2K	1	L17	
Coil, LK21254R7K	2	L312.313	
Coil, LK21256R8K	1	L16	
Coil, LK2125100R	1	L18	
Coil, LK2125100K	3	L13,14,15	
Line Filter ELKF101FA	3	L302,314,315	
Line Filter N3002	1	L309	
Inductor, LAL04SK6R8K	1	L4	
RF Transformer SMD0100	1	T1	
RF Transformer SMD0101	6	T2,3,4,5,6,7	
RF Transformer SMD0102	2	T9,10	
RF Transformer LTR0016	1	T8	
<u>IC</u>			
IC M57710A(S-AV6)	1	IC1	1032698-85
IC LM2904	2	IC2,31	
IC MB1505PF	1	IC9	
IC BA1604F	1	IC10	
IC NJM3404AM	2	IC13,30	
IC 78M05	1	IC15	
ICTA7280P	1	IC305	G623760-15
ICTA31136FN	1	IC307	
ICTC4S66F	1	IC308	
<u>Miscellaneous</u>			
Filter 21.6RB	1	FIL101	
Filter CFWM455E	1	FIL3	G263479-18
Filter CDB455C24	1	FIL4	
Crystal 12.8MHz	1	XTL1	
Crystal 21.145MHz	1	XTL4	G263479-19
Variable Capacitor 20p	1	CV1	
Variable Capacitor 10p	2	CV2,3	

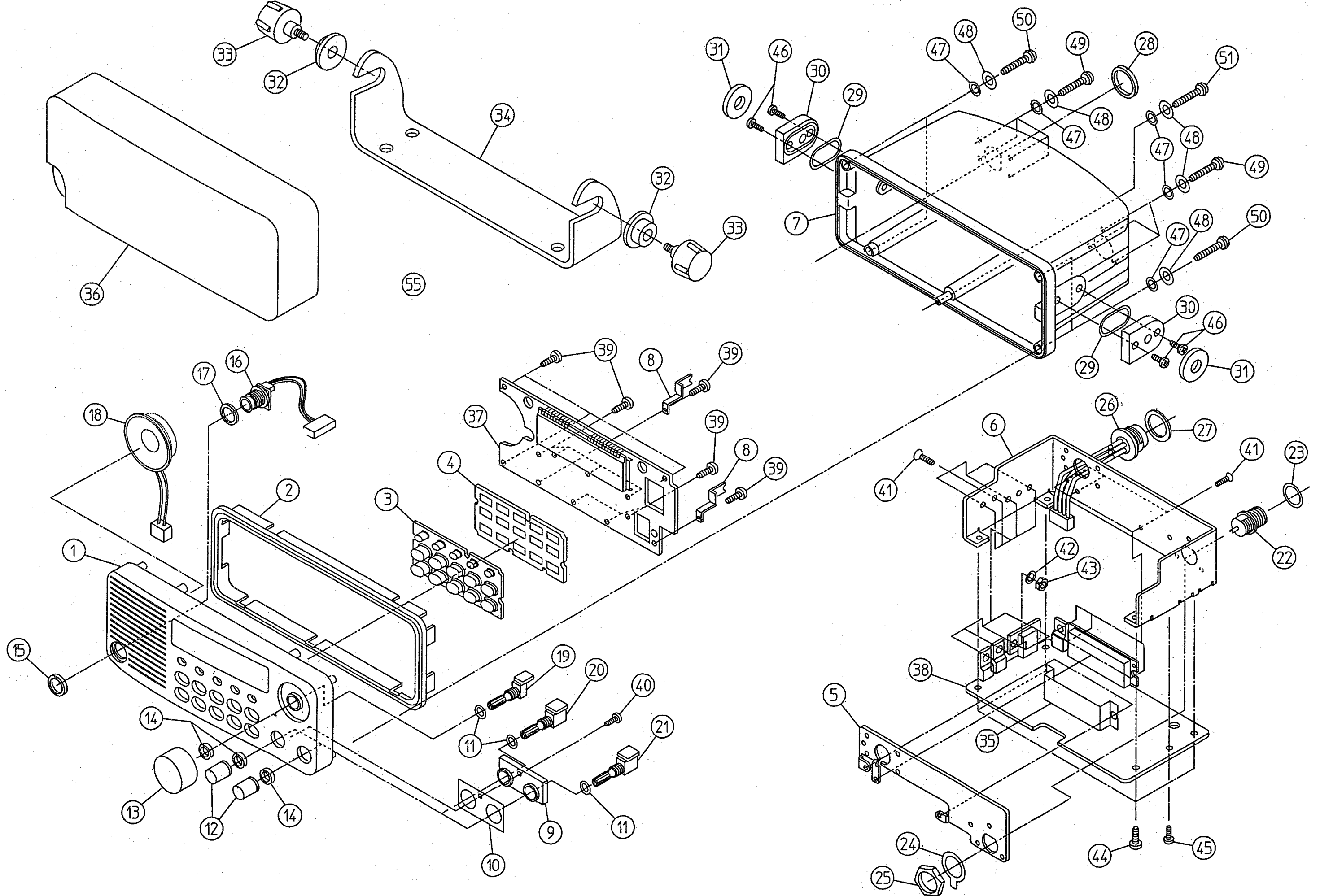
DESCRIPTION	Q'ty	Symbol	Parts No.
Variable resistor 10k ohm	4	RV2,3,4,5	
Variable resistor 3k ohm	2	RV1,6	
Connector 52559-3177	1	J101	
Connector IL-S-6P-S2TS-EF	1	J104	
Connector IL-S4P-S2TS-EF	1	J103	
Connector IL-S-2P-S2TS-EF	1	J107	
Connector B2P-VH	1	J106	
RF Connector	1	J105	

*****CPU PCB Assembly*****

DESCRIPTION	Q'ty	Symbol	Parts No.
<u>Capacitor</u>			
Ceramic, 33pF	2	C18,19	
Ceramic, 100pF	1	C23	
Ceramic, 220pF	3	C6,7,8	
Ceramic, 1000pF	20	C20,27,28,44,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62	
Ceramic, 4700pF	1	C31	
Ceramic, 6800pF	1	C22	
Ceramic, 0.047uF	2	C21,29	
Ceramic, 0.082uF	1	C100	
Ceramic, 0.01µF	2	C4,5	
Ceramic, 0.1µF	7	C1,2,3,10,24,26,45	
Tant., 0.47µF 25V	2	C25,40	
Tant., 1µF 16V	3	C41,42,43	
Tant., 1µF 50V	1	C17	
Tant., 10µF 16V	10	C14,15,32,33,34,36,37,38,39,64	
Elec., 100µF 16V	1	C46	
Elec., 220µF 25V	1	C16	
<u>Diode</u>			
Diode UDZ9.1	1	D1	
Diode DA204K	1	D2	
<u>Transistor</u>			
Transistor 2SA1298	1	Q9	
Transistor 2SC1623	2	Q3,7	
Transistor 2SD1767	4	Q4,5,10,11	
Transistor DTC114EKA	3	Q1,2,8	
Transistor DTC343TK	1	Q6	
<u>Resistor</u>			
Resistor 10 ohm (3226)	1	R64	
Resistor 22 ohm (3226)	1	R14	
Resistor 120 ohm (3226)	6	R87,88,89,94,98,99	
Resistor 330 ohm (3226)	1	R15	
Resistor 0 ohm	1	R44	
Resistor 10 ohm	1	R46	
Resistor 100 ohm	2	R37,47	
Resistor 220 ohm	1	R100	
Resistor 330 ohm	1	R42	
Resistor 1k ohm	24	R6,7,9,10,11,63,66,67,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,33	
Resistor 1.2k ohm	2	R16,31	
Resistor 2.2k ohm	4	R24,12,13,95	
Resistor 3.3k ohm	2	R26,45	
Resistor 4.7k ohm	7	R69,70,71,92,96,175,93	
Resistor 5.6k ohm	2	R36,38	
Resistor 6.8k ohm	1	R28	
Resistor 10k ohm	8	R19,30,35,43,49,50,65,90	
Resistor 18k ohm	1	R17	
Resistor 22k ohm	3	R22,40,41	
Resistor 33k ohm	2	R4,5	

DESCRIPTION	Q'ty	Symbol	Parts No.
Resistor 39k ohm	1	R23	
Resistor 68k ohm	1	R29	
Resistor 100k ohm	5	R21,25,39,62,97	
Resistor 150k ohm	1	R27	
Resistor 470k ohm	1	R32	
<u>IC</u>			
IC M3825728GP	1	IC1	
IC BR93LC56AF	1	IC2	
IC M51951AML	1	IC3	
ICTA78L05F	1	IC4	
IC LM2092NS	1	IC5	
IC NJM386M	1	IC6	
<u>Miscellaneous</u>			
Switch SKQMAL	15	S1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	
Filter ELKF101FA	1		
Crystal 4.91MHz	1	X1	
ELFC004-BG	1	EL1	
LampT-3/4	6	PL1,2,3,4,5,6	
Transformer T-7-073	1	L1	
LCD TD 624002	1	U1	
Connector 52559-3317	1	J1	
Connector IL-S-6P-S2T2-EF	1	J4	
Connector IL-T-2P-S2C2-W	2	J5,6	

6.2 RAY210 ASSEMBLY DRAWING



MECHANICAL PARTS LIST

Description	Q'ty	Parts No.
FRONT CASE	1	G623760-3
GASKET (MAIN)	1	G6237604
KEY	1	
SPACER (KEY)	1	
HEATSINK PLATE	1	
HEATSINK	1	
PEAR CASE	1	
BRACKET (PCB)	2	
SPACER (ROT)	1	
W FACE O RING	1	
KNOB (VOL)	2	G623760-5
KNOB (ROT)	1	G623760-10
NUT (VOL)	3	
NUT (MIC)	1	
MIC CONNECTOR	1	G263129-1
GASKET	1	
SPEAKER	1	G623760-11
CHANNEL SWITCH	1	G623760-12
SQL SWITCH	1	G623760-13
VOL SWITCH	1	G623760-14
ANTENNA CONNECTOR	1	
O RING	1	
EARTH RING	1	
HEXAGON NUT	1	
PWR CONNECTOR	1	
O RING	1	
NUT(PWR)	1	
GASKET(SPACER)	2	
SPACER(FIX)	2	G623760-9
RUBBER INNER(FIX)	2	
RUBBER OUTER(FIX)	2	
KNOB(SCREW)	2	G623760-8
BRACKET(FIX)	1	G623760-7
SHIELD(PA)	1	
SUN COVER	1	G623759-4
CPU PCB ASSEMBLY	1	G623760-1
RF PCB ASSEMBLY	1	G623760-2
PAN HEAD P TIGHT 2.6x8	11	
PAN HEAD P TIGHT 2.6x6	1	
FLATHEAD M3x8	7	
SPRING WASHER	4	
HEXAGON NUT M3	4	
PAN HEAD M4x6	4	
PAN HEAD M3x6	1	
PAN HEAD M4x8	4	
O RING	12	
WASHER	12	
BINDING HEAD M3x6	7	
BINDING HEAD M3x8	4	
BINDING HEAD P TIGHT 3x14	1	

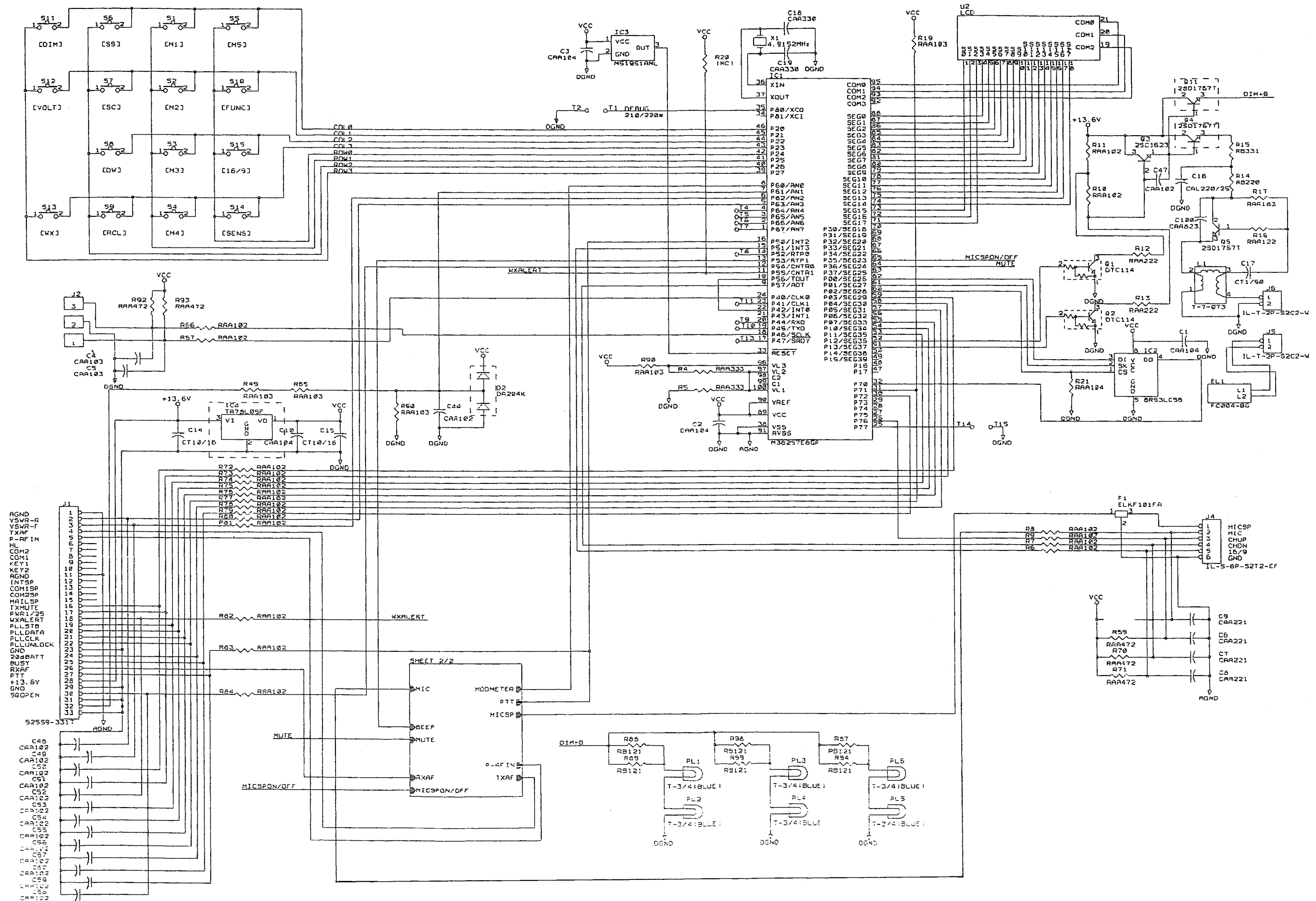


Fig.6-2 Schematic diagram/CPU PCB(1)

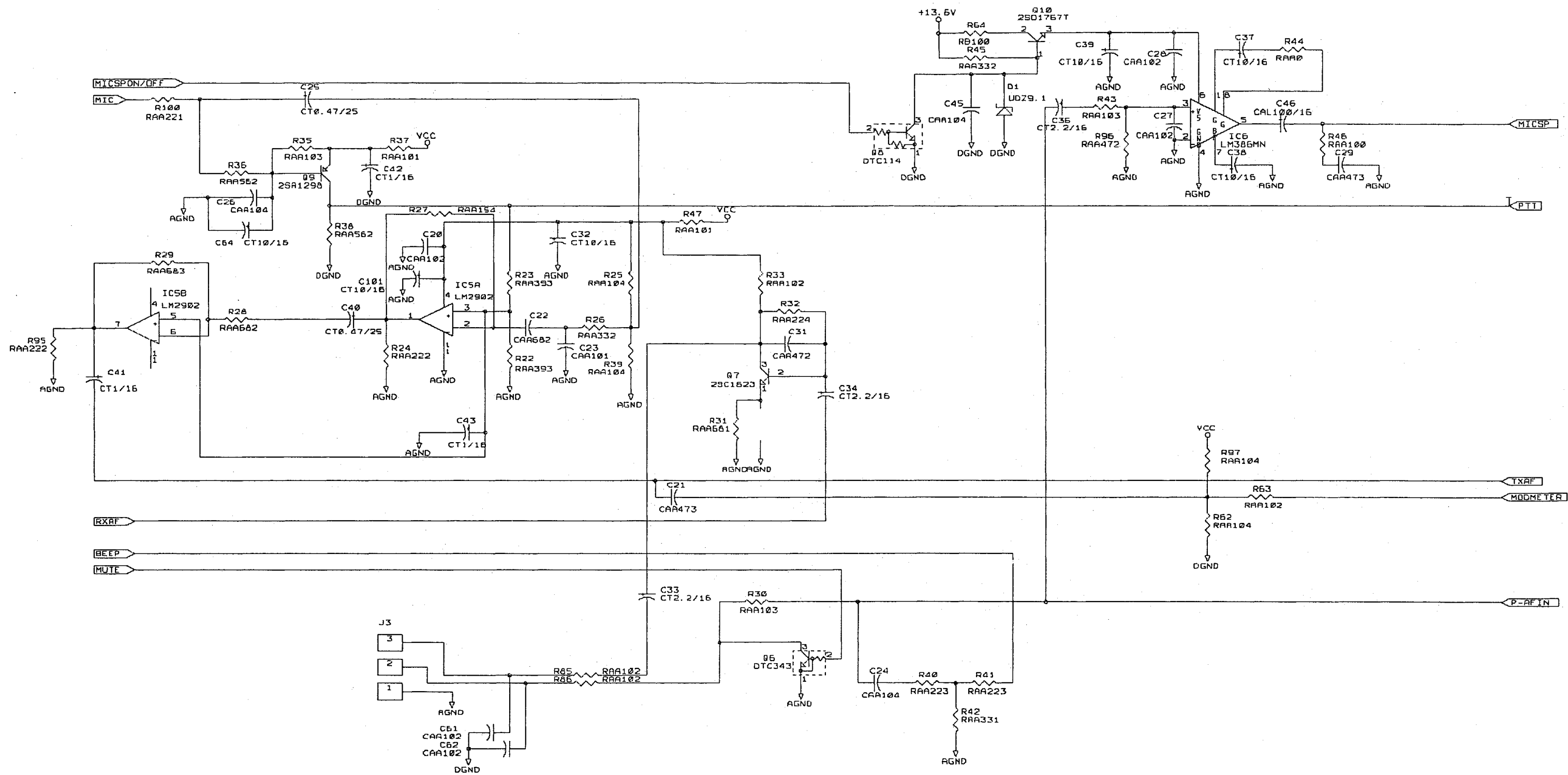


Fig.6-2 Schematic diagram/CPU PCB (2)

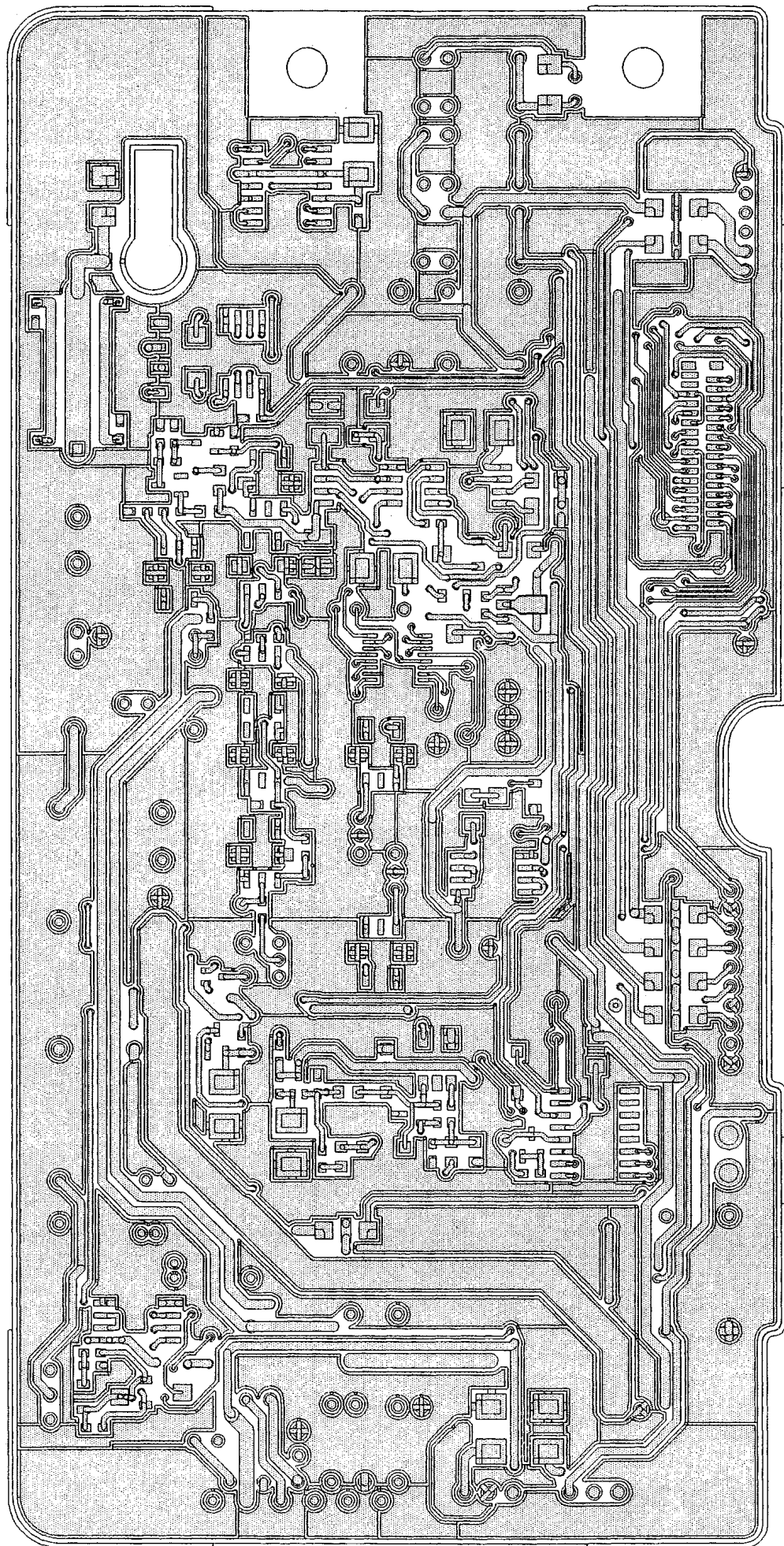
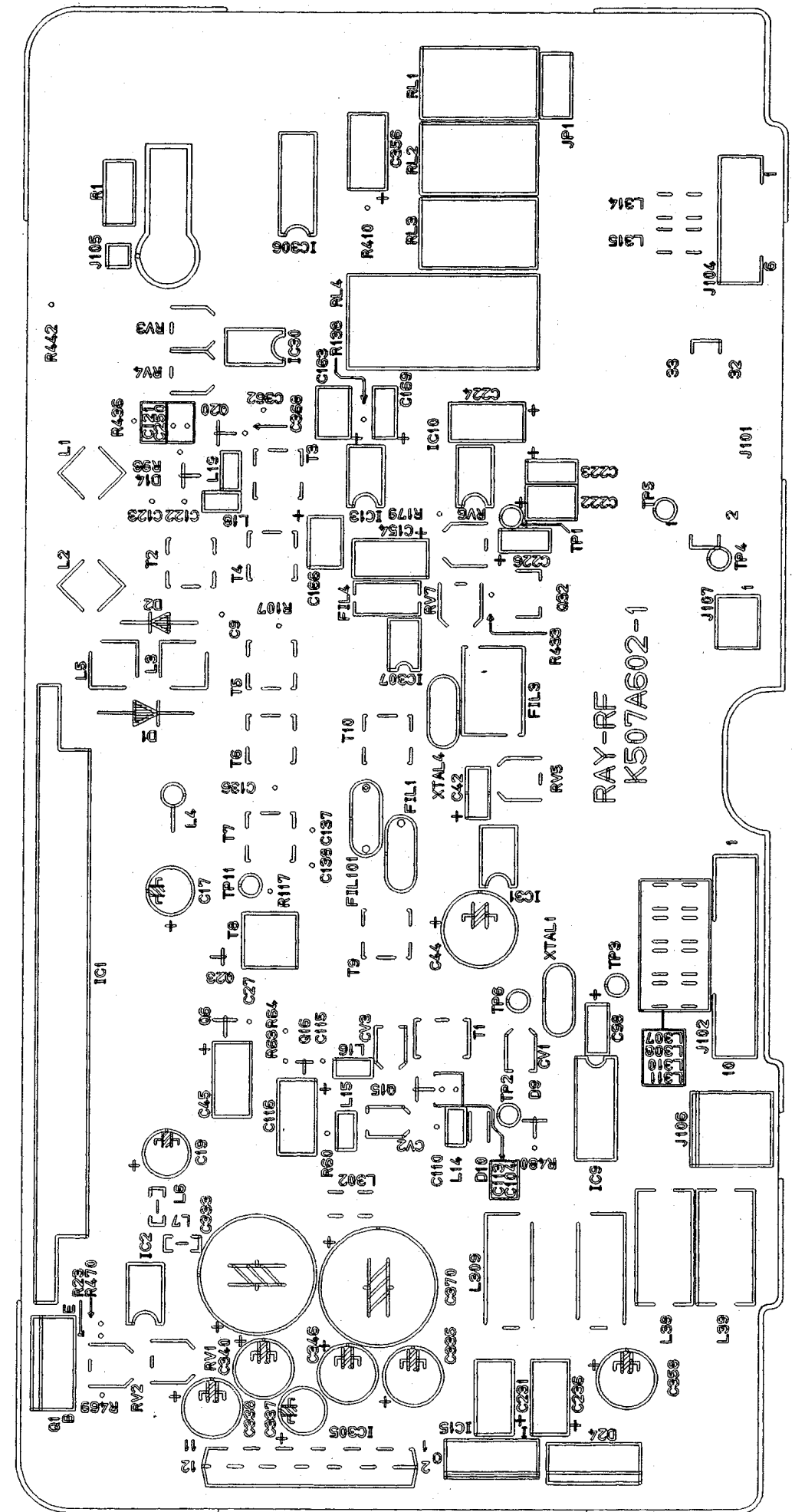


Fig.6-3 RF PCB Layout (Top View)



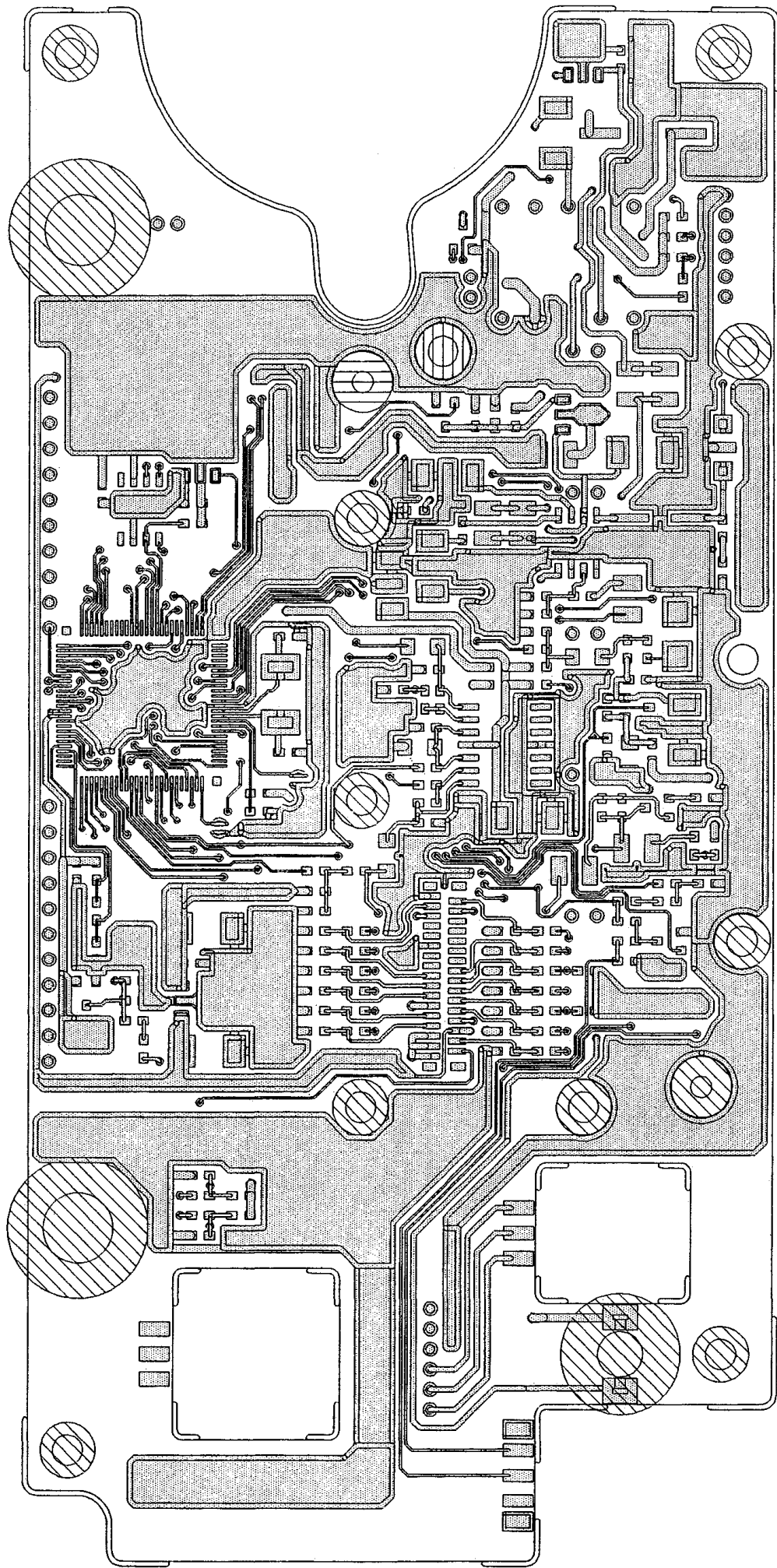
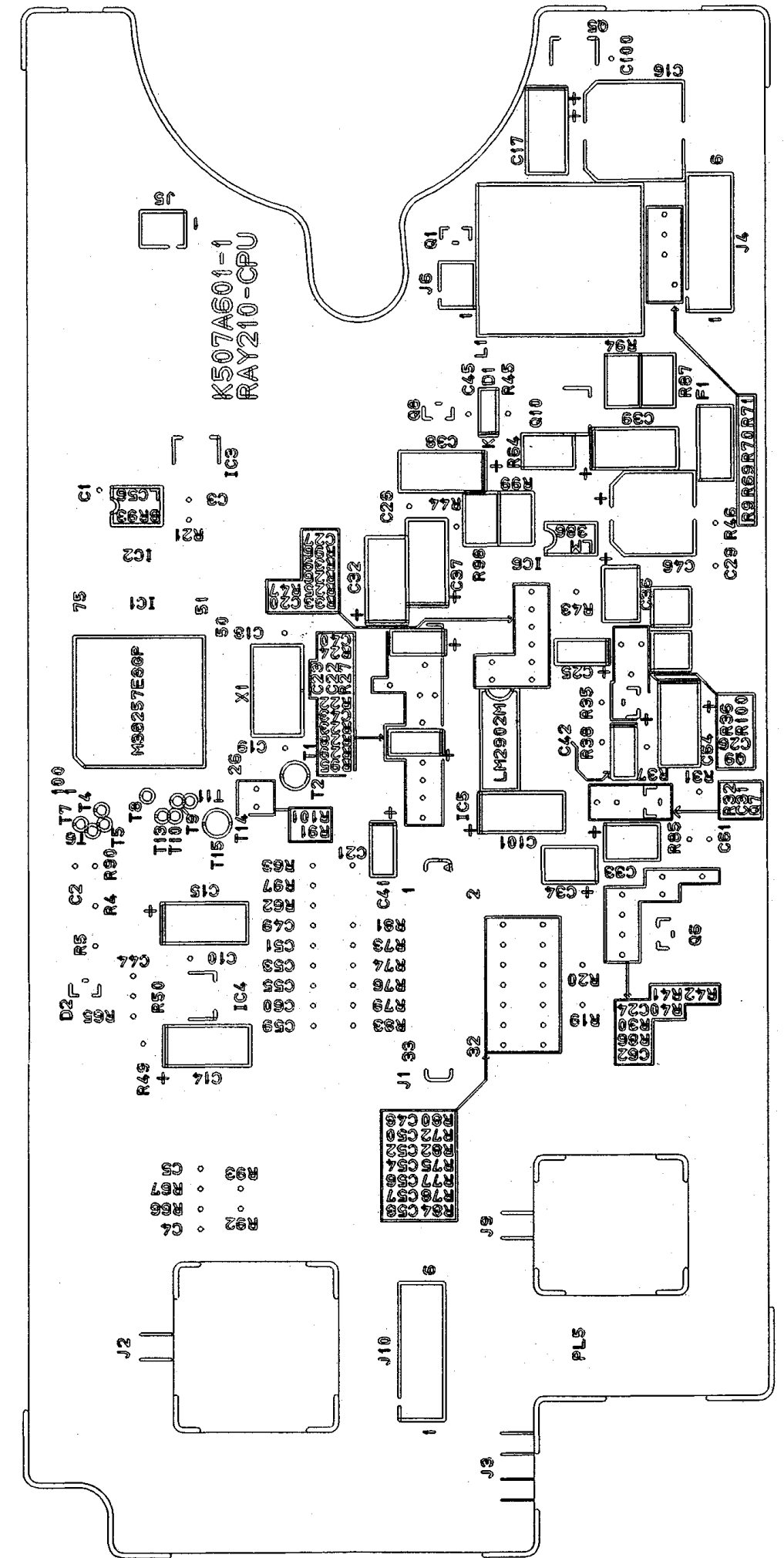


Fig.6-5 CPU PCB Layout (Top view)



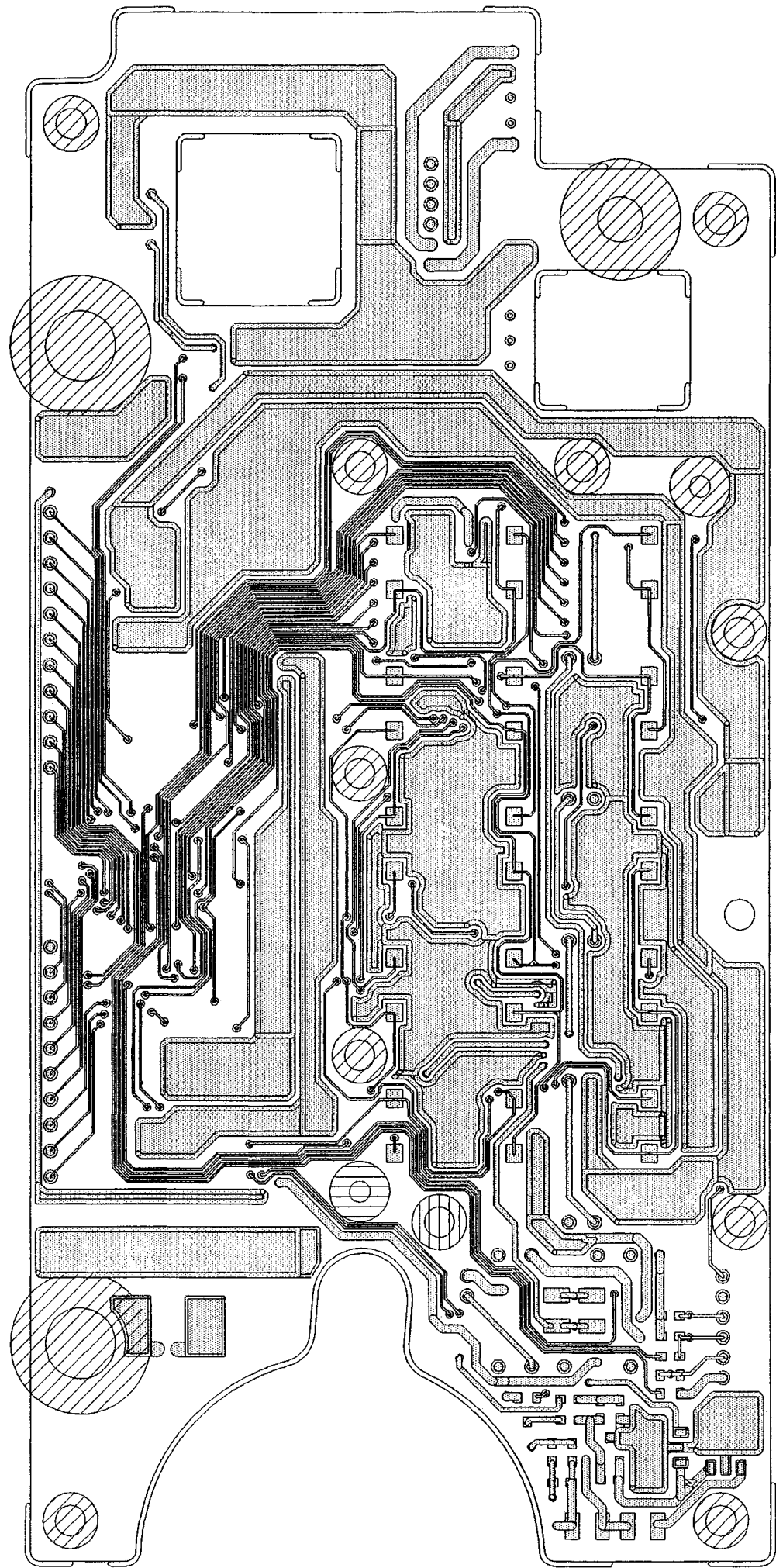
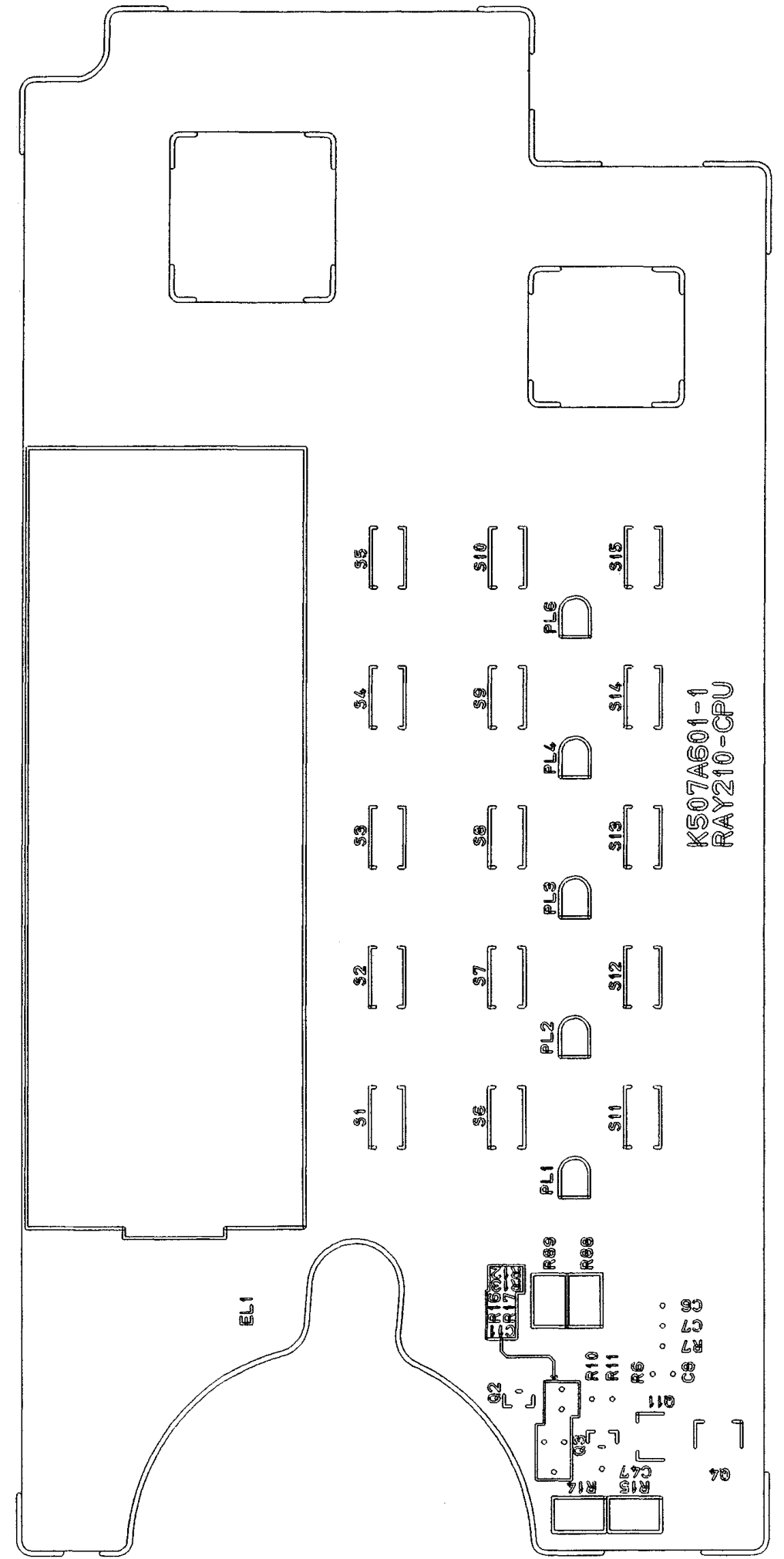


Fig.6-5 CPU PCB Layout (Rear View)



SECTION 7

APPENDIX

7.1 VHF MARINE CHANNEL USAGE GUIDE AND LICENSING REQUIREMENTS

Most of the information found in this section is reprinted in whole or in part from FCC Information Bulletin No. 2 February 1991 and FCC Fact Sheet PR-5000 March 1990.

REMEMBER:

- Maintain a radio watch on Channel 16. Channel 16 is for distress and purposes only.
- Use VHF Channel 70 only for Digital Selective Calling (DSC), It may be for general-purpose calling using DSC. Your cooperation in not using Channel 70 for intership communications is necessary to prevent interference.
- Your VHF transceiver has a high-low power switch. Use low power whenever feasible. Unnecessary high-power operations can interfere with other important communications
- Always use your radio call sign at the beginning and end of each transmission.
- Be sure only qualified persons operate your radio. You are responsible for control of your radio. Know the rules.
- Limit calls to other vessels to 30 seconds. If you receive no reply, wait 2 minutes; then try again. Keep communications brief and avoid chit-chat.
- Never transmit false distress and never use profanity on the air.

OTHER REMINDERS

“The FCC has revised its policy on radio licensing requirements for certain ships and stations in the 1996 Telecommunications Act Maritime Provisions (FCC96-145). This new rule eliminates the individual licensing requirement for recreational ships and private aircraft operating domestically which are not required by law to carry a radio. But, the operator is still bound to abide by the FCC rules governing the operation of a marine VHF transceiver and is subject to the penalties for non-compliance. Even though the station license is now not mandatory for recreational boaters, we still strongly recommend that one be obtained. The FCC station license application fee is \$75.00 and the license term is 10 years. If you plan to dock in a foreign port or leave a foreign port to dock in a U.S. port, however, you will need a station license as well as a radio operator license to operate a VHF marine radio.”

- Your radio license is not transferable. If you sell your boat, request the FCC to cancel your station license.

If you replace your radio, you do not need to change your license unless the new radio operates on another frequency band. If you install equipment to operate on another frequency band, apply for modification of your license.

- If you carry more than six passengers for hire, your vessel must be certified as a passenger-carrying vessel by the FCC and the Coast Guard.

Licensing Options for Hand Held Portable VHF Marine Transceivers 10 Watts Power or Less

VHF Marine hand held transceivers can be operated and licensed as follows:

a) Associated Ship Unit:

A hand held VHF Marine transceiver can be operated under an existing valid ship station license under the following conditions only:

i) Except for safety purposes, the hand held transceivers must be used only to communicate with the ship station with which it is associated. Such associated ship units MAY NOT be operated from shore.

ii) The transmitting power is limited to ONE WATT only.

iii) The hand held transceiver must be identified by the call sign of the ship station along with its associated unit designator.

b) Portable Ship Station:

The Commission may grant a station license permitting operation of a portable ship station aboard different vessels of the United States. Each application (FCC Form 506-Application for a Ship Radio Station License) for a portable ship station license must include a showing that:

i) The station will be operated aboard aboard a vessel.

ii) A station license for portable equipment is necessary to eliminate separate applications to a ship station aboard different vessels.

c) Marine Utility Station:

A utility station in the maritime mobile service consists of one or more hand held transceiver units licensed under a single authorization. Each unit is capable of operating while being hand carried by an individual. There are two types of stations authorized:

i) Marine Utility Coast- when transmitters are located on land; may communicate directly to vessels only.

ii) Marine Utility Coast/Ship- transmitters from land may communicate with vessels or when aboard a vessel, may communicate with other vessels or coast stations.

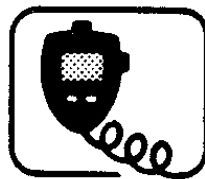
NOTE: A Marine Utility Ship license will not be authorized.

The station operates under the rules applicable to a private coast station when the unit (s) are on land and under the rules applicable to a ship station when the unit(s) are aboard a vessel. FCC Form 503, application for Land Radio Station License is used when applying for a marine utility License.

USAGE GUIDE



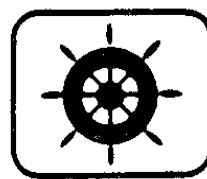
Emergency



Calling



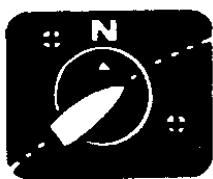
Monitoring



Intership Safety



U.S. Coast Guard



Navigation



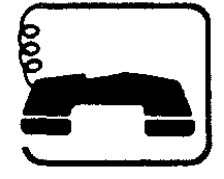
Port Operations



Noncommercial



Commercial



Marine Operator



State Control



Environmental



Weather



Emergency

Channel 16

If:

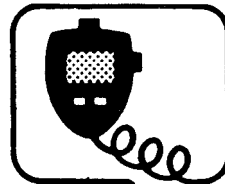
- Your ship is **sinking**, or **on fire**
- Someone has been lost overboard
- There exists grave and imminent danger

Use this distress procedure:

- Select Channel 16
- Say "Mayday, Mayday, Mayday."
- Give call sign and boat name
- Give location of boat
- Describe emergency
- If no answer, repeat; then try and other channel

Caution

Every ship at sea is obliged to give absolute priority to radio communications relating to ships in distress — it is vital that false distress calls or messages not be broadcast.



Calling

Channel 16 & Working Channel

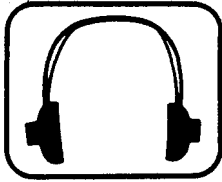
If — you wish to establish communications with another station
And — you know which working channel the station is monitoring
Then — initiate the call directly on that working channel

If — you wish to establish communications with another station
And — you do not know what working channel the station may be monitoring
Then — initiate the call on channel 16.
After contact is made switch to a working channel.

NOTE: Due to congestion on channel 16 caused by frequent hailing of other vessels, the FCC has approved channel 9 as a second hailing channel.

Avoid excessive calling and radio checks
Always monitor before transmitting

Never interrupt emergency communications



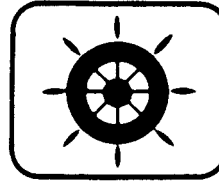
Monitoring

Channel 16 & Working Channel

When — your VHF station is turned on and it is not being used to exchange communications

You Must — monitor channel 16

As an operating convenience, many stations employ a second receiver so that they can monitor a working channel and channel 16 simultaneously.



Intership Safety

Channel: 6

Vessels: Any

Use: Communicating navigational and weather warnings to other ships

Communicating with U.S. Coast Guard stations or other vessels during search and rescue operations

Between: Ship-to-ship only

Comments: Do not use for routine communications. This is a safety channel.



U.S. Coast Guard

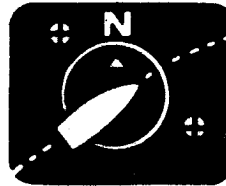
Channel: 22

Vessels: Any

Use: Working channel for exchange of communications with stations of the U.S. Coast Guard

Between: Ship to U.S. Coast Guard ship, coast to aircraft stations

Comments: U S. Coast Guard does not regularly monitor this channel Establish contact on channel 16 and shift to channel 22 as directed.



Navigation

Channel: 13

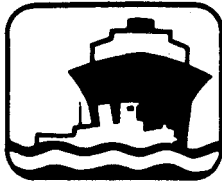
Vessels: Any

Use: Safety communications pertaining to the manoeuvring of vessels or the directing of vessel movements

Primarily ship-to-ship and secondarily ship-to coast

This is commonly called the Bridge-to-Bridge channel. Large vessels and towboats depend on this channel for their safe navigation. Railway or highway bridges which open for ship navigation often operate on this channel

Bridge-to-Bridge stations must reduce power to one watt for routine operations.



Port Operations

Channels: 5,12, 14, 20, 65, 66, 73, 74, [77]

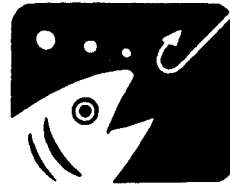
Vessels: Any

Use: Messages relating to the operational handling, movement and safety of vessels in or near ports, locks and waterways

Between: Ship-to-ship or ship-to-coast

Comments: Channel 77 is limited to communications to and from commercial pilots concerning the movement and docking of vessels.

Note: Channels 11, 12, 13 and 14 are used for vessel traffic service on the Great Lakes, St. Lawrence Seaway and designated major ports.



Non commercial (Boat Operations)

Channels: 9,68,69,71,72,78

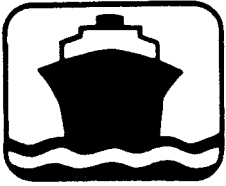
Vessels: Recreational boats and any not used primarily for commercial transport

Use: communications pertaining to the needs of the vessel (i.e., fishing, rendezvous, manoeuvres, berthing, scheduling of repairs, provisioning, etc.)

Between: Ship-to-ship or ship to limited coast stations

Comments: Channel 72 may not be used for ship to coast communications. Channel 9 is shared with Commercial users.

If you regularly monitor one of these channels with a second receiver, please notify frequently-called stations of this practice. Help reduce congestion on channel 16 .



Commercial

Channels: 7, 8, 9, 10, 11, 18, 19, 67, 79, 80, [88]

Vessels: Those used primarily for commercial transport of persons or goods, or engaged in servicing other vessels

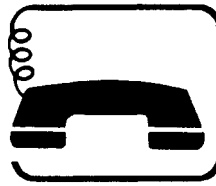
Use: Communications pertaining to the purpose for which the vessel is used

Between; Commercial transport vessels (ship-to-ship) or between commercial transport vessels and limited coast stations

Channels 8, 67 and 88 may not be used for ship-to-coast communications

Recreational boats are not permitted to use these channels

Channel 88 not available on Great Lakes and St. Lawrence Seaway.



Marine Operator

Channels: 24, 25, 26, 27, 28, 84, 85, 86, 87, 88

Vessels: Any

Use: To place a telephone call to any location in the world or to a vessel outside of your transmitting range

Between: Vessels and public coast stations

Comments: Contact the marine operator on the channel assigned to your navigating area. If unable to determine this channel, use channel 16,

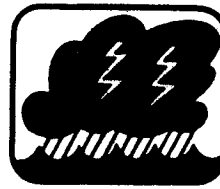
Be patient. Do not interrupt calls in progress. Avoid excessive calling if the operator does not answer — give the operator a chance to reply.



State Control

Channel: 17

Vessels: State and local government
Use: Coordination, regulation and control of boating activities and the rendering of assistance to vessels.
Between: Ship and coast stations associated with state and local governments.



Environmental

Channel: 15

Vessels: Any (receive only)
Use: Broadcast of information concerning the environmental conditions in which vessels operate - weather, sea conditions, time signals, notices to mariner, hazards to navigation
Between: One-way broadcast from coast to ship stations
Note: Currently used for Class C EPIRB emergency signals.



Weather

Channels: WX1, WX2, WX3

Vessels: Any

Use: Continuous weather information from NOAA (National Oceanic and Atmospheric Administration)

Between: One-way broadcast from NOAA to any interested parties

Comments: Receive only. You are not allowed to transmit on these frequencies

PHONETIC ALPHABET:

To help make call letters more clearly understood, and to assist in spelling out similar sounding or unfamiliar words, radiotelephone users usually employ the international phonetic alphabet.

Phonetic alphabet:

A - ALPHA

J - JULIET

S - SIERRA

B - BRAVO

K - KILO

T - TANGO

C - CHARLIE

L - LIMA

U - UNIFORM

D - DELTA

M - MIKE

V - VICTOR

E - ECHO

N - NOVEMBER

W - WHISKEY

F - FOX-TROT

O - OSCAR

X - X-RAY

G - GOLF

P - PAPA

Y - YANKEE

H - HOTEL

Q - QUEBEC

Z - ZULU

I - INDIA

R - ROMEO



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