INSTRUCTION MANUAL

FT-127RA

YAESU MUSEN CO , LTD.

TOKYO JAPAN.

TABLE OF CONTENTS

FT-127RA SCANNING MEMORIZER
222 MHz FM TRANSCEIVER

The model FT-127RA is a PLL synthesized FM transceiver designed to provide high performance for the discriminating FM operator.

Channel selection is by means of photo-interrupter scheme, providing selection of as many as 600 PLL channels between 222 and 225 MHz. This optical coupling system eliminates noisy, unreliable rotary switches used in other makes of equipment. Digital display of the last four digits of the operating frequency is provided.

A memory circuit allows storage and recall of any channel with the press of a switch. The memorized frequency may be held when the power switch is turned off, via the backup circuitry.

For repeater operation, selectable ±1.6 MHz split is provided, and auxiliary splits may be programmed using the memory system. Tone burst generation is built in, and a subaudible tone squelch encoder/decoder is an available option for the FT-127RA.

Superb convenience is provided by the PLL scanner, allowing UP/DOWN scanning control from the microphone, without rotation of the main tuning dial.

Your FT-127RA represents the latest developments in solid-state technology. If the transceiver is not abused, and the directions contained in this manual are followed, the FT-127RA should provide many years of trouble-free operation. The owner is encouraged to read this manual in its entirety, in order to become better aquainted with the exciting new FT-127RA, the latest development from the hams at YAESU.

SPECIFICATIONS FOR FT-127RA

GENERAL

Frequency Coverage
222 to 225 MHz

Number of Channels
600 channels

Speaker
Internal 3" dynamic speaker with provision for connecting an external 8 ohm dynamic speaker.

Microphone
Dynamic push-to-talk microphone with retractable coiled cord. Impedance is 600 ohms.

Power Requirement
13.8 Volts DC, ±10%

Current Consumption
0.5 Amps Receive
2.5 Amps Transmit

Metering
Illuminated front panel meter indicates received signal strength and relative transmitter power output.

Dimensions
180 (W) x 60 (H) x 220 (D) mm

Weight
2.7 kg

TRANSMITTER

RF Output
10 Watts into 50 ohm load at 13.8 Volt DC

Frequency Stability
±0.003%

Modulation
F3

Deviation
±5 kHz

Audio Response
+1, −3 dB of 6 dB/Octave pre-emphasis characteristic from 300 to 2500 Hz

Spurious Emissions
60 dB below carrier minimum

Tone Burst
Nominally one second at 1800 Hz

Repeater Split
±1.6 MHz or any frequency

RECEIVER

Type
Double conversion superheterodyne

Intermediate Frequencies
21.6 MHz first IF;
455 kHz second IF

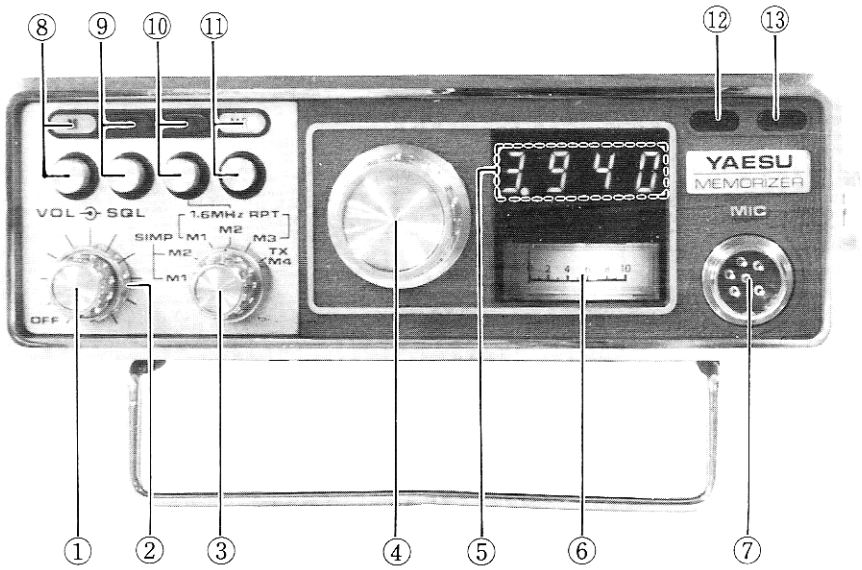
Sensitivity
Better than 0.35 μV for 20 dB QS

Selectivity
±6 kHz at −6 dB, ±12 kHz at −60 dB

Audio Output
1.5 Watts at 8 ohms

Specifications subject to change without notice or obligation.

CONTROLS AND SWITCHES



1) **VOL**
The VOLUME control adjusts the receiver audio output level. When rotated to the extreme CCW position, the power is turned off.

2) **SQL**
The SQUELCH control adjusts the receiver squelch threshold sensitivity.

3) **FUNCTION switch**
This switch selects the transmit frequency. Positions M1 and M2 (SIMP) can be used for simplex operation. Positions M1–M3 can be used for ±1.6 MHz split, for repeater operation. M4 is used for programming an auxiliary split of up to 4 MHz. Refer to the section on operation for details.

4) **Channel selector**
Endless optical coupling dial selects the operating frequency in 10 kHz steps.

5) **Display**
The digital display indicates the last four digits of the operating frequency.

6) **Meter**
The meter indicates signal strength on receive, and relative power output on transmit.

7) **MIC jack**
The 6 pin microphone jack is used for microphone input, push-to-talk relay actuation, and scanner control.

8) **M (MEMORY) switch**
Press this switch to store a frequency in memory.

9) **5 UP**
Pressing this switch shifts the operating frequency up 5 kHz.

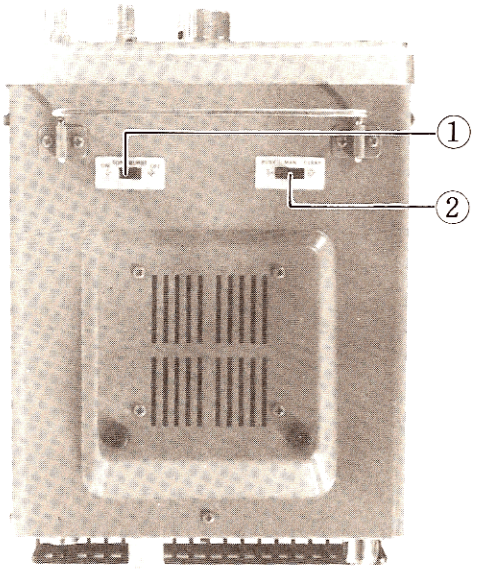
10) **+TX**
This switch is used to select the direction of the repeater split. When the switch is not pushed, repeater split of −1.6 MHz is selected. With the switch pushed, repeater split of +1.6 MHz is selected. Refer to the section on repeater operation.

11) **MR (MEMORY RECALL) switch**
When this switch is pressed, a memorized frequency will be recalled.

12) **BUSY lamp**
When a signal is being received, the BUSY lamp will be illuminated.

13) **ON AIR lamp**
When the PTT switch is pressed, and transmission hence takes place, the ON AIR lamp will be illuminated.

CABINET BOTTOM



1) **BURST**

When this switch is in the ON position, a short duration audio tone of 1800 Hz will be superimposed on the transmitted signal. This is normally used only with repeaters requiring tone access.

2) **BUSY/MAN/CLEAR**

This switch selects the mode of the PLL scanner. In the BUSY position, the scanner will search until it finds an occupied channel (one containing a signal strong enough to trip the FT-127RA squelch). In the MAN position, scanner stop commands come exclusively from the microphone. In the CLEAR position, the scanner will search until it finds a channel which has no signal present.

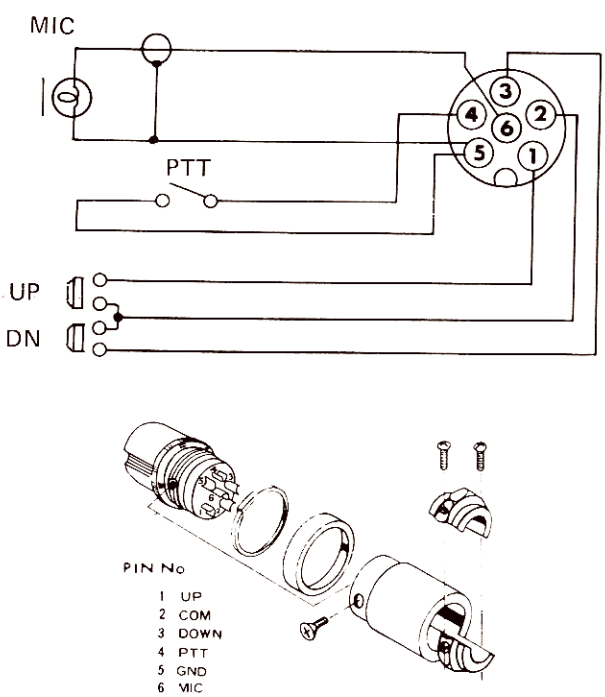
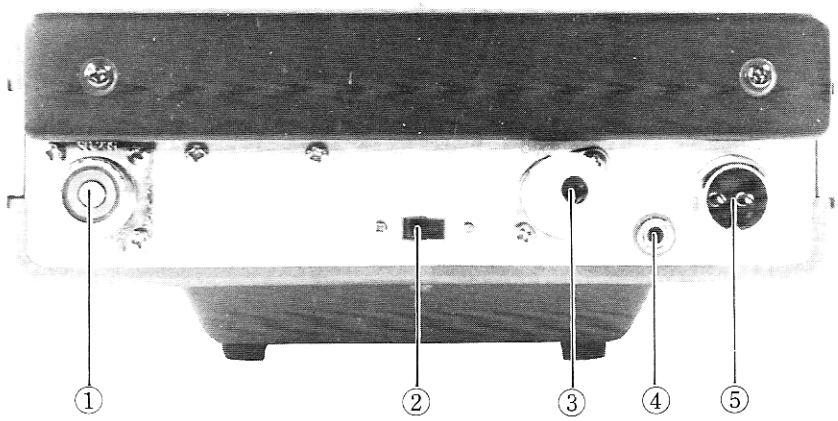


Fig. 1
Microphone Connections

REAR APRON



1) **ANT receptacle**
Standard UHF type coaxial fitting for connection of antenna.

2) **TONE SQ**
When the optional tone squelch unit is installed, pressing this switch activates the subaudible tone encoder/decoder.

3) **ACC**
The ACCESSORY socket is used for external control of the transceiver.

4) **SP**
Audio output is provided at this jack for use of an external speaker. Audio output impedance is 8 ohms, and the internal speaker will be disconnected when a plug is inserted into the SP jack.

5) **POWER receptacle**
A two-pin receptacle is used for connection to a 13.8 volt DC, negative ground power source.

ACCESSORIES

The following accessories are included with this transceiver:

1. Dynamic microphone with retractable, coiled cord.
2. Mobile mounting bracket with hardware.
3. DC power cable.
4. Cigarette lighter adapter.
5. Spare fuses.
6. Microphone hanger.
7. Miniature phone plug for external speaker.
8. Accessory plug (must be inserted in rear of transceiver at all times).
~~9. Tap connector.~~

CAUTION

IMPROPER FUSE REPLACEMENT CAN CAUSE PERMANENT DAMAGE IN THE EVENT OF UNUSUAL OPERATING CONDITIONS. OUR WARRANTY DOES NOT COVER DAMAGE CAUSED BY IMPROPER FUSE REPLACEMENT. USE ONLY A 3 AMPERE FUSE.

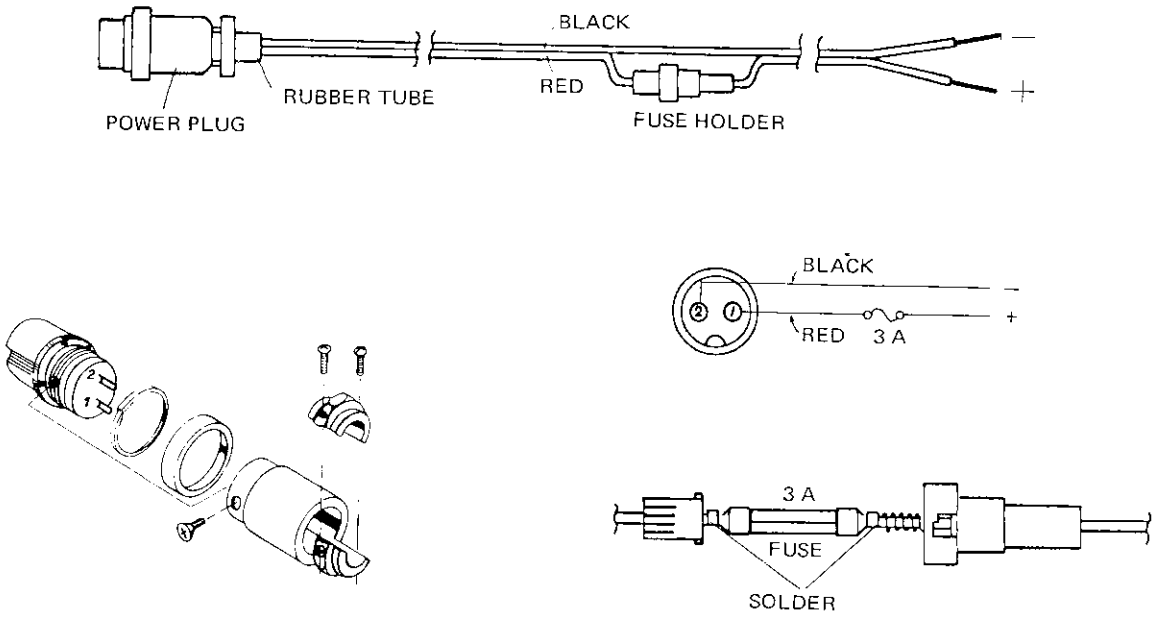


Figure 2.

POWER CABLE CONNECTIONS

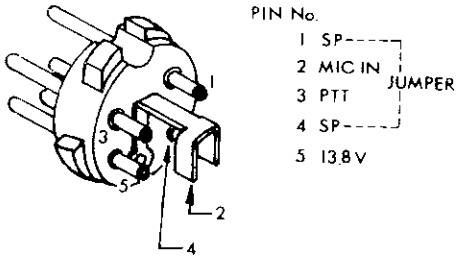


Figure 3.

ACC (TONE IN) PLUG CONNECTIONS

INSTALLATION

The FT-127RA transceiver is designed primarily for mobile service, requiring only an antenna and 13.8 volt DC power source for operation. The transceiver has been pre-tuned at the factory, and requires no further adjustment for normal operation into a 50 ohm load.

Under no circumstances should the power cable ever be connected to AC power. OUR WARRANTY DOES NOT COVER DAMAGE CAUSED BY APPLICATION OF AC POWER TO THE POWER JACK OF THIS TRANSCEIVER.

ANTENNA CONSIDERATIONS

In antenna installations, it is desirable that the antenna be located as high and in the clear as possible. In addition, be certain that the SWR on the feedline is less than 1.5:1. A higher SWR may cause a reduction in power output because of the protective circuitry incorporated in design. As well, high SWR will increase your feedline losses.

In all installations, do not economize on coaxial cable. For mobile applications, in which the feedline length is 20 feet or less, type RG-58A/U cable is satisfactory, and the foam types are preferred, owing to their lower losses. For base station runs, type RG-8A/U may be used for moderate lengths, and for very long runs we recommend the use of type RG-17A/U, air-dielectric "heliax" cable, or aluminum-jacketed "foamflex" coax. Be wary of "bargain" coax, as the shield coverage may be very poor, and at 220 MHz this can seriously degrade performance.

BASE STATION INSTALLATION

As a base station, the FT-127RA requires a power source of 13.8 volts DC at 2.5 amperes. A base station stand is provided for easy viewing.

MOBILE INSTALLATION

For mobile service, the FT-127RA should be installed where the controls, indicators, and microphone are easily visible and accessible for operation. The unit may be mounted in any position without loss of performance. Suitable locations are under the dash, atop transmission tunnel, etc. A universal bracket is supplied with the transceiver for this purpose. Install the FT-127RA as follows (refer to figure 4).

1. Use the universal mounting bracket as a template to locate the mounting holes. Use a 3/16" diameter drill for these holes and allow clearance for the transceiver, its controls, and connecting cables. Secure the mounting bracket with the screws, washers and nuts supplied, as shown in Figure 4A.

2. Install the transceiver in the mounting bracket, sliding it into the guide rail of the bracket, and tighten the screws on both sides.

3. The microphone hanger may be affixed to any convenient place for handling the microphone.

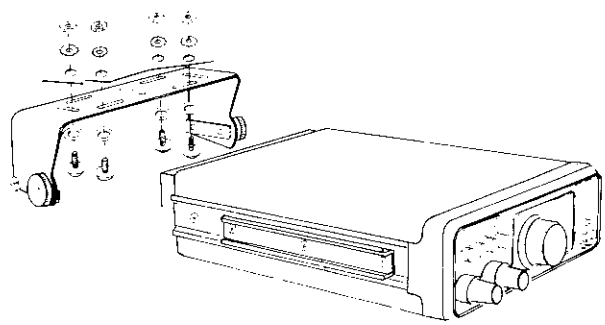


Figure 4A

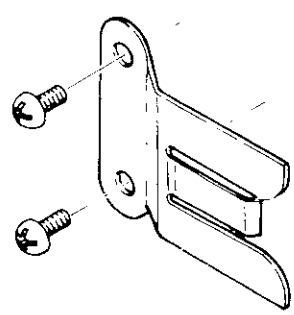


Figure 4B

4. The supplied power cable may be plugged directly into the vehicle's cigarette lighter receptacle, for casual operation. For permanent installation, the lighter plug may be removed, and the leads routed directly to the battery (red positive, black negative or ground), or the nearest termination to the battery, e.g. ignition switch, fuse block, etc. If it is necessary to extend the power leads, use #16AWG insulated copper wire and do not extend the leads further than required to avoid excessive voltage drop. The frequency display will move to 224.000 MHz or 224.005 when the supply voltage is accidentally opened by a loose contact of the power lead.

CAUTION

BEFORE CONNECTING THE POWER CABLE TO THE TRANSCEIVER, CHECK THE BATTERY VOLTAGE WITH THE ENGINE RUNNING (BATTERY CHARGING). IF THE VOLTAGE EXCEEDS 15 VOLTS DC, THE REGULATOR SHOULD BE READJUSTED SO THE HIGHEST CHARGING RATE DOES NOT EXCEED 15 VOLTS. ALSO, BE SURE TO OBSERVE PROPER POLARITY WHEN MAKING BATTERY CONNECTIONS (REVERSED POLARITY WILL NOT DAMAGE THE FT-127RA BECAUSE OF THE PROTECTIVE CIRCUITRY INCORPORATED IN THE DESIGN. HOWEVER, THE EQUIPMENT WILL NOT OPERATE UNDER THIS CONDITION).

5. Connect the power cable to the POWER receptacle on the rear panel.

6. Connect the 50 ohm antenna cable to the ANT receptacle on the rear panel.

7. Connect the microphone cable to the 6-pin microphone receptacle on the front panel.

8. An external 8 ohm speaker may be connected at the SP receptacle on the rear panel if desired (this automatically disconnects the internal speaker). Use the external speaker plug supplied.

HOW TO USE THE TAP CONNECTOR

(a) Do NOT strip insulation from wires.

(b) The tap connector will handle most wire sizes used in automotive instrument panels.

(c) Slice the "hot" lead into tap connector as shown.

(d) Insert transceiver power lead 3/4 of the way into connector (just past metal connector element).

(e) Using pliers, press the metal connector element until it is FLUSH.

(f) Fold the hinged cover over the connector element and snap firmly in place.

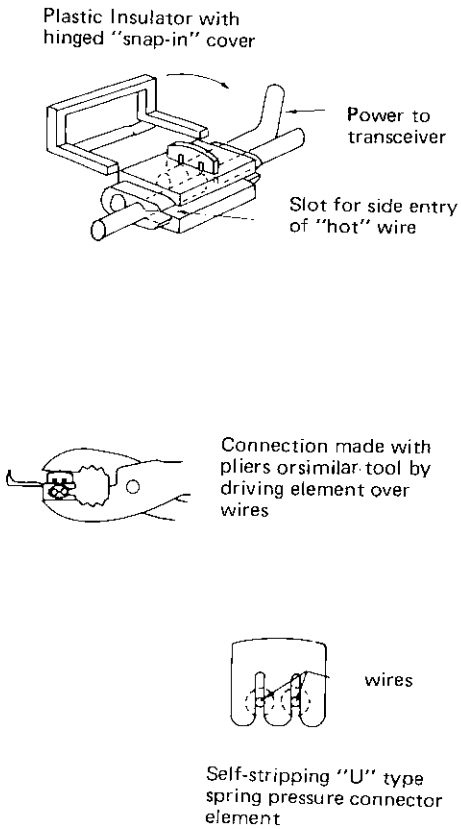


Figure 5

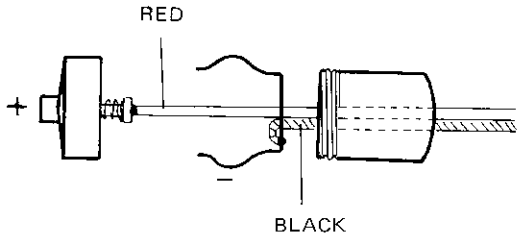


Figure 6

OPERATION

INITIAL CHECK

1) Rotate the VOL control switch in a clockwise direction to apply power. The meter will become illuminated, and the channel frequency will automatically be preset to 224.000 MHz

2) Rotate the SQL control fully counter-clockwise.

3) Adjust the VOL control for a comfortable listening level for the background noise or signal present.

4) Rotate the channel selector to locate a clear channel, and then rotate the SQL control clockwise until the receiver is just silenced. Do not rotate the SQL beyond the point required to silence the receiver, or else the receiver will not respond to weak signals.

FREQUENCY SELECTION

The channel selection knob selects the operating frequency in 10 kHz steps. Clockwise rotation increases the frequency up to 225.000 MHz, while counter-clockwise rotation lowers the frequency to 221.990 MHz. On 221.990 and 225.000 MHz, the transmitter section is disabled to prevent out-of-range operation. This protection applies, as well, to memorized frequencies in the same manner as dial frequencies.

CAUTION

CHANNEL SELECTION MUST NOT BE MADE WHILE THE PUSH-TO-TALK SWITCH IS ACTIVATED FOR TRANSMISSION.

SCANNER OPERATION

The PLL scanner will allow remote scanning for easy frequency change. Set the BUSY/MAN/CLEAR switch to MAN. Now, pressing the UP switch on the microphone for an instant will shift the operating frequency up 10 kHz. Pressing the DN switch will, likewise, lower the operating frequency 10 kHz.

Now, press the UP switch, and hold it in the depressed position. After an initial shift of 10 kHz, and a delay of approximately 1 second, the scanner will be activated, and the frequency will be shifted rapidly upward until the UP or DN switch is pressed again, at which time the scan will be halted. When the upper band edge is reached, the scan will reverse itself, and will begin scanning in a lower direction.

The same relations apply when the DN switch is pressed, except that when the lower band edge is reached, the scanner will reverse itself and begin scanning upward.

To set the scanner for searching for an occupied channel, set the BUSY/MAN/CLEAR switch to BUSY. Now, when the scanner is activated, the scan will be halted whenever the squelch is activated by an incoming signal. If the squelch is not adjusted to silence the receiver (with no signal present), the scanner will advance only 10 kHz per press, thinking that an occupied channel has been found.

To set the scanner for searching for a clear channel, set the BUSY/MAN/CLEAR switch to CLEAR. Now, the scanner will halt when the squelch is **silenced** (no signal present).

Whether in the BUSY, MAN, or CLEAR modes, the scan may be halted at any time by pressing either the UP or DN switches while scanning. If the PTT switch is pressed while scanning, the scan will be halted and transmission will occur on the frequency on which the scan was halted.

MEMORY OPERATION

Select the channel desired with the main dial or scanner controls. Set the FUNCTION switch to M1 (SIMP), and press the M (Memory) switch. Now the frequency on the dial is memorized, and both TX and RX will occur on the memorized frequency. For instant recall to the memorized frequency, press MR (Memory Recall). In like fashion, another frequency may be memorized for simplex operation, by setting the FUNCTION switch to M2 (SIMP), and pressing the M button.

Rotation of the FUNCTION switch to positions M1–M3 (1.6 MHz RPT), automatically shifts the transmit frequency 1.6 MHz down from the memorized frequency. If you memorize 222.340 MHz in the M1 (1.6 MHz RPT) position, press MR, and press the +TX button, you will be transmitting on 223.940 MHz, while receiving on 222.340 MHz. Be careful, as it is possible to transmit outside the 222–225 MHz range when using the repeater shift mode.

The M4 position may be used for split frequency operation, with a split of up to 4 MHz possible. Rotate the main dial or scan to the desired transmit frequency, and press the M button. Now rotate the dial or scan to the desired receive frequency. You will transmit on the memory frequency, while receiving on the dial frequency. The position of the MR button is not important in the case of the MR position of the FUNCTION switch.

REPEATER OPERATION

When the FUNCTION switch is set to positions M1–M3 (1.6 MHz RPT), and the MR switch is not pushed, automatic split of −1.6 MHz will be applied to the dial frequency. With the FUNCTION switch set to M1–M3 (1.6 MHz RPT), and the MR switch **pushed**, the −1.6 MHz split will be applied to the memorized frequency.

When operating in the repeater mode, the repeater shift may be made +1.6 MHz, by pressing the +TX button.

Be careful when using the repeater shift, as it is possible to transmit outside the 222–225 MHz range of the transceiver.

Remember: placing the FUNCTION switch in the M1–M2 (SIMP) position will provide simplex operation.

When the BURST switch on the bottom of the transceiver is placed in the ON position, a tone of 1800 Hz of approximately 1 second duration will be superimposed on the speech signal. This tone is normally used only with "tone access" repeaters, and the BURST switch should be turned OFF when using repeaters not requiring this access tone.

TRANSMISSION

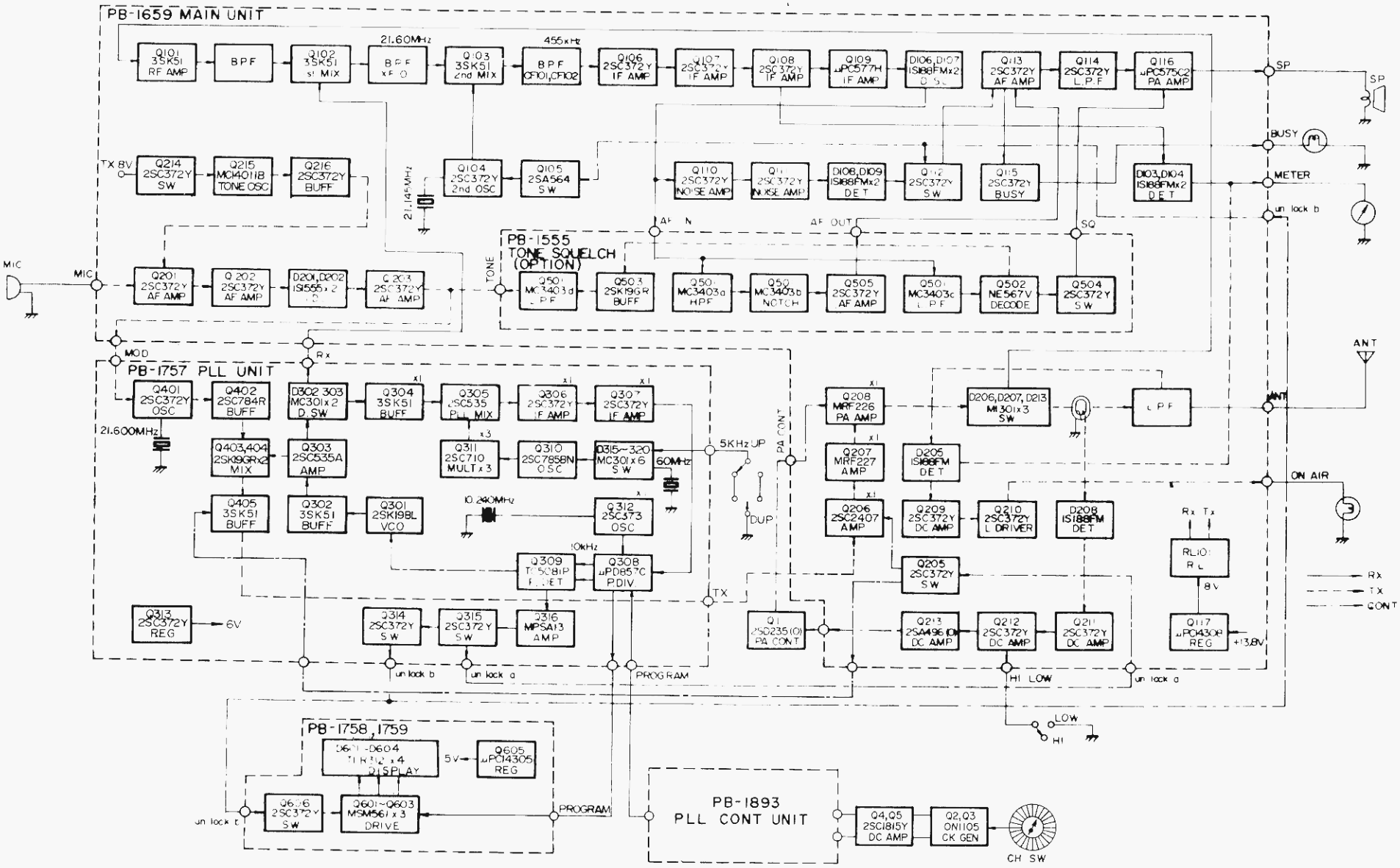
When ready to transmit, hold the microphone close to your mouth, press the PTT switch, and speak into the microphone in a normal voice. Check that the red ON AIR lamp is illuminated when the PTT switch is pressed. Release the PTT switch for receiver recovery.

OPTIONAL TONE SQUELCH OPERATION

The tone squelch option allows silent monitoring of busy channels. When the tone squelch unit is installed, and the TONE SQ button pushed, a subaudible tone will be superimposed on the transmitted signal. On receive, the squelch will not open unless a subaudible tone is superimposed on the transmitted signal of the other station. The tone frequency can be set to any frequency between 70 and 250 Hz, as shown in the Alignment section of this manual.

To install the tone squelch option, remove the transceiver from its case. Locate the space provided for the tone squelch circuit board, and align the board so that it fits down over the pins, as shown. Solder the connections shown, and remove the red jumper wire shown in the illustration.

With the tone squelch option installed, the BUSY lamp will light up when **any** signal is received, but the squelch will open only when a subaudible tone is received on an incoming signal. The operator should check the BUSY lamp before transmitting, out of courtesy to other operators who may be using the channel. The tone squelch system is designed to allow silent monitoring of busy channels; it is **not** designed to allow two operators so equipped to have priority use of a channel.



FT-127RA MEMORIZER BLOCK DIAGRAM

CIRCUIT DESCRIPTION

The block diagram and circuit description below will provide you with a better understanding of your transceiver. Refer to the schematic diagram for specific circuit details.

The FT-127RA consists of a double conversion superheterodyne receiver and a frequency modulated (FM) transmitter section. A digital phase locked loop synthesizer provides channel selection throughout the operating range, 222–225 MHz. Solid state components are used throughout, and the transceiver is designed for operation from a 13.8 volt DC power source.

TRANSMITTER

The transmitter produces a frequency modulated (FM) signal. The audio signal from the microphone is set to the proper level by VR_{201}, and amplified by Q_{201}, Q_{202}, and Q_{203} (2SC372Y). The audio output from Q_{202} is coupled to the IDC (Instantaneous Deviation Control) circuit, where both positive and negative peaks are clipped by diodes D_{201} and D_{202} (1S1555). The output from Q_{203} is fed through a low-pass filter, which attenuates frequency components above the speech range caused by clipping. Deviation control potentiometer VR_{202} controls the clipping level, which normally is set to produce a deviation of ±5 kHz.

The speech signal is then applied to phase modulator varactor diode D_{401} (1SV50), which varies the frequency of the 21.6 MHz crystal controlled oscillator, Q_{401} (2SC372Y). The frequency modulated signal at 21.6 MHz is then amplified by buffer amplifier Q_{402} (2SC784R), and then fed to a balanced mixer, consisting of Q_{403} and Q_{404} (2SK19GR). Here the signal is converted up to 222–225 MHz by mixing with the 200.4–203.4 MHz signal delivered from the VCO.

The output from the balanced mixer is fed through the tuned circuits consisting of T_{404}–T_{407}, to amplifier Q_{405} (3SK51). Transformers T_{404}–T_{407} are tuned to the transmitter frequency by varactor diodes D_{403}–D_{406} (1S2209), in which capacitance changes are produced in accordance with changes in the DC output voltage of the PLL unit. The 222–225 MHz signal is then amplified by amplifier stages Q_{206} (2SC2407), Q_{207} (MRF227), and Q_{208} (MRF226), providing 10 watts of RF energy, through a diode switch and low-pass filter, into a 50 ohm load.

Diodes D_{205} and D_{211} (1S188FM) rectify a small portion of the RF output, and the resulting DC voltage is applied to the meter for an indication of the relative power output from the transmitter. The DC output from D_{205} is also delivered to lamp drivers Q_{209} and Q_{210} (2SC372Y), which turn the ON AIR lamp on during transmission.

If the transmitter is activated without an antenna being connected, or if a high SWR exists at the antenna receptacle, the reflected power is detected through T_{202} and a diode, D_{208} (1S188FM), producing a DC voltage. Q_{211} (2SC372Y) conducts in accordance with the DC voltage, which is fed through VR_{205}, causing a decrease in the collector current of Q_{212} (2SC372Y).

This causes a drop in the collector voltage of Q_{213} (2SA496(O)), causing Q_1 (2SD235(O)) to reduce the current and supply voltage to the PA stages, thus providing protection for these components. The threshold level is set by VR_{205}.

The tone burst circuit consists of a timing generator and a gated multivibrator. When the BURST switch is ON, a DC voltage is applied to the tone burst circuit. When the transmitter is keyed, Q_{214} (2SC372Y) conducts, triggering a one-shot multivibrator, located on Q_{215} (MC14011B). The other half of Q_{215} generates a tone signal, which is amplified by buffer Q_{216} (2SC372Y). The signal is then delivered to the AF amplifier stages of the transmitter.

The tone frequency is adjusted by VR_{207}, and the output level (deviation) is adjusted by VR_{209}. The burst duration is set by VR_{208}.

RECEIVER

The input signal from the antenna is fed through a low-pass filter consisting of L_1, L_{213}, L_{214}, C_1, and C_{243}–C_{245} to diode changeover switch D_{206}, D_{207} and D_{213} (MI301). On receive, the signal is fed to the RF amplifier, Q_{101} (3SK51), a dual gate FET with superior cross-modulation rejection. The amplified signal is then applied through a 4-stage high-Q coaxial resonator to the first mixer, Q_{102} (3SK51). The use of the dual gate FET RF amplifier, along with the high-Q bandpass filter, provides excellent noise figure for the system, with high immunity from spurious responses.

The 222–225 MHz signal is heterodyned with the first local oscillator signal, producing a 21.60 MHz first IF. The first local oscillator signal of 200.4–203.4 MHz is delivered from the PLL (Phase Locked Loop) VCO (Voltage Controlled Oscillator) circuit.

The first IF signal is fed through a crystal filter, XF_{101}, which has a passband of ±7.5 kHz, to the second mixer, Q_{103} (3SK51). Here the first IF signal is mixed with the second local oscillator signal of 21.145 MHz, producing a 455 kHz second IF. The second local signal is produced by Q_{104} (2SC372Y), and switch Q_{105} (2SA564) will disconnect the supply voltage to Q_{104} when the PLL is unlocked.

Cascade-connected ceramic filters CF_{101} and CF_{102} provide narrow band selectivity in the second IF. The signal is then amplified by the IF amplifier chain consisting of Q_{106}, Q_{107}, Q_{108} (all 2SC372Y), and Q_{109} (μPC577H). The limiting action of Q_{109} removes any amplitude variation on the IF signal, which subsequently is passed to the ceramic discriminator, consisting of CD_{101}, D_{106}, and D_{107} (1S188FM).

The discriminator produces an audio output in response to a corresponding shift in the IF signal. The output audio signal is amplified by Q_{113} and Q_{114} (2SC372Y), and fed through volume control VR_1 to the input of the final audio amplifier, Q_{116} (μPC575C2). The output from Q_{116} is applied in series through the ACC socket to the internal speaker. The low-pass filter between Q_{113} and Q_{114} attenuates the audio spectrum above 3 kHz, increasing the readability of the received signal.

A portion of the 455 kHz IF signal is rectified by D_{103} and D_{104} (1S188FM) for S-meter indication. VR_{101} provides adjustment of the S-meter sensitivity.

When no carrier is present in the 455 kHz IF, the high frequency noise at the discriminator output is amplified by Q_{110} and Q_{111} (2SC372Y), then detected by D_{108} and D_{109} (1S188FM), producing a DC voltage. This voltage is applied to Q_{112} (2SC372Y), turning it ON. With the conduction of Q_{112}, the base of Q_{113} is grounded, squelching the audio amplifier. When a carrier is present in the 455 kHz IF, the noise is removed from the discriminator output, and the audio amplifier returns to normal operation.

When the squelch circuit is opened, Q_{113} conducts, causing lamp driver Q_{115} (2SC372Y) to draw current, lighting up the BUSY lamp. Squelch controls VR_2 and VR_{102} set the threshold level for the squelch circuit.

HETERODYNE OSCILLATOR

The heterodyne signal is generated by the PLL (Phase Locked Loop) circuit, which consists of a VCO (Voltage Controlled Oscillator), a reference crystal oscillator, a programmable divider, and a phase comparator.

The VCO oscillator, Q_{301} (2SK19BL), generates a 200.4–203.4 MHz signal. The oscillator frequency is controlled by varactor diode D_{301} (1S2209), which varies the capacitance of a tuned circuit consisting of L_{301}, TC_{301}, C_{302}, and C_{303}, in accordance with a DC voltage supplied from phase comparator Q_{309} (TC5081P).

The output signal from Q_{301} is amplified by buffer amplifier Q_{302} (3SK51) and amplifier Q_{303} (2SC535A), and fed through diode switches D_{302} or D_{303} (MC301) to the receiver or transmitter mixers.

A portion of the output from Q_{303} is fed through buffer amplifier Q_{304} (3SK51) to the PLL mixer, Q_{305} (2SC535A), which produces a 1–4 MHz PLL IF signal by mixing with the PLL heterodyne signal.

The PLL heterodyne signal is generated by an overtone crystal controlled oscillator, Q_{310} (2SC785BN). The crystal frequency is shown in Table 1. Diode switches D_{315}–D_{320} (MC301) select the appropriate crystal, in accordance with the settings of the FUNCTION switch and the 5 UP switch. The output from Q_{310} is fed to tripler Q_{311} (2SC710), yielding the PLL heterodyne signal.

The PLL IF signal is fed through a low-pass filter, consisting of L_{305}, C_{331}, and C_{332}, to amplifiers Q_{306} and Q_{307} (2SC372Y). The amplified signal is then fed to programmable divider Q_{308}, (μPD857C).

Crystal oscillator Q_{312} (2SC373) generates a 10.24 MHz signal, and its output is fed to scaler/divider Q_{308}, where the 10.24 MHz signal is converted to a 10 kHz reference signal.

The digital phase comparator, Q_{309}, compares the phase of the PLL IF signal with that of the 10 kHz reference signal, and any phase difference is converted into an error-correcting voltage. This voltage is fed to varactor diode D_{301}, which changes the output signal phase to lock with that of the reference signal.

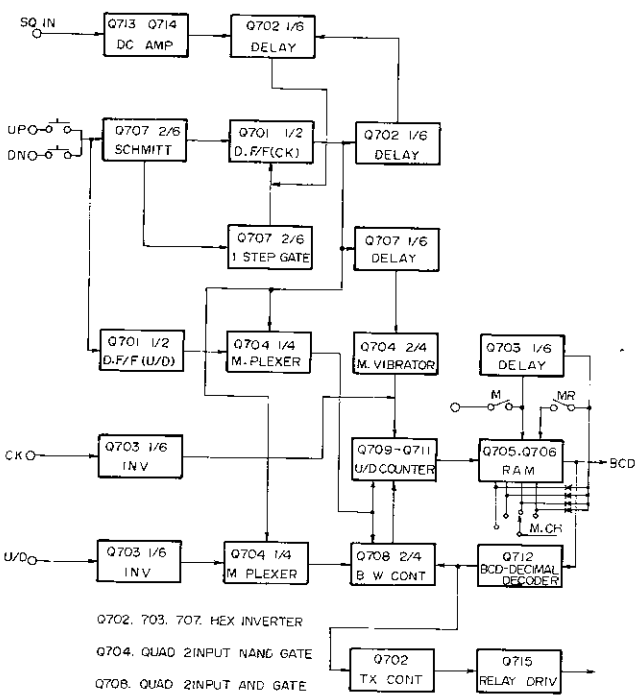
When the VCO is locked, the constant voltage at pin 4 of Q_{309} is applied to Q_{316} (MPSA13), causing it to conduct, and in turn, Q_{315} (2SC372Y) cuts off. The "H" voltage at the collector of Q_{315} turns Q_{205} (2SC372Y) on, supplying DC voltage to the early stages of the exciter, Q_{204} and Q_{206}. When the VCO is unlocked, the DC voltage at the emitter of Q_{205} drops, preventing normal operation of Q_{204} and Q_{206}.

The output voltage from Q_{315} is reversed in polarity by Q_{314} (2SC372Y), and applied to Q_{606} (2SC372Y), keeping the collector of Q_{606} at "H" level, allowing Q_{601}–Q_{603} (MSM561) to drive the digital display normally. The voltage is also applied to Q_{105}, which supplies DC voltage to the second heterodyne oscillator, Q_{104}.

When the VCO is unlocked, the collector voltage at Q_{606} drops, causing the display LEDs to turn off. Simultaneously, the second heterodyne oscillator ceases oscillation. Thus, the receiver is muted until VCO lock occurs.

PLL CONTROL UNIT

Please refer to the PLL Control Unit logic diagram for questions regarding the operation of this circuitry. A complete treatment of every logic state is beyond the scope of this manual.



Crystal	Frequency	PLL Het. Freq.	Remarks
X301	66.1333 MHz	198.400 MHz	Simplex
X302	65.6000 〃	169.800 〃	TX −1.6 MHz shift
X303	66.6666 〃	200.000 〃	TX +1.6 MHz shift
X304	66.1350 〃	198.405 〃	Simplex 5 kHz up
X305	65.6016 〃	169.805 〃	TX −1.6 MHz 5 kHz up
X306	66.6683 〃	200.005 〃	TX +1.6 MHz 5 kHz up

POWER SUPPLY

A 13.8 volt DC supply is used for the audio power amplifier, Q_{116}, as well as the relay and lamps. The supply voltage for the driver and final amplifier is fed through voltage regulator Q_{111} (2SD235D), which is controlled by the automatic final protection unit.

Voltage regulator Q_{605} (μPC14305) regulates the supply voltage at 5 volts, to supply Q_{308} and the display unit. Q_{313} (2SC372Y) and D_{301} (RD68EB) regulates the supply voltage at 6 volts for the VCO and phase comparator. The 5 volt supply for the PLL control unit is regulated by zener diode D_3 (WZ050), and is connected directly (not via the power switch) for memory backup purposes.

A regulated 8 volt circuit using Q_{117} (μPC14308) is used for all other circuits.

When the transceiver is used in the memory mode, D_4 and D_5 (WZ050) supply 5 volts to the receiver and transmitter, respectively.

TONE SQUELCH UNIT (OPTION)

The tone squelch circuit disables the audio circuit of the receiver until a preset, subaudible tone is received. On transmit, a subaudible tone is superimposed on the output audio signal. The frequency of this tone can be set to any frequency between 70 Hz and 250 Hz.

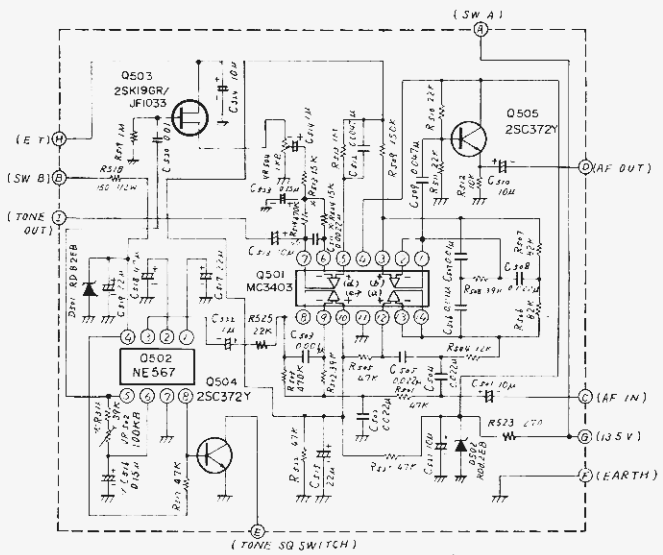
The tone signal is generated by Q_{502} (NE567), and its frequency is set by R_{516}, VR_{502}, and C_{516}. The level of the tone signal is set by VR_{504}, and the signal is subsequently fed through buffer amplifier Q_{503} (2SK19GR) to a low pass filter on unit "d" of operational amplifier Q_{501} (MC3403). The tone signal is then superimposed on the speech signal at Q_{202}. The constants for setting the subaudible tone frequency are shown in Table 2.

The audio output signal from the receiver discriminator is fed to unit "a" of Q_{501}. Unit "a" of Q_{501} acts as a high-pass filter, while unit "b" acts as a T-notch filter. These filters remove the subaudible tone from the audio signal, which is then fed through audio amplifier Q_{505} (2SC372Y) to amplifier Q_{113}.

The subaudible tone then passes through a low-pass filter at unit "c" of Q_{501}, and is fed to Q_{502}. When the tone frequency is the same as that preset for transmission, the voltage at pin 8 of Q_{502} becomes low, causing Q_{504} (2SC372Y) to turn off. In turn, proper bias voltage is applied to Q_{119}, allowing normal operation.

When the proper tone signal is not present, Q_{504} conducts, removing the bias from Q_{119}, thus disabling the audio circuit.

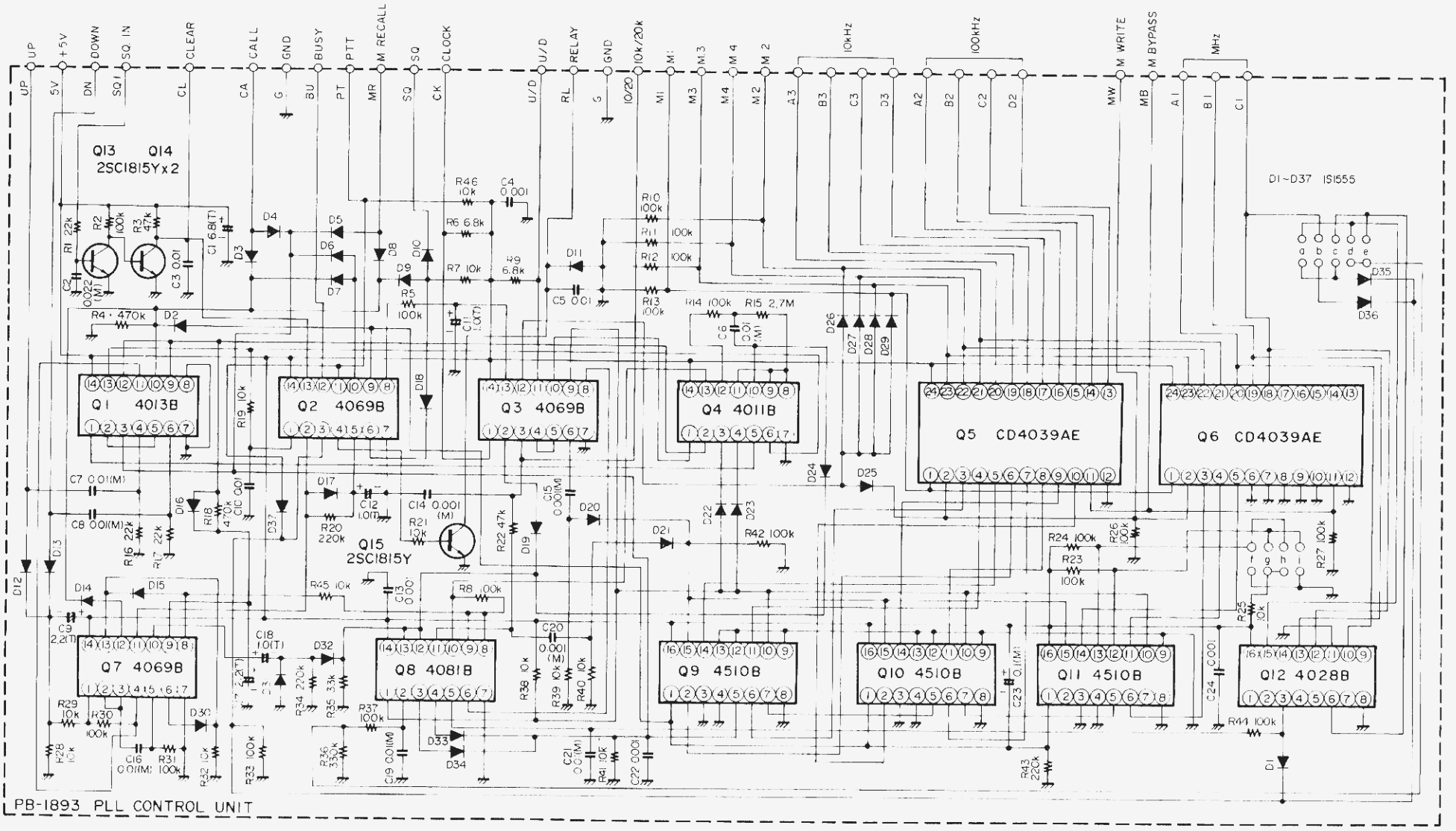
As the conventional carrier-controlled squelch is still in operation, irrespective of the condition of the tone squelch, the BUSY lamp will light up when any carrier is received. This feature alerts the operator that the channel is occupied, though no signal may be heard.



TONE SQUELCH (PB-1555A) OPTION

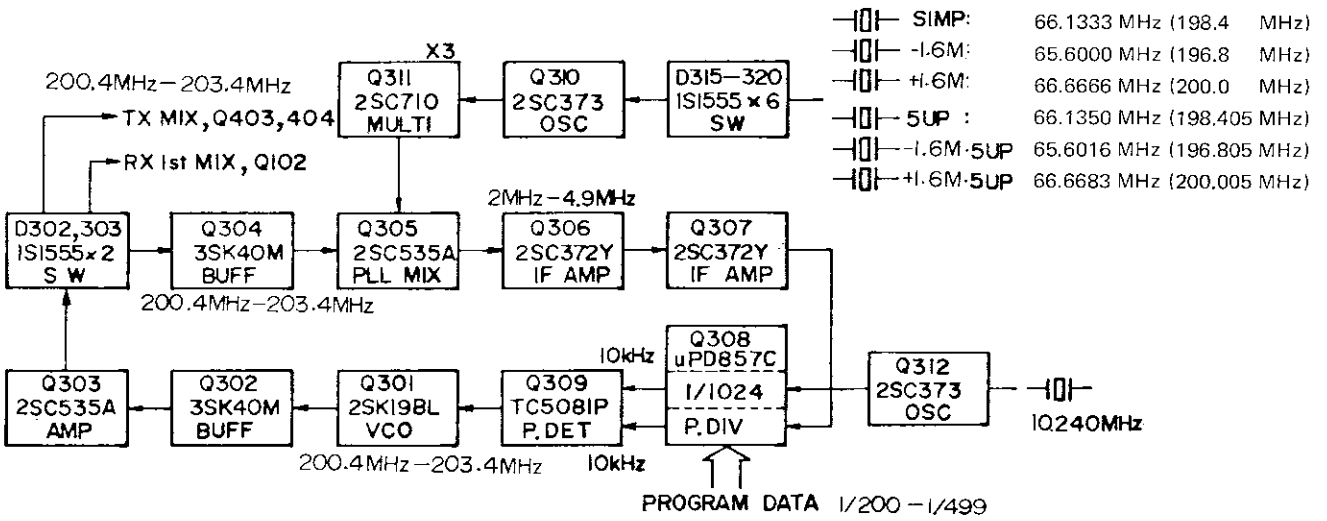
	C516*	R516*	R513*	R514*	R524*
70Hz / 160Hz	0.15μF	39KΩ	15KΩ	470KΩ	15KΩ
160Hz / 250Hz	0.1μF	33KΩ	8.2KΩ	270KΩ	8.2KΩ

Table 2



PLL CONTROL UNIT PB-1893

PLL CIRCUIT FREQUENCY RELATIONS



CRYSTAL DATA FT-127RA

FUNCTION	HOLDER	RANGE (MHz)	MODE	LOAD C	SERIES R	DRIVE LEVEL
Reference (X_{407})	HC-18/U	10.240	Fundamental	30 pF	25 Ω	2 mW
2nd Local (X_{101})	HC-18/U	21.145	Fundamental	30 pF	20 Ω	2 mW
Carrier (X_{401})	HC-18/U grounded case type	*21.600	Fundamental	30 pF	20 Ω	2 mW
(X_{301})		66.1333				
(X_{302})		65.6000				
PLL Local (X_{303})	HC-18/U	66.6666	3rd overtone	(series resonant)	40 Ω	2 mW
(X_{304})		66.1350				
(X_{305})		65.6016				
(X_{306})		66.6683				

* ACTUAL FREQUENCY : 21.64 MHz
40 kHz UP (Decided by circuit)

Q308 (μPD857C) PROGRAMMABLE DIVIDER CODE

Q308 PROGRAMMABLE INPUT PIN→			1	2	3	4	5	6	7	8	9	10	11
P/J 305		→	4	5	6	7	8	9	10	11	12	13	14
P/J 304		→	11	10	9	8	7	6	5	4	3	2	1
FREQUENCY ↓	DIAL DISPLAY ↓	PROGRAMMABLE DIVIDER RATIO ↓	P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8	P_9	P_{10}	P_{11}
222.00	2.000	1/200	0	0	0	0	0	0	0	0	0	1	0
2.01	2.010	1/201	1	0	0	0	0	0	0	0	0	1	0
2.02	2.020	1/202	0	1	0	0	0	0	0	0	0	1	0
2.03	2.030	1/203	1	1	0	0	0	0	0	0	0	1	0
2.04	2.040	1/204	0	0	1	0	0	0	0	0	0	1	0
2.05	2.050	1/205	1	0	1	0	0	0	0	0	0	1	0
2.06	2.060	1/206	0	1	1	0	0	0	0	0	0	1	0
2.07	2.070	1/207	1	1	1	0	0	0	0	0	0	1	0
2.08	2.080	1/208	0	0	0	1	0	0	0	0	0	1	0
2.09	2.090	1/209	1	0	0	1	0	0	0	0	0	1	0
222.10	2.100	1/210	0	0	0	0	1	0	0	0	0	1	0
2.11	2.110	1/211	1	0	0	0	1	0	0	0	0	1	0
2.12	2.120	1/212	0	1	0	0	1	0	0	0	0	1	0
2.13	2.130	1/213	1	1	0	0	1	0	0	0	0	1	0
2.14	2.140	1/214	0	0	1	0	1	0	0	0	0	1	0
2.15	2.150	1/215	1	0	1	0	1	0	0	0	0	1	0
2.16	2.160	1/216	0	1	1	0	1	0	0	0	0	1	0
2.17	2.170	1/217	1	1	1	0	1	0	0	0	0	1	0
2.18	2.180	1/218	0	0	0	1	1	0	0	0	0	1	0
2.19	2.190	1/219	1	0	0	1	1	0	0	0	0	1	0
222.20	2.200	1/220	0	0	0	0	0	1	0	0	0	1	0
2.30	2.300	1/230	0	0	0	0	1	1	0	0	0	1	0
2.40	2.400	1/240	0	0	0	0	0	0	1	0	0	1	0
2.50	2.500	1/250	0	0	0	0	1	0	1	0	0	1	0
2.60	2.600	1/260	0	0	0	0	0	1	1	0	0	1	0
2.70	2.700	1/270	0	0	0	0	1	1	1	0	0	1	0
2.80	2.800	1/280	0	0	0	0	0	0	0	1	0	1	0
2.90	2.900	1/290	0	0	0	0	1	0	0	1	0	1	0
223.00	3.000	1/300	0	0	0	0	0	0	0	0	1	1	0
223.01	3.010	1/301	1	0	0	0	0	0	0	0	1	1	0
223.02	3.020	1/302	0	1	0	0	0	0	0	0	1	1	0
223.03	3.030	1/303	1	1	0	0	0	0	0	0	1	1	0
223.04	3.040	1/304	0	0	1	0	0	0	0	0	1	1	0
223.05	3.050	1/305	1	0	1	0	0	0	0	0	1	1	0
223.06	3.060	1/306	0	1	1	0	0	0	0	0	1	1	0
223.07	3.070	1/307	1	1	1	0	0	0	0	0	1	1	0
223.08	3.080	1/308	0	0	0	1	0	0	0	0	1	1	0
223.09	3.090	1/309	1	0	0	1	0	0	0	0	1	1	0
223.10	3.100	1/310	0	0	0	0	1	0	0	0	1	1	0
223.20	3.200	1/320	0	0	0	0	0	1	0	0	1	1	0
223.30	3.300	1/330	0	0	0	0	1	1	0	0	1	1	0
223.40	3.400	1/340	0	0	0	0	0	0	1	0	1	1	0
223.50	3.500	1/350	0	0	0	0	1	0	1	0	1	1	0
223.60	3.600	1/360	0	0	0	0	0	1	1	0	1	1	0
223.70	3.700	1/370	0	0	0	0	1	1	1	0	1	1	0
223.80	3.800	1/380	0	0	0	0	0	0	0	1	1	1	0
223.90	3.900	1/390	0	0	0	0	1	0	0	1	1	1	0
224.00	4.000	1/400	0	0	0	0	0	0	0	0	0	0	1
225.00	5.000	1/500	0	0	0	0	0	0	0	0	1	0	1

※1 HIGH LEVEL (5V)
※0 LOW LEVEL (0V)

MAINTENANCE & ALIGNMENT

The FT-127RA transceiver has been carefully aligned, tested, and submitted to a number of quality control examinations at the factory. If the transceiver is not abused, and if normal, routine maintenance is carried out, the FT-127RA should provide the owner with years and years of trouble-free operation.

The following precautions must be observed, in order to prevent damage to the transceiver:

(1) Do NOT exceed 15 volts DC at the POWER jack. For mobile operation, the voltage regulator must be adjusted to that the battery voltage does not exceed a maximum level of 15 volts. The engine should be running fast enough to show a charge for this test. As well, do not operate the transceiver if the supply voltage is less than 12 volts DC.

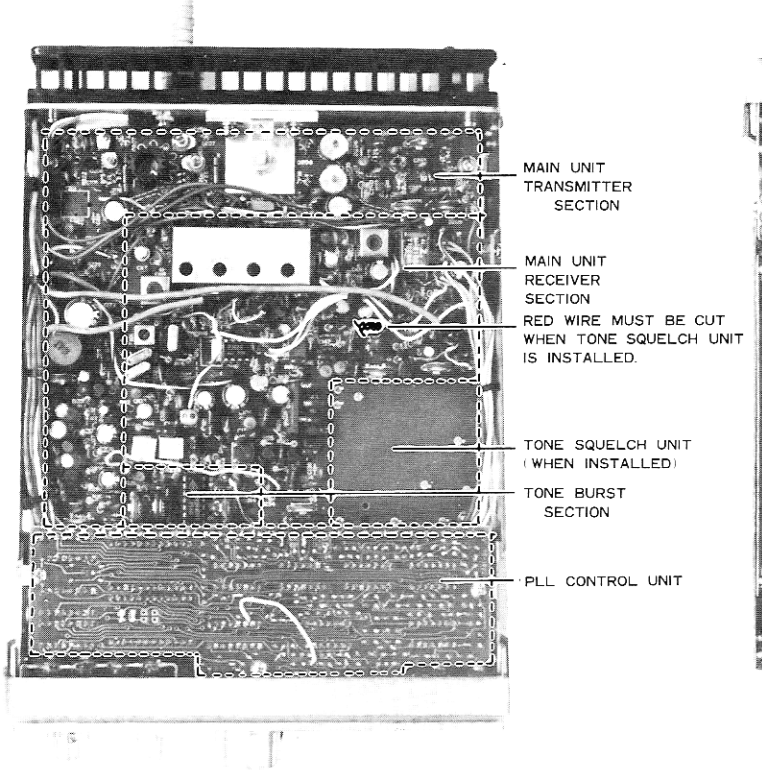
(2) Do not expose the transceiver to water nor long periods of direct, hot sunlight.

ROUTINE MAINTENANCE

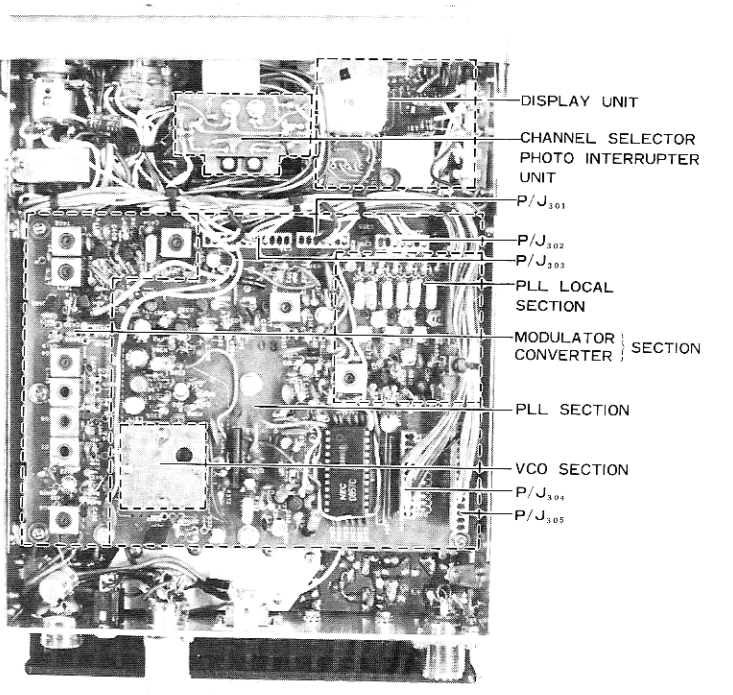
For the most part, maintenance of your FT-127RA should be limited to keeping the transceiver clean. Periodic checks of transmitter RF power output and receiver sensitivity will ensure top performance.

CLEANING

When the transceiver has been used in a dusty or sandy environment, the interior may require cleaning. A vacuum cleaner should be used, and any caked or accumulated dirt may be loosened with a soft brush. Check the interior to make sure that it is thoroughly dry before replacing the case and operating the unit. The exterior of the transceiver may be wiped with a damp cloth whenever required.



TOP VIEW



BOTTOM VIEW

PERFORMANCE CHECKS

Make all performance checks at 13.5 V DC under load.

Check the transmitter side as follows:

(a) Connect a suitable 50 ohm dummy load/RF wattmeter to the ANT receptacle.

(b) Set the channel selector to any channel, and set the power output selector to HI. Key the transmitter, and observe the power output. The power should be approximately 10 watts, while the FT-127RA S-meter should read between 6 and 8 on the relative output scale.

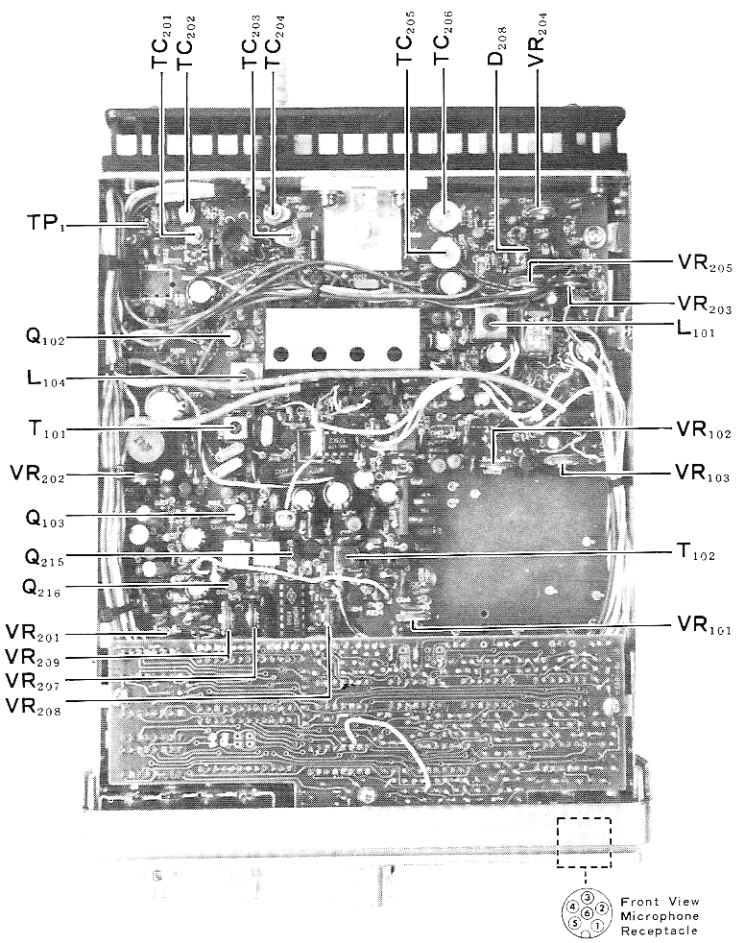
Check the receiver sensitivity as follows:

(a) Connect an AC VTVM to the SP receptacle, and set the SQUELCH control fully counter-clockwise. The tone squelch (if installed) should be OFF.

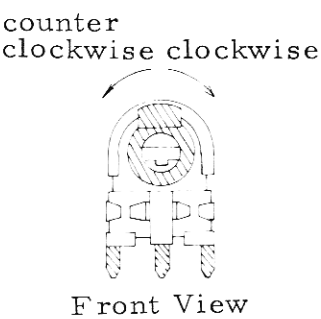
(b) Connect the RF output of a precision VHF signal generator to the ANT receptacle, and note the VTVM reading with no signal applied. Adjust the transceiver volume control and the VTVM range, as required, to secure approximately a full scale VTVM reading. DO NOT change the volume control setting after marking this adjustment.

(c) Set the signal generator to the receive frequency of the transceiver, and adjust the output amplitude of the signal generator until the VTVM registers a 1/100th (20 dB decrease) reading as compared to the no-signal case. The signal generator output voltage at this point is the 20 dB quieting sensitivity, and this level should be approximately 0.35 μV.

If the above performance checks indicate a need for realignment, it is recommended that you take the instrument to your Yaesu dealer for servicing. The alignment procedures require special test equipment not normally available to the station owner, and any attempt to align this unit without the proper knowledge and test equipment may result in seriously degraded performance.



ALIGNMENT POINT



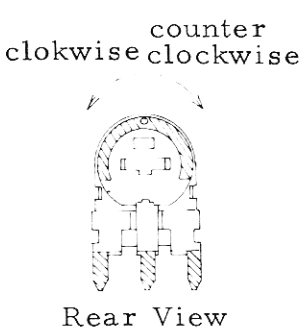


Figure 7

ALIGNMENT

SOME OF THE FOLLOWING ALIGNMENT PROCEDURES REQUIRE SPECIAL TEST EQUIPMENT. SERVICING SHOULD NOT BE ATTEMPTED BY OTHER THAN AN EXPERIENCED TECHNICIAN.

TRANSMITTER

(1) RF Power Amplifier

(a) Set the main dial to 223.5 MHz. Connect a suitable VHF dummy load/wattmeter to the antenna jack.

(b) Set VR_{205} to the extreme counterclockwise (CCW) position. Peak TC_{201}–TC_{206} for maximum power output as indicated on the wattmeter.

(2) PO Meter

(a) Connect the dummy load to the antenna jack. Key the transmitter, and set VR_{203} for a reading of 8 on the PO scale, at full power.

(3) AFP (Automatic Final Protection)

(a) Connect a dummy load to the antenna jack. Set VR_{205} to the extreme CCW position. Connect a VTVM to the cathode of D_{208}, and adjust VR_{204} for a minimum VTVM indication.

(b) Disconnect the dummy load from the antenna jack. Set VR_{205} to the fully clockwise position. Key the transmitter, and slowly rotate VR_{205} in a CCW direction until the PO meter reading becomes 4.

(4) Deviation

(a) Connect a dummy load to the antenna jack, connect the output of an audio oscillator between pin 6 (mic) and pin 5 (gnd) of the microphone jack, and a deviation meter as shown in Figure 8.

(b) Connect a VTVM to TP_3, and peak T_{402} for maximum power output.

(c) Now connect a frequency counter between TP_3 and ground. Key the transmitter, and adjust T_{401} for a 21.6 MHz counter reading.

(d) Connect the RF probe of the VTVM between the TX OUT terminal of the PLL UNIT and ground. Peak T_{402}–T_{408} for a maximum VTVM reading on transmit (1.5 V RMS typ.).

(e) Set the level of the audio signal generator to 25 mV at 1 kHz, and adjust VR_{202} for ±4.5 kHz deviation on transmit.

(f) Set the audio generator output level to 2.5 mV. Adjust VR_{201} for a deviation of ±3.5 kHz while transmitting.

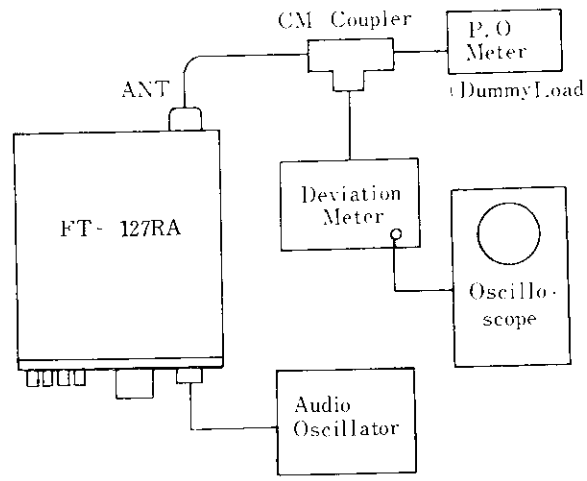


Figure 8

(5) Tone Burst

(a) Connect the dummy load to the antenna jack, and disconnect the microphone, so as to prevent voice modulation of the transmitter.

(b) Temporarily connect pin 5 of Q_{215} to pin 14.

(c) Connect a frequency counter to the emitter of Q_{216}, and set the TONE BURST switch ON.

(d) Key the transmitter, and adjust VR_{207} for the desired burst frequency.

(e) Connect a VTVM to the MIC IN terminal, and adjust VR_{209} for a 2.5 mV reading.

(f) Disconnect the previously-connected wire between pin 5 and pin 14 of Q_{215}. Key the transmitter, and adjust VR_{208} for the desired tone burst duration.

RECEIVER

(1) RF Amplifier

(a) Connect a precision VHF signal generator to the antenna jack. Set the channel selector to 223.500 MHz.

(b) Tune the signal generator to the channel frequency, and adjust L_{101}, L_{104}, and TC_{101}–TC_{104} for a maximum S-meter reading.

(2) First IF Amplifier

(a) Connect a sweep generator to gate 1 of Q_{102}. Connect an oscilloscope through a detector to the drain of Q_{103}.

(b) Set the frequency of the sweep generator to 21.6 MHz, and apply this output. Adjust T_{101} until the scope pattern indicated in Figure 9 is obtained.

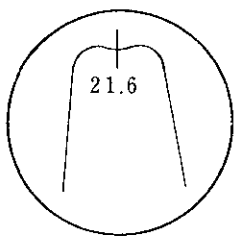


Figure 9

(c) Connect the VTVM to the emitter of Q_{104}, and measure the RF injection voltage, which should be 0.8–1.0 V RMS.

(d) Now connect a frequency counter to the emitter of Q_{104}. Confirm that the frequency is 21.145 MHz.

(3) S-Meter Sensitivity

(a) Connect the signal generator to the antenna jack. Set the channel selector to any channel, and tune the signal generator output to the channel frequency.

(b) Set the output level of the signal generator to 20 dB, adjust VR_{101} for a full scale indication on the S-meter.

(4) Noise Squelch Threshold

(a) Set the SQL control fully clockwise. Apply a 0 dB signal from the signal generator, and peak the signal generator output frequency to the channel frequency.

(b) Adjust VR_{102} until the squelch just opens. Now set the signal generator level to −10 dB, and set the SQL control fully counterclockwise. Adjust VR_{103} until the squelch just closes.

(c) With the above adjustment, the squelch should just open, with no signal present, at approximately the 9–10 o'clock position.

PLL CIRCUIT

(a) Set the channel frequency to 223.50 MHz.

(b) Connect the frequency counter to TP_1 on the PLL UNIT, and adjust TC_{309} for precisely 5.1200 MHz. Connect the VTVM to the emitter of Q_{312}, and check to be sure the injection voltage is 2 volts RMS.

(c) Connect the RF probe of the VTVM to TP_4, and peak TC_{308} for a maximum VTVM reading. Slowly rotate TC_{308} past the peak in the direction of increasing capacitance, until the VTVM reading becomes 5% lower than the peak indication (approx. 60 mV RMS).

(d) Connect the VTVM (DC 10 volts range) between the cathode D_{324} and ground. Adjust TC_{301} for a reading of 3 volts on the VTVM.

(e) Connect the VTVM to the cathode of D_{302}. Adjust T_{301} for a maximum VTVM reading (0.3V RMS typ.).

(f) Connect the frequency counter to the cathode of D_{302}. Set TC_{302}–TC_{307} to the center of their ranges. Set the FUNCTION switch to one of the SIMP positions. Adjust L_{307} for a reading of 201.900 MHz.

(g) Set the FUNCTION switch to one of the 1.6 MHz RPT positions. Adjust TC_{303} for a reading of 203.500 MHz.

(h) Press the +TX button, and adjust TC_{304} for a reading of 200.300 MHz.

(i) Set the FUNCTION switch to one of the SIMP positions, and press the 5 UP button. Adjust TC_{305} for a reading of 201.905 MHz.

(j) Set the FUNCTION switch to one of the 1.6 MHz RPT positions, with the +TX button not pressed. Adjust TC_{306} for a reading of 203.505 MHz.

(k) Press the 5 UP button, and adjust TC_{307} for a reading of 200.305 MHz.

PLL CONTROL UNIT

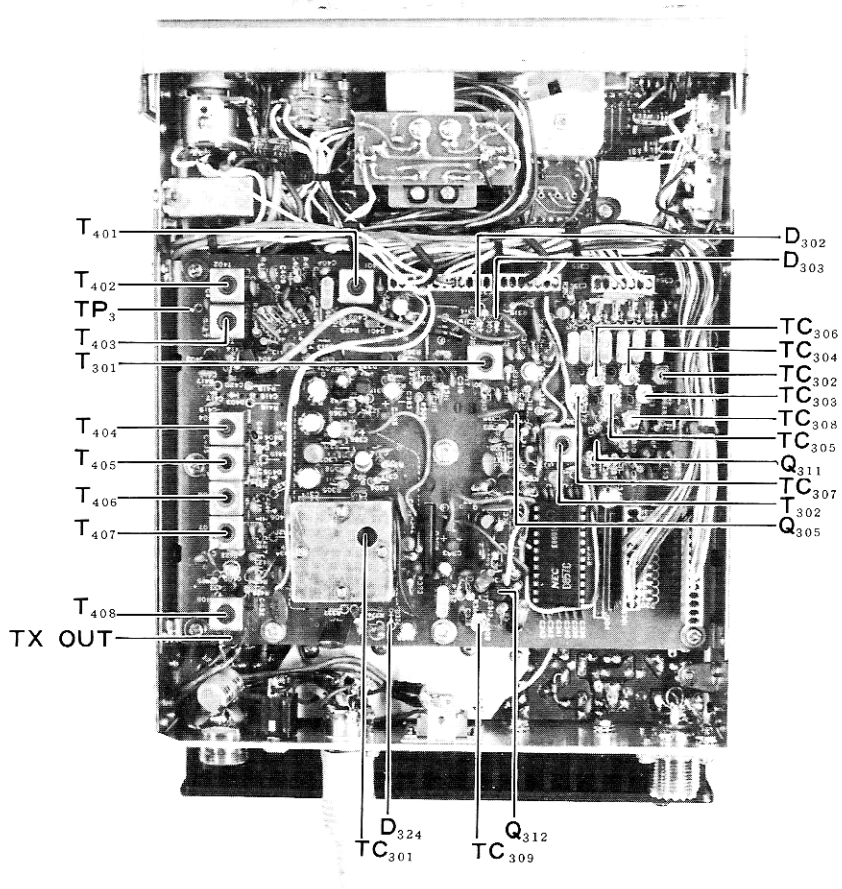
As this unit requires no alignment, trouble in this unit should be referred to a qualified technician for fault detection and parts replacement. This unit is highly sophisticated, and any attempt to service it without the proper knowledge is discouraged.

TONE SQUELCH UNIT (OPTION)

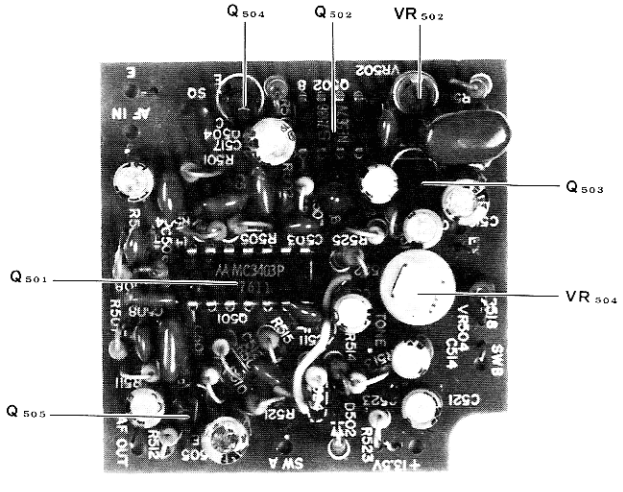
The optional tone squelch unit has been preset to 77 Hz center frequency at the factory. However,

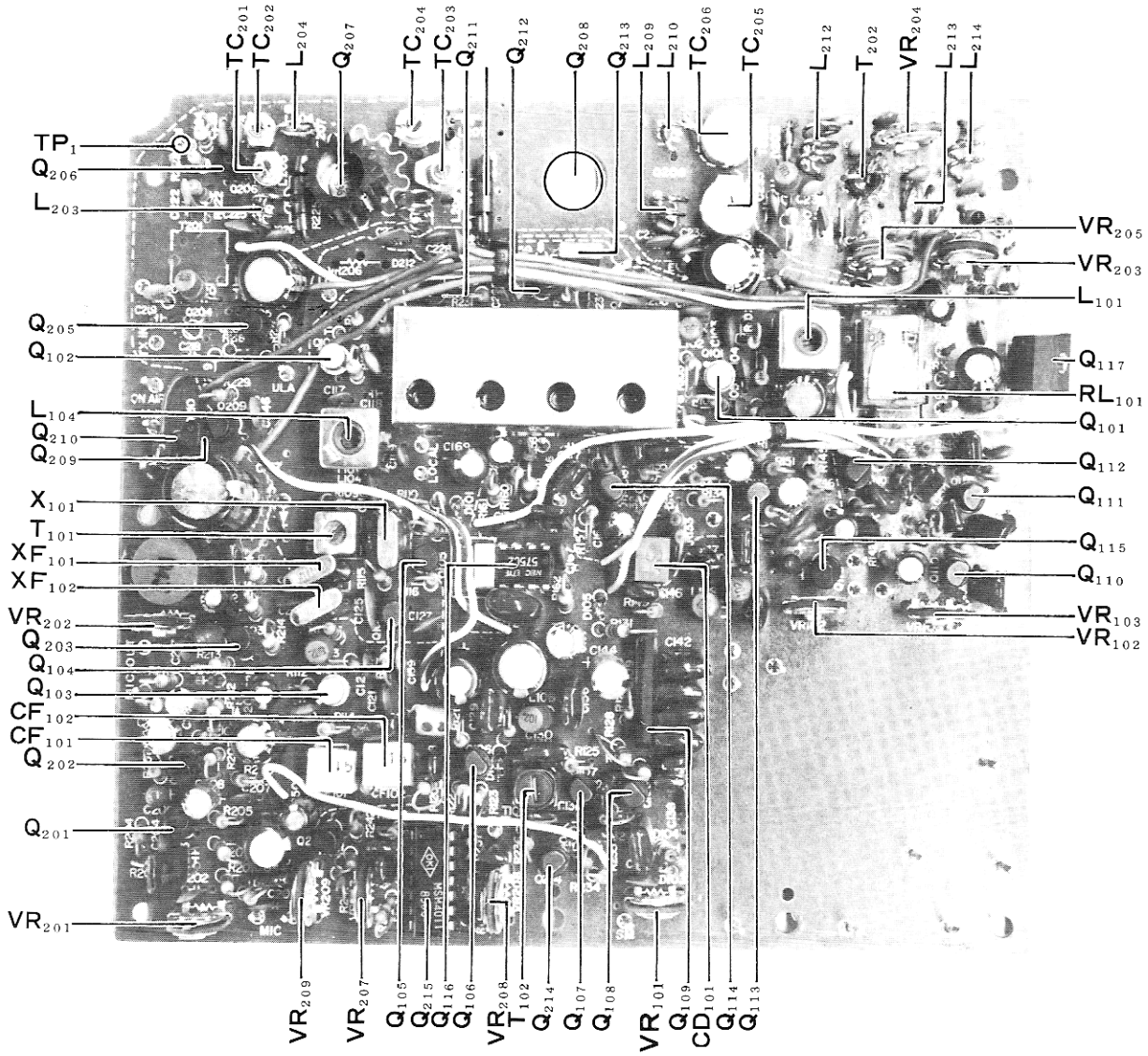
the frequency can be set to any frequency between 70 Hz and 250 Hz by referring to Table 2, located on page 15, and by adjustment of VR_{504}.

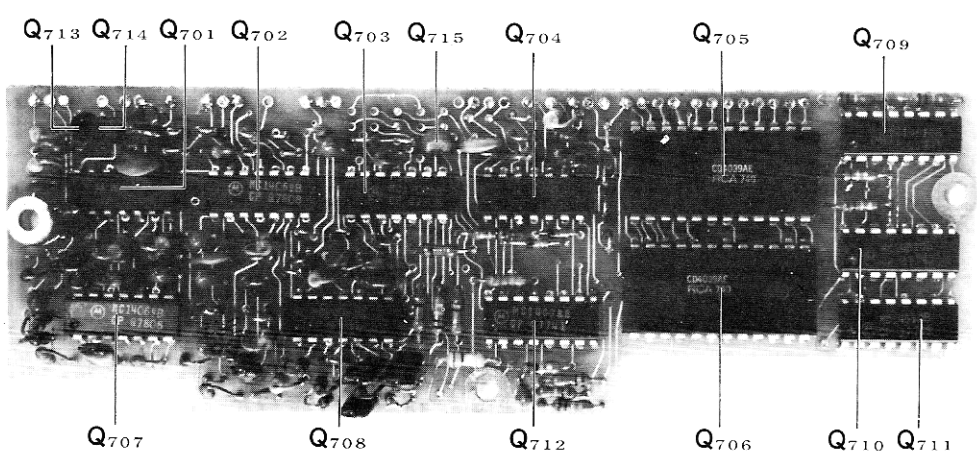
The tone output level adjustment is made at VR_{504}.



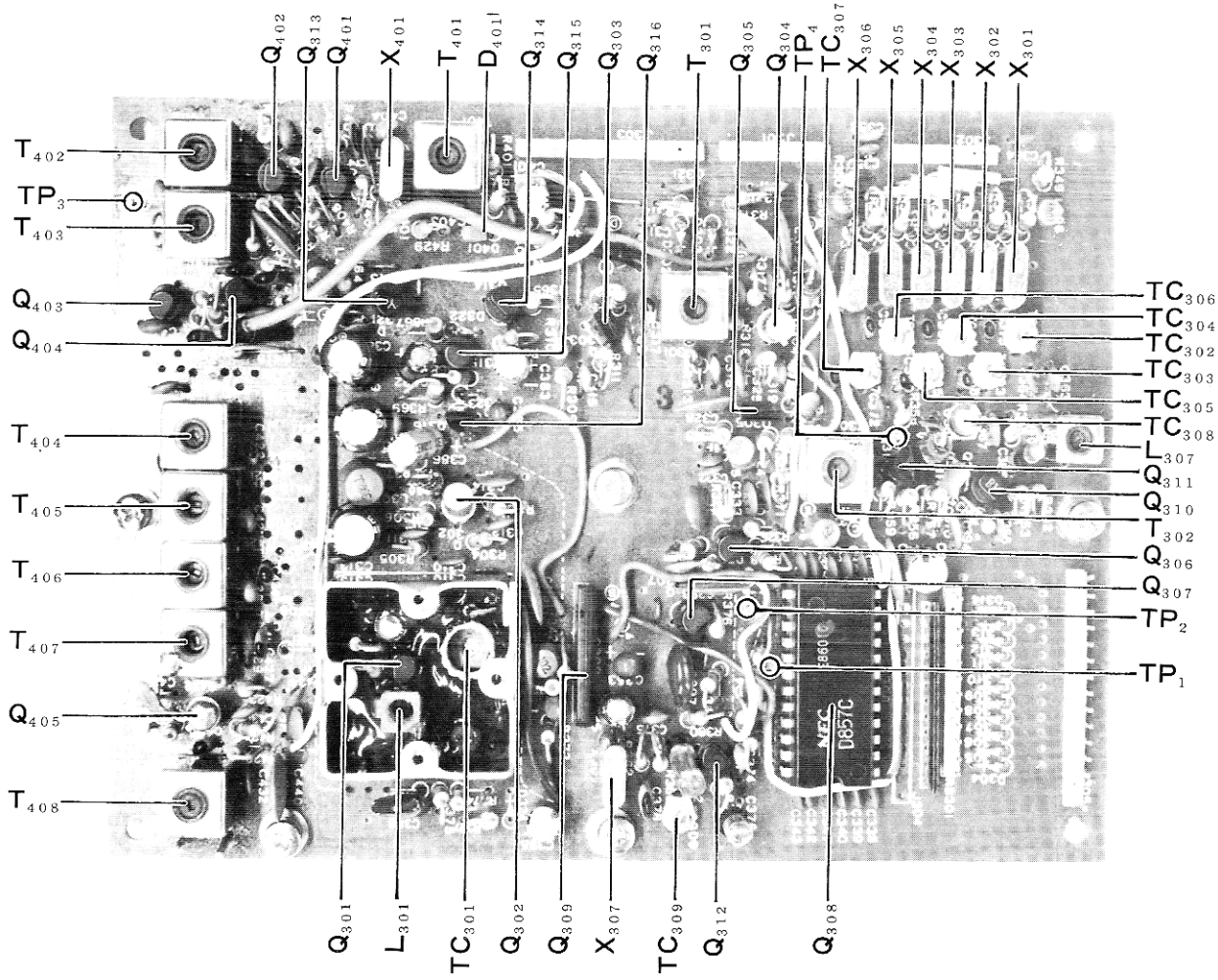
ALIGNMENT POINT



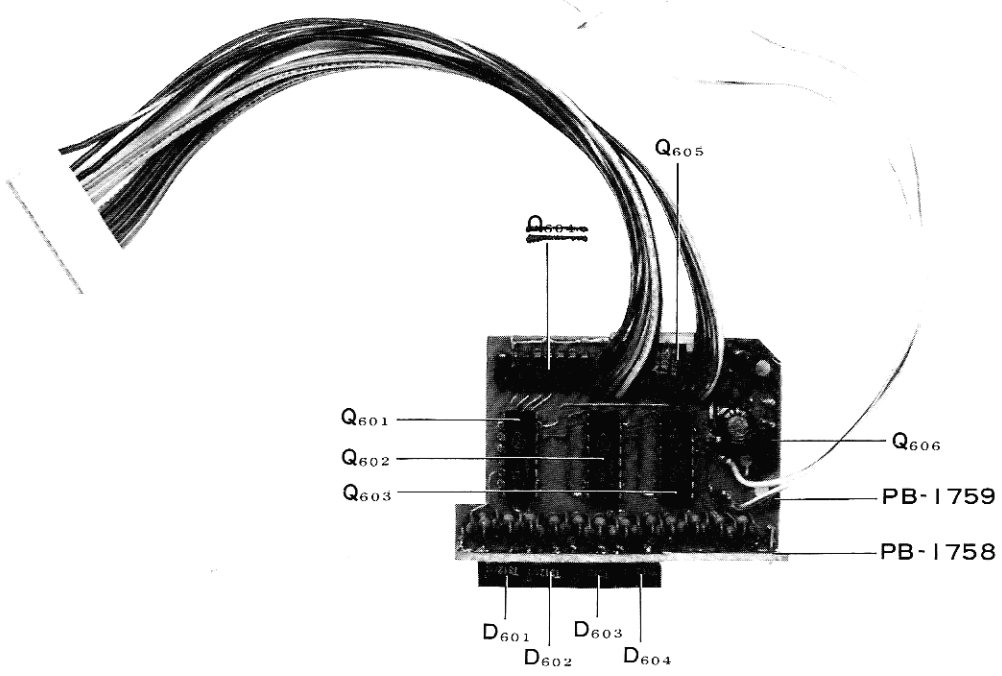




PLL CONTROL UNIT



PLL UNIT



DISPLAY UNIT

PARTS LIST

MAIN CHASSIS

Symbol Number	Parts Number	Description
		TRANSISTOR
Q1	22402353	Silicon 2SD235-O
		DIODE
D1	21090130	Silicon U05B
D5,7,8	21015550	〃 1S1555
D2,3,4	21090111	Zener WZ050
		RESISTOR
R2	41143100	Carbon film ¼W TJ 10Ω
R1	41143821	〃 〃 〃 〃 820Ω
R4,5	40143821	〃 〃 〃 VJ 820Ω
R6	40143562	〃 〃 〃 〃 5.6KΩ
R3	40143103	〃 〃 〃 〃 10KΩ
R7	42124220	Carbon Composition ½W GK 22Ω
		POTENTIOMETER
VR1(With S1)	49800079	DM11A-5M1111 10KΩB/10KΩA
		CAPACITOR
C1	31829100	Ceramic disc 50WV 10pF(SL)
C10	30820102	〃 〃 〃 0.001μF
C2,3	30820103	〃 〃 〃 0.01μF
C7	34120107	Electrolytic 10WV 100μF
C6,8,9	34220106	〃 16WV 10μF
C5	34220226	〃 〃 22μF
C4	34220107	〃 〃 100μF
		INDUCTOR
L1	55003356	♯220520
		AF CHOKE
CH1	50000010	♯230012
		METER
M1	74000310	AP-120
		SPEAKER
SP1	76000013	SM-77K-Y
		SWITCH
S6,7	63000008	SSF-22-08
S8	61000600	SRN2046N
S9	63000011	SSH-23-08
S1(with VR1)	—	
		RECEPTACLE
J1	68020006	FM142S
J2	68060002	FM146S
J3	68050003	CS250
J4	68000007	JSO239
J5	68020012	SG8050
J6	68020020	1625-06R-1 with Wire ♯240113A

		PLUG
P6	68060019	1625-06P-1with Wire ♯240114A
		TERMINAL BOARD
TB1	90020002	1L4P 2-0-2
		PILOT LAMP
PL1-5,7	14000025	BQ054-32732B 14V 40mA
PL6(with M1)	—	

PHOTO INTERRUPTER BOARD

Symbol Number	Parts Number	Description
	019810AZ	Photo interrupter board with components
PB-1981	60319510	P.C. BOARD
		TRANSISTOR
Q4,5	22318154	2SC1815Y
		PHOTO INTERRUPTER
Q2,3	29090014	ON1105
		RESISTOR
R11,13	42144221	Carbon Composition ½W GK 220Ω
R12,14	42144103	〃 〃 〃 〃 10KΩ

SWITCH BOARD

Symbol Number	Parts Number	Description
PB-1896	60318960	P. C. Board
		PUSH SWITCH
S2,3,5	65000022	2U-EE-20
S4	65000043	2U-OA-20

PARTS LIST

MAIN UNIT

Symbol Number	Parts Number	Description	
PB-1659I)	60316594	P. C. Board	
		IC, FET & Transistor	
Q109	25000118	IC	μPC577H
Q116	25000119	〃	μPC525C2
Q117	25000116	〃	μPC14308
Q215	25000114	〃	MC14011B
Q101,102,103	23800510	FET	3SK51
Q213	22104963	Transistor	2SA496(O)
Q105	22105640	〃	2SA564
Q104,106~108,110 111~115,201~203 205,209~212,214 216	22303724	〃	2SC372Y
Q206	22324070		2SC2407
Q208	22390013		MRF226
Q207	22390014		MRF227
		DIODE	
D103,104,106~109	21001880	Germanium Diode	1S188FM
D205,208,209,211 101,102,105,110 111~113,201~204 210	21015550	Silicon Diode	1S1555
D206,207,213	21090128	〃 〃	MI301
		CRYSTAL	
X101	71800130	HC-18/U 21.145MHz	#210129
		MONOLITHIC FILTER	
XF101	71000039	21L2B3	
		CERAMIC FILTER	
CF101,102	71200016	LFB-15	
		CERAMIC DISCRIMINATOR	
CD101	70900001	SFD455S4	
		RESISTOR	
R224	40143220	Carbon film ¼W VJ	22Ω
R102,105,107,112	40143560	〃 〃 〃 〃	56Ω
R110,124,131,157,201 208	40143101	〃 〃 〃 〃	100Ω
R225	41143101	〃 〃 〃 TJ	100Ω
R162	40143121	〃 〃 〃 VJ	120Ω
R123	40143151	〃 〃 〃 〃	150Ω
R147,215	40143221	〃 〃 〃 〃	220Ω
R126,128,129,163,223 228,232	40143471	〃 〃 〃 〃	470Ω
R253	41143471	〃 〃 〃 TJ	470Ω
R209	40143561	〃 〃 〃 〃	560Ω
R206,216 111,114,142,151	40143102	〃 〃 〃 VJ	1KΩ
R202	40143182	〃 〃 〃 〃	1.8KΩ
R149,161,221,233	40143222	〃 〃 〃 〃	2.2KΩ
R120,210	40143272	〃 〃 〃 〃	2.7KΩ
R117,138,140,204	40143332	Carbon film ¼W VJ	3.3KΩ
R122	40143392	〃 〃 〃 〃	3.9KΩ
R156,222,229,231 235,236,244	40143472	〃 〃 〃 〃	4.7KΩ
R132,133,141,203,217 230	40143562	〃 〃 〃 〃	5.6KΩ
R154,155	40143822	〃 〃 〃 〃	8.2KΩ
R115,116,118,119,134 143,205,211,213	40143103	〃 〃 〃 〃	10KΩ
R109	40143153	〃 〃 〃 〃	15KΩ
R121	40143183	〃 〃 〃 〃	18KΩ
R103,104,135,234,249	40143223	〃 〃 〃 〃	22KΩ
R101,106,108,113,125 127,146,158	40143103	〃 〃 〃 〃	47KΩ
R144	40143563	〃 〃 〃 〃	56KΩ
R145,152	40143823	〃 〃 〃 〃	82KΩ
R153,242,243	40143104	〃 〃 〃 〃	100KΩ
R160	40143124	〃 〃 〃 〃	120KΩ
R137,139,159,212,214	40143154	〃 〃 〃 〃	150KΩ
R239	40143184	〃 〃 〃 〃	180KΩ
R207	40143274	〃 〃 〃 〃	270KΩ
R238	40143824	〃 〃 〃 〃	820KΩ
R237,240,241	40143105	〃 〃 〃 〃	1MΩ
R246	42124101	Carbon Composition ½W	100Ω
		THERMISTOR	
TH101	29090001	SDT-250	
		POTENTIOMETER	
VR204	49902501	TR11R3	500ΩB
VR202,209	49902102	〃	1KΩB
	49902202	〃	2KΩB
VR102,201	49902502	〃	5KΩB
VR101,103,205	49902103	〃	10KΩB
VR203	49902503	〃	50KΩB
VR207	49902104	〃	100KΩB
VR208	49902205	〃	2MΩB
		CAPACITOR	
C238	31829059	Ceramic 50WV SL	0.5pF
C102,233	31820010	〃 〃 CH	1pF
C239	31829020	〃 〃 SL	2pF
C241	31829030	〃 〃 SL	3pF
C113,184	31820060	〃 〃 CH	6pF
C107	31820080	〃 〃 CH	8pF
C109,111	31820090	〃 〃 〃	9pF
C119,243	31829100	〃 〃 SL	10pF
C269	31829150	〃 〃 〃	15pF
C180,244,245	31829200	〃 〃 〃	20pF
C270,271	31829510	〃 〃 〃	51pF
C124	31820510	〃 〃 CH	51pF
C126,157,267	31829101	〃 〃 SL	100pF
C125	31829201	〃 〃 〃	200pF
C103,104,106,115,117 123,138,167,170,176 201,202,204,207,217 219,222,223,226,228 232,234,235,237,240 242,247,258,259	30820102	〃 〃	0.001μF
C105,116,120,121,127 139,178,181,182,214 224,225,227,231,236	30820103	〃 〃	0.01μF

PARTS LIST

C246,257,260,261	30820103	Ceramic	50WV	0.01μF
C264	30825103	Ceramic Chip	25WV	0.01μF
C128,131,132,133,135 147,179,251,252	36825102	Mylar Film	50WV	0.001μF
C162	36825472	〃 〃	〃	0.0047μF
C137,146,151,152,154 161,254,255	36825103	〃 〃	〃	0.01μF
C148~150,153,164 166,203	36825223	〃 〃	〃	0.022μF
C122,129,130,134,136 140,141~143,215 216	36825473	〃 〃	〃	0.047μF
C172	36825104	〃 〃	〃	0.1μF
C266	36416107	Tantalum	3.15WV	100μF
C159	36226475	〃	16WV	4.7μF
C205	36226106	〃	〃	10μF
C253	36526104	〃	35WV	0.47μF
C144,169,171,209	34120476	Electrolytic	10WV R	47μF
C165,173,175,206,213	34120107	〃	〃 〃	100μF
C163,183,211,212,250	34220106	〃	16WV 〃	10μF
C174,229,263	34220107	〃	〃 〃	100μF
C177	34220108	〃	〃 〃	1000μF
C155,156,168	34320475	〃	25WV 〃	4.7μF
C158,160,208,210,262	34820105	〃	50WV 〃	1μF
		TRIMMER CAPACITOR		
TC101~104	39000010	ECV-1ZW	10×53	10pF
TC201,202	39000011	〃	20×53	20pF
TC204	39000073	〃	40×53	40pF
TC203	39000005	〃	50×32	50pF
TC205,206	39000066	TC-10		40pF
		INDUCTOR		
L203,213,214	55003302			♯220193
L101,104	55003359			♯220509
L103	55003360			♯220514
L204,210	55003361			♯220515
L216	55003362			♯220516
L209	55003363			♯220518
L206,212	55003364			♯220519
L205,208	55003365			♯220570
L102,215	53020031	Micro Inductor		0.68μH
L211	53020035	〃		1μH
L110	53020037	〃		8.2μH
L105	53010004	〃		220μH
L106,108,109	53020001	〃		1mH
L201	53050001	〃		100mH
		TRANSFORMER		
T101	55003357	IFT		♯220512
T202	55003358			♯220521
T102	55003084	7MC-31262N0		
		RELAY		
RL101	70000031	BR211AD012M		
		IC SOCKET		
QS201	68140008	116-14-30-114		

	56000024	Ferrite Beads 4A-RI 3×3-1
	91100008	Wrapping Terminal C
	95000004	Heat Sink C T0-5, ℓ=15㎜
	80038283	Resonator Case
	80049580	Ground Pin
	80042481	Ground Plate

PLL UNIT

Symbol Number	Parts Number	Description	
PB-1757B	60317572	P. C. Board	
PB-1921	60319210	〃	
		IC, FET & Transistor	
Q308	25000086	IC	μPD857C
Q309	25000087	〃	TC5081P
Q301	22800196	FET	2SK19BL
Q403,404	22800195	〃	2SK19GR
Q302,304,405	23800510	MOS FET	3SK51
Q306,307,313~315 401	22303724	Transistor	2SC372Y
Q312	22303730	〃	2SC373
Q303,305	22305351	〃	2SC535A
Q311	22307104	〃	2SC710
Q402	22307842	〃	2SC784R
Q316	22390001	〃	MPS-A13
		DIODE	
D322~324,326	21015550	Silicon Diode	1S1555
D302,303,315~320	21090142	〃 〃	MC301
D402	29090004	〃 〃	MV103
D401	21090108	Varactor Diode	1SV50
D301	21022090	〃 〃	1S2209
D321	21090131	Zener Diode	RD6.8EB
		CRYSTAL	
X301	71800131	HC-18/U	66.1333MHz
X302	71800132	〃	66.6666MHz
X303	71800133	〃	65.6000MHz
X304	71800134	〃	66.1350MHz
X305	71800135	〃	66.6683MHz
X306	71800136	〃	65.6016MHz
X307	71800137	〃	10.240MHz
X401	71800138	〃	21.600MHz
		RESISTOR	
R364,425,428	40143560	Carbon film	¼W VJ 56Ω
R302,303,307,312,319 354,359,360,371,378 379,408,418	40143101	〃 〃	〃 〃 100Ω
R311,358,412~415	40143221	〃 〃	〃 〃 220Ω
R351	40143471	〃 〃	〃 〃 470Ω
R373	40143681	〃 〃	〃 〃 680Ω

PARTS LIST

R324,327,355,356,361 365,367	40143821	Carbon film			1/4W	VJ	820Ω	C330,333,335,366,367 375,384,394,409,410 415,416,442,443,447,448	30820103	Ceramic disk	50WV 0.01μF
R369,407,411	40143102	〃	〃	〃	〃		1KΩ				
R334	40143122	〃	〃	〃	〃		1.2KΩ	C334	30820223	〃	〃 〃 0.022μF
R323,372,375	40143152	〃	〃	〃	〃		1.5KΩ	C322,328,329,336,350 351,391,393,397,399 436,439,440	30820473	〃	〃 〃 0.047μF
R313,328,349,350	40143222	〃	〃	〃	〃		2.2KΩ				
R381~383	41143222	〃	〃	〃	TJ		2.2KΩ				
R314,315,343~348	40143332	〃	〃	〃	VJ		3.3KΩ	C376	36824101	Styrol	100pF
R404	40143562	〃	〃	〃	〃		5.6KΩ	C377	36824221	〃	220pF
R309,321,325,335,336 352,357,363,409,426 427	40143103	〃	〃	〃	〃		10KΩ	C388	36825473	Mylar film	50WV 0.047μF
								C385	36526104	Tantalum	35WV 0.1μF
								C387	36226475	〃	16WV 4.7μF
R353	40143123	〃	〃	〃	〃		12KΩ	C349	34120476	Electrolytic	10WV R 47μF
R368,374	40143153	〃	〃	〃	〃		15KΩ	C379,381,389	34120107	〃	〃 R 100μF
R317,362,366,401,406 410	40143223	〃	〃	〃	〃		22KΩ	C309,353,382,396	34220106	〃	16WV R 10μF
								C383,386,398,401	34820105	〃	50WV R 1μF
R326	40143273	〃	〃	〃	〃		27KΩ				
R310,318,402,430	40143333	〃	〃	〃	〃		33KΩ				
R322,423	40143393	〃	〃	〃	〃		39KΩ				
R405	40143473	〃	〃	〃	〃		47KΩ			TRIMMER CAPACITOR	
R301	40143563	〃	〃	〃	〃		56KΩ	TC301	39000080	TZ01Y070A	7pF
R304~306,316,342 370,377,422,429	40143104	〃	〃	〃	〃		100KΩ	TC302~307,309	39000011	ECV-1ZW 20×53	20pF
								TC308	39000010	ECV-1ZW 10×53	10pF
R376	40143154	〃	〃	〃	〃		150KΩ				
		BLOCK RESISTOR								INDUCTOR	
RB301	47000009	100KΩ×11,RA1/16 100KΩ×11						L301	55003289	VCO COIL	#220359
								L309	55003150		#220205
								L303,304	55003120		#220206
		CAPACITOR						L307	55003317		#220417
C326,423,426	31829059	Ceramic disc			50WV	SL	0.5pF	L302,313	53020031	Micro Inductor	0.68μH
C427	31820010	〃	〃	〃		CH	1pF	L306,308	53020018	〃 〃	10μH
C327	31829020	〃	〃	〃		SL	2pF	L305	53020025	〃 〃	33μH
C427,433	31820020	〃	〃	〃		CH	2pF	L312	53010004	〃 〃	220μH
C323	31829030	〃	〃	〃		SL	3pF	L311,401	53020001	〃 〃	1mH
C420,424	31820030	〃	〃	〃		CH	3pF	L310	53020003	〃 〃	3.9mH
C373,422	31820040	〃	〃	〃		CH	4pF				
C404,	31827040	〃	〃	〃		UJ	4pF				
C310,317	31820050	〃	〃	〃	〃		5pF				
C303	31827060	〃	〃	〃		UJ	6pF			TRANSFORMER	
C301	31820090	〃	〃	〃		CH	9pF	T301,302,305~308	55003367		#220510
C332	31829100	〃	〃	〃		SL	10pF	T404	55003366		#220508
C302,306,357~362	31820100	〃	〃	〃		CH	10pF	T492,403	55003368		#220511
C365	31820150	〃	〃	〃	〃		15pF	T401	55003369		#220513
C438	31829150	〃	〃	〃		SL	15pF				
C331	31829010	〃	〃	〃	〃		18pF				
C413,414	31820200	〃	〃	〃		CH	20pF				
C429	31829220	〃	〃	〃		SL	22pF			MINI CONNECTOR	
C307,368	31820270	〃	〃	〃		CH	27pF	J301,302	67060005	5048-06A	
C369	31820300	〃	〃	〃	〃		30pF	J303,304	67110004	5048-11A	
C378	31820330	〃	〃	〃	〃		33pF	J305	67140001	5048-14A	
C374	31829470	〃	〃	〃		SL	47pF				
C438	31829560	〃	〃	〃	〃		56pF	P301	68060008	5047-06 with Wire	#240046B
C449	31820470	〃	〃	〃		CH	47pF	P302	68060009	〃 〃	#240047
C314,352	31829101	〃	〃	〃		SL	100pF	P303	68110010	5047-11 〃	#240115
C405,406	31820101	〃	〃	〃		CH	100pF	P304	68110007	〃 〃	#240049
C403	31827101	〃	〃	〃		UJ	100pF	P305	68140007	5047-14 〃	#240050
C308,311~313,315 316,318,319~321 324,325,338~348 354~356,363,364 371,372,380,395,402 419,430~432,444 445	30820102	〃	〃	〃			0.001μF				
										IC SOCKET	
								QS401	68240001	116-24-30-114	

PARTS LIST

	80041041	VCO Case
	80041051	VCO Case Cover
	91100008	Wrapping Terminal C

DISPLAY UNIT

Symbol Number	Parts Number	Description
	017580AZ	Display unit with components
PB-1758	60417580	Display Board
PB-1759	60417590	Driver Board
		IC & TRANSISTOR
Q605	25000109	IC μPC14305
Q601~603	25000085	〃 MSM561
Q606	22303724	Transistor 2SC372Y
		DIODE
D601~604	21090122	LED TLR312D
		RESISTOR
R623	40143181	Carbon Film ¼W VJ 180Ω
R625	40143331	〃 〃 〃 VJ 330Ω
R601~622	40143471	〃 〃 〃 VJ 470Ω
R624	40143681	〃 〃 〃 VJ 680Ω
R626	40143103	〃 〃 〃 VJ 10KΩ
		CAPACITOR
C601	30820102	Ceramic 50WV 0.001μF
C602	36526474	Tantalum 35WV 0.47μF
C603	34120476	Electrolytic 10WV R 47μF
	80039531	Heat Sink A
	67200003	Board Joint 163740
	91100008	Wrapping Terminal C

PLL CONTROL UNIT

Symbol Number	Parts Number	Description
	018931AZ	PLL Control unit with components
PB-1893A	60518931	P.C. Board
		IC & TRANSISTOR
Q704	25000114	IC MC14011B
Q701	25000113	〃 MC14013B
Q712	25000136	〃 MC14028B
Q702,703,707	25000178	〃 MC14069B
Q708	25000093	〃 MC14081B
Q709~711	25000091	〃 MC14510B
Q705,706	25000192	〃 CD4039AE
Q713~715	22318154	Transistor 2SC1815Y
		DIODE
D701~737	21015550	Silicon 1S1555

		RESISTOR
R706,709	40143682	Carbon film ¼W VJ 6.8KΩ
R707,719,728,729 732,738,741,746	40143103	〃 〃 〃 〃 10KΩ
R721,725,739,740,745	41143103	〃 〃 〃 TJ 10KΩ
R701,716,717	40143223	〃 〃 〃 VJ 22KΩ
R735	41143333	〃 〃 〃 TJ 33KΩ
R703,722	40143473	〃 〃 〃 VJ 47KΩ
R702,705,714,730,731 733,737,744	40143104	〃 〃 〃 〃 100KΩ
R708,710~713,723 724,726,727,742	41143104	〃 〃 〃 TJ 100KΩ
R720,734	40143224	〃 〃 〃 VJ 220KΩ
R743	41143224	〃 〃 〃 TJ 220KΩ
R704,718	40143474	〃 〃 〃 VJ 470KΩ
R715	42144275	〃 composition 〃 GK 2.7MΩ
		CAPACITOR
C704,713,722,724	30820102	Ceramic disc 50WV 0.001μF
C703,705	30820103	〃 〃 〃 0.01μF
C714,715,720	36825102	Mylar 〃 0.001μF
C706~708,716,719 721	36825103	〃 〃 0.01μF
C702	36825223	〃 〃 0.022μF
C710,723	36526104	Tantalum 35WV 0.1μF
C711,712,718	36526105	〃 25WV 1μF
C709,717	36526225	〃 〃 2.2μF
C701	36326685	〃 (N.P.) 20WV 6.8μF

ACCESSORIES

Symbol Number	Parts Number	Description
	97000017	Microphone Assembly YE-17
		with Microphone hanger, screws
	67060001	Microphone plug FM-146P
	67050003	ACC Plug CP0084
	96000020	Power cord Assembly #240028
	67020006	Power plug FM142P
	69020002	Fuse Holder SN1101
	73000003	Fuse 3A
	67020008	Cigarette Lighter Adapter
	73000003	Fuse 3A
	67020003	External Speaker plug P-2240
	80038631	Stand
	80038661	Mobile Bracket Assembly
		with Set Screws

TONE SQUELCH UNIT

Symbol Number	Parts Number	Description
		Tone Squelch Board with Components
PB-1555A	60315551	Printed Circuit Board
		IC, FET & TRANSISTOR
Q501		IC MC3403
Q502		〃 NE567
Q503	22800195	FET 2SK19GR
Q504,505	22303724	Tr 2SC372Y
		DIODE
D501	21090131	Zener Diode RD8.2EB
		RESISTOR
R518	40143101	Carbon Film 1/4W VJ 100Ω
R512	40143103	〃 〃 〃 〃 10KΩ
R504	40143123	〃 〃 〃 〃 12KΩ
R510,511,517	40143223	〃 〃 〃 〃 22KΩ
R502,508	40143393	〃 〃 〃 〃 39KΩ
R501,505,521,522	40143473	〃 〃 〃 〃 47KΩ
R506,507	40143823	〃 〃 〃 〃 82KΩ
R509,514	40143154	〃 〃 〃 〃 150KΩ
R503	40143474	〃 〃 〃 〃 470KΩ
R515,519	40143105	〃 〃 〃 〃 1MΩ
R513,524	40143153	〃 〃 〃 〃 15KΩ
R516	40143393	〃 〃 〃 〃 39KΩ
R513,524※	40143822	〃 〃 〃 〃 8.2KΩ
R514※	40143274	〃 〃 〃 〃 270KΩ
R516※	40143333	〃 〃 〃 〃 33KΩ
		POTENTIOMETER
VR501,504	49905102	SR-19R 1KΩB
VR502	49800084	TM062P 100KΩB
		CAPACITOR
C503	36825102	Mylar 50WV 0.001μF
C512	36825472	〃 〃 0.0047μF
C506,507,520	36825103	〃 〃 0.01μF
C502,504,505,508,511	36825223	〃 〃 0.022μF
C509	36825473	〃 〃 0.047μF
C516	36825154	〃 〃 0.15μF
C516※	36825104	〃 〃 0.1μF
C514,522	34820105	Electrolytic 50WV 1μF
C501,510,513,521,524	34226106	〃 16WV 10μF
C515,517,519	34226226	〃 〃 22μF
C523	36226154	Tantalum 35WV 0.15μF
C518	36226475	〃 〃 4.7μF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