

INSTRUCTION

MANUAL

FT-127RA

YAESU MUSEN CO , LTD.

TOKYO JAPAN.

TABLE OF CONTENTS

| | (Page) |
|---------------------------------|--------|
| INTRODUCTION | 1 |
| SPECIFICATIONS | 2 |
| CONTROLS AND SWITCHES | 3 |
| REAR APRON | 5 |
| INSTALLATION | 7 |
| OPERATION | 9 |
| BLOCK DIAGRAM | 11 |
| CIRCUIT DESCRIPTION | 12 |
| MAINTENANCE AND ALIGNMENT | 19 |
| PARTS LIST | 26 |

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 acquainted 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, $\pm 10\%$

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
 $\pm 0.003\%$

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

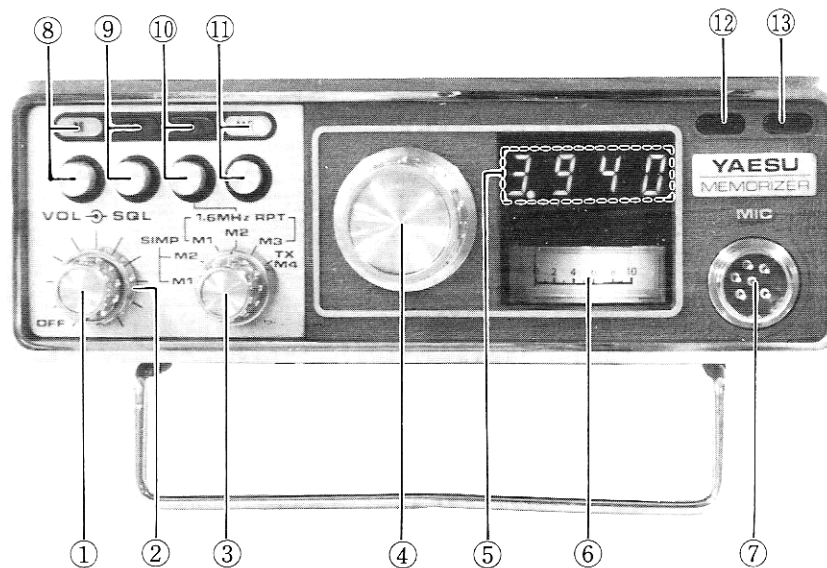
Sensitivity
Better than $0.35 \mu\text{V}$ for 20 dB QS

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

Audio Output
1.5 Watts at 8 ohms

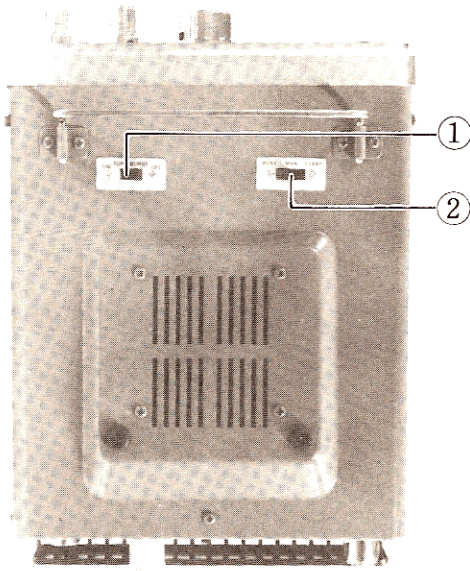
Specifications subject to change without notice or obligation.

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.

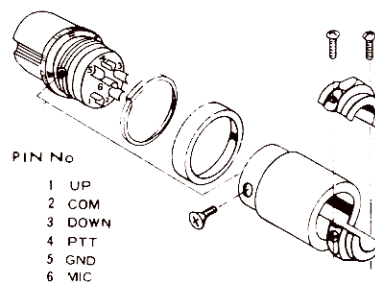
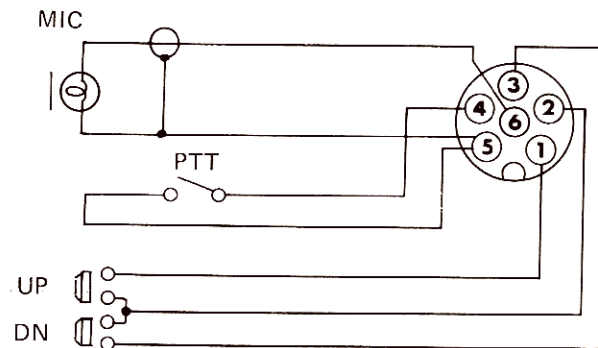
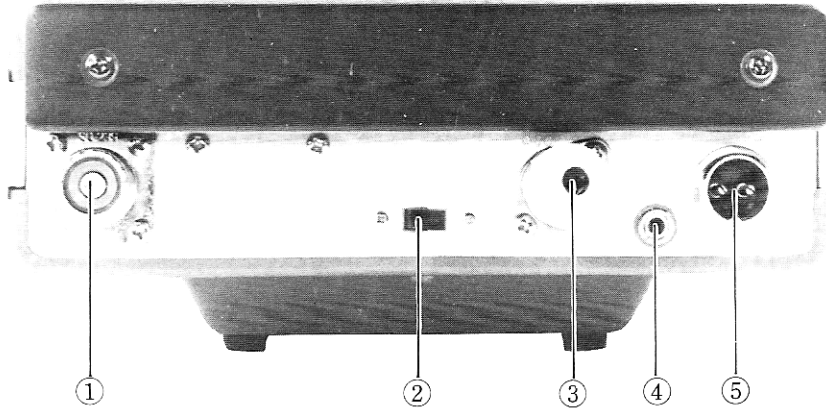


Fig. 1
Microphone Connections

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.

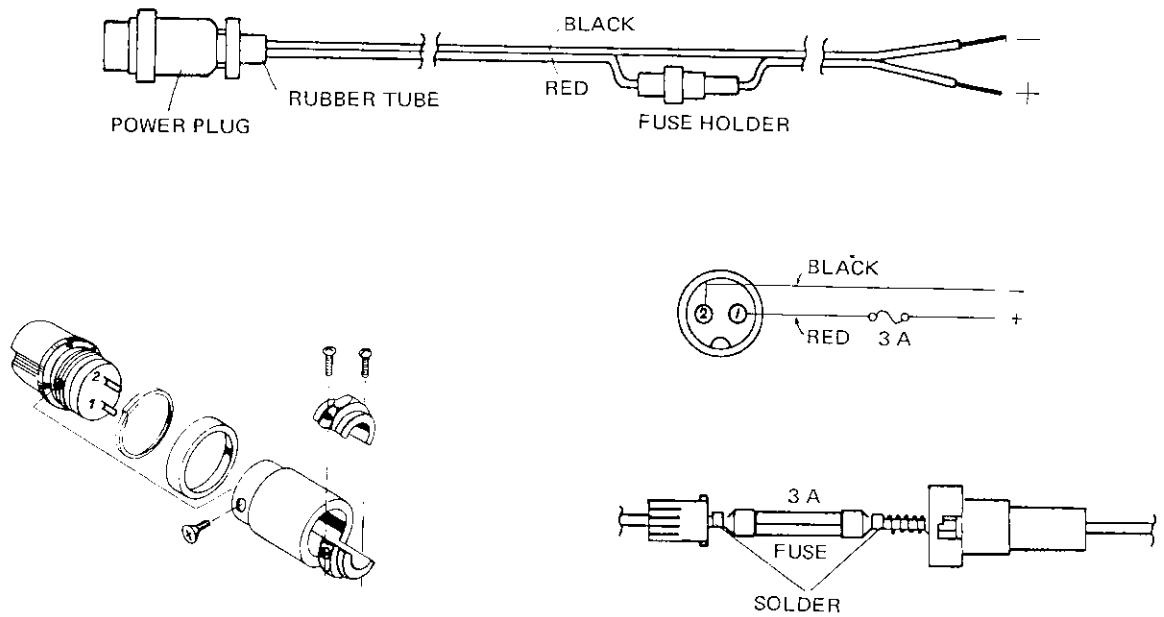


Figure 2.

POWER CABLE CONNECTIONS

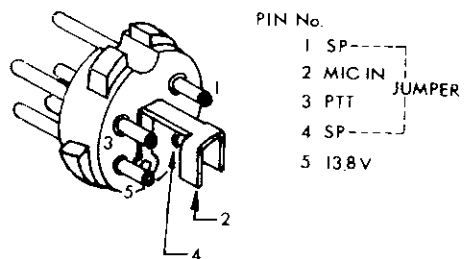


Figure 3.

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 "heliac" 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.

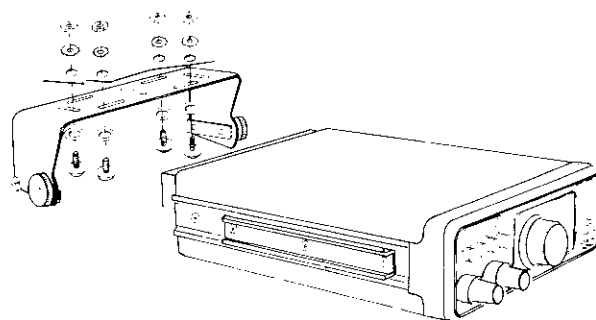


Figure 4A

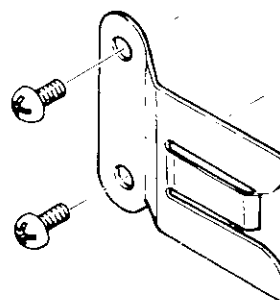


Figure 4B

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.

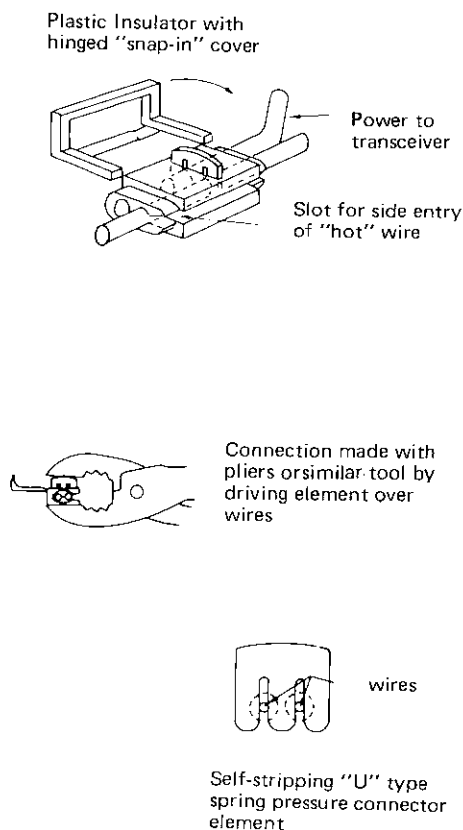


Figure 5

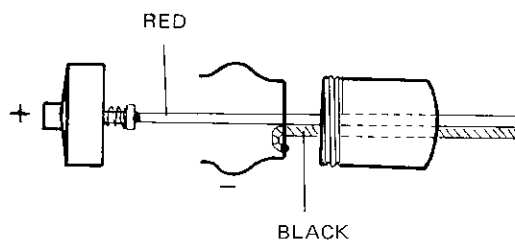


Figure 6

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

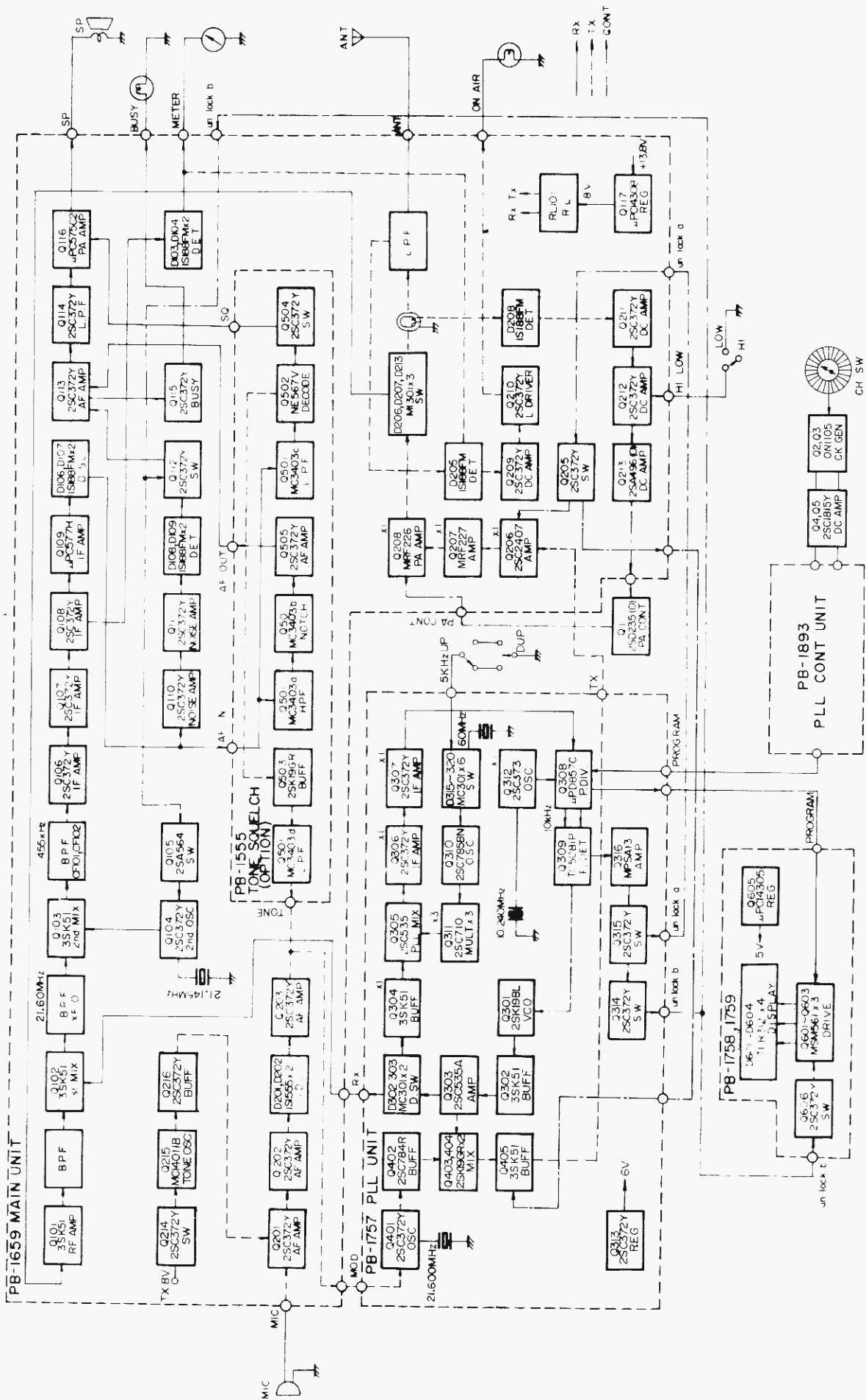
When ready to transmit, hold the microphone close to your mouth, press the PTT switch, and speak into the microphone in a normal voice. Check that the red ON AIR lamp is illuminated when the PTT switch is pressed. Release the PTT switch for receiver recovery.

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 sub-audible 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 VR₂₀₁, and amplified by Q₂₀₁, Q₂₀₂, and Q₂₀₃ (2SC372Y). The audio output from Q₂₀₂ is coupled to the IDC (Instantaneous Deviation Control) circuit, where both positive and negative peaks are clipped by diodes D₂₀₁ and D₂₀₂ (1S1555). The output from Q₂₀₃ is fed through a low-pass filter, which attenuates frequency components above the speech range caused by clipping. Deviation control potentiometer VR₂₀₂ 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 D₄₀₁ (1SV50), which varies the frequency of the 21.6 MHz crystal controlled oscillator, Q₄₀₁ (2SC372Y). The frequency modulated signal at 21.6 MHz is then amplified by buffer amplifier Q₄₀₂ (2SC784R), and then fed to a balanced mixer, consisting of Q₄₀₃ and Q₄₀₄ (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 T₄₀₄–T₄₀₇, to amplifier Q₄₀₅ (3SK51). Transformers T₄₀₄–T₄₀₇ are tuned to the transmitter frequency by varactor diodes D₄₀₃–D₄₀₆ (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 Q₂₀₆ (2SC2407), Q₂₀₇ (MRF227), and Q₂₀₈ (MRF226), providing 10 watts of RF energy,

through a diode switch and low-pass filter, into a 50 ohm load.

Diodes D₂₀₅ and D₂₁₁ (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 D₂₀₅ is also delivered to lamp drivers Q₂₀₉ and Q₂₁₀ (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 T₂₀₂ and a diode, D₂₀₈ (1S188FM), producing a DC voltage. Q₂₁₁ (2SC372Y) conducts in accordance with the DC voltage, which is fed through VR₂₀₅, causing a decrease in the collector current of Q₂₁₂ (2SC372Y).

This causes a drop in the collector voltage of Q₂₁₃ (2SA496(O)), causing Q₁ (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 VR₂₀₅.

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, Q₂₁₄ (2SC372Y) conducts, triggering a one-shot multivibrator, located on Q₂₁₅ (MC14011B). The other half of Q₂₁₅ generates a tone signal, which is amplified by buffer Q₂₁₆ (2SC372Y). The signal is then delivered to the AF amplifier stages of the transmitter.

The tone frequency is adjusted by VR₂₀₇, and the output level (deviation) is adjusted by VR₂₀₉. The burst duration is set by VR₂₀₈.

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} (μ PC577H). 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} (μ PC575C2). 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, Q₃₁₀ (2SC785BN). The crystal frequency is shown in Table 1. Diode switches D₃₁₅–D₃₂₀ (MC301) select the appropriate crystal, in accordance with the settings of the FUNCTION switch and the 5 UP switch. The output from Q₃₁₀ is fed to tripler Q₃₁₁ (2SC710), yielding the PLL heterodyne signal.

The PLL IF signal is fed through a low-pass filter, consisting of L₃₀₅, C₃₃₁, and C₃₃₂, to amplifiers Q₃₀₆ and Q₃₀₇ (2SC372Y). The amplified signal is then fed to programmable divider Q₃₀₈, (μ PD857C).

Crystal oscillator Q₃₁₂ (2SC373) generates a 10.24 MHz signal, and its output is fed to scaler/divider Q₃₀₈, where the 10.24 MHz signal is converted to a 10 kHz reference signal.

The digital phase comparator, Q₃₀₉, 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 D₃₀₁, 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 Q₃₀₉ is applied to Q₃₁₆ (MPSA13), causing it to conduct, and in turn, Q₃₁₅ (2SC372Y) cuts off. The “H” voltage at the collector of Q₃₁₅ turns Q₂₀₅ (2SC372Y) on, supplying DC voltage to the early stages of the exciter, Q₂₀₄ and Q₂₀₆. When the VCO is unlocked, the DC voltage at the emitter of Q₂₀₅ drops, preventing normal operation of Q₂₀₄ and Q₂₀₆.

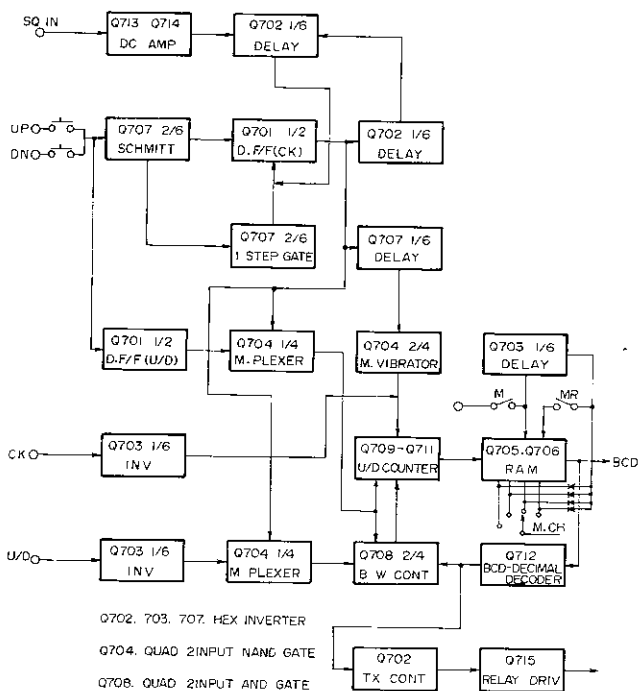
The output voltage from Q₃₁₅ is reversed in polarity by Q₃₁₄ (2SC372Y), and applied to Q₆₀₆ (2SC372Y), keeping the collector of Q₆₀₆ at “H”

level, allowing Q₆₀₁–Q₆₀₃ (MSM561) to drive the digital display normally. The voltage is also applied to Q₁₀₅, which supplies DC voltage to the second heterodyne oscillator, Q₁₀₄.

When the VCO is unlocked, the collector voltage at Q₆₀₆ 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 -1.6MHz shift |
| X303 | 66.6666 " | 200.000 " | TX +1.6MHz shift |
| X304 | 66.1350 " | 198.405 " | Simplex 5 kHz up |
| X305 | 65.6016 " | 169.805 " | TX -1.6MHz 5 kHz up |
| X306 | 66.6683 " | 200.005 " | TX +1.6MHz 5 kHz up |

POWER SUPPLY

A 13.8 volt DC supply is used for the audio power amplifier, Q₁₁₆, as well as the relay and lamps. The supply voltage for the driver and final amplifier is fed through voltage regulator Q₁₁₁ (2SD235D), which is controlled by the automatic final protection unit.

Voltage regulator Q₆₀₅ (μ PC14305) regulates the supply voltage at 5 volts, to supply Q₃₀₈ and the display unit. Q₃₁₃ (2SC372Y) and D₃₀₁ (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 D₃ (WZ050), and is connected directly (not via the power switch) for memory backup purposes.

A regulated 8 volt circuit using Q₁₁₇ (μ PC14308) is used for all other circuits.

When the transceiver is used in the memory mode, D₄ and D₅ (WZ050) supply 5 volts to the receiver and transmitter, respectively.

STONE 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.

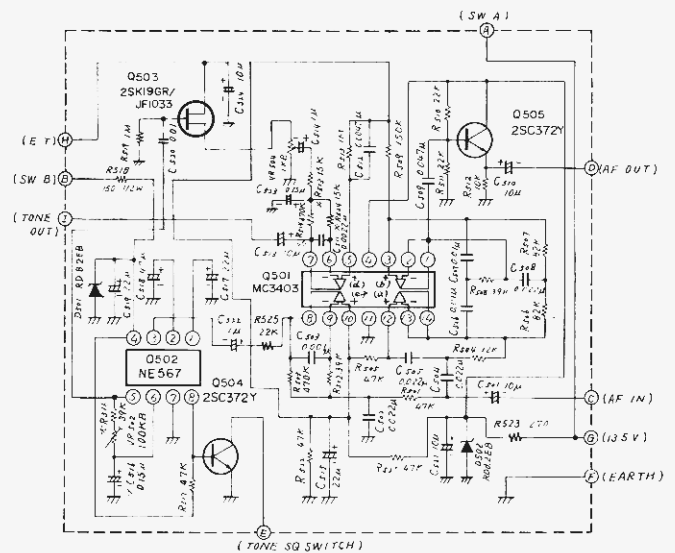
The tone signal is generated by Q₅₀₂ (NE567), and its frequency is set by R₅₁₆, VR₅₀₂, and C₅₁₆. The level of the tone signal is set by VR₅₀₄, and the signal is subsequently fed through buffer amplifier Q₅₀₃ (2SK19GR) to a low pass filter on unit "d" of operational amplifier Q₅₀₁ (MC3403). The tone signal is then superimposed on the speech signal at Q₂₀₂. 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 Q₅₀₁. Unit "a" of Q₅₀₁ acts as a high-pass filter, while unit "b" acts as a T-notch filter. These filters remove the sub-audible tone from the audio signal, which is then fed through audio amplifier Q₅₀₅ (2SC372Y) to amplifier Q₁₁₃.

The subaudible tone then passes through a low-pass filter at unit "c" of Q₅₀₁, and is fed to Q₅₀₂. When the tone frequency is the same as that preset for transmission, the voltage at pin 8 of Q₅₀₂ becomes low, causing Q₅₀₄ (2SC372Y) to turn off. In turn, proper bias voltage is applied to Q₁₁₉, allowing normal operation.

When the proper tone signal is not present, Q₅₀₄ conducts, removing the bias from Q₁₁₉, thus disabling the audio circuit.

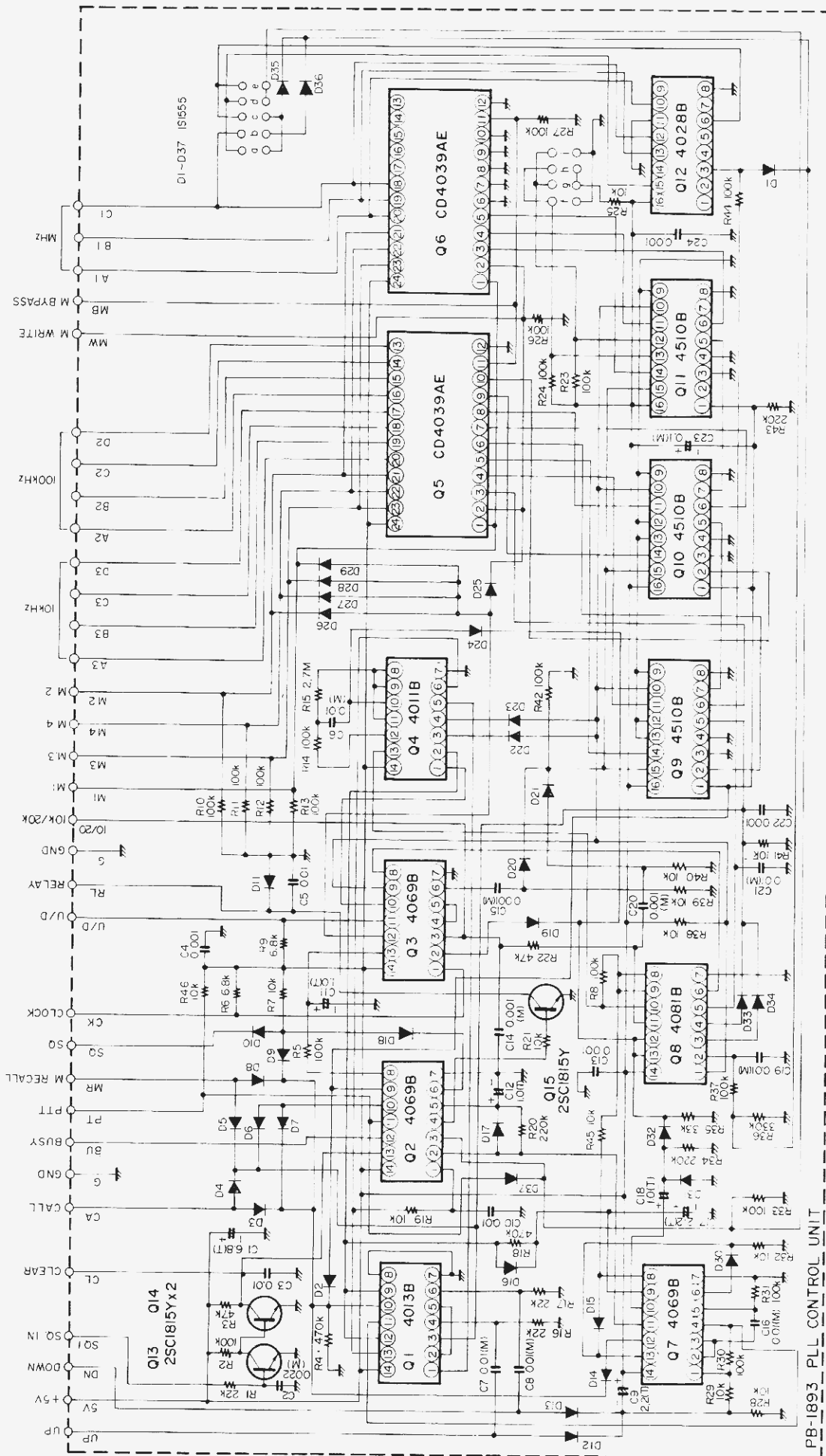
As the conventional carrier-controlled squelch is still in operation, irrespective of the condition of the tone squelch, the BUSY lamp will light up when any carrier is received. This feature alerts the operator that the channel is occupied, though no signal may be heard.



TONE SQUELCH (PB-1555A) OPTION

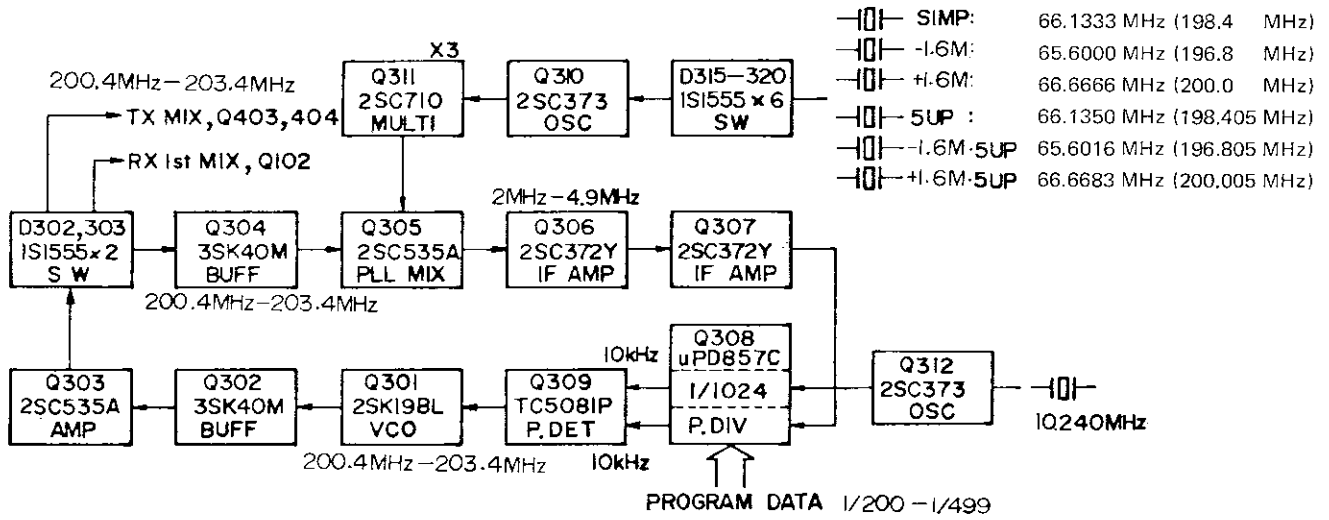
| | C 516 * | R 516 * | R 513 * | R 514 * | R 524 * |
|---------------------|--------------|--------------|---------------|---------------|---------------|
| 70Hz 160Hz | 0.15 μ F | 39K Ω | 15K Ω | 470K Ω | 15K Ω |
| 160Hz 250Hz | 0.1 μ F | 33K Ω | 8.2K Ω | 270K Ω | 8.2K Ω |

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 (μ PD857C) 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:

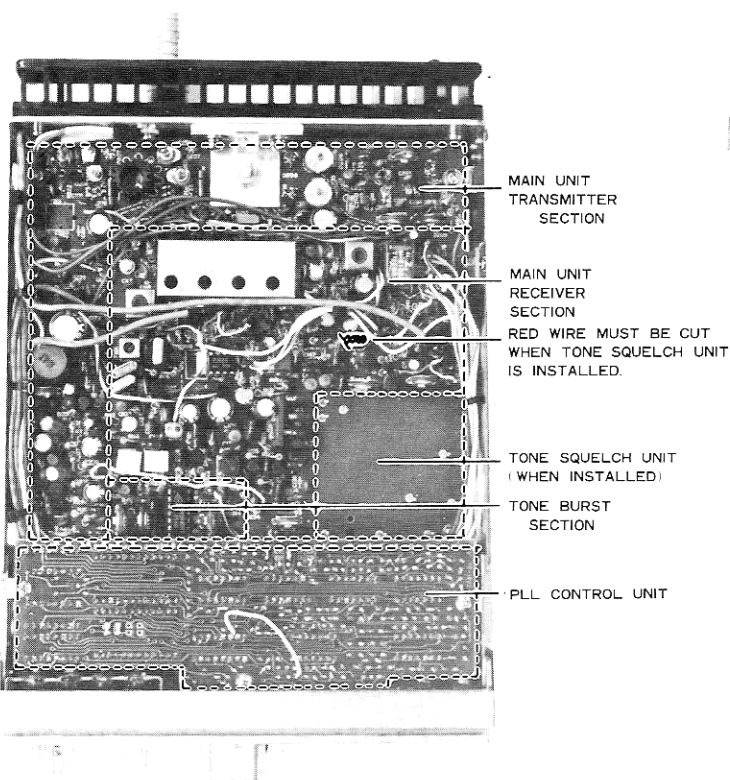
- (1) Do NOT exceed 15 volts DC at the POWER jack. For mobile operation, the voltage regulator must be adjusted to that the battery voltage does not exceed a maximum level of 15 volts. The engine should be running fast enough to show a charge for this test. As well, do not operate the transceiver if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

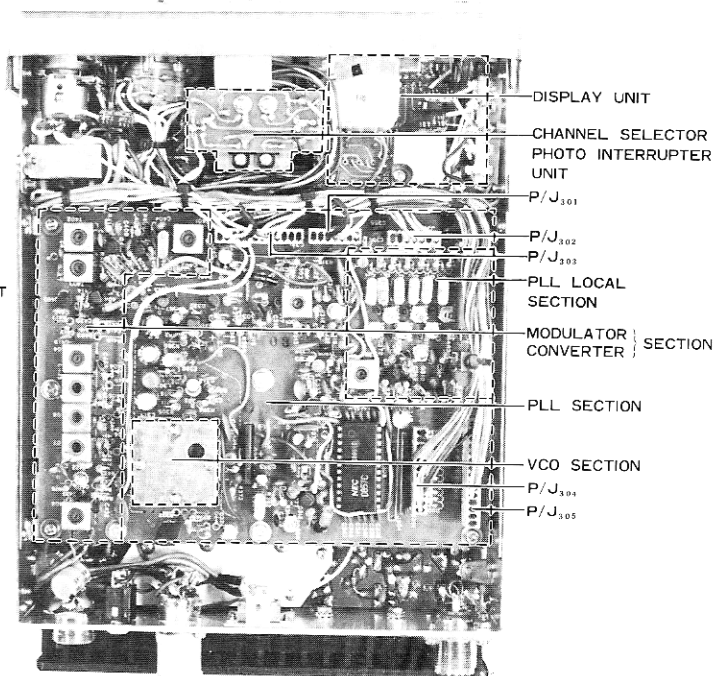
For the most part, maintenance of your FT-127RA should be limited to keeping the transceiver clean. Periodic checks of transmitter RF power output and receiver sensitivity will ensure top performance.

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.

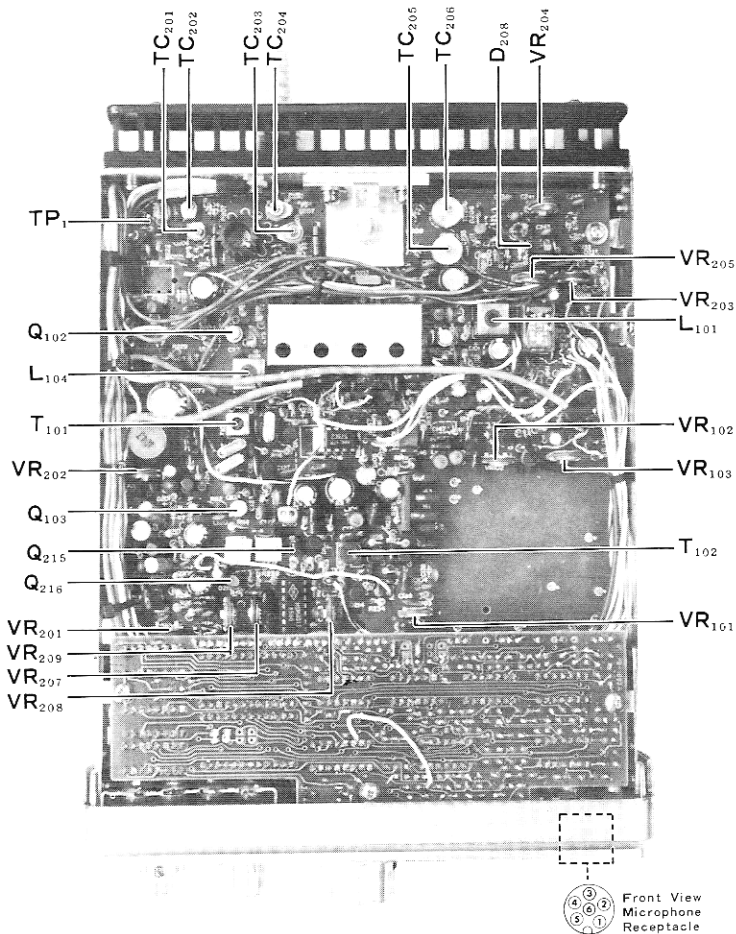
Check the receiver sensitivity as follows:

- (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

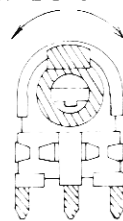
note the VTVM reading with no signal applied. Adjust the transceiver volume control and the VTVM range, as required, to secure approximately a full scale VTVM reading. DO NOT change the volume control setting after marking this adjustment.

- (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 μ V.

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.

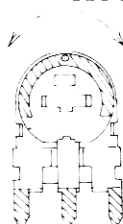


counter clockwise clockwise



Front View

counter clockwise clockwise



Rear View

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 VR₂₀₅ to the extreme counterclockwise (CCW) position. Peak TC₂₀₁–TC₂₀₆ 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 VR₂₀₃ 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 VR₂₀₅ to the extreme CCW position. Connect a VTVM to the cathode of D₂₀₈, and adjust VR₂₀₄ for a minimum VTVM indication.
- (b) Disconnect the dummy load from the antenna jack. Set VR₂₀₅ to the fully clockwise position. Key the transmitter, and slowly rotate VR₂₀₅ 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 TP₃, and peak T₄₀₂ for maximum power output.
- (c) Now connect a frequency counter between TP₃ and ground. Key the transmitter, and adjust T₄₀₁ 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 T₄₀₂–T₄₀₈ 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 VR₂₀₂ for ±4.5 kHz deviation on transmit.
- (f) Set the audio generator output level to 2.5 mV. Adjust VR₂₀₁ for a deviation of ±3.5 kHz while transmitting.

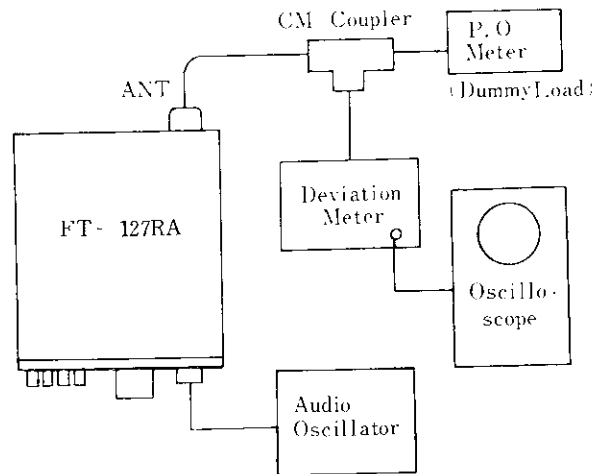


Figure 8.

(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 Q₂₁₅ to pin 14.
- (c) Connect a frequency counter to the emitter of Q₂₁₆, and set the TONE BURST switch ON.
- (d) Key the transmitter, and adjust VR₂₀₇ for the desired burst frequency.
- (e) Connect a VTVM to the MIC IN terminal, and adjust VR₂₀₉ for a 2.5 mV reading.
- (f) Disconnect the previously-connected wire between pin 5 and pin 14 of Q₂₁₅. Key the transmitter, and adjust VR₂₀₈ 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.

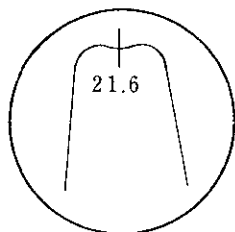


Figure 9

- (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.

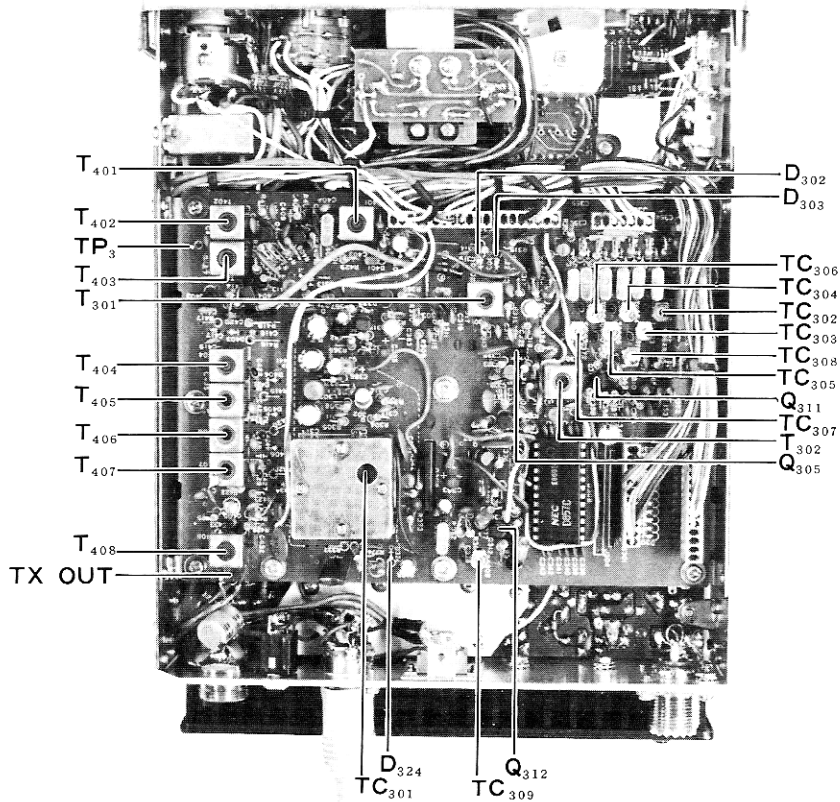
PLL CONTROL UNIT

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.

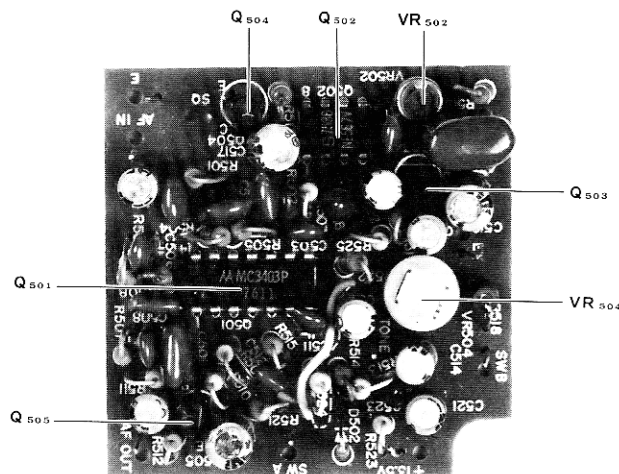
TONE SQUELCH UNIT (OPTION)

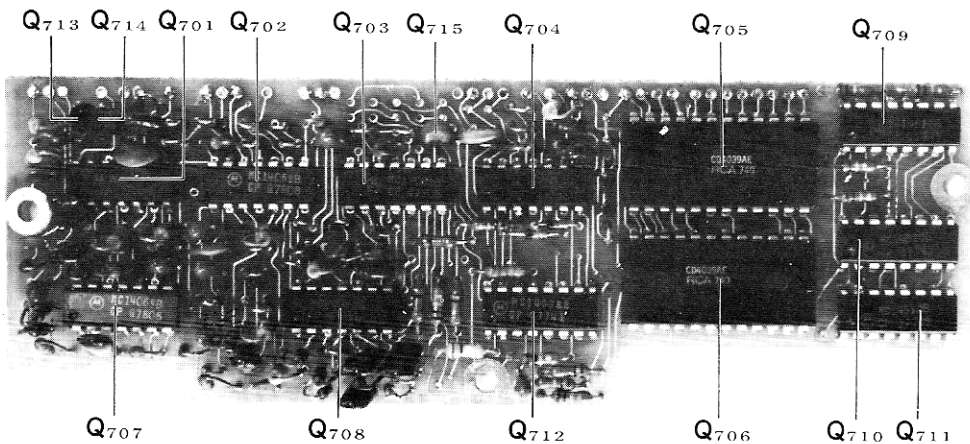
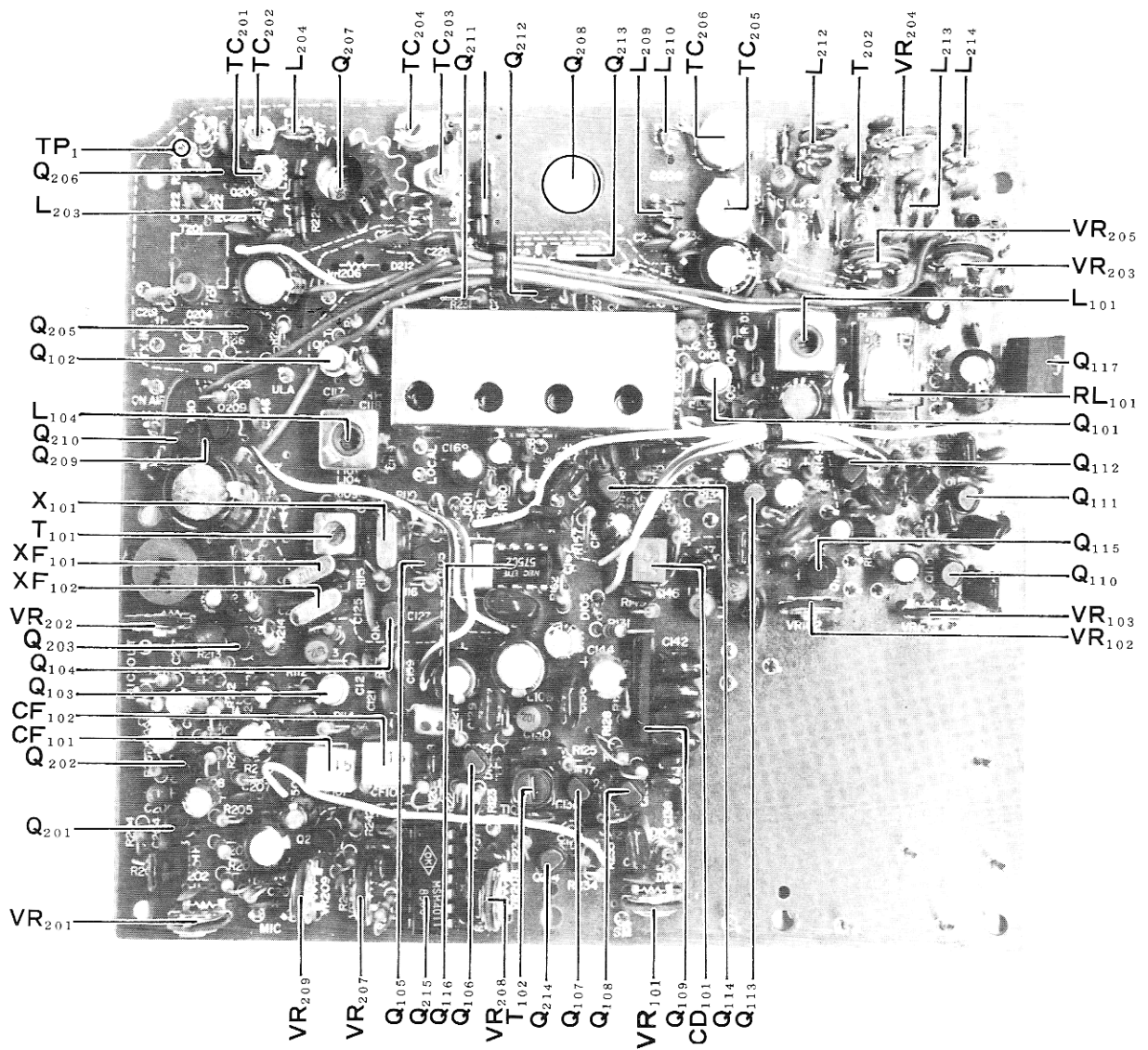
The optional tone squelch unit has been preset to 77 Hz center frequency at the factory. However, the frequency can be set to any frequency between 70 Hz and 250 Hz by referring to Table 2, located on page 15, and by adjustment of VR₅₀₄.

The tone output level adjustment is made at VR₅₀₄.

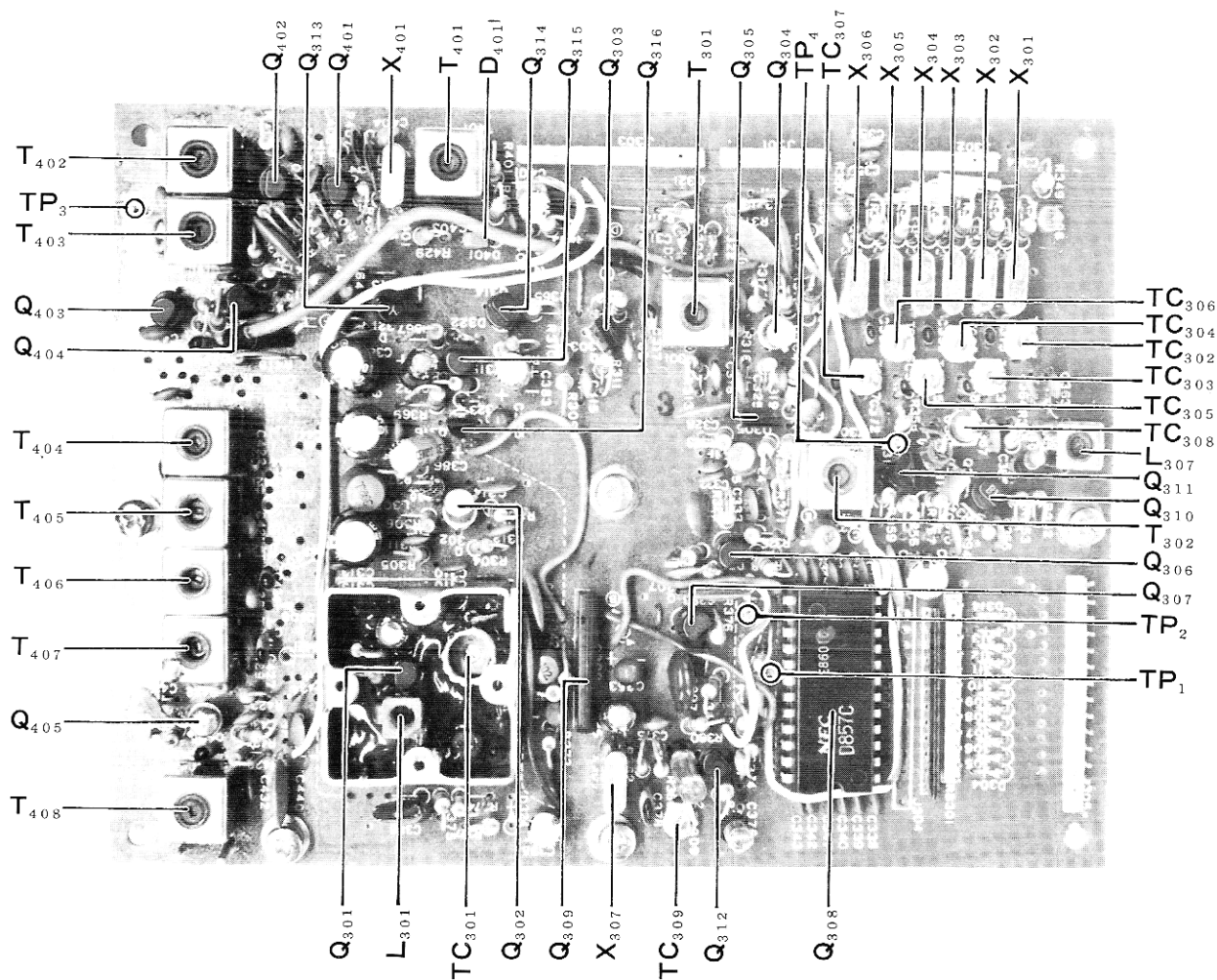


ALIGNMENT POINT

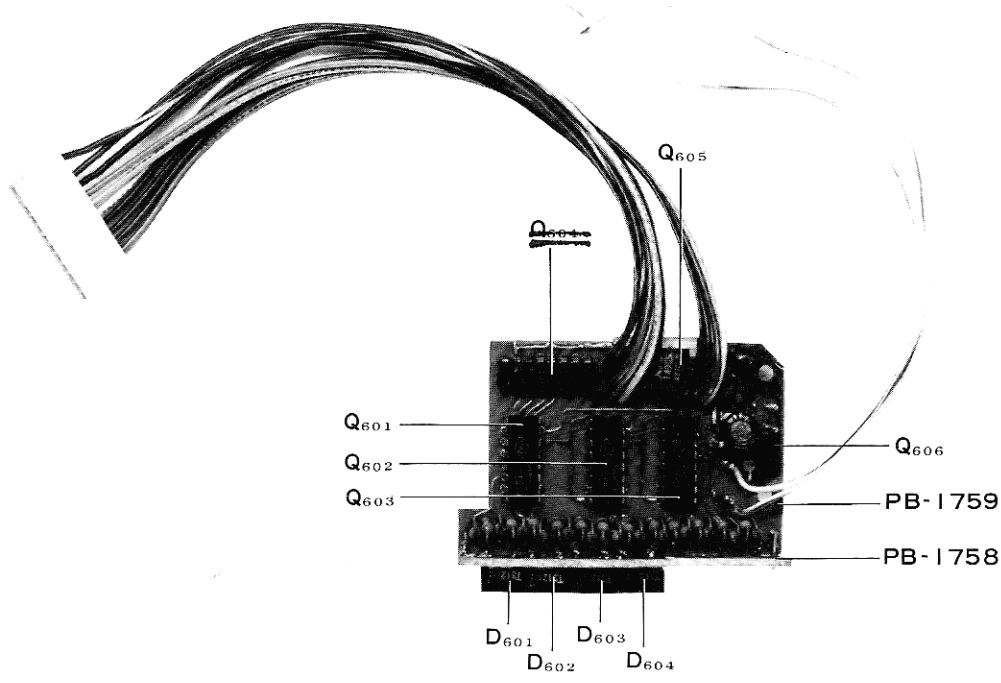




PLL CONTROL UNIT



PLL UNIT



DISPLAY UNIT

PARTS LIST

| MAIN CHASSIS | | | PLUG | | | |
|---------------|--------------|--------------------------------|---------------|--------------|---|----------|
| Symbol Number | Parts Number | Description | P6 | 68060019 | 1625-06P-1 with Wire | #240114A |
| | | TRANSISTOR | | | | |
| Q1 | 22402353 | Silicon 2SD235-O | | | | |
| | | | | | TERMINAL BOARD | |
| | | | TB1 | 90020002 | 11.4P 2-0-2 | |
| | | DIODE | | | | |
| D1 | 21090130 | Silicon U05B | | | | |
| D5,7,8 | 21015550 | " " " " 1S1555 | | | PILOT LAMP | |
| D2,3,4 | 21090111 | Zener WZ050 | PL1-5,7 | 14000025 | BQ054-32732B 14V | 40mA |
| | | | PL6 (with M1) | | | |
| | | RESISTOR | | | | |
| R2 | 41143100 | Carbon film 1/4W Tj 10Ω | | | | |
| R1 | 41143821 | " " " " 820Ω | | | | |
| R4,5 | 40143821 | " " " " VJ 820Ω | | | | |
| R6 | 40143562 | " " " " 5.6KΩ | | | | |
| R3 | 40143103 | " " " " 10KΩ | | | | |
| R7 | 42124220 | Carbon Composition 1/2W GK 22Ω | | | | |
| | | | | | PHOTO INTERRUPTER BOARD | |
| | | | Symbol Number | Parts Number | Description | |
| | | | | 019810AZ | Photo interrupter board with components | |
| | | | PB-1981 | 60319510 | P.C. BOARD | |
| | | POTENTIOMETER | | | | |
| VRI (With S1) | 49800079 | DM11A-5M1111 10KΩB/10KΩA | | | TRANSISTOR | |
| | | | Q4,5 | 22318154 | 2SC1815Y | |
| | | CAPACITOR | | | | |
| C1 | 31829100 | Ceramic disc 50WV 10pF(SL) | | | PHOTO INTERRUPTER | |
| C10 | 30820102 | " " " " 0.001μF | Q2,3 | 29090014 | ON1105 | |
| C2,3 | 30820103 | " " " " 0.01μF | | | | |
| C7 | 34120107 | Electrolytic 10WV 100μF | | | | |
| C6,8,9 | 34220106 | " " " " 16WV 10μF | | | RESISTOR | |
| C5 | 34220226 | " " " " 22μF | R11,13 | 42144221 | Carbon Composition 1/2W GK 220Ω | |
| C4 | 34220107 | " " " " 100μF | R12,14 | 42144103 | " " " " 10KΩ | |
| | | | | | | |
| | | INDUCTOR | | | | |
| L1 | 55003356 | " " " " #220520 | | | | |
| | | | | | SWITCH BOARD | |
| | | AF CHOKE | Symbol Number | Parts Number | Description | |
| CH1 | 50000010 | " " " " #230012 | PB-1896 | 60318960 | P.C. Board | |
| | | | | | | |
| | | METER | | | PUSH SWITCH | |
| M1 | 74000310 | AP-120 | S2,3,5 | 65000022 | 2U-EE-20 | |
| | | | S4 | 65000043 | 2U-OA-20 | |
| | | SPEAKER | | | | |
| SP1 | 76000013 | SM-77K-Y | | | | |
| | | | | | | |
| | | SWITCH | | | | |
| S6,7 | 63000008 | SSF-22-08 | | | | |
| S8 | 61000600 | SRN2046N | | | | |
| S9 | 63000011 | SSH-23-08 | | | | |
| S1 (with VRI) | | | | | | |
| | | | | | | |
| | | RECEPTACLE | | | | |
| J1 | 68020006 | FM142S | | | | |
| J2 | 68060002 | FM146S | | | | |
| J3 | 68050003 | CS250 | | | | |
| J4 | 68000007 | JS0239 | | | | |
| J5 | 68020012 | SG8050 | | | | |
| J6 | 68020020 | 1625-06R-1 with Wire #240113A | | | | |

PARTS LIST

| MAIN UNIT | | | | | | | |
|--------------------------|--------------|-----------------------|--------------------------|---------------------------|-------------|--------------------|---------------|
| Symbol Number | Parts Number | Description | | | | | |
| PB-1659D | 60316594 | P. C. Board | R117, 138, 140, 204 | 40143332 | Carbon film | 1/4W VJ | 3.3KΩ |
| | | | R122 | 40143392 | " " | " " | 3.9KΩ |
| | | | R156, 222, 229, 231 | 40143472 | " " | " " | 4.7KΩ |
| | | | 235, 236, 244 | | | | |
| | | | R132, 133, 141, 203, 217 | 40143562 | " " | " " | 5.6KΩ |
| | | | 230 | | | | |
| | | IC, FET & Transistor | | | | | |
| Q109 | 25000118 | IC | μPC577H | R154, 155 | 40143822 | " " | 8.2KΩ |
| Q116 | 25000119 | " | μPC525C2 | R115, 116, 118, 119, 134 | 40143103 | " " | 10KΩ |
| Q117 | 25000116 | " | μPC14308 | 143, 205, 211, 213 | | | |
| Q215 | 25000114 | " | MC14011B | R109 | 40143153 | " " | 15KΩ |
| Q101, 102, 103 | 23800510 | FET | 3SK51 | R121 | 40143183 | " " | 18KΩ |
| Q213 | 22104963 | Transistor | 2SA496(O) | R103, 104, 135, 234, 249 | 40143223 | " " | 22KΩ |
| Q105 | 22105640 | " | 2SA564 | R101, 106, 108, 113, 125 | 40143103 | " " | 47KΩ |
| Q104, 106~108, 110 | 22303724 | " | 2SC372V | 127, 146, 158 | | | |
| 111~115, 201~203 | | | | R144 | 40143563 | " " | 56KΩ |
| 205, 209~212, 214 | | | | R145, 152 | 40143823 | " " | 82KΩ |
| 216 | | | | R153, 242, 243 | 40143104 | " " | 100KΩ |
| Q206 | 22324070 | | 2SC2407 | R160 | 40143124 | " " | 120KΩ |
| Q208 | 22390013 | | MRF226 | R137, 139, 159, 212, 214 | 40143154 | " " | 150KΩ |
| Q207 | 22390014 | | MRF227 | R239 | 40143184 | " " | 180KΩ |
| | | | | R207 | 40143274 | " " | 270KΩ |
| | | | | R238 | 40143824 | " " | 820KΩ |
| | | DIODE | | R237, 240, 241 | 40143105 | " " | 1MΩ |
| D103, 104, 106~109 | 21001880 | Germanium Diode | 1S188FM | R246 | 42124101 | Carbon Composition | 1/2W 100Ω |
| D205, 208, 209, 211 | 21015550 | Silicon Diode | 1S1555 | | | | |
| 101, 102, 105, 110 | | | | | | | |
| 111~113, 201~204 | | | | | | | |
| 210 | | | | TH101 | 29090001 | THERMISTOR | SDF-250 |
| D206, 207, 213 | 21090128 | " " | MI301 | | | | |
| | | | | | | | |
| | | | | | | POTENTIOMETER | |
| | | CRYSTAL | | VR204 | 49902501 | TR11R3 | 500ΩB |
| X101 | 71800130 | HC-18/U 21.145MHz | # 210129 | VR202, 209 | 49902102 | " | 1KΩB |
| | | | | | 49902202 | " | 2KΩB |
| | | | | VR102, 201 | 49902502 | " | 5KΩB |
| | | MONOLITHIC FILTER | | VR101, 103, 205 | 49902103 | " | 10KΩB |
| XF101 | 71000039 | 21L2B3 | | VR203 | 49902503 | " | 50KΩB |
| | | | | VR207 | 49902104 | " | 100KΩB |
| | | | | VR208 | 49902205 | " | 2MΩB |
| | | CERAMIC FILTER | | | | | |
| CF101, 102 | 71200016 | LFB-15 | | | | | |
| | | | | | | CAPACITOR | |
| | | | | C238 | 31829059 | Ceramic | 50WV SL 0.5pF |
| | | CERAMIC DISCRIMINATOR | | C102, 233 | 31820010 | " | CH 1pF |
| CD101 | 70900001 | SFD455S4 | | C239 | 31829020 | " | SL 2pF |
| | | | | C241 | 31829030 | " | SL 3pF |
| | | | | C113, 184 | 31820060 | " | CH 6pF |
| | | RESISTOR | | C107 | 31820080 | " | CH 8pF |
| R224 | 40143220 | Carbon film | 1/4W VJ 22Ω | C109, 111 | 31820090 | " | " 9pF |
| R102, 105, 107, 112 | 40143560 | " " | " " 56Ω | C119, 243 | 31829100 | " | SL 10pF |
| R110, 124, 131, 157, 201 | 40143101 | " " | " " 100Ω | C269 | 31829150 | " | " 15pF |
| 208 | | | | C180, 244, 245 | 31829200 | " | " 20pF |
| R225 | 41143101 | " " | " TJ 100Ω | C270, 271 | 31829510 | " | " 51pF |
| R162 | 40143121 | " " | " VJ 120Ω | C124 | 31820510 | " | CH 51pF |
| R123 | 40143151 | " " | " " 150Ω | C126, 157, 267 | 31829101 | " | SL 100pF |
| R147, 215 | 40143221 | " " | " " 220Ω | C125 | 31829201 | " | " 200pF |
| R126, 128, 129, 163, 223 | 40143471 | " " | " " 470Ω | C103, 104, 106, 115, 117, | 30820102 | " | " 0.001μF |
| 228, 232 | | | | 123, 138, 167, 170, 176 | | | |
| R253 | 41143471 | " " | " TJ 470Ω | 201, 202, 204, 207, 217 | | | |
| R209 | 40143561 | " " | " " 560Ω | 219, 222, 223, 226, 228 | | | |
| R206, 216 | 40143102 | " " | " VJ 1KΩ | 232, 234, 235, 237, 240 | | | |
| 111, 114, 142, 151 | | | | 242, 247, 258, 259 | | | |
| R202 | 40143182 | " " | " " 1.8KΩ | C105, 116, 120, 121, 127 | 30820103 | " | " 0.01μF |
| R149, 161, 221, 233 | 40143222 | " " | " " 2.2KΩ | 139, 178, 181, 182, 214 | | | |
| R120, 210 | 40143272 | " " | " " 2.7KΩ | 224, 225, 227, 231, 236 | | | |

PARTS LIST

| | | | | | | | | |
|--|----------|--------------------------|----------------|----------------|--|---------------------|---------------------------------|--|
| C246, 257, 260, 261 | 30820103 | Ceramic | 50VV | 0.01 μ F | 56000024 | Ferrite Beads | 4A-RI 3 \times 3-1 | |
| C264 | 30825103 | Ceramic Chip | 25VV | 0.01 μ F | | | | |
| C128, 131, 132, 133, 135 147, 179, 251, 252 | 36825102 | Mylar Film | 50VV | 0.001 μ F | 91100008 | Wrapping Terminal | C | |
| C162 | 36825472 | " | " | 0.0047 μ F | 95000004 | Heat Sink C | T0-5, ℓ =15mm | |
| C137, 146, 151, 152, 154 161, 254, 255 | 36825103 | " | " | 0.01 μ F | 80038283 | Resonator Case | | |
| C148~150, 153, 164 166, 203 | 36825223 | " | " | 0.022 μ F | 80049580 | Ground Pin | | |
| C122, 129, 130, 134, 136 140, 141~143, 215 216 | 36825473 | " | " | 0.047 μ F | 80042481 | Ground Plate | | |
| C172 | 36825104 | " | " | 0.1 μ F | | | | |
| C266 | 36416107 | Tantalum | 3.15VV | 100 μ F | | | | |
| C159 | 36226475 | " | 16VV | 4.7 μ F | | | | |
| C205 | 36226106 | " | " | 10 μ F | | | | |
| C253 | 36526104 | " | 35VV | 0.47 μ F | | | | |
| C144, 169, 171, 209 | 34120476 | Electrolytic | 10VV R | 47 μ F | | | | |
| C165, 173, 175, 206, 213 | 34120107 | " | " | 100 μ F | | | | |
| C163, 183, 211, 212, 250 | 34220106 | " | 16VV | 10 μ F | | | | |
| C174, 229, 263 | 34220107 | " | " | 100 μ F | | | | |
| C177 | 34220108 | " | " | 1000 μ F | | | | |
| C155, 156, 168 | 34320475 | " | 25VV | 4.7 μ F | | | | |
| C158, 160, 208, 210, 262 | 34820105 | " | 50VV | 1 μ F | | | | |
| | | | | | | PLL UNIT | | |
| | | | | | Symbol Number | Parts Number | Description | |
| | | | | | PB-1757B | 60317572 | P. C. Board | |
| | | | | | PB-1921 | 60319210 | " | |
| | | | | | | | | |
| | | | | | | | IC, FET & Transistor | |
| | | | | | Q308 | 25000086 | IC μ PD857C | |
| | | | | | Q309 | 25000087 | " TC5081P | |
| | | | | | Q301 | 22800196 | FET 2SK19BI. | |
| | | | | | 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 | |
| | | | | | | | | |
| | | TRIMMER CAPACITOR | | | | | | |
| TC101~104 | 39000010 | ECV-1ZW | 10 \times 53 | 10pF | Q302, 304, 405 | 23800510 | MOS FET 3SK51 | |
| TC201, 202 | 39000011 | " | 20 \times 53 | 20pF | Q306, 307, 313~315 401 | 22303724 | Transistor 2SC372Y | |
| TC204 | 39000073 | " | 40 \times 53 | 40pF | Q312 | 22303730 | " 2SC373 | |
| TC203 | 39000005 | " | 50 \times 32 | 50pF | Q303, 305 | 22305351 | " 2SC535A | |
| TC205, 206 | 39000066 | TC-10 | | 40pF | Q311 | 22307104 | " 2SC710 | |
| | | | | | Q402 | 22307842 | " 2SC784R | |
| | | | | | Q316 | 22390001 | " MPS-A13 | |
| | | | | | | | | |
| | | INDUCTOR | | | | | | |
| L203, 213, 214 | 55003302 | | | #220193 | | | DIODE | |
| L101, 104 | 55003359 | | | #220509 | D322~324, 326 | 21015550 | Silicon Diode 1S1555 | |
| L103 | 55003360 | | | #220514 | D302, 303, 315~320 | 21090142 | " " MC301 | |
| L204, 210 | 55003361 | | | #220515 | D402 | 29090004 | " " MV103 | |
| L216 | 55003362 | | | #220516 | D401 | 21090108 | Varactor Diode 1SV50 | |
| L209 | 55003363 | | | #220518 | D301 | 21022090 | " " 1S2209 | |
| L206, 212 | 55003364 | | | #220519 | D321 | 21090131 | Zener Diode RD6.8EB | |
| L205, 208 | 55003365 | | | #220570 | | | | |
| L102, 215 | 53020031 | Micro Inductor | | 0.68 μ H | | | | |
| L211 | 53020035 | " | | 1 μ H | | | CRYSTAL | |
| L110 | 53020037 | " | | 8.2 μ H | X301 | 71800131 | HC-18/U 66.1333MHz | |
| L105 | 53010004 | " | | 220 μ H | X302 | 71800132 | " 66.6666MHz | |
| L106, 108, 109 | 53020001 | " | | 1mH | X303 | 71800133 | " 65.6000MHz | |
| L201 | 53050001 | " | | 100mH | X304 | 71800134 | " 66.1350MHz | |
| | | | | | X305 | 71800135 | " 66.6683MHz | |
| | | | | | X306 | 71800136 | " 65.6016MHz | |
| | | | | | X307 | 71800137 | " 10.240MHz | |
| | | | | | X401 | 71800138 | " 21.600MHz | |
| | | TRANSFORMER | | | | | | |
| T101 | 55003357 | IFT | | #220512 | | | | |
| T202 | 55003358 | | | #220521 | | | | |
| T102 | 55003084 | 7MC-31262N0 | | | | | | |
| | | | | | | | | |
| | | | | | | | RESISTOR | |
| | | | | | R364, 425, 428 | 40143560 | Carbon film 1/4W VJ 56 Ω | |
| | | | | | R302, 303, 307, 312, 319 354, 359, 360, 371, 378 379, 408, 418 | 40143101 | " " " " 100 Ω | |
| | | | | | R311, 358, 412~415 | 40143221 | " " " " 220 Ω | |
| | | | | | R351 | 40143471 | " " " " 470 Ω | |
| QS201 | 68140008 | 116-14-30-114 | | | R373 | 40143681 | " " " " 680 Ω | |

PARTS LIST

| | | | | | | | | | | | |
|--|----------|-----------------------------------|---------------------------|-------|--------------------|---|----------|-------------------|----------------|---------------|----------|
| R324, 327, 355, 356, 361, 365, 367 | 40143821 | Carbon film | $\frac{1}{4}$ W | VJ | 820 Ω | C330, 333, 335, 366, 367, 375, 384, 394, 409, 410, 415, 416, 442, 443, 447, 448 | 30820103 | Ceramic disk | 50WV | 0.01 μ F | |
| R369, 407, 411 | 40143102 | " | " | " | 1K Ω | | | " | " | " | |
| R334 | 40143122 | " | " | " | 1.2K Ω | C334 | 30820223 | " | " | 0.022 μ F | |
| R323, 372, 375 | 40143152 | " | " | " | 1.5K Ω | C322, 328, 329, 336, 350 | 30820473 | " | " | 0.047 μ F | |
| R313, 328, 349, 350 | 40143222 | " | " | " | 2.2K Ω | 351, 391, 393, 397, 399, 436, 439, 440 | | " | " | " | |
| R381~383 | 41143222 | " | " | " | T.J. 2.2K Ω | | | " | " | " | |
| R314, 315, 343~348 | 40143332 | " | " | " | VJ 3.3K Ω | C376 | 36824101 | Styrol | " | 100pF | |
| R404 | 40143562 | " | " | " | 5.6K Ω | C377 | 36824221 | " | " | 220pF | |
| R309, 321, 325, 335, 336, 352, 357, 363, 409, 426, 427 | 40143103 | " | " | " | 10K Ω | C388 | 36825473 | Mylar film | 50WV | 0.047 μ F | |
| R353 | 40143123 | " | " | " | 12K Ω | C385 | 36526104 | Tantalum | 35WV | 0.1 μ F | |
| R368, 374 | 40143153 | " | " | " | 15K Ω | C387 | 36226475 | " | 16WV | 4.7 μ F | |
| R317, 362, 366, 401, 406, 410 | 40143223 | " | " | " | 22K Ω | C349 | 34120476 | Electrolytic | 10WV R | 47 μ F | |
| R326 | 40143273 | " | " | " | 27K Ω | C379, 381, 389 | 34120107 | " | " R | 100 μ F | |
| R310, 318, 402, 430 | 40143333 | " | " | " | 33K Ω | C309, 353, 382, 396 | 34220106 | " | 16WV R | 10 μ F | |
| R322, 423 | 40143393 | " | " | " | 39K Ω | C383, 386, 398, 401 | 34820105 | " | 50WV R | 1 μ F | |
| R405 | 40143473 | " | " | " | 47K Ω | | | TRIMMER CAPACITOR | | | |
| R301 | 40143563 | " | " | " | 56K Ω | TC301 | 39000080 | TZ01Y070A | " | 7pF | |
| R304~306, 316, 342, 370, 377, 422, 429 | 40143104 | " | " | " | 100K Ω | TC302~307, 309 | 39000011 | ECV-1ZW | 20 \times 53 | 20pF | |
| R376 | 40143154 | " | " | " | 150K Ω | TC308 | 39000010 | ECV-1ZW | 10 \times 53 | 10pF | |
| | | BLOCK RESISTOR | | | | | | | INDUCTOR | | |
| RB301 | 47000009 | 100K Ω \times 11, RA1/16 | 100K Ω \times 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 | | 0.68 μ H | |
| C427 | 31820010 | " | " | CH | 1pF | L306, 308 | 53020018 | " | " | 10 μ H | |
| C327 | 31829020 | " | " | SL | 2pF | L305 | 53020025 | " | " | 33 μ H | |
| C427, 433 | 31820020 | " | " | CH | 2pF | L312 | 53010004 | " | " | 220 μ H | |
| C323 | 31829030 | " | " | SL | 3pF | L311, 401 | 53020001 | " | " | 1mH | |
| C420, 424 | 31820030 | " | " | CH | 3pF | L310 | 53020003 | " | " | 3.9mH | |
| C373, 422 | 31820040 | " | " | CH | 4pF | | | TRANSFORMER | | | |
| C404 | 31827040 | " | " | UJ | 4pF | | | | | | |
| C310, 317 | 31820050 | " | " | " | 5pF | | | | | | |
| C303 | 31827060 | " | " | UJ | 6pF | T301, 302, 305~308 | 55003367 | | | # 220510 | |
| C301 | 31820090 | " | " | CH | 9pF | T404 | 55003366 | | | # 220508 | |
| C332 | 31829100 | " | " | SL | 10pF | T492, 403 | 55003368 | | | # 220511 | |
| C302, 306, 357~362 | 31820100 | " | " | CH | 10pF | T401 | 55003369 | | | # 220513 | |
| C365 | 31820150 | " | " | " | 15pF | | | | | | |
| C438 | 31829150 | " | " | SL | 15pF | | | | | | |
| C331 | 31829010 | " | " | " | 18pF | | | | | | |
| C413, 414 | 31820200 | " | " | CH | 20pF | | | MINI CONNECTOR | | | |
| C429 | 31829220 | " | " | SL | 22pF | J301, 302 | 67060005 | 5048-06A | | | |
| C307, 368 | 31820270 | " | " | CH | 27pF | J303, 304 | 67110004 | 5048-11A | | | |
| C369 | 31820300 | " | " | " | 30pF | J305 | 67140001 | 5048-14A | | | |
| C378 | 31820330 | " | " | " | 33pF | | | | | | |
| 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 | " | " | " | 0.001 μ F | | | IC SOCKET | | | |
| | | | | | | QS401 | 68240001 | 116-24-30-114 | | | |

| TONE SQUELCH UNIT | | | R513,524 | 40143153 | " | " | " | " | 15K Ω |
|-------------------|--------------|------------------------------------|---------------------------------|----------------------|--------------|----------|--------------|------|-----------------|
| Symbol Number | Parts Number | Description | R516 | 40143393 | " | " | " | " | 39K Ω |
| | | Tone Squelch Board with Components | R513,524* | 40143822 | " | " | " | " | 8.2K Ω |
| PB-1555A | 60315551 | Printed Circuit Board | R514* | 40143274 | " | " | " | " | 270K Ω |
| | | | R516* | 40143333 | " | " | " | " | 33K Ω |
| | | IC, FET & TRANSISTOR | | | | | | | |
| Q501 | | IC | MC3403 | | | | | | |
| Q502 | | " | NE567 | | | | | | POTENTIOMETER |
| Q503 | 22800195 | FET | 2SK19GR | VR501,504 | 49905102 | | SR-19R | | 1K Ω B |
| Q504,505 | 22303724 | Tr | 2SC372Y | VR502 | 49800084 | | TM062P | | 100K Ω B |
| | | DIODE | | | | | CAPACITOR | | |
| D501 | 21090131 | Zener Diode | RD8.2EB | C503 | 36825102 | | Mylar | 50WV | 0.001 μ F |
| | | | | C512 | 36825472 | | " | " | 0.0047 μ F |
| | | RESISTOR | | | C506,507,520 | 36825103 | | " | 0.01 μ F |
| R518 | 40143101 | Carbon Film | $\frac{1}{4}$ W VJ 100 Ω | C502,504,505,508,511 | 36825223 | | " | " | 0.022 μ F |
| R512 | 40143103 | " | " | " | 36825473 | | " | " | 0.047 μ F |
| R504 | 40143123 | " | " | " | 36825154 | | " | " | 0.15 μ F |
| R510,511,517 | 40143223 | " | " | " | 36825104 | | " | " | 0.1 μ F |
| R502,508 | 40143393 | " | " | " | 34820105 | | Electrolytic | 50WV | 1 μ F |
| R501,505,521,522 | 40143473 | " | " | " | 34226106 | | " | 16WV | 10 μ F |
| R506,507 | 40143823 | " | " | " | 34226226 | | " | " | 22 μ F |
| R509,514 | 40143154 | " | " | " | 36226154 | | Tantalum | 35WV | 0.15 μ F |
| R503 | 40143474 | " | " | " | 36226475 | | " | " | 4.7 μ F |
| R515,519 | 40143105 | " | " | " | | | " | " | 1M Ω |

