Instruction Manual
FT-225RD
FT-225R

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YAESU MUSEN CO, LTD
TOKYO JAPAN

ALL-MODE VHF MEMORY TRANSCEIVER

FT-225RD FT-225R

The FT-225RD two meter transceiver is a precision-built communications module bringing state-of-the-art features together in a compact, rugged package. Capable of operation over the entire 144-148 MHz range, the FT-225RD provides the flexibility of SSB, CW, AM, and FM operation, and Yaesu's exciting memory feature, which allows storage and recall of any frequency within the 1 MHz band being used, is available as an option. Advanced PLL (Phase Locked Loop) circuitry offers unsurpassed stability and a clean, spurious-free output signal. All circuits are fully solid state, and computer type plug-in modules are used for increased reliability and ease of maintenance.

The FT-225RD provides output power in excess of 25 watts on FM, SSB, and CW, and 8 watts on AM. Deluxe features which are built into every FT-225RD are digital plus analog readout, VOX, semi-break-in CW with sidetone, noise blanker, discriminator center meter, and offset tuning (clarifier) for both receive and transceive frequencies. For tone burst repeater accessing, a programmable tone burst generator is included. The FT-225R, with analog display only, contains a crystal calibrator for precise frequency determination.

The VFO coverage of the two-meter band is in 1 MHz segments, to avoid frequent changes of the bandswitch when crossing the 500 kHz point. In addition to VFO or optional memory operation, 44 crystal-controlled channels (11 channels x 4 bands) are possible. Repeater shift, which is normally set to 600 kHz, may be set to an alternative split of up to 1 MHz by the addition of an optional crystal or by use of the memory system.

The transceiver is entirely self-contained, requiring only an antenna and a power source for operation. The FT-225RD is normally supplied with 117 VAC and 13.6 VDC capability, but the power transformer may be rewired for operation from 100/110/117/200/220/234 VAC power. Two power cords are supplied with the transceiver. Selection of AC or DC operation is made by insertion of the proper line cord into the rear panel receptacle.

The transceiver weighs approximately 9 kg, and is 280 mm wide, 125 mm high, and 315 mm deep. Construction using heavy-gauge steel provides an extremely rugged package which is virtually immune to the effects of vibration and shock which are encountered in mobile service.

SPECIFICATIONS

GENERAL

Frequency Range:
144 — 145 MHz
145 — 146 MHz
146 — 147 MHz
147 — 148 MHz

Frequency Readout:
Digital readout to 0.1 kHz, analog display resolution better than 1 kHz.

Modes of Operation:
LSB, USB, CW, AM, FM.

Frequency Stability:
Within 100 Hz during any 30 minute period after warmup. Not more than 20 Hz with 10 % line voltage variation.

Intermediate Frequencies:
First IF = 10.7 MHz
Second IF = 455 kHz

Antenna Impedance:
50 ohms unbalanced.

Repeater Split:
600 kHz installed, any split up to 1 MHz possible with optional crystal.

Power Requirements:
AC 100/110/117/200/220/234 Volts, 50/60 Hz
DC 11.5 — 16.0 Volts, negative ground

Power Consumption:
AC Receive 30 VA
Transmit 160 VA at full output power
DC Receive 1.2 A
Transmit 6.5 A

Size:
280 (W) x 125 (H) x 315 (D) mm

Weight:
Approx. 9.0 kg

RECEIVER

Sensitivity:
SSB/CW 0.3 μV for 10 dB S/N
FM 0.35 μV for 20 dB QS
AM 1.0 μV for 10 dB S/N
(400 Hz 30 % modulation)

Selectivity:
SSB/CW/AM 2.3 kHz at 6 dB down
4.1 kHz at 60 dB down
FM 12 kHz at 6 dB down
28 kHz at 60 dB down

Image Response:
Better than – 60 dB

Spurious Response:
Better than 1 μV at antenna input

Audio Output Impedance:
4 ohms nominal

Audio Output:
2 watts @ 10% THD

TRANSMITTER

Audio Response:
350 ~ 2600 Hz ± 3 dB

Carrier Suppression:
Better than – 40 dB

Unwanted Sideband Suppression:
Better than – 40 dB

Spurious Radiation:
Better than – 60 dB

FM Deviation:
Factory set at ± 5 kHz, maximum ± 12 kHz

Power Output:
SSB 24 watts PEP
FM/CW 25 watts DC
AM 8 watts DC

SEMICONDUCTOR COMPLEMENT

Integrated Circuits (IC):

μPC14305	1
μPC14308S	2
μPC78L05	1
μPC1037H	1
TA7045M	1
TA7061AP	2
μA703HC	1
SN76514	1
SN75450B	1
SN75453	3
MC14011B	4
MC4044P (μPC1008C)	1
MSM561	1
MSM5564	1
MSM5576	1
F4011	1
TC5032	1

Field Effect Transistors (FET):

2SK19BL	1
2SK19GR	11
2SK19Y	1
3SK40M	2
3SK51	2

Transistors:

2SA496	1
2SA564A	1
2SA695	1
2SB529	1
2SC372Y	34
2SC373	9
2SC496	7
2SC710	2
2SC711	1
2SC730	1
2SC735Y	2
2SC784R	10
2SC1000BL	2
2SC1000GR	4
2SC2053	2
2SD313D	2
2SD359	1
2N5591	1
MRF212	1
MJ802	1

Germanium Diodes:

1S188FM	9
1S1007(GB)	10

Silicon Diodes:

1S1555	65
1S1941	1
10D1	14
MC301	5
U05B	1

Varactor Diodes:

1S2208	2
1S2209	14
1SV50	1
FC63	1

Zener Diodes:

1N4732	1
WZ090	1
WZ110	1

Light Emitting Diodes (LED):

GD4-203SRD	11

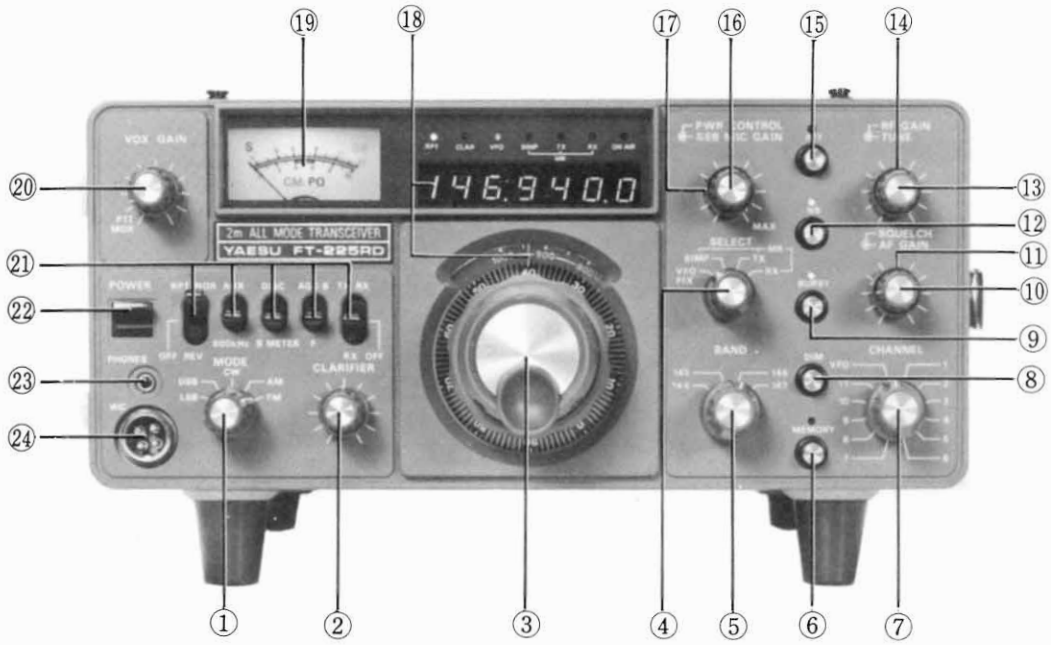
LED Display:

5082-7740	7

Specifications subject to change without notice.

CONTROLS AND SWITCHES

This transceiver has been specifically designed for ease of operation and versatility. All internal controls have been carefully preset at the factory. The operator may, however, be unfamiliar with the operation of some of the controls, and improper adjustment thereof may result in poor transceiver performance. The various front panel controls and switches are described in the following section, and the operator should be familiar with the function of every control before attempting transceiver operation.



(1) MODE switch

This switch chooses the mode of operation: LSB, USB, CW, AM, or FM.

(2) CLARIFIER

The clarifier control allows a means of offsetting the transceive or receive frequency ±4 kHz from the frequency established by the main VFO dial.

(3) MAIN TUNING DIAL

The tuning control is a dual rate, double-shaft mechanism which provides for both fast and slow tuning rates. The main dial skirt is calibrated in 1 kHz increments, and the analog dial window is calibrated in 100 kHz increments. Determination of the 1 MHz band segment is made by the BAND switch.

(4) SELECT switch

This switch selects frequency control between the VFO/FIX mode and memory (optional) control of the transmit, receive, or transceive frequency.

(5) BAND switch

The BAND switch selects one of the four 1 MHz segments of the two-meter band.

(6) MEMORY

When the optional memory unit is installed, a new frequency may be stored in memory by pressing the MEMORY switch.

(7) CHANNEL

This switch selects between VFO control or one of the 11 crystal controlled positions available per band.

(8) DIM

This switch, when pressed, dims the front panel lamps and the digital display for reduced power consumption or nighttime mobile operation.

(9) BURST

This switch activates the tone burst generator.

(10) AF GAIN

The AF GAIN control adjusts the audio output level to the speaker and headphones. Clockwise rotation increases the audio output level.

(11) SQUELCH

This control adjusts the FM receiver squelch threshold level.

(12) NB

This switch, when pressed, activates the noise blanker for elimination of pulse-type noise. The noise blanker is not operative in the FM mode, because impulse noise is amplitude modulation and the FM receiver does not respond to such noise.

(13) TUNE

The TUNE control peaks all transceiver signal circuits for the frequency being used.

(14) RF GAIN

The RF GAIN control varies the gain of the receiver IF and RF amplifiers. Maximum sensitivity is obtained when the control is set to the fully clockwise position.

(15) ATT

When pushed, the ATT (RF attenuator) places approximately 20 dB of attenuation in the incoming receive signal path, thus preventing overload of the receiver front end.

(16) SSB MIC GAIN

This control varies the output from the microphone amplifier stages for SSB and AM operation. The control has sufficient range to permit the use of any 500–600 ohm dynamic microphone.

(17) PWR CONTROL

This control allows continuously variable power output adjustment, when it is desirable to reduce the level of the transmitted signal, as, for example, when a transverter is used that requires very little driving power.

(18) DIAL

Frequency readout is by means of the digital and the analog displays. The digital display reads out all digits of the operating frequency, with resolution to 100 Hz. The analog sub-dial is calibrated every 100 kHz, and the BAND switch and main dial skirt are used to establish the precise operating frequency.

(19) METER

The meter reads signal strength or FM discriminator center current on receive, and relative power output on transmit.

(20) VOX GAIN

The VOX GAIN control selects between PTT and MOX (manual transmit) operation, and adjusts the level of the VOX amplifier stage.

(21) FUNCTION switches

RPT

This switch is used for repeater operation. For operation in the U.S., the transmitter frequency is shifted 600 kHz lower in the 144, 145, and 146 MHz bands, and in the 147 MHz band, the transmit frequency is shifted 600 kHz higher. The offset may be reversed by placing this switch in the REV position.

AUX/600 kHz

This switch selects the normal 600 kHz repeater offset or an auxiliary split established through use of an optional crystal.

DISC

This switch selects between meter indication of discriminator center current or signal strength on receive.

AGC

This switch selects between slow and fast AGC action.

CLARIFIER switch

The CLARIFIER switch selects between transceive frequency or receive frequency offset using the clarifier control. In the center (horizontal) position the clarifier is switched off.

(22) POWER

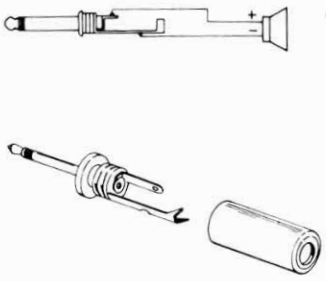
This is the main ON/OFF switch for both AC and DC operation.

(23) PHONES

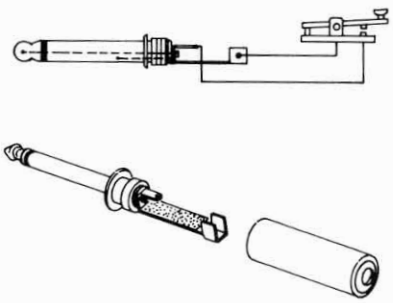
This is a miniature phone jack for use of headphones or a speaker. The internal speaker is disabled when a plug is inserted into this jack.

(24) MIC

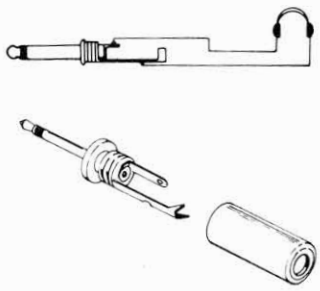
This is a four-conductor jack for microphone and PTT connections.



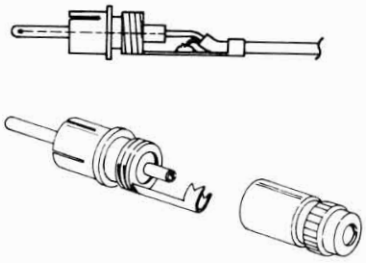
Speaker Plug



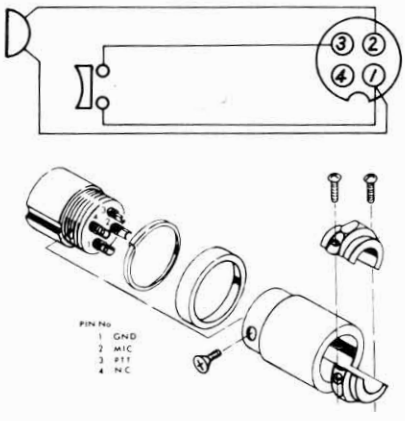
Key Plug



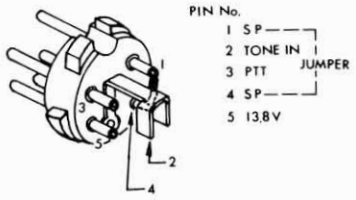
Headphone Plug



Phono Plug

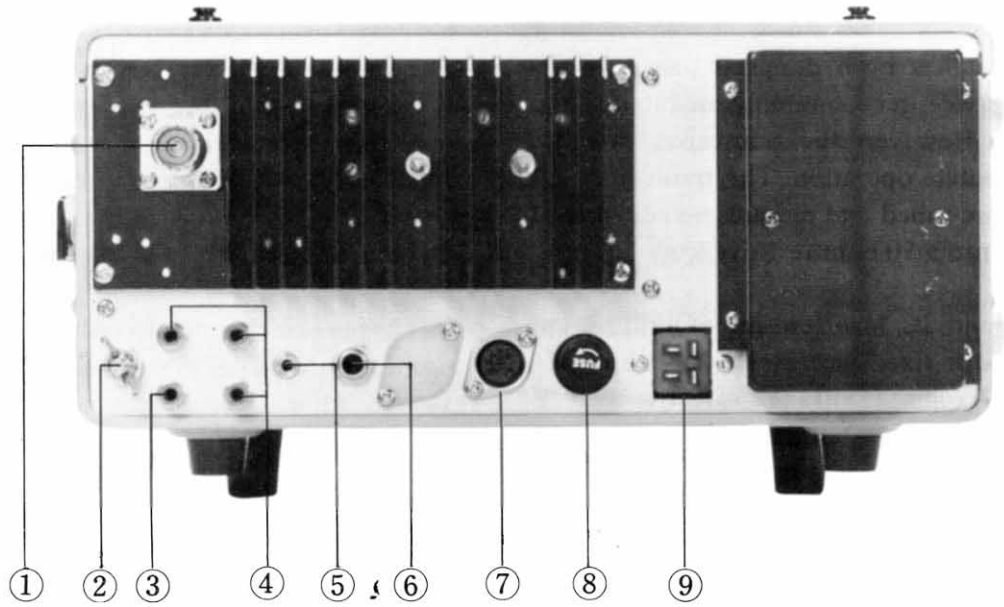


Microphone Connector



Tone In Plug

REAR PANEL CONNECTIONS



(1) ANT

UHF female coaxial connector for antenna input.

(2) GND

Ground connection.

(3) ALC

ALC (automatic level control) input.

(4) RL (make, break, common)

Relay contacts for control of station equipment.

(5) SP

External speaker audio output.

(6) KEY

Key jack for CW operation.

(7) TONE-IN

Tone pad input jack.

(8) FUSE

Fuse holder. For AC operation, a 3 amp fuse is used on 117 volts, and a 2 amp fuse is used for 220 volt operation. For DC operation, a 10 amp fuse is located in the DC power cord. When replacing fuses, be certain to replace the blown fuse with one of the proper rating. WARRANTY DOES NOT COVER DAMAGE CAUSED BY IMPROPER FUSE REPLACEMENT.

(9) POWER receptacle

Both AC and DC cables are connected to this receptacle. They are both supplied with the transceiver.

INSTALLATION

GENERAL

The FT-225RD has been designed primarily for base station service, requiring only an antenna and power source. However, the transceiver provides for efficient mobile operation. The transceiver has been factory pre-tuned and requires no adjustment for operation into a 50 ohm resistive load.

The antenna and its location are of critical importance in both fixed and mobile operation. In most cases, communications effectiveness is directly related to antenna height. The antenna should be as high and in the clear as possible, and a minimum separation of 5 feet should be maintained between VHF and other antennas. In mobile operation, it is desirable to locate the antenna as far away from the engine as paracticable so as to avoid noise pickup from the ignition system. The most popular mobile antennas are the 1/4 wavelength whip, and the 5/8 wavelength whip which provides approximately 3.5 dB gain over the 1/4 wavelength whip. The Yaesu RSL-145 mobile antenna is available through your dealer.

To minimize loss in the antenna system do not economize on coaxial cable, and use the shortest length of cable that is practical, avoiding sharp angles or kinks. Use type RG8A/U if the transmission line length exceeds 25 feet, while RG-58A/U may be used for shorter runs. Type RG-17A/U, air-dielectric "heliax", or aluminum-jacketed foam-dielectric coax should be used for very long runs.

BASE STATION INSTALLATION

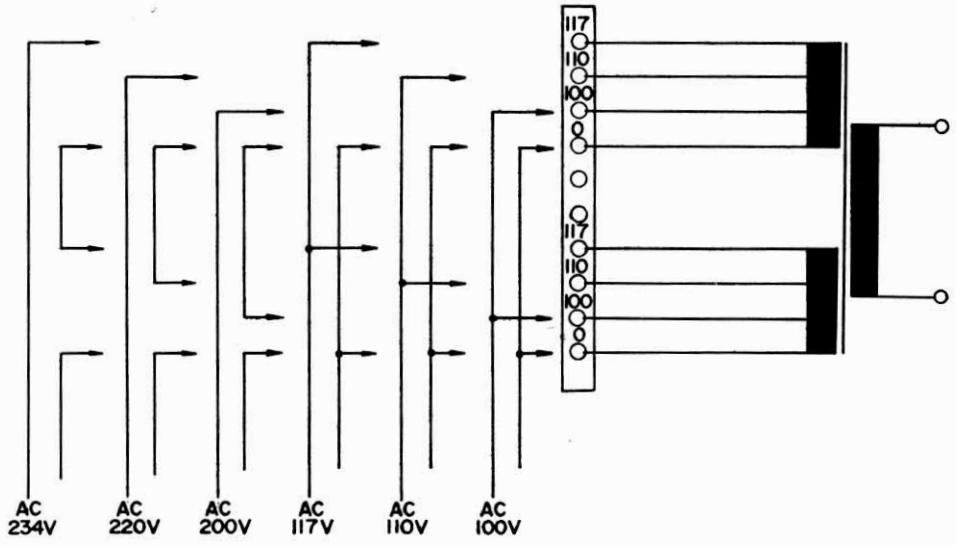
The transceiver is designed for use in many areas of the world where the supply voltage may differ from the operator's local supply voltage. Therefore, before connecting the AC cord to the power outlet, be absolutely certain that the voltage marked on the rear of the transceiver agrees with the local AC supply voltage. If not, please refer to the transformer primary winding chart for the proper connections.

CAUTION

PERMANENT DAMAGE WILL RESULT IF IMPROPER AC SUPPLY VOLTAGE IS APPLIED TO THE TRANSCEIVER; OUR WARRANTY DOES NOT COVER THE DAMAGE CAUSED BY SUCH AN IMPROPER SUPPLY VOLTAGE.

Be sure that a proper fuse is used for the local supply voltage: 3 amps for 117 volts and 2 amps for 220 volts. The transceiver should be connected to a good ground. The ground lead should be connected to the terminal marked GND on the rear panel.

It is recommended that excessively warm locations be avoided. The transceiver should be placed in a location that has adequate space to permit free air circulation through the cabinet openings.



POWER TRANSFORMER PRIMARY CONNECTIONS

MOBILE INSTALLATION

The transceiver will operate satisfactorily from any 12 volt negative ground battery source by connecting the DC power cord to the rear panel receptacle. In the car, a location should be selected that is clear of heater ducts to protect it from excessive heat. No special mounting precautions need to be observed if adequate ventilation is available. A minimum of two inches of air space is recommended to allow proper air flow around the transceiver. You may put it on the seat but be sure there is clearance between the cabinet bottom and the seat. Since the transceiver requires an average of 6.5 A on transmit, the fuse in the DC power cable should be rated for 10 amps.

When making connections to the car battery, be certain that the RED lead is connected to the positive (+) terminal and the BLACK lead is connected to the negative (–) terminal of the battery. Reversed connections could permanently damage the transceiver. The power cable should be as short as possible, and should be connected to the battery so as to take advantage of the filtering action of the battery.

Prior to operating the transceiver in a mobile installation, the voltage regulator setting should be checked. In many vehicles, the voltage regulation is very poor, and in some cases the regulator may be set for an excessively high charging voltage. As the battery and regulator age, the maximum voltage while charging can increase to a very high level. This is not only detrimental to the battery, but it may damage the transceiver. The transceiver is designed to operate from a source voltage of 11–16.5 volts. It is desirable to set the regulator so that the highest charging voltage does not exceed 14 volts, so as to give a margin of safety. The transceiver should be switched OFF when the vehicle is started so as to prevent voltage transients from damaging the transistors.

It is recommended that the microphone furnished with this transceiver be used: however, any quality microphone of 500–600 ohm impedance may be used. Refer to Fig. 2 for the microphone plug wiring connections. The microphone bracket may be put on the side of the cabinet, or at any other convenient place by drilling two 2.5 mm holes spaced 13 mm.

A speaker is built into the transceiver. However, audio output is also available for use with an external speaker. Any speaker having an impedance of 4 ohms may be used. When an external speaker plug is inserted in the EXT SP jack on the rear panel, the internal speaker is disabled.

OPERATION

The tuning procedure for this transceiver is not complicated. However, care should be exercised in operation to ensure peak performance. The following paragraphs describe the procedure for receiver and transmitted tuning.

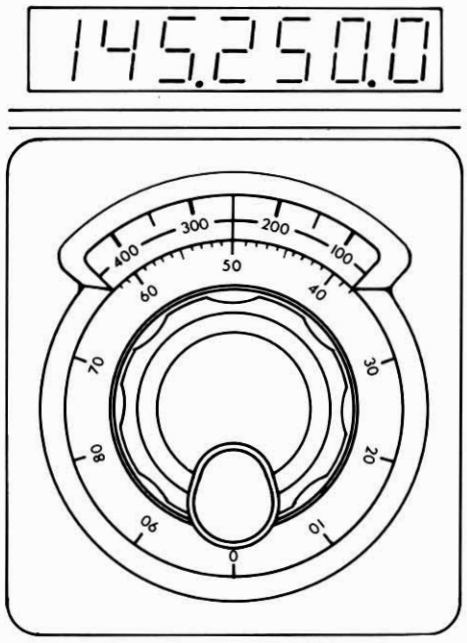
INITIAL CHECK

Before connecting the transceiver to a power source, carefully examine the unit for any visible damage. Be sure that all modules and crystals are firmly in place, and that controls and switches are operating normally. Be certain that the voltage specification marked on the rear panel matches the supply voltage.

FREQUENCY READOUT

The digital display includes all digits of the operating frequency, with accuracy to 0.1 kHz.

The analog display consists of three components: the bandswitch, the analog dial window, and the main tuning dial skirt. For example, let us say it is desired to operate on 145.250 MHz. The bandswitch should be placed in the "145" position, the main dial should be rotated so that the dial window indicates half way between "200" and "300", and the dial skirt should indicate "50". By changing the position of the bandswitch, this positioning of the main tuning dial will also yield 144.250, 146.250, and 147.250 MHz.



RECEIVER

After the transceiver is properly set up for operation, set the controls and switches as follows:

POWER	Down to OFF positon
MODE	Desired mode
BAND	Desired band segment
RPT	Lever position horizontal to OFF position
AUX/600 kHz	Lever position horizontal for 600 kHz shift
DISC	Lever position horizontal to S-meter position
CLAR	Lever position horizontal to OFF position
Main tuning dial	Desired operating frequency
VOX GAIN	PTT
AF GAIN	Adjust subsequently for comfortable level
RF GAIN	Fully clockwise position
SELECT	VFO/FIX
CHANNEL	VFO
SQUELCH	Fully counter-clockwise
NB	OFF (not depressed)
ATT	OFF (not depressed)
AGC	Slow or fast, as desired

Connect the appropriate power cord to the proper power source, and connect an antenna to the antenna connector on the rear panel.

CAUTION

PERMANENT DAMAGE WILL RESULT IF IMPROPER SUPPLY VOLTAGE IS APPLIED TO THE TRANSCEIVER. WARRANTY DOES NOT COVER THE DAMAGE CAUSED BY IMPROPER SUPPLY VOLTAGE.

Turn on the POWER switch. The dial and meter lamps and digital display LED's should light up; the transceiver is now ready to operate. Peak the TUNE control for maximum receiver background noise; this will also peak the transmitter circuits for maximum power output.

(1) SSB and AM Modes

Using the main tuning control, tune in an SSB signal. Upper sideband (USB) is the more commonly used mode for 2 meter SSB operation; if, however, the incoming station, cannot be tuned in, he or she may be using lower sideband (LSB). The RF GAIN control is normally set to the fully clockwise position, but if the incoming signal is extremely strong, or if you are trying to copy a weak station adjacent to an extremely strong station, reducing the RF GAIN control setting may improve reception. When pulse-type noise such as ignition noise is encountered, press the NB (noise blanker) switch.

(2) CW Mode

With the clarifier in the OFF position, tune in a CW signal. When the incoming signal is tuned to a beat note of 800 Hz, your transmit frequency will coincide with that of the other station. If another beat note is desired, or if the other station drifts, then use the clarifier control.

(3) FM Mode

Using the main tuning control, tune in an FM signal for a maximum and steady S-meter reading and a clear, natural voice output from the speaker. For accurate tuning, set the meter switch to the DISC position, and carefully readjust the tuning control until the pointer is exactly vertical (zero on the discriminator scale).

If the S-meter wobbles, or if it is impossible to obtain clean audio, it is possible that the incoming signal is on another mode, such as SSB.

FREQUENCY CALIBRATION

(1) FT-225RD (Digital plus analog model)

The digital display is automatically calibrated, and no further adjustment is needed. The analog dial skirt should be rotated so that it coincides with the frequency shown on the digital display.

(2) FT-225R (Analog model)

A. SSB/CW Modes

Activate the MARK switch, rotate the main tuning dial to the nearest 100 kHz point, and tune in the marker signal for a zero beat (lowest pitch frequency). Rotate the dial skirt, so as to align the "0" calibration with the vertical calibration marking. The transceiver must be recalibrated when changing modes, as, for example, when changing from LSB to USB.

B. AM Mode

Activate the MARK switch, and rotate the main tuning dial to the nearest 100 kHz point, and tune in the marker signal for a maximum S-meter reading. Rotate the dial skirt to align the "0" calibration with the vertical calibration marking.

C. FM Mode

Place the meter switch in the DISC position. Activate the MARK switch, and rotate the main tuning dial to the nearest 100 kHz point. Tune in the marker signal for a vertical indication of the meter pointer ("0" on the discriminator center meter). Rotate the dial skirt for calibration at the "0" point, as in the previous sections.

NOTE: WHEN THE MARKER SWITCH IS ACTIVATED, THE ANTENNA IS DISCONNECTED FOR EASIER CALIBRATION.

TRANSMITTER

Connect a 50 ohm dummy load or matched antenna to the coaxial fitting on the rear panel. If the TUNE control has been adjusted no further adjustment is needed for full transmitter output. The adjustment of the TUNE control for maximum output is very broad.

For adjustment of the power output level, the PWR CONTROL may be rotated as required. Some transverters require very little drive power for proper operation, and this control allows the operator to control the transmitter output level as needed.

(1) SSB Mode

The SSB MIC GAIN control should be adjusted while speaking in a normal voice a long syllable such as the word "four". The SSB MIC GAIN control should only be advanced to the point where the output does not increase further. Excessive advancement of the gain control will result in splatter and distortion, thus reducing intelligibility. The microphone PTT switch may be used, or the VOX circuitry may be utilized (see part (5) of this section).

(2) AM Mode

When the microphone PTT switch is depressed, the proper amount of carrier is automatically inserted. Adjust the SSB MIC GAIN control until the meter indicates a very slight movement with voice peaks while speaking into the microphone in a normal voice.

(3) CW Mode

Plug a key into the KEY jack on the rear panel. In the key-down condition, the meter will indicate between 6 and 8 on the relative output scale. For semi-break-in operation, advance the VOX GAIN control until the sidetone oscillator activates the VOX relay when the key is closed. For PTT operation, rotate the VOX GAIN control to the PTT position. Keying is accomplished by closing the DC 8V line to ground. Key down current is approximately 8 mA. Use caution when utilizing an electronic keyer so as to avoid damage due to reversed polarity.

(4) FM Mode

Push the PTT switch on the microphone while speaking normally into the microphone. The mic gain is automatically set in the FM mode. While transmitting, the relative output meter will read between 6 and 8. Release the microphone PTT switch for return to receive.

(5) VOX (Voice Controlled) Operation

Adjust the VOX GAIN control on the front panel until your voice actuates the transmitter while you are speaking in a normal voice into the microphone. Set the antitrip control VR_{402}, which is located on the AF AMP UNIT, to the minimum point that prevents the speaker output from tripping the VOX circuit. Do not use more VOX GAIN nor ANTITRIP than necessary. Adjust the DELAY control VR_{401} for the desired release time. The RELAY control provides a coarse adjustment for the relay sensitivity, and this has been preset at the factory. The RELAY and DELAY controls are also located on the AF AMP UNIT.

(6) PTT Operation

Push-to-talk operation is accomplished by rotating the VOX GAIN control to the PTT position (but not into the click-stop, which is the MOX position). The PTT circuit may then be activated either by the microphone PTT switch, or by a footswitch. If a footswitch is used, it may be connected through the rear panel TONE IN jack; the switch should be connected between pin 3 and ground.

REPEATER OPERATION

The transmit frequency may be shifted 600 kHz for repeater operation. When the RPT switch is in the NOR (normal) position, the transmit frequency is shifted 600 kHz lower in the 144, 145, and 146 MHz bands, and 600 kHz higher in the 147 MHz band (US model). These relations are reversed when the RPT switch is placed in the REV position. That is, on the 144, 145, and 146 MHz bands, when the RPT switch is placed in the REV position, the receive frequency is shifted 600 Hz down; on 147 MHz, the receive frequency is shifted 600 kHz up. Extreme caution should be exercised so as not to transmit outside the amateur bands while using the RPT switch.

In some areas, repeater splits other than 600 kHz have been authorized. In this case, an optional crystal may be installed in the local unit to provide repeater splits of up to 1 MHz. The AUX/600 kHz switch must be placed in the AUX position for actuating the optional crystal.

Determination of the AUX crystal frequency is made as follows:

Band 144 (144.0–145.0 MHz)
(125.1 + Shift frequency) ÷ 9
(125.1 – Shift frequency) ÷ 9
Band 145 (145.0–146.0 MHz)
(126.1 + Shift frequency) ÷ 9
(126.1 – Shift frequency) ÷ 9
Band 146 (146.0–147.0 MHz)
(127.1 + Shift frequency) ÷ 9
(127.1 – Shift frequency) ÷ 9
Band 147 (147.0–148.0 MHz)
(128.1 + Shift frequency) ÷ 9
(128.1 – Shift frequency) ÷ 9

Example 1

Calculate the crystal frequency for −800 kHz shift in the 146 MHz band segment (TX frequency 800 kHz lower):
(127.1 − 0.8) ÷ 9 = 14.033 MHz

Example 2

Calculate the crystal frequency for +800 kHz shift in the 147 MHz band segment (TX frequency 800 kHz higher):
(128.1 + 0.8) ÷ 9 = 14.3222 MHz

When the optional memory unit is installed, the output frequency of the repeater may be stored by pressing the MEMORY button and placing the SELECT switch in the SIMPLEX position. By placing the RPT switch in the NOR or REV positions, the desired offset will occur. If the repeater input and output frequencies are within the same 1 MHz width of the BAND switch, the input frequency may be stored in memory, and then recalled for transmission only by placing the SELECT switch in the TX MR position. The VFO can then be tuned to the output frequency of the repeater. In this way, "oddball" splits can be accommodated.

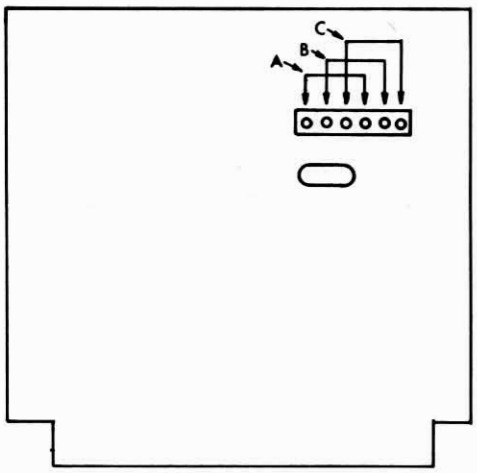
Tone actuated repeaters can be accessed by means of the built-in tone burst generator, which is actuated by pressing the BURST switch on the front panel. With this button depressed, pushing the microphone PTT witch will cause insertion of the burst signal at the beginning of each transmission.

The audio frequency of the tone burst signal may be programmed for any frequency between 671 and 2900 Hz, by use of a crystal and by positioning the selector plug on the tone burst unit. The US model normally is set up for 1800 Hz operation, and the European model for 1750 Hz operation. The charts will show the relation between the position of the selector plug, the crystal frequency, and the tone frequency. Moving the selector plug will change the tone frequency by a factor of two or four, as shown in the charts.

Tone Frequency (Hz)	Multiplier	Plug Position	Crystal Frequency (kHz)
671−1342	4096	A	2750−5500
1343−2685	2048	B	2750−5500
2686−2900	1024	C	2750−2970

Crystal frequency = Tone frequency × Multiplier.

Table 2



BAND	Simplex/Split	Local Frequency (MHz)	Crystal Frequency (MHz)	Multiplier
144	Simplex	★ 125.1	13.9000	×9
	+600kHz Shift	125.7	13.9666··	
	−600kHz Shift	★ 124.5	13.8333··	
145	Simplex	★ 126.1	14.0111··	
	+600kHz Shift	126.7	14.0777··	
	−600kHz Shift	★ 125.5	13.9444··	
146	Simplex	★ 127.1	14.1222··	
	+600kHz Shift	127.7	14.1888··	
	−600kHz Shift	★ 126.5	14.0555··	
147	Simplex	★ 128.1	14.2333··	
	+600kHz Shift	★ 128.7	14.3000	
	−600kHz Shift	127.5	14.1666··	

Table 1 (★ US model)

CRYSTAL CONTROLLED OPERATION

In addition to normal VFO operation, eleven crystals may be selected by the channel switch on the front panel for crystal controlled operation. Such operation is often useful for operation on favorite calling or repeater frequencies. Since the 2 meter band is divided into four segments in the FT-225RD, these eleven crystals could provide for operation on 44 different frequencies.

The crystal holders accept standard HC-25/U type crystals. All crystal frequencies must fall between 8,200 kHz and 9,200 kHz. A trimmer capacitor is connected in series with each crystal to permit fine tuning of the crystal frequency; Adjustment of this trimmer will move the crystal frequency approximately 1 kHz.

The correct crystal frequency for any desired operating frequency may be determined by using the following formula:

$$f_x = f_0 - f_1$$

where f_x = crystal frequency
f_0 = operating frequency
f_1 = a constant shown in Table 3

Example: Calculate the required crystal frequency for 144.25 MHz CW operation.

$$f_x = f_0 - f_1 = 144250 - 135799.3 = 8450.7 \text{ kHz}$$

It can be seen from the chart that a crystal for 144.51 MHz FM can also be used for 145.51, 146.51, and 147.51 MHz FM by changing the position of the BAND switch.

MEMORY OPERATION
(With optional MEMORY UNIT installed)

The memory circuitry can be used to store any frequency within a 1 MHz band segment for recall and control of the receive, transmit, or transceive frequencies. A frequency is memorized by pressing the MEMORY button, and the frequency is recalled by positioning the SELECT switch as needed. In the SIMPLEX position, the transceive frequency is locked on the memorized frequency. In the TX MR position, the transmitter is locked on the memorized frequency, and the receiver is controlled by the main VFO (or FIX unit). In the RX MR position, the receiver is locked on the memorized frequency, and the transmitter is controlled by the main VFO.

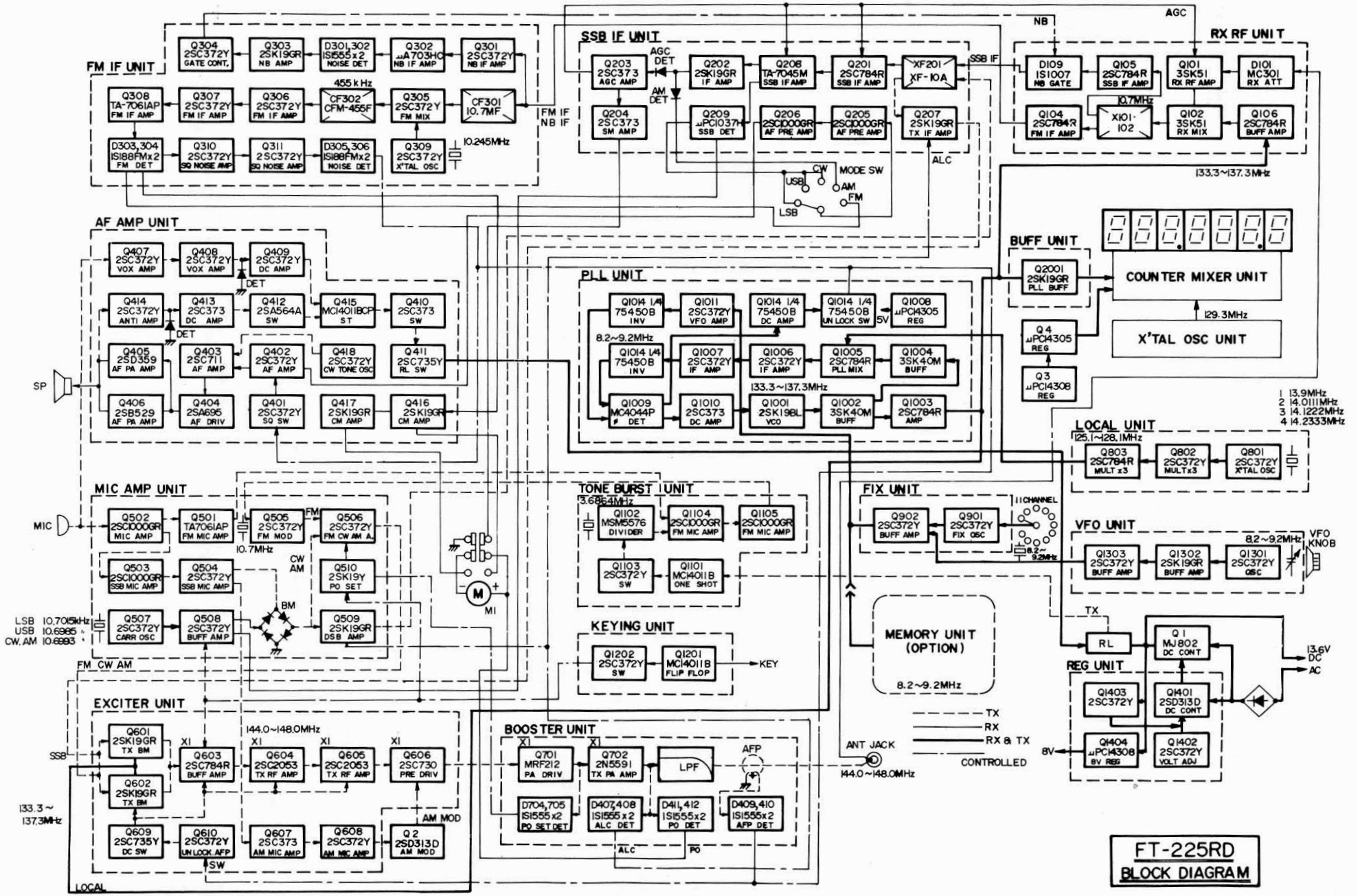
Caution should be observed during repeater operation: if the SELECT switch is in the TX MR position, for example, and the RPT switch is in the NOR position, the 600 kHz shift will be applied to the memorized frequency, which will be recalled during transmission periods. Unless the operator is careful, an unwanted repeater may be activated, causing interference to other users.

Optional batteries inserted in the MEMORY UNIT will allow the memorized frequency to be held, even though the FT-225RD is turned off.

For most repeater work, the memorized repeater frequency can be recalled by placing the SELECT switch in the SIMPLEX position, and placing the RPT in the NOR or REV position as needed. The main VFO may then be turned to another frequency, such as another repeater or calling frequency; return to the VFO frequency is made by placing the SELECT switch in the VFO/FIX position. Alternatively, the repeater input frequency may be memorized and recalled by placing the SELECT switch in the TX MR position; the VFO can then be turned to the repeater output frequency, and the RPT switch should be OFF.

BAND (MHz)	f_1			
	LSB(MHz)	USB(MHz)	AM·FM (MHz)	CW (MHz)
144~145	135.8015	135.7985	135.8000	135.7993
145~146	136.8015	136.7985	136.8000	136.7993
146~147	137.8015	137.7985	137.8000	137.7993
147~148	138.8015	138.7985	138.8000	138.7993

Table 3


FM IF UNIT
Q304 2SC372Y GATE CONT.
Q303 2SK19GR NB AMP
D301,302 1S1555x2 NOISE DET
Q302 μA703HC NB IF AMP
Q301 2SC372Y NB IF AMP
Q308 TA-7061AP FM IF AMP
Q307 2SC372Y FM IF AMP
Q306 2SC372Y FM IF AMP
455 k Hz
CF302 CFM-455F
Q305 2SC372Y FM MIX
CF301 10.7MF
D303,304 1S188FMx2 FM DET
Q310 2SC372Y SQ NOISE AMP
Q311 2SC372Y SQ NOISE AMP
D305,306 1S188FMx2 NOISE DET
Q309 2SC372Y X'TAL OSC
10.245MHz
FM IF
NB IF
SSB IF UNIT
Q203 2SC373 AGC AMP
AGC DET
AM DET
Q202 2SK19GR IF AMP
Q208 TA-7045M SSB IF AMP
Q201 2SC784R SSB IF AMP
XF201 XF-10A
SSB IF
Q204 2SC373 SM AMP
Q209 μPC1037H SSB DET
Q206 2SC1000GR AF PRE AMP
Q205 2SC1000GR AF PRE AMP
Q207 2SK19GR TX IF AMP
ALC
CW
MODE SW
USB
AM
FM
LSB
NB
AGC
RX RF UNIT
D109 1S1007 NB GATE
Q105 2SC784R SSB IF AMP
Q101 3SK51 RX RF AMP
D101 MC301 RX ATT
10.7MHz
Q104 2SC784R FM IF AMP
X101-102
Q102 3SK51 RX MIX
Q106 2SC784R BUFF AMP
133.3~137.3MHz
AF AMP UNIT
Q407 2SC372Y VOX AMP
Q408 2SC372Y VOX AMP
Q409 2SC372Y DC AMP
DET
Q414 2SC372Y ANTI AMP
Q413 2SC373 DC AMP
Q412 2SA564A SW
Q415 MC14011BCP ST
Q410 2SC373 SW
DET
Q405 2SD359 AF PA AMP
Q403 2SC711 AF AMP
Q402 2SC372Y AF AMP
Q418 2SC372Y CW TONE OSC
Q411 2SC735Y RL SW
SP
Q406 2SB529 AF PA AMP
Q404 2SA695 AF DRIV
Q401 2SC372Y SQ SW
Q417 2SK19GR CM AMP
Q416 2SK19GR CM AMP
PLL UNIT
Q1014 1/4 75450B INV
Q1011 2SC372Y VFO AMP
Q1014 1/4 75450B DC AMP
Q1014 1/4 75450B UN LOCK SW
5V
Q1008 μPC14305 REG
8.2~9.2MHz
Q1014 1/4 75450B INV
Q1007 2SC372Y IF AMP
Q1006 2SC372Y IF AMP
Q1005 2SC784R PLL MIX
Q1004 3SK40M BUFF
133.3~137.3MHz
Q1009 MC4044P Φ DET
Q1010 2SC373 DC AMP
Q1001 2SK19BL VCO
Q1002 3SK40M BUFF
Q1003 2SC784R AMP
BUFF UNIT
Q2001 2SK19GR PLL BUFF
Q4 μPC14305 REG
Q3 μPC14308 REG
COUNTER MIXER UNIT
129.3MHz
X'TAL OSC UNIT
1 13.9MHz
2 14.0111MHz
3 14.1222MHz
4 14.2333MHz
LOCAL UNIT
125.1~128.1MHz
Q803 2SC784R MULT x3
Q802 2SC372Y MULT x3
Q801 2SC372Y X'TAL OSC
MIC AMP UNIT
MIC
Q502 2SC1000GR MIC AMP
Q501 TA7061AP FM MIC AMP
Q505 2SC372Y FM MOD
FM
Q506 2SC372Y FM CW AM A.
10.7MHz
CW AM
Q503 2SC1000GR SSB MIC AMP
Q504 2SC372Y SSB MIC AMP
Q510 2SK19Y PO SET
BM
M
MI
LSB 10.7015kHz
USB 10.6985 "
CW, AM 10.6993 "
Q507 2SC372Y CARR OSC
Q508 2SC372Y BUFF AMP
Q509 2SK19GR DSB AMP
FM CW AM
TONE BURST UNIT
3.6864MHz
Q1102 MSM5576 DIVIDER
Q1104 2SC1000GR FM MIC AMP
Q1105 2SC1000GR FM MIC AMP
Q1103 2SC372Y SW
Q1101 MC14011B ONE SHOT
KEYING UNIT
Q1202 2SC372Y SW
Q1201 MC14011B FLIP FLOP
KEY
FIX UNIT
Q902 2SC372Y BUFF AMP
Q901 2SC372Y FIX OSC
11CHANNEL
8.2~9.2MHz
VFO UNIT
8.2~9.2MHz
VFO KNOB
Q1303 2SC372Y BUFF AMP
Q1302 2SK19GR BUFF AMP
Q1301 2SC372Y OSC
MEMORY UNIT (OPTION)
8.2~9.2MHz
TX
RL
Q1 MJ802 DC CONT
13.6V DC AC
REG UNIT
Q1403 2SC372Y
Q1401 2SD313D DC CONT
Q1404 μPC14308 8V REG
Q1402 2SC372Y VOLT ADJ
8V
EXCITER UNIT
SSB
Q601 2SK19GR TX BM
XI
Q603 2SC784R BUFF AMP
144.0~148.0MHz
Q604 2SC2053 TX RF AMP
Q605 2SC2053 TX RF AMP
Q606 2SC730 PRE DRIV
Q602 2SK19GR TX BM
133.3~137.3MHz
AM MOD
Q609 2SC735Y DC SW
Q610 2SC372Y UN LOCK AFP
SW
Q607 2SC373 AM MIC AMP
Q608 2SC372Y AM MIC AMP
Q2 2SD313D AM MOD
LOCAL
BOOSTER UNIT
Q701 MRF212 PA DRIV
Q702 2N5591 TX PA AMP
LPF
AFP
D704,705 1S1555x2 PO SET DET
D407,408 1S1555x2 ALC DET
D411,412 1S1555x2 PO DET
D409,410 1S1555x2 AFP DET
ALC
PO
ANT JACK
144.0~148.0MHz
TX
RX
RX & TX CONTROLLED
FT-225RD
BLOCK DIAGRAM

CIRCUIT DESCRIPTION

GENERAL

The block diagram and circuit description below will provide you with a better understanding of the transceiver. Computer-type plug-in modules are utilized throughout this transceiver.

The FT-225RD uses a single conversion receiver with a 10.7 MHz IF for SSB, CW, and AM; a double conversion receiver with a 10.7 MHz first IF and a 455 kHz second IF is used for FM. A single conversion transmitter, utilizing a 10.7 MHz high frequency crystal filter for SSB generation, and varactor diode frequency modulation of a 10.7 MHz crystal oscillator, is incorporated.

Each printed board has its own parts numbers, beginning, usually with number $-_{01}$. For example, the IF amplifier transistor 2SC784R on PB-1778 is Q_{201}.

RECEIVER

RX RF UNIT (PB-1746)

The 144 MHz input signal from the antenna is fed through the antenna relay RL_{701} to pin 5 of the RX RF unit. The signal is then amplified by RF amplifier Q_{102} (3SK51), a field effect transistor, and then fed to gate 1 of the first mixer Q_{103} (3SK40M), where the input signal is heterodyned with a 133.3 MHz to 137.3 MHz signal delivered from the PLL unit, thus producing an IF signal of 10.7 MHz at the drain of Q_{103}.

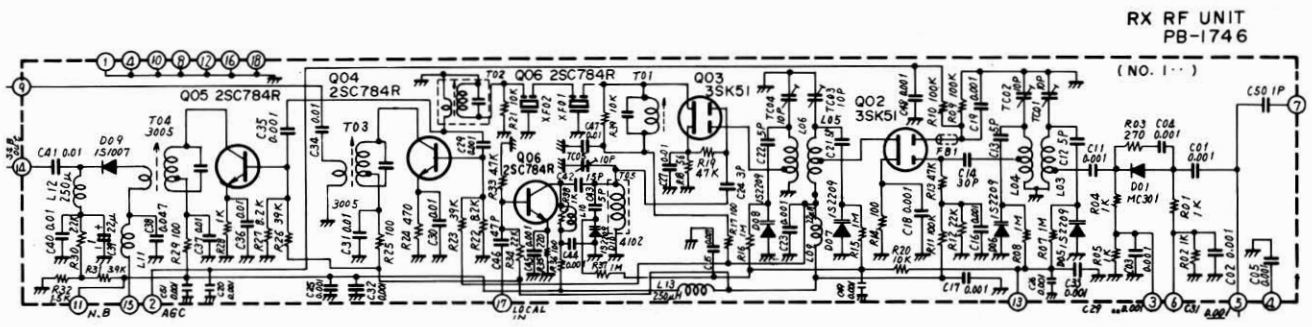
The input and output circuits of the RF amplifier utilize a double tuned circuit, which is sharply tuned to the center of the band by varactor diodes D_{105} — D_{108} (1S2209), thus eliminating cross modulation and intermodulation effects.

The IF signal passes through crystal filters XF_{101} and XF_{102} (both 10M2A2), and the SSB, AM, and CW signal is then fed to the first IF amplifier Q_{105} (2SC784R); the FM signal is fed to Q_{104} (2SC784R). The amplified SSB, CW or AM signal is fed through a noise blanker gate diode D_{109} (1S1007) to pin 14 of the printed board, while the amplified FM signal is fed to pin 9.

SSB IF UNIT (PB-1778)

The SSB, AM, and CW signal from pin 14 of the RX RF unit is fed through pin 3 of the SSB IF unit. The signal is then fed through a diode switch and a crystal filter XF_{201} (XF10A) to the IF amplifier Q_{201} (2SC784R). The signal is amplified by Q_{201} and Q_{208} (TA7045M), and then fed to the balanced demodulator Q_{209} (μPC1037), where a carrier signal is applied through pin 32 from the carrier oscillator in the MIC AMP unit.

The audio output is fed through pin 33 and the MODE switch S3D to pin 25 of the printed board. The IF signal is further amplified by Q_{202} (2SK-19GR), and detected by the AM detector D_{204} (1S188FM) in the AM mode. The audio signal is then fed through pin 28 to the MODE switch S3D.



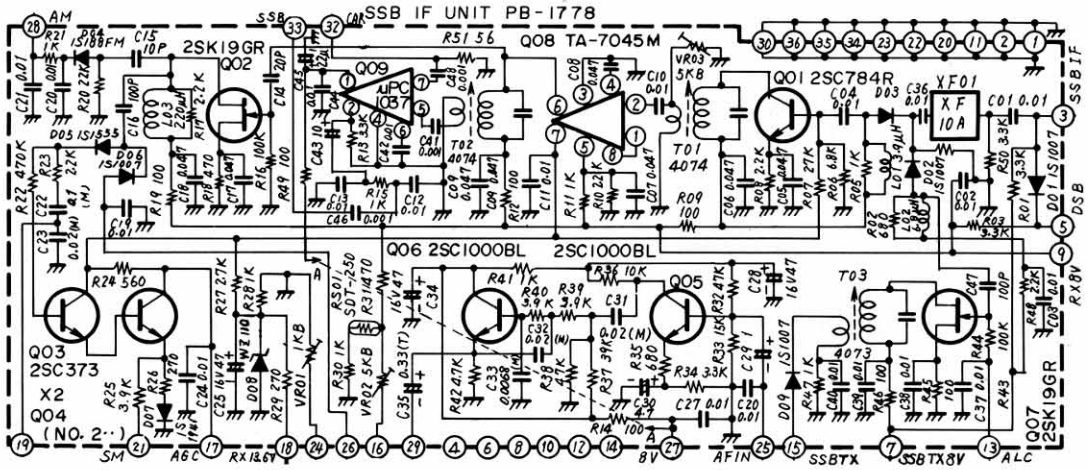
RX RF UNIT

A portion of the IF signal output from Q_{202} is rectified by D_{205} (1S1555) and D_{206} (1S1007) for AGC (automatic gain control) purposes. The AGC voltage is amplified by Q_{203} and Q_{204} (both 2SC373); this voltage controls the gain of IF amplifiers Q_{201} and Q_{208}. A portion of the AGC voltage is fed through pin 17 to the RX RF unit to control the gain of RF amplifier Q_{102}. The AGC voltage is amplified by the S-meter amplifier Q_{204} (2SC373) and fed to the S-meter through the DISC/S METER switch on the front panel.

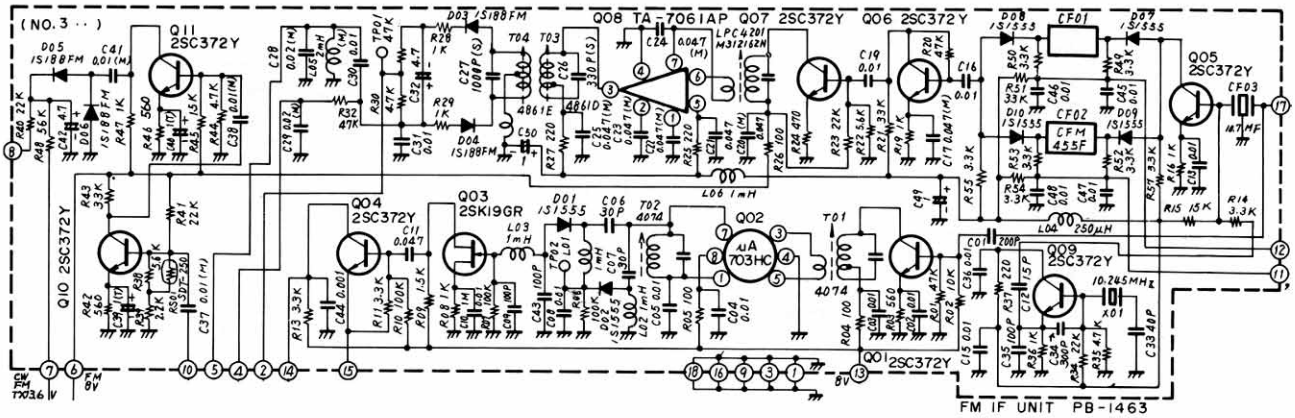
The audio signal from the MODE switch is pre-amplified by Q_{205} and Q_{206} (both 2SC100BL) and fed through pin 29 to the AF AMP unit.

FM IF UNIT (PB-1463)

The FM IF signal from pin 17 of the printed board is fed through a ceramic filter CF_{303} (10.7 MF BR) to the second mixer Q_{305} (2SC372Y), where the 10.7 MHz signal is mixed with the 10.245 MHz signal generated by the second heterodyne oscillator Q_{309} (2SC372Y), thus producing a 455 kHz second IF signal. The 455 kHz IF signal is fed through a ceramic filter CF_{302} to the second IF amplifier Q_{306} and Q_{307} (both 2SC372Y) and also to the amplifier limiter Q_{308} (TA7061AP), which removes any amplitude modulation component of the signal. The output of Q_{308} is applied to the discriminator D_{303} and D_{304} (both 1S188FM). The discriminator produces an audio output in response



SSB IF UNIT



FM IF UNIT

to a corresponding frequency (or phase) shift in the 455 kHz IF signal. The discriminator output is then fed to the common audio amplifier stage in the SSB IF unit through the MODE switch.

For FM reception, when no carrier is present in the 455 kHz IF, the noise at the discriminator output is fed through the squelch threshold potentiometers VR_6 and VR_{1b} to the noise amplifier Q_{310} and Q_{311} (2SC372Y), and is detected by D_{805} and D_{806} (1S188FM). The DC voltage is applied from pin 8 to the squelch controller Q_{401} (2SC372Y) in the AF AMP unit.

The 10.7 MHz signal is also applied to the noise blanker amplifier Q_{301} (2SC372Y). The signal is amplified by Q_{301} and Q_{302} (μA703HC). The noise rectifier diodes D_{301} an D_{302} (1S1555) produce a DC voltage which is amplified by noise pulse amplifier Q_{303} (2SK19GR).

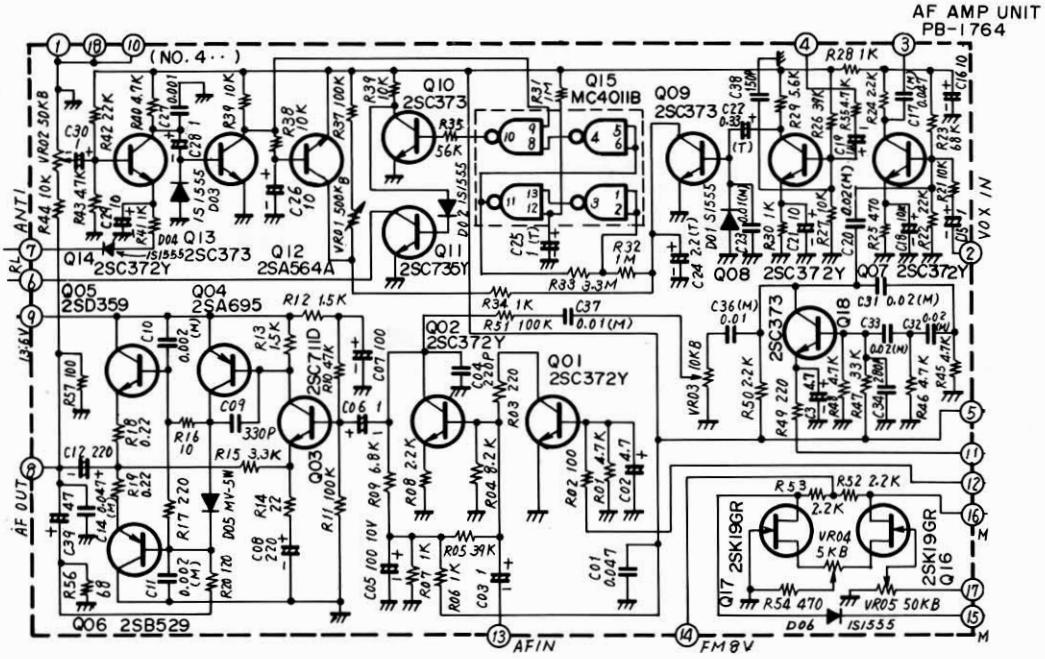
Under normal conditions, Q_{303} conducts, producing the cut-off voltage to the base of gate controller Q_{304} (2SC372Y); in turn, the high collector voltage of Q_{304} is supplied from pin 15 to the gate diode D_{109} (1S1007) in the RX RF unit, which conducts to pass the signal freely. With pulse noise, Q_{304} conducts, and its collector voltage drops, causing the gate diode D_{109} to disconnect the IF signal during the noise pulse duration.

AF AMP UNIT (PB-1764)

The audio signal is pre-amplified in the SSB IF unit and fed through pin 13 to the audio amplifier stage consisting of Q_{402} (2SC372Y), Q_{403} (2SC711), Q_{404} (2SA695), Q_{405} (2SD359), and Q_{406} (2SB-529). The audio power amplifier uses OTL (output transformerless) circuitry, and delivers 2 watts output to the speaker from pin 8.

In the FM mode, the squelch voltage is applied from pin 12 to the squelch controller Q_{401} (2SC372Y), which conducts when only noise (no signal) is present; in turn, the audio input is grounded to quiet the audio amplifier. When the signal is present, Q_{401} is cut off, and the audio amplifier operates normally. DC voltage is also applied from pin 12 to quiet the audio amplifier when the PLL circuit is unlocked.

A portion of the microphone input is delivered to pin 2 of the printed board. The speech signal is amplified by Q_{407} and Q_{408} (both 2SC372Y) and is applied to the base of Q_{409} (2SC373), which conducts with the speech signal, causing the collector to reach the "low" state. When a speech signal is not present, Q_{409} cuts off, and the voltage across C_{424} becomes "high".



AF AMP UNIT

C_{424}, VR_{401}, R_{437}, and R_{434} form the delay circuit to adjust the VOX relay hold time. The collector voltage is applied to NAND gate Q_{415} (MC14011B), causing pin 8 to become "high". When pin 8 and pin 9 are "high", pin 10 of Q_{415} becomes "low", causing Q_{410} (2SC373) to cut off; in turn, relay controller Q_{411} (2SC735) actuates the VOX relay.

The antitrip circuit provides a bucking voltage to prevent the speaker output from tripping the transmitter. The receiver audio output is connected through ANTITRIP potentiometer VR_{402} to the antitrip amplifier Q_{414} (2SC372Y). Amplifier Q_{413} (2SC373) will conduct with the rectified voltage, thus keeping the potential at pin 9 of Q_{415} "low", thus maintaning Q_{415} in an "off" configuration while receiving.

The collector voltage of Q_{413} is also fed to the base of Q_{412}, which conducts with high collector voltage on Q_{413}, causing Q_{414} to become "high" rapidly for immediate relay actuation when a speech signal appears in the microphone circuit.

The tone oscillator Q_{418} (2SC373) operates when the MODE switch is in the CW position. It is a phase shift oscillator, operating at approximately 800 Hz.

The tone output is activated by the keying circuit through the emitter circuit of Q_{418}. It is coupled through sidetone level control VR_{403} to the receiver audio amplifier Q_{403} for sidetone monitoring on CW. The output from Q_{418} is also coupled to the VOX amplifier Q_{408} for semi-break-in CW operation. In the FM mode, a DC voltage at the discriminator output is applied from pin 17 to the differential amplifier Q_{416} and Q_{417} (2SK19GR).

When the frequency of the received signal is shifted from the discriminator center, the resulting DC voltage causes either Q_{416} or Q_{417} to conduct, and the amount of shift is displayed on the meter when the meter switch is in the DISC position. VR_{404} balances the differential amplifier, and VR_{405} calibrates the sensitivity of the meter.

TRANSMITTER

MIC AMP (UNIT PB-1753)

The speech signal from the microphone is fed from pin 23 to the first microphone amplifier Q_{502} (2SC1000GR). The input impedance of the microphone amplifier is 600 ohms. This signal is controlled in amplitude by the MIC GAIN control between pins 27 and 20, and is amplified by the second microphone amplifier Q_{503} (2SC1000GR), and applied to emitter follower Q_{504} (2SC372Y) to be delivered to the ring modulator D_{507} — D_{510} (1S1007).

The carrier oscillator Q_{507} (2SC372Y) oscillates at 10.7015 MHz for LSB, 10.6985 MHz for USB, and 10.6993 MHz for AM/CW, depending on the position of the MODE switch. In the CW position, the carrier oscillator oscillates at 10.6993 MHz for transmit and 10.6985 MHz for receive, producing an 800 Hz beat note in the receive mode. In the AM mode, the carrier oscillator does not function on receive. The MODE switch selects the crystal by means of a diode switch. The output from the oscillator is fed through the buffer amplifier Q_{508} (2SC372Y) to the balanced ring modulator D_{507}— D_{510} (1S1007). The carrier signal output from the buffer amplifier Q_{508} is fed from pin 20 to the SSB IF unit for SSB and CW reception. Carrier balance is obtained with potentiometer VR_{505} and trimmer capacitor TC_{504}. The double sideband, suppressed carrier signal is amplified by Q_{509} (2SK19GR) and fed from pin 17 to pin 5 of the SSB IF unit. In the AM and CW modes, the balanced modulator is unbalanced by the DC voltage applied from pin 13, and the carrier sgnal is fed through T_{502} to carrier amplifier Q_{506} (2SC372Y). The amplified carrier is fed from pin 3 to the EXCITER unit.

The audio signal output from Q_{504} is fed from pin 22 to pin 12 of the EXCITER unit to be amplified to a sufficient level for low level amplitude modulation.

In the FM mode, the speech signal delivered to pin 23 of the MIC AMP unit is amplified by Q_{502} (2SC1000GR) and Q_{501} (TA7061AP), a limiter amplifier, and is fed through deviation control potentiometer VR_{502} (narrow) or VR_{503} (wide) to pin 7 of the TONE BURST unit. Here it is amplified through an active low-pass filter circuit, Q_{1104}

(2SC1000GR), which attenuates all audio frequency components above 2700 Hz. The signal is further amplified by Q_{1105} (2SC1000GR) and applied to the modulator, varactor diode D_{501} (FC63). The frequency modulated signal is then amplified by Q_{506} (2SC372Y) and fed through a diode switch to the EXCITER unit.

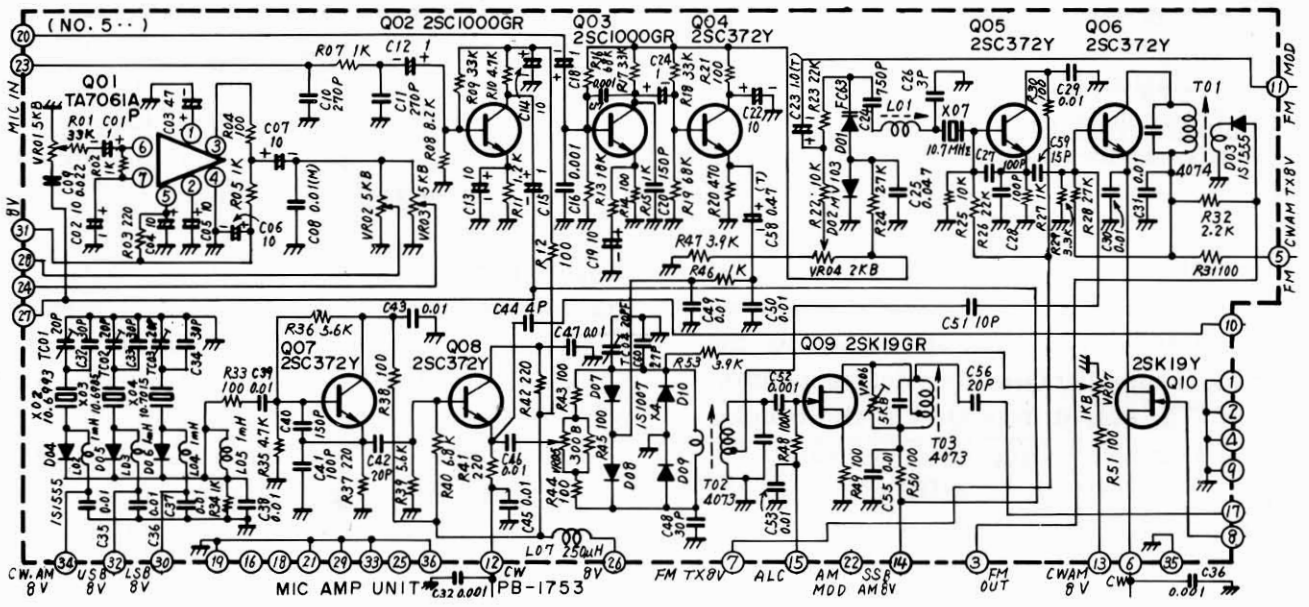
EXCITER UNIT (PB-1762)

The SSB output signal from the SSB IF unit, as well as the AM, CW, and FM output signals (10.7 MHz) from the MIC AMP unit,are fed to the EXCITER unit from pin 3 and pin 5, respectively.

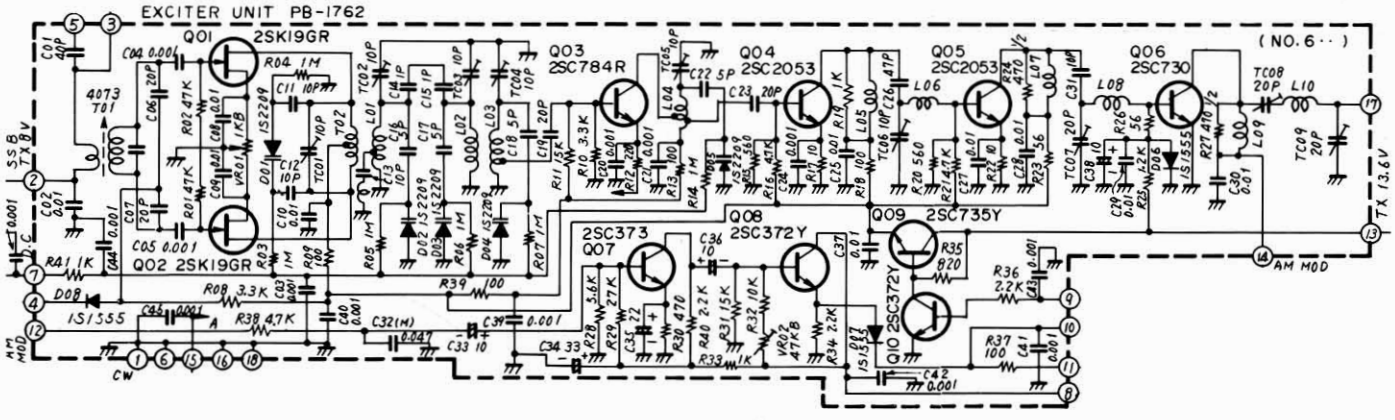
The 10.7 MHz signal is fed to the balanced mixer consisting of Q_{601} and Q_{602} (2SK19GR), where the signal is mixed with the 133.3 to 137.3 MHz heterodyne signal delivered from pin 4 of the printed board, thus producing a 144 — 148 MHz signal. The output signal from the balanced mixer passes through the tuned circuits consisting of T_{602} and L_{601}—L_{603}, which are tuned by varactor diodes D_{601}—D_{604} (1S2209), in which voltages are preset in accordance with the position of the bandswitch. Thus, the circuit is tuned exactly to the operating frequency, and spurious radiation is effectively eliminated. The signal is then amplified by the amplifier chain consisting of Q_{603} (2SC784R), Q_{604} and Q_{605} (2SC2053), and Q_{606} (2SC730), and delivered from pin 17 to the BOOSTER unit.

The DC voltage for Q_{601} through Q_{604} is supplied through Q_{609} (2SC735Y). When the PLL circuit is unlocked, the controller transistor Q_{610} (2SC372Y) stops conducting, and in turn Q_{609} stops supplying DC voltage for Q_{601}—Q_{604}.

The speech signal from pin 22 of the MIC AMP unit is fed through the AM amplifier Q_{607} (2SC373) and emitter follower Q_{608} (2SC372Y) to the AM modulator Q_2 (2SD213D), which controls the supply voltage for Q_{606} (2SC730).



MIC AMP UNIT



EXCITER UNIT

BOOSTER UNIT (PB-1744, PB-1745)

The signal from the EXCITER unit is fed to the BOOSTER unit and amplified by the driver amplifier Q_{701} (MRF212) and the final amplifier Q_{702} (2N5591), which delivers 25 watts of RF power to the antenna through a two-stage low-pass filter.

The bias voltage is stabilized at 9 volts by zener diode D_{701} (1N4732). Two diodes, D_{702} and D_{703} (both 10D1), are used to protect the final transistor from damage due to heating by reducing the bias voltage when the temperature rises. A small portion of the RF output is rectified by a diode D_{712} (1S188FM), which delivers the resulting DC voltage to the meter, where an indication of the relative power output is provided.

The DC voltage obtained from rectifying a small portion of the RF output by the ALC diodes D_{707} and D_{708} (1S1555) is applied to the gate of Q_{207} in the SSB IF unit and Q_{509} in the MIC AMP unit. Diodes D_{707} and D_{708} are biased by the ALC threshold control VR_{703}. Thus, the gain of Q_{207} and Q_{509} is controlled in order to control automatically the driving level to the PA transistor, in order to prevent any distortion caused by overdrive.

Blocking diodes D_{714} and D_{715} disconnect the supply voltage to Q_{702} while the antenna is disconnected for marker calibration (analog model).

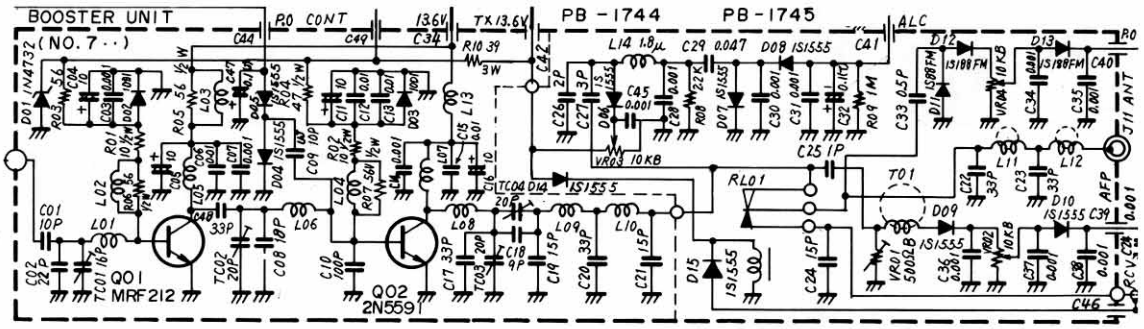
TONE BURST UNIT (PB-1752)

When the PTT switch is activated, a DC voltage is applied to trigger Q_{1101} (F-4011), which generates a pulse of duration 0.5 — 1 second. The pulse switches Q_{1103} (2SC372Y) to supply DC voltage to Q_{1102} (MSM5576), where the clock signal is divided by 1024, 2048, or 4096, producing an accurate tone burst frequency. The burst signal is fed to the base of the MIC amplifier Q_{1104} (2SC-1000GR).

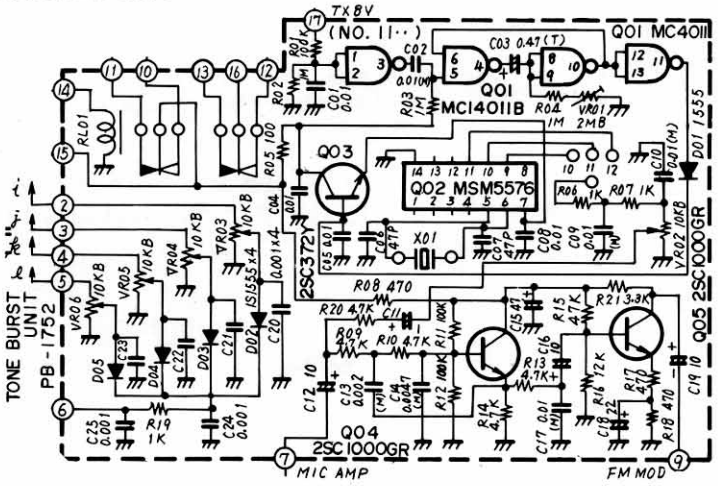
The tone duration is set by VR_{1101}, and the tone level is set by VR_{1102}.

The exact tone frequency is determined by a crystal and the plug position, as described in the OPERATION section.

In the European model, the tone burst signal is activated by depressing the BURST switch.



BOOSTER UNIT



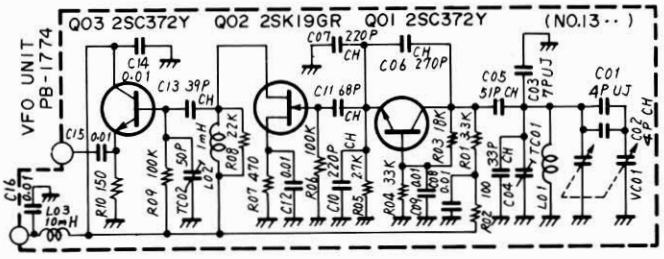
TONE BURST UNIT

COMMON CIRCUITS

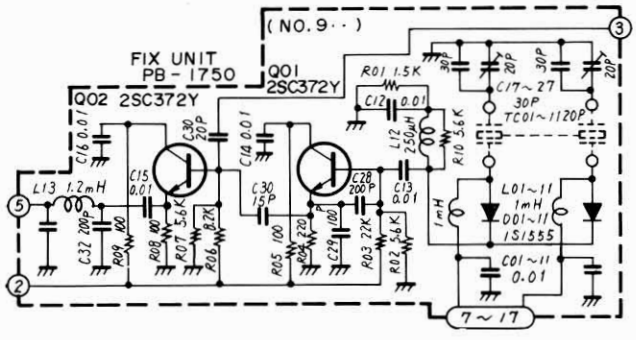
The FT-225RD utilizes a phase locked loop (PLL) system for the heterodyne oscillator, which provides a stable signal varying from 133.3 to 137.3 MHz, thus providing coverage of the entire 2 meter band.

VFO UNIT (PB-1774)

The VFO module board is installed in the VFO chassis. The VFO (variable frequency oscillator) Q_{1301} (2SC372Y) generates an 8,200 to 9,200 kHz signal, thus producing a 1 MHz tuning range. Frequency drift is minimized through the use of a temperature compensation circuit utilizing a differential trimmer capacitor. The signal is fed through the amplifier buffer stage Q_{1302} (2SK19GR) and Q_{1303} (2SC372Y) to pin 3 of the FIX oscillator board. The buffer amplifier provides isolation and amplification of the VFO signal.



VFO UNIT



FIX UNIT

FIX UNIT (PB-1750)

In addition to VFO or optional memory operation, 11 crystals may be employed for crystal controlled operation with the selector switch located on the front panel.

The FIX channel crystal oscillator Q_{901} (2SC372Y) oscillates at the frequency of the crystal selected by the diode switch D_{101} — D_{111} (1S1555). The output is fed from pin 8 through the buffer amplifier Q_{902} (2SC372Y) to the PLL UNIT.

The signal from the VFO also passes through this buffer stage and through jumper J_{26} or the memory unit to the PLL unit.

The crystal frequency falls between 8,200 kHz and 9,200 kHz, and is determined by the formula $f_X = f_0 - f_1$ where f_x is the crystal frequency, f_0 is the operating frequency, and f_1 is a constant found in Table 3 on page 14.

LOCAL UNIT (PB-1805)

The local oscillator generates a heterodyne signal which is used to convert the VCO (voltage controlled oscillator) signal into an 8,200 — 9,200 kHz signal; this is used for the comparison of the phase with that of the reference VFO signal.

The crystal controlled oscillator Q_{801} (2SC372Y) oscillates at the fundamental frequency of the crystal. A varactor diode D_{813} (1SV50), connected to the base of Q_{801}, is used as a clarifier to shift the oscillator frequency for offset tuning.

The output from the oscillator is fed to the frequency multiplier stage Q_{802} and Q_{803} (both 2SC784R), producing the ninth harmonic at its output. The crystal is selected by a diode switch connected to the bandswitch. The relation between the frequency and band is shown in Table 1. The multiplied signal is then fed from pin 33 to the PLL unit.

For repeater operation, a fundamental crystal at 14.0555 MHz, X_{807}, is used to generate a heterodyne signal of 126.5 MHz, when the bandswitch is set to the 144, 145, or 146 MHz bands. X_{808} (fundamental frequency 14.300 MHz) is used to

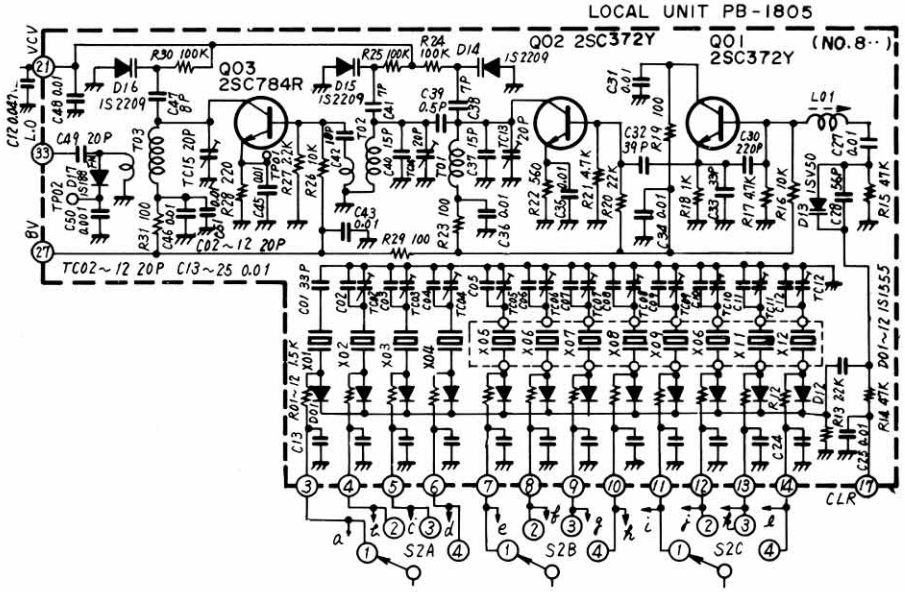
generate a 128.7 MHz signal, which is 600 kHz higher than the normal heterodyne signal, when the bandswitch is set to the 147 MHz band. A relay, RL_{1101}, which is located on the TONE BURST unit, is used to select the above crystals when the RPT switch S_{1505} is activated.

When the RPT switch is in the NOR position, the crystals are selected as above. When the RPT switch is placed in the REV position, the receive frequency is shifted down in the 144, 145, and 146 MHz bands, and the receive frequency is shifted up in the 147 MHz band. In the REV position, the analog dial indicates the transmit frequency, while the digital display indicates the receive and transmit frequencies properly.

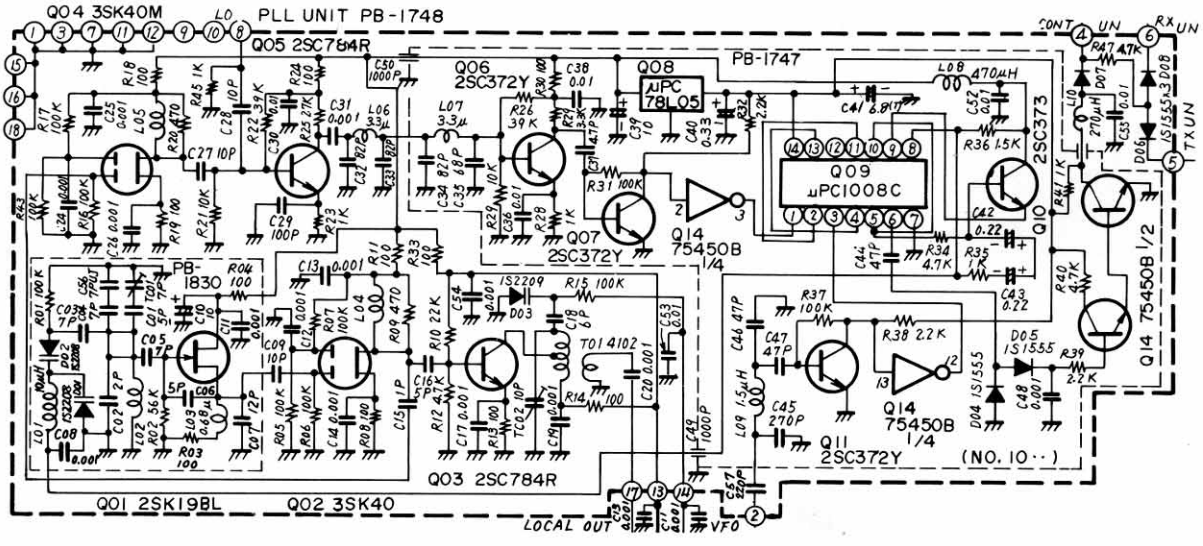
PLL UNIT (PB-1748)

The PLL unit generates a heterodyne signal for the transmitter and receiver mixer in conjunction with the phase locked oscillator.

A voltage controlled oscillator Q_{1001} (2SK19GR) generates a signal between 133.3 and 137.3 MHz, which is determined by L_{1002} and D_{1001}/D_{1002} (both 1S2208). The output from Q_{1001} is fed through a two-stage buffer amplifier consisting of Q_{1002} and Q_{1004} (both 3SK40M), to the mixer Q_{1005} (2SC784R), where the signal is mixed with the 125.1 MHz signal delivered from the local oscillator, thus producing an 8.2—9.2 MHz comparison signal.



LOCAL UNIT



PLL UNIT

The comparison signal is amplified by Q_{1006} and Q_{1007} (both 2SC372Y), and the wave is shaped by Q_{1014} (SN75450B). The output of Q_{1014} is fed to a phase comparator Q_{1009} (MC4044P), which compares the phase of the comparison signal against that of the reference signal, and any difference is converted into an error correcting DC voltage. The DC voltage is amplified by Q_{1002} to control the frequency of the VCO.

When the VCO is unlocked, the pulse signal appearing at pin 6 of Q_{1009} is rectified by D_{1004} and D_{1005} (both 1S1555). The rectified DC voltage is amplified by Q_{1014} and fed to the counter unit to turn the LED's off, indicating that the VCO is unlocked.

The DC voltage switches Q_{401} in the AF AMP unit to quiet the receiver when the PLL is unlocked. In transmit, this voltage switches Q_{610} in the EXCITER unit to turn the transmitter off.

OSC UNIT (PB-1761) (Digital model only)

The unit is installed in the digital model to produce a 129.3 MHz heterodyne signal for the counter. A crystal controlled oscillator Q_{1701} (2SC373) oscillates on 14.3667 MHz, and its output is multiplied 9 times by triplers Q_{1702} and Q_{1703} (both 2SC710), producing the 129.3 MHz heterodyne signal. The diode switch connected in series with crystal X_{1701} compensates the frequency when changing modes.

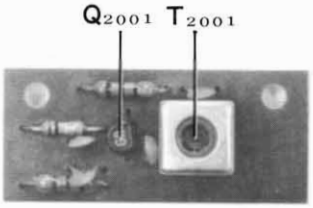
COUNTER UNIT (PB-1734, PB-1735)

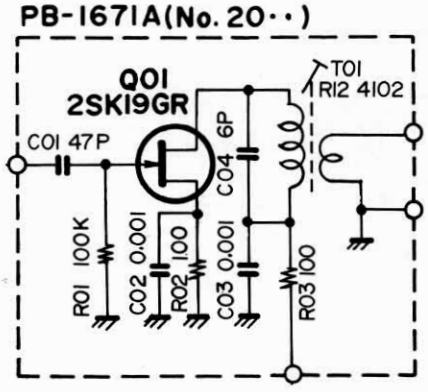
The frequency of operation is indicated in MHz, kHz, and to 100 Hz resolution by seven large LED's.

The heterodyne signal for the counter is delivered to pin 5 from the PLL unit, and amplified by Q_{1801} (2SK19GR). It is then fed to the double balanced mixer Q_{1802} (SN76514), where the signal is mixed with the 129.3 MHz heterodyne signal, producing a 4 to 6 MHz signal at its output.

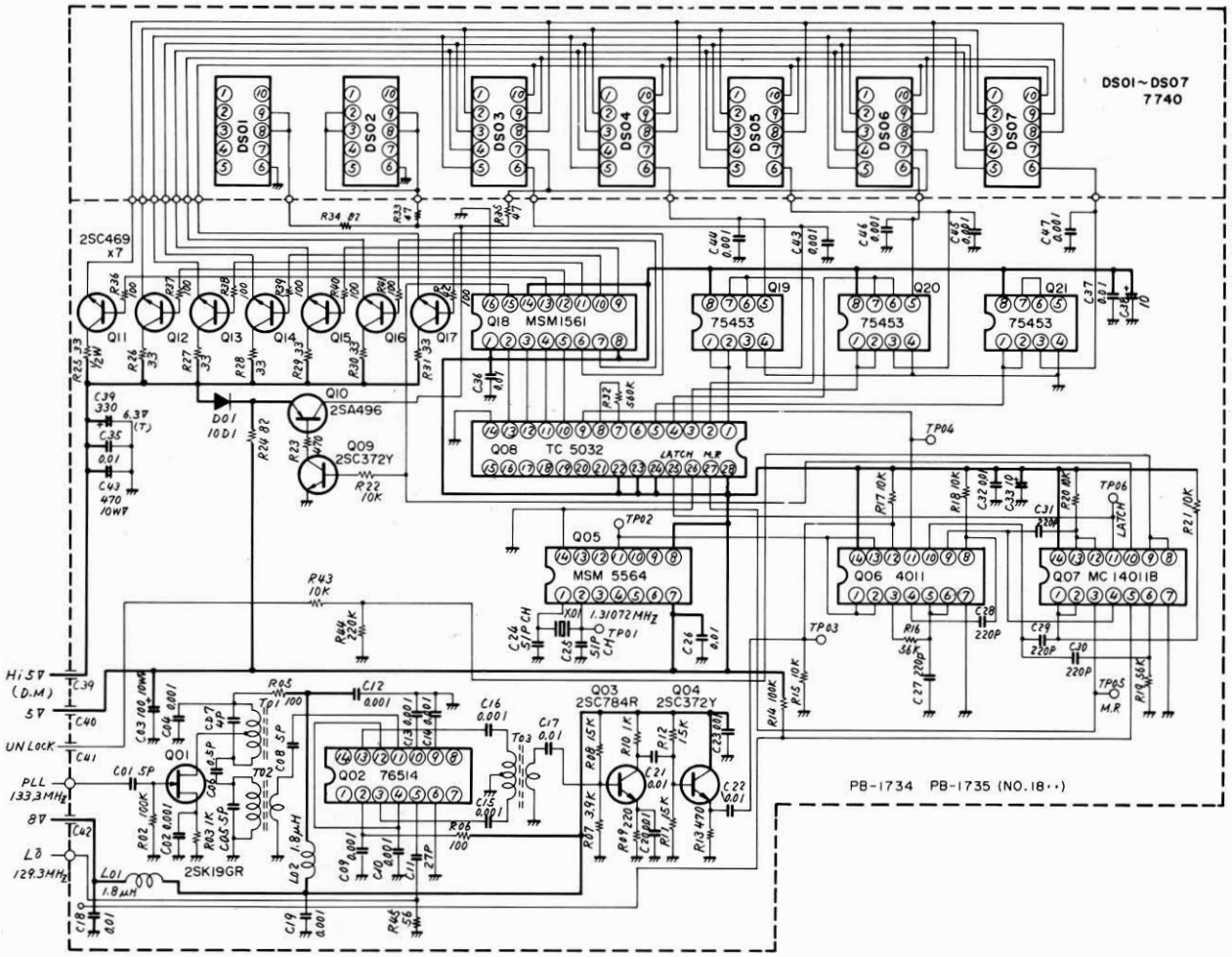
The 4 — 6 MHz signal is amplified by Q_{1803} (2SC784R) and fed through a waveform shaper Q_{1804} (2SC372Y) to a counter gate Q_{1806} (F4011), which counts the pulses which pass while the gate is opened. The pulses are fed to the six digit decade counter Q_{1808} (TC5032P), which counts 100 Hz, 1 kHz, 10 kHz, 100 kHz, and 1 MHz. The BCD output signal from Q_{1808} is fed through LED dimmer Q_{1818} (MSM561) and Q_{1811} — Q_{1817} (all 2SC496) to the display LED's, Q_{1822} — Q_{1828} (all HP5082—7740). Q_{1819} — Q_{1821} (SN75453) work as a series of switches operated by a timing signal delivered by Q_{1808} to select the output of Q_{1808} which drives the display in the sequence 100 Hz, 1 kHz, 10 kHz, 100 kHz, 1 MHz.

When the unlock signal is received from the PLL unit, Q_{1809} (2SC372Y) and Q_{1810} (2SA496) generate a blanking signal to the LED driver.

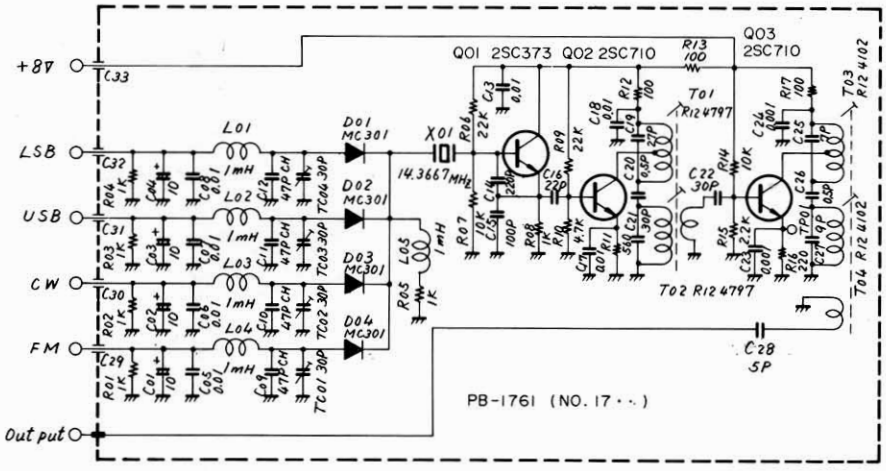




VFO BUFFER UNIT



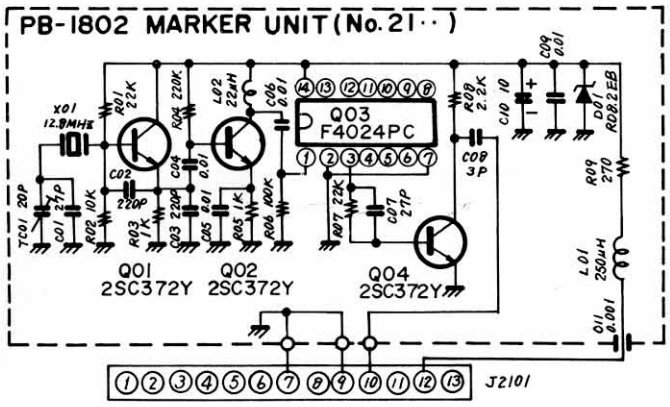
COUNTER UNIT



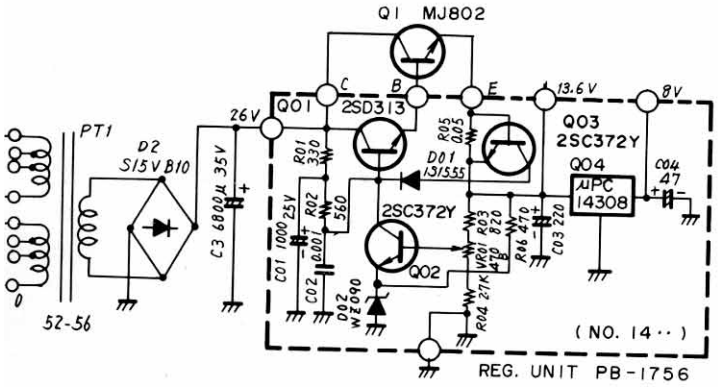
OSC UNIT

MARKER UNIT (PB-1802) (Analog model only)

The crystal marker generator Q_{2101} (2SC372Y) generates a 12.8 MHz signal, and its output is fed through buffer amplifier Q_{2102} (2SC372Y) to frequency divider Q_{2103} (34024PC), where the 12.8 MHz signal generates a 100 kHz marker signal. The marker signal is fed through a buffer amplifier Q_{2104} (2SC372Y) to the RX RF unit. When the marker switch is activated, the antenna relay is actuated, disconnecting the antenna.



MARKER UNIT



REG UNIT

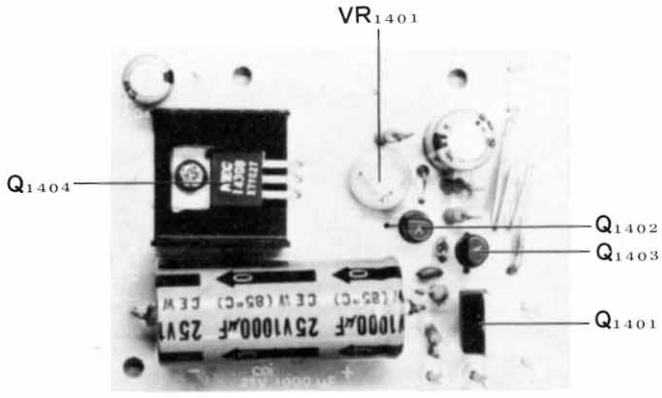
POWER SUPPLY & REGULATOR UNIT (PB-1469)

The power supply has been designed to operate from 100/110/117/200/220/234 V AC 50/60 Hz, or 12 V DC, negative ground. Inserting the appropriate power cord into the rear panel receptacle makes the necessary connections for operation from an AC or DC supply.

For AC operation, the DC voltage is supplied from the bridge rectifier unit D_2 (S15VB10), which is connected to a 20 volt, 6 amp secondary winding of the power transformer. The DC voltage is regulated at 13.6 volts by the voltage regulator circuit consisting of Q_{1401} (2SD313D) and Q_1 (MJ802).

Since such circuits as the VFO, local oscillator, and PLL require an extremely stable voltage, the 13.6 V DC supply is further stabilized at 8 volts by voltage regulator Q_{1404} (μPC14308). Q_{1403} (2SC372Y) switches to disable the voltage regulator (consisting of Q_1 and Q_{1401}) when the current exceeds the preset value.

For DC operation, the positive voltage is connected to pin 3 and the negative voltage to pin 4 of power receptacle J_1. To protect the circuits from reversed polarity of the DC voltage, D_1 (U05B) conducts heavily under reversed polarity conditions to blow the line fuse in the DC cord. It is placed between pin 3 and ground on J_1.



REG UNIT (PB-1756)

MAINTENANCE & ALIGNMENT

GENERAL

Your FT-225RD transceiver has been carefully aligned and tested at the factory prior to shipment. The reliability of the solid-state devices used in the FT-225RD should provide years of trouble-free service if the transceiver is not abused, and if routine maintenance is carried out.

The following precautions should be observed, so as to prevent damage to the transceiver:

(1) Do not interchange the AC and DC power cords.
(2) Do not apply any AC voltage other than that voltage determined by the transformer primary winding.
(3) When replacing fuses, be certain to use a fuse of the proper rating for the voltage being used.
(4) Do not exceed 14 volts DC, at the POWER receptacle, for DC operation. When operating mobile, the battery voltage should be measured with the battery under load (transmitter "keyed" in the FM mode), with the engine running fast enough so that the ammeter shows a "charge". In addition, do not operate the FT-225RD if the supply voltage is less than 12 volts DC.
(5) Avoid direct exposure to sunlight or water.

ROUTINE MAINTENANCE

Routine maintenance should be limited to keeping the transceiver clean, and performing occasional performance checks of the transmitter RF power output and the receiver sensitivity.

Cleaning:

When the transceiver has been used in a dusty or sandy environment, the interior should be cleaned periodically. A vacuum cleaner or low pressure air blower should be used.

Accumulated dirt may be removed with a soft brush. Check that the interior is thoroughly dry before replacing the cabinet and/or operating the equipment. Wipe the exterior with a damp cloth when necessary.

PERFORMANCE CHECKS

Make all performance checks at 13.6 volts DC (under load), or on the appropriate AC voltage as determined by the transformer primary wiring.

Check the transmitter as follows:

(a) Connect a suitable 50 ohm dummy load/RF wattmeter to the ANT receptacle.
(b) Set the MODE switch to the FM position, and key the transmitter while observing the power output, which should be approximately 25 watts. At full power, the S-meter should indicate between 6 and 8 on the relative power output scale.
(c) Set the MODE switch to SSB, and key the transmitter. Speak in a normal voice into the microphone. The output meter should indicate between 3 and 5 nominally.

Check the receiver sensitivity as follows:

(a) Connect an AC VTVM to the SP jack. Set the MODE switch to the FM position, and set the SQUELCH control fully counterclockwise.
(b) Connect the RF output of a precision VHF signal generator to the ANT receptacle and note the VTVM reading with no signal input. Adjust the AF GAIN control and the VTVM range, as required, to obtain a full scale VTVM reading. Do NOT change the setting of the AF GAIN control after this calibration has been made.
(c) Set the signal generator to the receiving frequency of the transceiver, and adjust the output amplitude of the signal generator until the VTVM reads 1/100th (20 dB decrease) of the reading in step (b). The signal generator output voltage at this point is the 20 dB quieting sensitivity, and it should be approximately 0.35 μV.
(d) Set the MODE switch to SSB, and connect the AC VTVM to the speaker output. Apply an unmodulated 0.5 μV signal from the signal generator, and tune the transceiver tuning dial for a maximum VTVM reading.
(e) Advance the RF Gain control to the fully clockwise position, and adjust the AF GAIN control for a reading of 450 mV on the VTVM.

(f) Reduce the signal generator output, and read the VTVM; the VTVM reading should be less than 45 mV for a 10 dB S/N ratio.

If the above checks indicate a need for realignment, it is recommended that the unit be returned to the dealer for this procedure. Alignment requires special test equipment not normally available to the average station owner. Adjustment of the tuned circuits without the proper equipment or technical expertise will result in degraded transceiver performance.

ALIGNMENT

SOME OF THE FOLLOWING ALIGNMENT PROCEDURES REQUIRE SPECIAL TEST EQUIPMENT AND TECHNICAL KNOWLEDGE, AND SHOULD ONLY BE ATTEMPTED BY AN EXPERT TECHNICIAN.

AF AMP UNIT (PB-1764)

(1) CW Semi-break-in

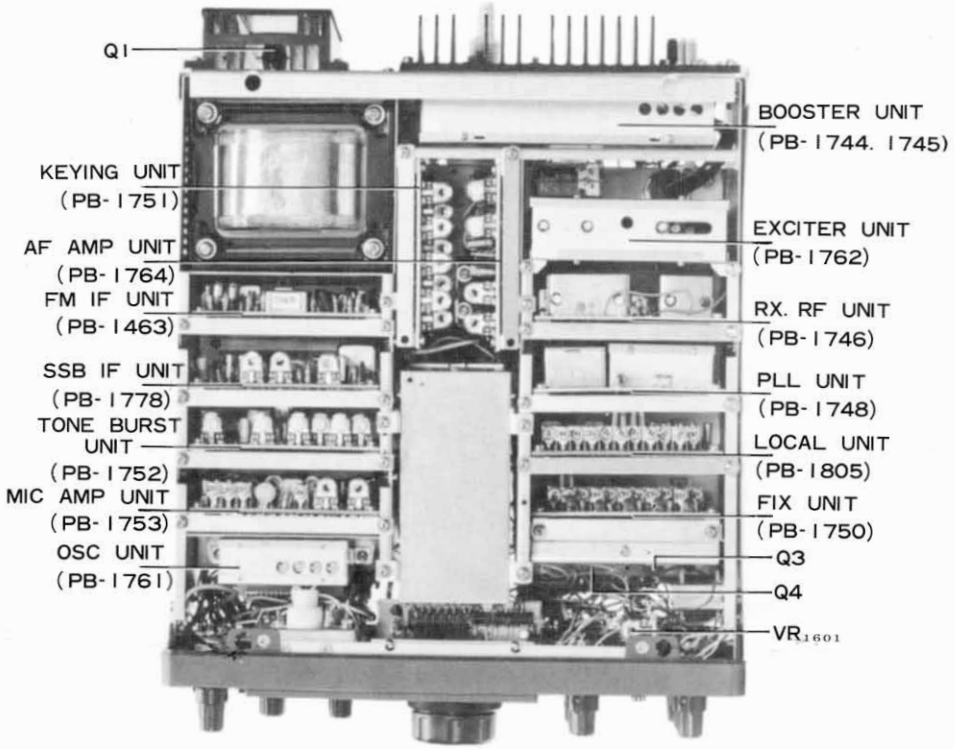
Adjust VR_{401}, the DELAY control, for the desired relay hold time.

(2) CW Sidetone Level

Adjust VR_{403} for the desired sidetone level.

(3) Antitrip

Set the ANTITRIP control, VR_{402}, to the minimum point that will prevent the speaker output from activating the VOX. The DELAY control, VR_{401}, may be adjusted for the desired relay hold time.

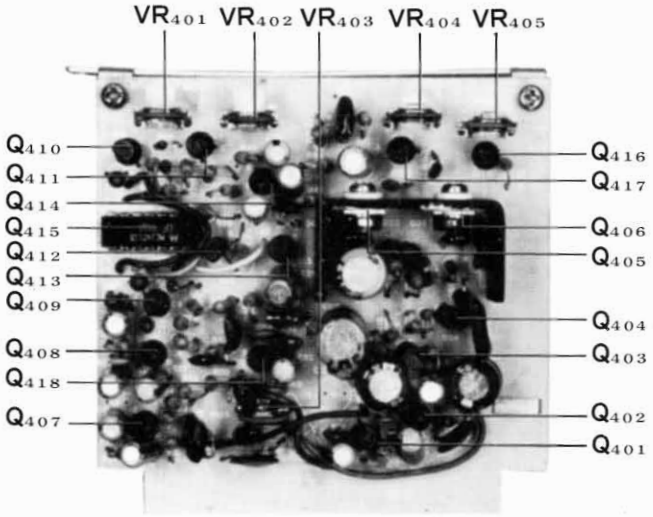


TOP VIEW

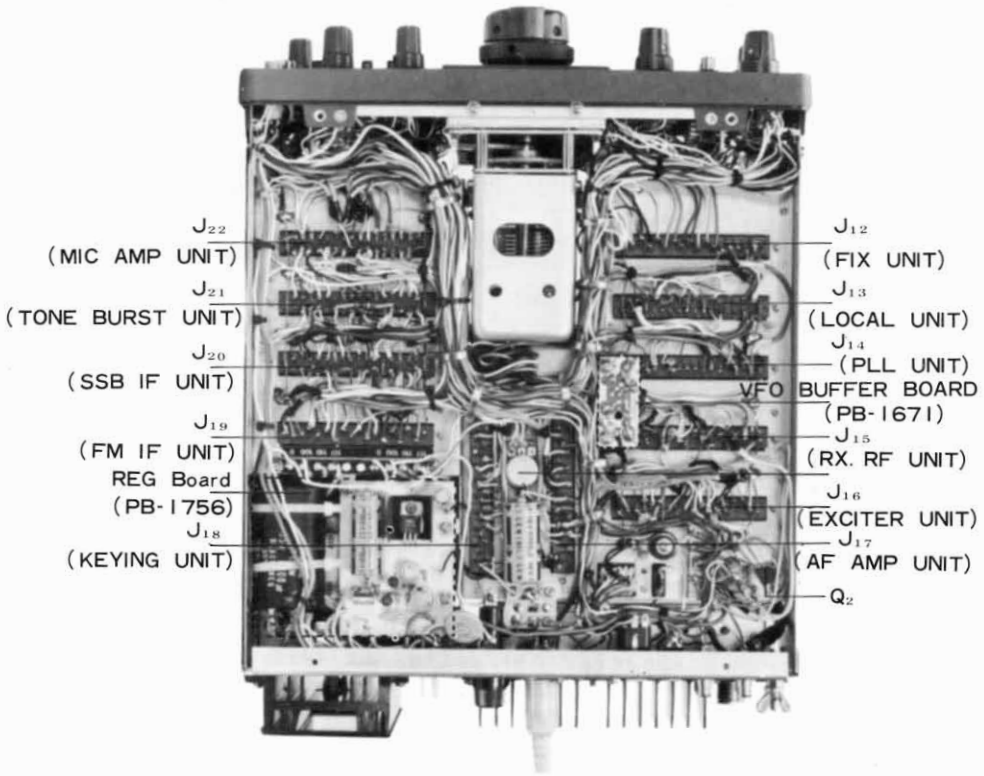
(4) Discriminator Center Meter

Set the controls as follows:
CHANNEL . . .VFO
MODE. . . . . .FM
DISC. . . . . .OFF (S-meter position)
RF GAIN . . . .Fully clockwise
MARKER . . . .ON (Analog model; for RD, connect signal generator to antenna receptacle)

Tune the transceiver for a maximum S-meter reading on the marker or signal generator signal. Tune the main dial so as to find the center of the maximum signal indication. Place the meter switch in the DISC position, and adjust the center potentiometer VR_{404} so that the meter pointer is exactly at midscale on the meter. Check to see that the meter moves an equal amount on either side of the center for an equal frequency excursion. Shift the VFO frequency 10 kHz lower than the reference signal, and adjust the DISC potentiometer, VR_{405} for a meter reading of 2 on the DISC scale.



AF AMP UNIT (PB-1764)

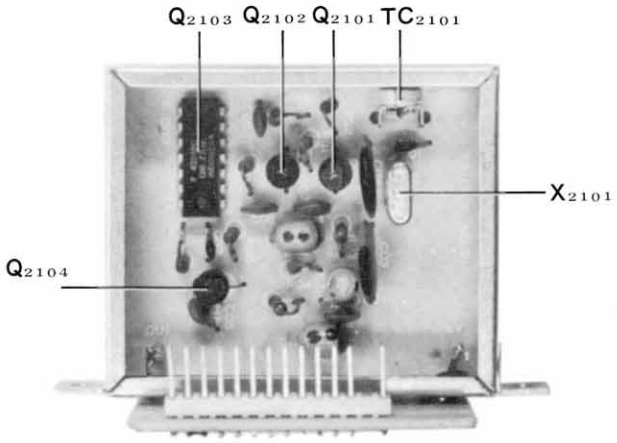


BOTTOM VIEW

MARKER UNIT (PB-1802) (Analog model only)

(1) Frequency Adjustment

Connect a frequency counter, through a 100 pF capacitor, to the collector of Q_{2102} (2SC372Y). Adjust TC_{2101} to set the crystal frequency exactly to 12.800 MHz. If a frequency counter is not available, use an external HF receiver, and zero the 100 kHz marker signal against WWV or JJY.



MARKER UNIT (PB-1802)

CW KEYING UNIT (PB-1751)

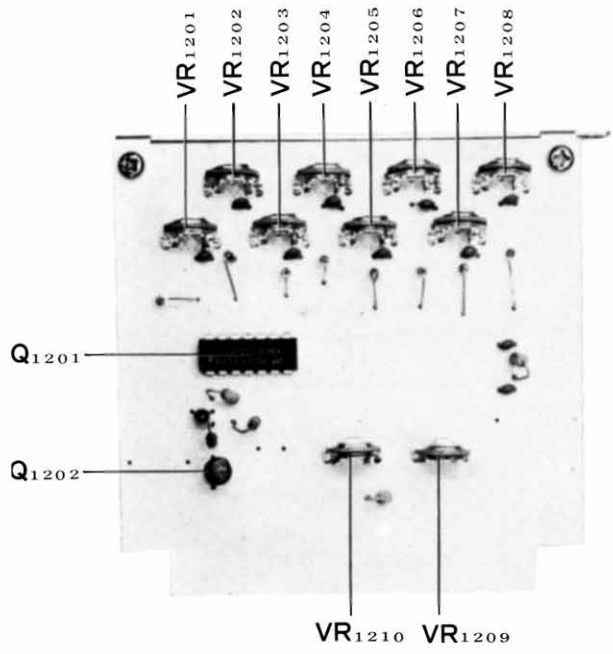
Voltage Adjustment for the Varicap Tuning Circuit

Measure the voltage at pins 2, 3, 4, 5, 14, 15, 16, and 17, with the VTVM connected between ground and the pin under test.

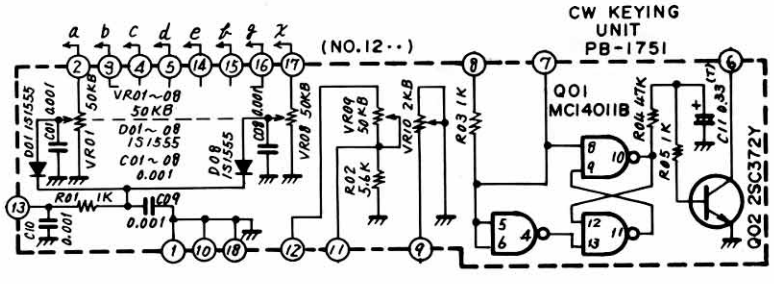
Adjust the appropriate potentiometer, VR_{1201}—VR_{1208}, for the following pin voltages.

	BAND	VOLTAGE		
VR 1201	144	2.5 V		
VR 1202	145	3.5 V		
VR 1203	146	4.5 V		
VR 1204	147	5.5 V		
VR 1205	144 RPT	1.9 V	★	TX−600kHz shift
VR 1206	145 RPT	2.9 V	★	〃
VR 1207	146 RPT	3.9 V	★	〃
VR 1208	147 RPT	5.9 V	★	TX+600kHz shift

TUNE control 12 O'clock ★ US model



CW KEYING UNIT (PB-1751)



CW KEYING UNIT

SSB IF UNIT (PB-1778)

(1) S-Meter Setting

Disconnect the antenna from the coax receptacle. Set the MODE switch to the AM position, and set the RF GAIN control to the fully clockwise position. Adjust VR_{201} ("ZERO") until the meter indicates zero. Then set the RF GAIN control fully counter-clockwise. Adjust VR_{202} ("FULL SCALE") until the meter reads full scale. Return the RF GAIN control to the fully clockwise position, and connect a signal generator to the antenna receptacle. Set the output of the signal generator to 144.5 MHz with an output of 0 dB, and tune the receiver to the generator signal. Place the TUNE control in the 12 o'clock position, and adjust VR_{203} for a reading of S3 on the S-meter. Repeat the above procedures until the full scale, zero, and S3 readings are achieved for the above settings.

MIC AMP UNIT (PB-1753)

(1) SSB Carrier Frequency

Connect a 50 ohm dummy load, such as the Yaesu YP-150, to the antenna receptacle, and connect the output of an audio oscillator to the microphone input. Set the MODE switch to an SSB mode. Apply a 1 kHz audio signal to the microphone input, and adjust the SSB MIC GAIN control or the audio oscillator output for an RF output of 10 watts as indicated on the wattmeter. Change the audio frequency to 350 Hz, and adjust TC_{503} for LSB and TC_{502} for USB to obtain 2.5 watts output. Change the audio frequency to 2600 Hz; the RF output should be 2.5 watts.

(2) AM and CW Carrier Frequency

Tune the transceiver in the USB mode into a dummy load, and use another receiver to monitor the transmitted signal. Tune the external receiver until the transmitted voice quality is natural. Change the FT-225RD to AM (leave the external receiver in the USB mode), and adjust TC_{501} for a zero beat as heard in the external receiver.

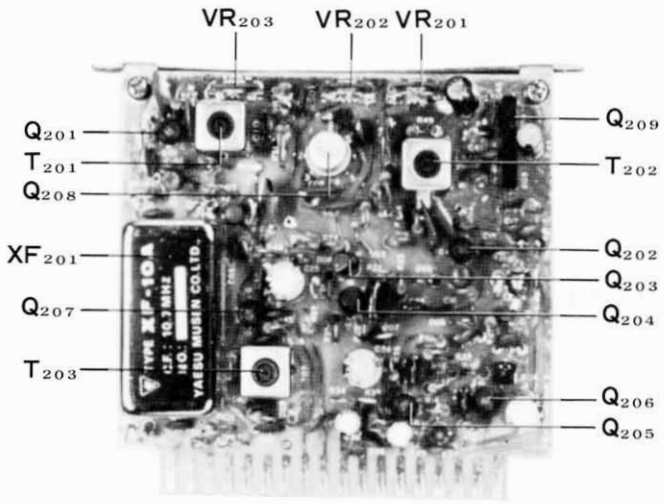
(3) Carrier Balance

Connect a dummy load to the antenna receptacle, and the RF probe of a VTVM to the center conductor of the antenna receptacle. Set the MODE switch to LSB. Set the SSB MIC GAIN control to the fully counter-clockwise position, and set the VOX GAIN switch to the MOX position. Adjust VR_{505} and TC_{504} ("CARRIER BALANCE") alternately to minimize the VTVM reading.

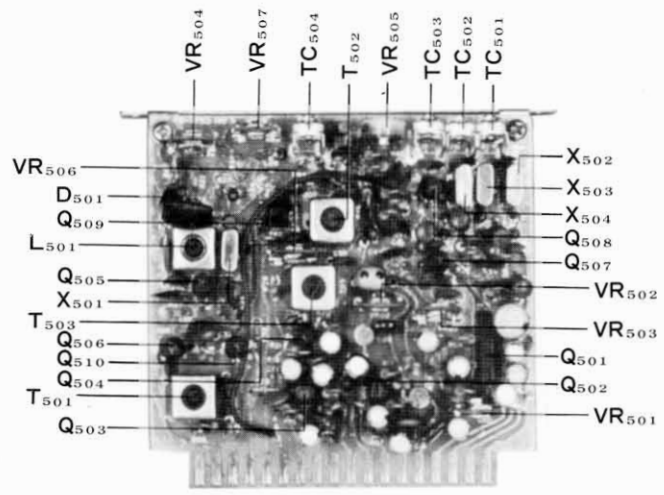
Repeat this procedure on USB, then repeat the procedure, so that a minimum reading is obtained on both sidebands.

(4) CW Carrier Level

Set the CW level control, VR_{507}, to the point where the RF output no longer increases when the control is advanced.



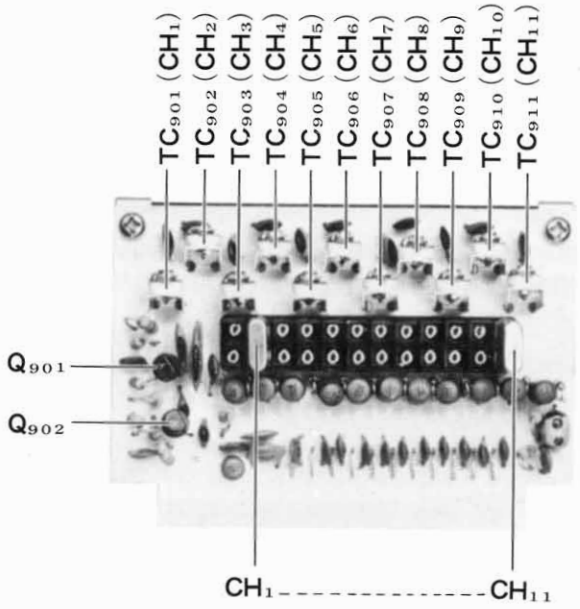
SSB IF UNIT (PB-1778)



MIC AMP UNIT (PB-1753)

FIX UNIT (PB-1750)

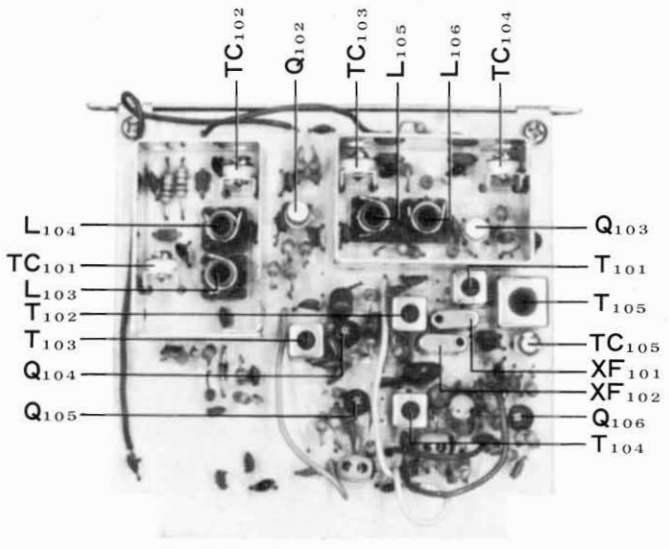
Precise frequency alignment of the fixed channel crystals may be made by adjusting TC_{901} – TC_{911}.



FIX UNIT (PB-1750)

RX RF UNIT (PB-1746)

Set the BAND switch to 144, the CHANNEL switch to VFO, the RF GAIN control fully clockwise, and the MODE switch to USB. Tune the VFO to a 10 dB signal at 144.500 MHz from a signal generator connected to the antenna receptacle. Peak TC_{101}, TC_{102}, TC_{103}, and TC_{104} for a maximum S-meter reading. If the majority of your operating is done in the upper part of the band (146 — 148 MHz), it is recommended that this alignment be performed on 146.5 MHz.



RX RF UNIT (PB-1746)

EXCITER UNIT/BOOSTER UNIT (PB-1762), (PB-1744), (PB-1745)

(1) Power Output

It is recommended that an insulated alignment tool be used for this alignment. Connect a dummy load to the antenna receptacle. Set the BAND switch to 145, the CHANNEL switch to VFO, and the MODE switch to FM. Set the VFO to 145.00 MHz, and set the VOX GAIN control to the MOX position. Peak TC_{601} — TC_{609} and TC_{701} — TC_{704} for maximum power output.

Change the frequency to 144.1 MHz and repeat the above procedures for maximum power output. Change the frequency to 147.9 MHz and repeat the above procedures for maximum power output.

Repeat the above alignments alternately on 144.1, 145.0, and 147.9 MHz until unity power output is obtained across the band.

(2) PO Meter Set

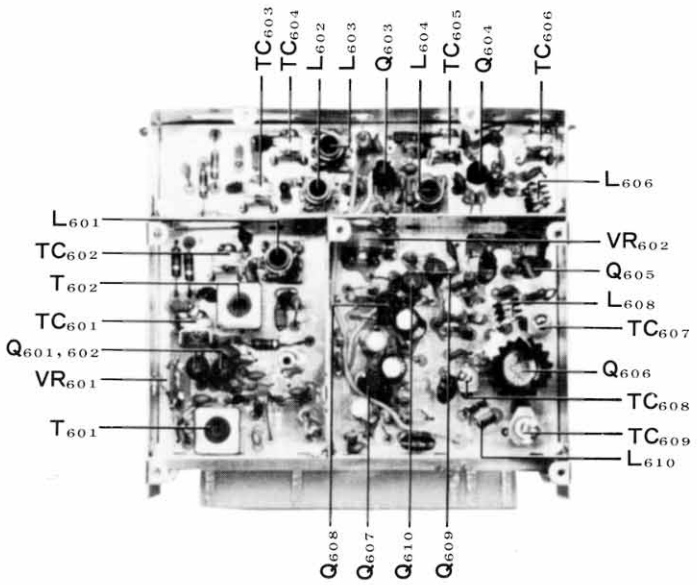
The PO (Power Output) meter indicates relative power output. After completion of the above power output alignment, set the meter control VR_{704} to the point where the meter pointer indicates 80% of full scale at full output.

(3) AM Carrier Level

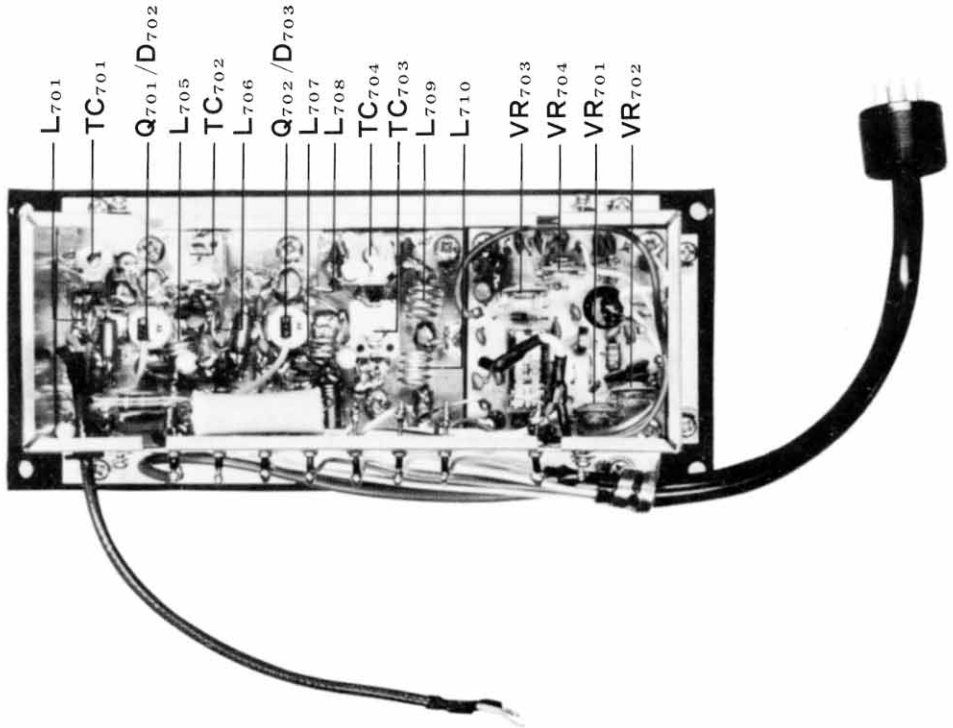
Set the MODE switch to AM. Adjust VR_{602}, in the EXCITER UNIT, for 8 watts unmodulated carrier output into a dummy load.

(4) ALC Threshold

Connect the output from a two-tone signal generator to the microphone input, and connect a dummy load/wattmeter to the antenna receptacle. Set the BAND switch to 145, the CHANNEL switch to VFO and the MODE switch to USB. Set the VOX GAIN control to the MOX position. Apply a 1 kHz single tone signal to the microphone input, and adjust the signal generator output until the power meter shows 2.5 watts. Then apply a 1.5 kHz tone, and adjust its level to produce 2.5 watts output. Leaving these levels at the preset position, apply the 1 kHz/1.5 kHz two-tone signal, and adjust VR_{703} for a power output of 3 watts.



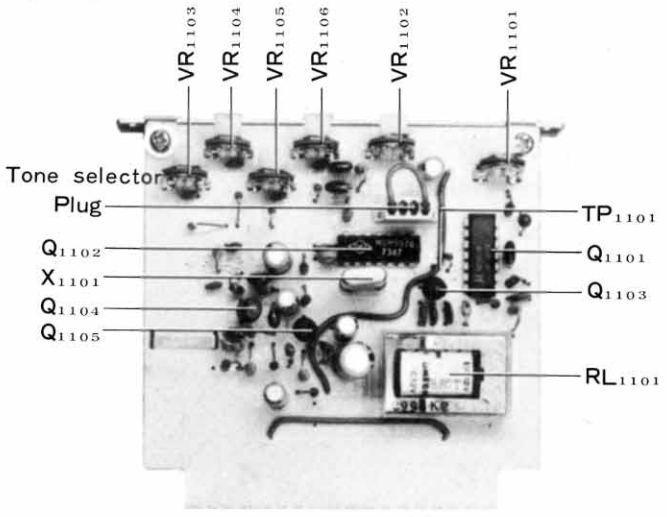
Exciter unit (PB-1762)



BOOSTER UNIT (PB-1744, 1745)

TONE BURST UNIT (PB-1752)

The burst signal is automatically transmitted when the PTT switch on the microphone is keyed, and when the BURST button is depressed. The length of the burst signal is preset at the factory for approximately 0.5 second. Adjustment of the burst length is made by VR_{1101}. Clockwise rotation increases the length of the burst.

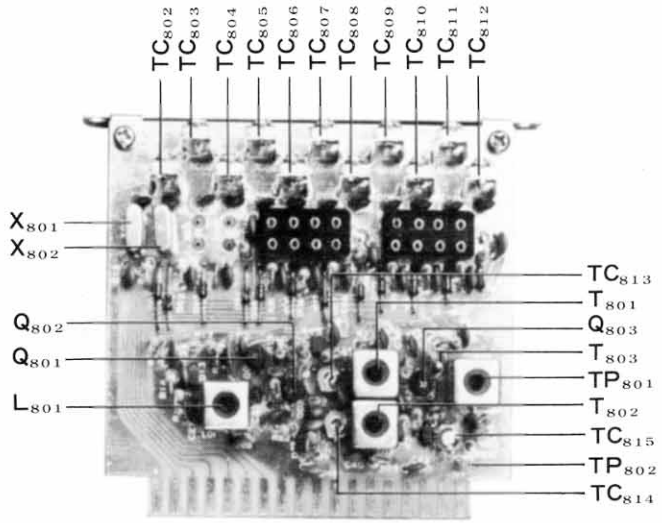


TONE BURST UNIT (PB-1752)

LOCAL UNIT (PB-1805)

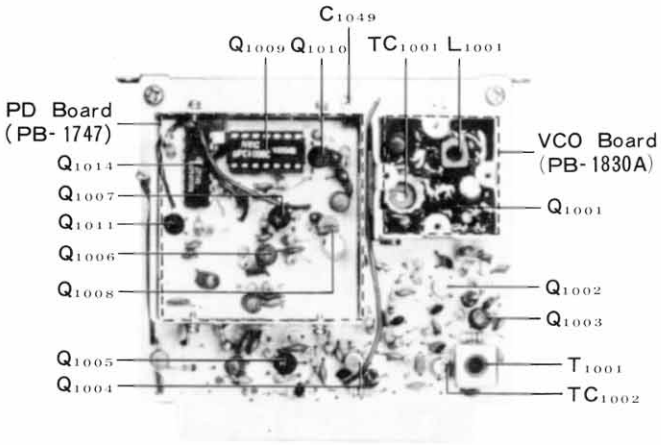
Set the MODE switch to USB, the BAND switch to 144.0, and the CHANNEL switch to VFO. Connect a frequency counter to pin 33 of J_{13}. Adjust L_{801} to 125.1 MHz ±100 Hz. Set the BAND switch to 145.0, and adjust TC_{802} to 126.1 MHz ±100 Hz. In like fashion, adjust TC_{803} for 127.1 MHz ±100 Hz for 146.0 MHz, and TC_{804} to 128.1 MHz ±100 Hz for 147.0 MHz.

Set the RPT switch to NORM, the AUX/600 kHz switch to 600 kHz, and the BAND switch to 144.0 MHz, and adjust TC_{806} to 125.5 MHz ±100 Hz. Likewise, adjust TC_{807} to 126.5 MHz ±100 Hz for 146.0 MHz, and TC_{808} to 127.5 MHz ±100 Hz for 147.0 MHz.



LOCAL UNIT (PB-1085)

Disconnect the frequency counter and connect it to pin 5 of J_{12}. Adjust the main tuning dial for a reading of 8200 kHz on the frequency counter. Set the analog sub-dial to zero. Adjust TC_{1802} on PB-1761 until the digital display reads 144.0015 MHz, making sure that the MODE switch is still on USB Adjust TC_{1801} for a reading of 143.9985 with the MODE switch on LSB: adjust TC_{1804} for a reading of 144.0000 on FM; adjust TC_{1803} to 143.9993 MHz on CW, transmit mode.

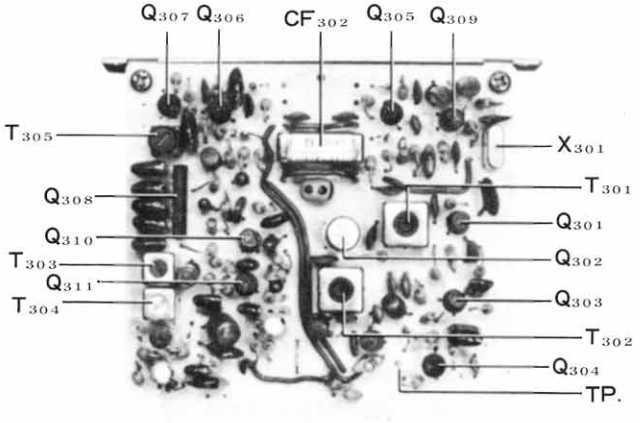


PLL UNIT (PB-1748, 1747, 1830)

PLL UNIT (PB-1748)

This unit does not require any adjustment unless major components are changed, and if this happens, precise measuring equipment is required for alignment. The following simple alignment can, though, be made:

Turn the transceiver to 144.0000 MHz. Connect a VTVM DC probe to C_{1049} (feedthrough capacitor) and adjust TC_{1001} for a reading of exactly 1.75 volts on the VTVM. Check to see that the PLL circuit locks at all frequencies.



FM IF UNIT (PB-1463)

SQUELCH THRESHOLD

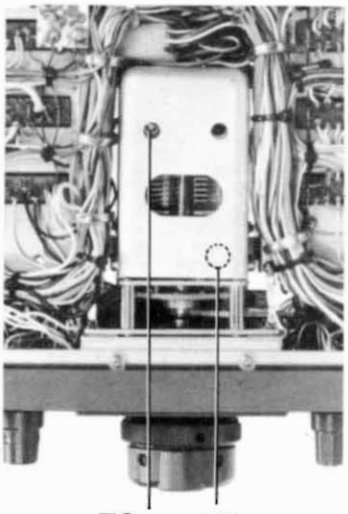
Disconnect the antenna from the receptacle. Set the BAND switch to 144, the CHANNEL switch to VFO, the RF GAIN control fully clockwise, the MODE switch to FM, and the SQUELCH control to the 9 o'clock position. Adjust VR_6 to the point where the receiver is just silenced. Do not go beyond this threshold point, or the SQUELCH control will not function properly.

FM DEVIATION ADJUSTMENT

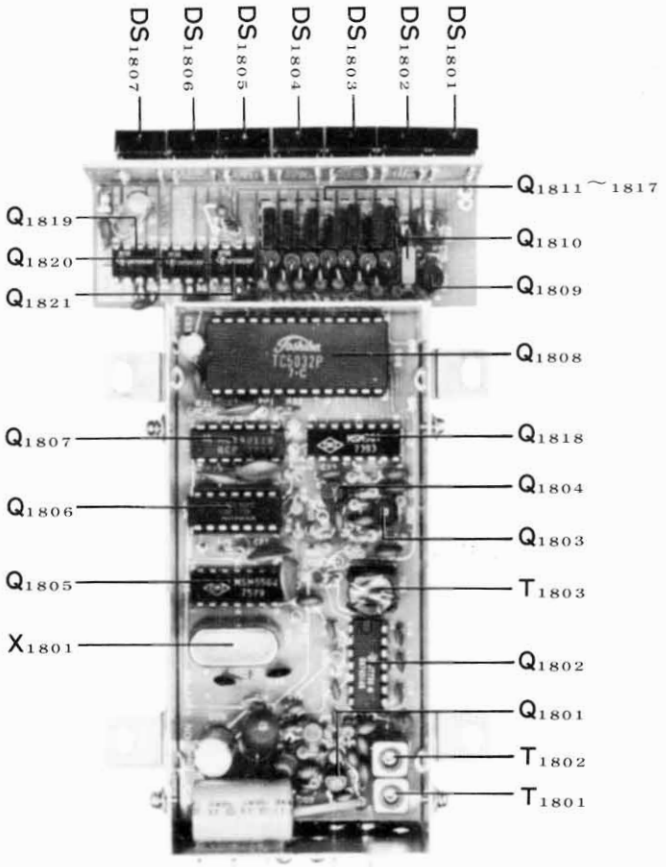
Connect a dummy load and an FM deviation meter to the antenna receptacle, and connect the output of an audio oscillator to the microphone input. Set the MODE switch to FM and the VOX GAIN control to MOX. Set VR_{501} to the fully clockwise position, and VR_{504} to the center of its range.

Apply a 1 kHz 3 mV audio signal to the microphone input. Observe the wave form on the oscilloscope display which is connected to a frequency deviation meter. Adjust VR_{504} until a sine wave is obtained in the scope pattern.

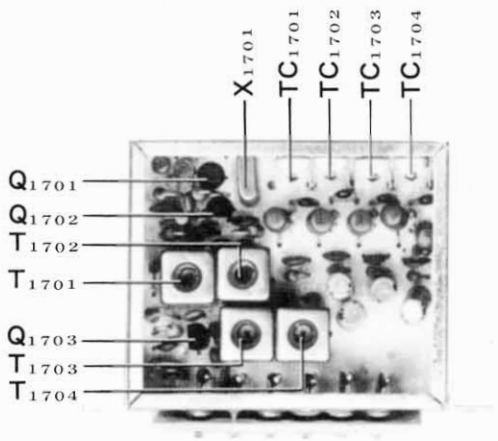
Connect a frequency counter to pin 3 of the MIC AMP UNIT and disconnect the audio signal input to the microphone input. Adjust L_{501} until the oscillating frequency becomes exactly 10.7 MHz. Connect the audio generator to the microphone input again, and adjust the input level until +5 kHz deviation with a sine wave pattern is obtained. If a sine wave is not obtained, repeat the above procedures. Increase the input level to 25 mV, and adjust VR_{502} for +5 kHz deviation.



VFO COMPARTMENT



COUNTER UNIT (PB-1735, 1803)



OSC UNIT (PB-1761)

PARTS LIST

MAIN CHASSIS

Symbol Number	Parts Number	Description
		IC & TRANSISTOR
Q3	25000116	IC μPC14308
Q4	25000109	〃 μPC14305
Q1 W/Insulator	22490003	Transistor MJ802
Q2	22403134	〃 2SD313D
		DIODE
D1	21090130	Silicon Diode U05B
D3～D19	21090011	〃 10D1
D2	21090144	〃 S15VB10
		RESISTOR
R8	41143223	Carbon Film ¼W TJ 22KΩ
R2	42124100	Carbon Composition ½W GK10Ω
R7	42124220	〃 〃 〃 〃22Ω
R1	42124101	〃 〃 〃 〃100Ω
R5	42124102	〃 〃 〃 〃1KΩ
R4	42124562	〃 〃 〃 〃5.6KΩ
R6	42124154	〃 〃 〃 〃150KΩ
		POTENTIOMETER
VR1,3	49900098	DM10A041 5KΩB /10KΩA
VR2	49900099	DM10A04 1KΩC /100KΩB
VR4	49900085	VM11A5M1112 10KΩA
VR5	49900100	FVH BOAS25B54 50KΩB
VR9	49800045	EVH BOAS15B54 50KΩB
		CAPACITOR
C1,2	30240472	Ceramic Disc 1.4KV 0.0047μF
C10,11,13～18,23～27 C29～33,36,38	30820102	〃 〃 50WV 0.001μF
C5～9,19,28,39	30820103	〃 〃 〃 0.01μF
C12,34,35,37,40	30820473	〃 〃 〃 0.047μF
C20～22	35220476	Electrolytic 16WV 4.7μF
C4	35220228	〃 16WV 2200μF
C3	34529001	〃 35 WV 6800μF
		CHOKE
CH1	55003001	SN-8S-500
CH2	50000010	50-12 #230012
		POWER TRANSFORMER
PT1	52000052	52-56 #230016

		METER
M1 (with PL3)	74000370	SP-38A
		SPEAKER
SP1	76000017	4Ω 3W SA-77KY
		RELAY
RL1	70000005	AE-3171-42
		RELAY SOCKET
RLS1	69000004	AE-3860
		SWITCH
S1	64000490	SRN 2020N
S2,4	64000520	〃 2064N
S3	64000510	〃 4085N
S5	64000200	〃 SP-2022
		PLUG
P1	68130002	5047-13 #240057A
P2	68100012	5047-10 #240058
P3	67040002	SI- 5908
		CONNECTOR
J1	67040004	QMS-AB4M
J2	68050003	CS-250
J3	68020002	SG-7615
J4	68020012	SG-8050
J5	68040003	FM-144J
J6	68020013	SG-8018
J7～11	68020001	CN-7017J
J24	68090001	SB-7702
J25 with Wire	96000104	#240030-3
J26	67090002	1625-9R-1 #240064
		MULTI JACK
J12,14～19,21	68360001	220D-36B-205
J13,20,22	68180003	121S-18B-105
		FUSE
F1	73000003	3A
		FUSE HOLDER
FH1	69030001	SN1001 #2
FH2	69030007	F3265

PARTS LIST

		LAMP
PL1,2	14000018	BQ044-32751A
PL3 (Meter)	—	BF342-01540A

RX·RF unit

Symbol Number	Parts Number	Description
PB-1746	60417460	Printed Circuit Board
	017460AZ	PCB with components
		FET & TRANSISTOR
Q102,103	23800510	MOS FET 3SK51
Q104~106	22307842	Silicon Transistor 2SC784R
		DIODE
D109	21010070	Germanium Diode 1S1007
D101	21090142	Silicon 〃 MC301
D105~108,110	21022090	Varactor 〃 1S2209
		CRYSTAL FILTER
XF101,102	71000025	10M2A-2
		RESISTOR
R118	40143560	Carbon Film ¼W VJ 56Ω
R114,117,125,129,136	40143101	〃 〃 〃 〃 100Ω
R135	40143221	〃 〃 〃 〃 220Ω
R103	40143271	〃 〃 〃 〃 270Ω
R124	40143471	〃 〃 〃 〃 470Ω
R101,102,104,105,128	40143102	〃 〃 〃 〃 1KΩ
R132	40143152	〃 〃 〃 〃 1.5KΩ
R130	10143222	〃 〃 〃 〃 2.2KΩ
R131	40143392	〃 〃 〃 〃 3.9KΩ
R133	40143472	〃 〃 〃 〃 4.7KΩ
R122,127	40143822	〃 〃 〃 〃 8.2KΩ
R120,121,139	40143103	〃 〃 〃 〃 10KΩ
R112,134	40143223	〃 〃 〃 〃 22KΩ
R123,126	40143393	〃 〃 〃 〃 39KΩ
R113,119	40143473	〃 〃 〃 〃 47KΩ
R109~111	40143104	〃 〃 〃 〃 100KΩ
R115,116,137	40143105	〃 〃 〃 〃 1MΩ
R107,108	41143105	〃 〃 〃 TJ 1MΩ
R138 (L110)	42104102	〃 Composition ¼W 1KΩ
		CAPACITOR
C150	31829010	Ceramic Disc 50WV 1PF SL
C124	31829030	〃 〃 〃 3PF SL
C152	31829080	〃 〃 〃 8PF SL
C114	31829300	〃 〃 〃 30PF SL
C146	31829470	〃 〃 〃 47PF SL
C112,113,121,122,143	31820050	〃 〃 〃 5PF CH
C142	31820150	〃 〃 〃 15PF CH
C101~105,111,115~	30820102	〃 〃 〃 0.001μF
C120,123,125,126,129 C132,133,135,144,145 C148,149,151	30820102	Ceramic Disc 50WV 0.001μF
C127,130,131,134,136 C137,140,141,147	30820103	〃 〃 〃 0.01μF
C138	36825473	Mylar 〃 〃 0.047μF
C139	34220105	Electrolytic 16WV 1μF
		TRIMMER CAPACITOR
TC101~104	39000006	ECV1ZW 10×40 10PF
TC105	39000010	〃 10×53 10PF
		INDUCTOR
L103	55003251	#220316
L104,106	55003252	#220317
L105	55003253	#220318
L110 (R138)	55003254	RF CHOKE #220310
L109,111	53020007	Micro Inductor FL-5H 22μH
L112,113	53010003	〃 〃 250μH
		TRANSFORMER
T101~104	55003083	3005 #220187
T105	54141020	R12-4102 #220111
		FERRITE BEADS
FB101	56000024	RI 3×3×1

SSB·IF unit

Symbol Number	Parts Number	Description
PB-1778	60417780	Printed Circuit Board
	017780AZ	PCB with components
		IC, FET & TRANSISTOR
Q208	25000098	IC TA7045
Q209	25000152	〃 μPC1037H
Q202,207	22800195	FET 2SK19GR
Q203,204	22303730	Silicon Transistor 2SC373
Q205,206	22310006	〃 〃 2SC1000BL
Q201	22307842	〃 〃 2SC784R
		DIODE
D201~203,206,209	21010070	Germanium Diode 1S1007
D204	21001880	〃 〃 1S188FM
D205	21015550	Silicon 〃 1S1555
D207	21019410	〃 〃 〃 1S1941
D208	21090036	Zener 〃 〃 WZ110

PARTS LIST

		THERMISTOR	
RS201	29090001	SDT-250	
		CRYSTAL FILTER	
XF201	71000020	XF10A	#210027
		RESISTOR	
R251	40143560	Carbon Film	¼W VJ 56Ω
R209,212,214,219,245	40143101	〃 〃	〃 〃 100Ω
R246,249		〃 〃	〃 〃
R226,229	40143721	〃 〃	〃 〃 270Ω
R218,231	40143471	〃 〃	〃 〃 470Ω
R224	40143561	〃 〃	〃 〃 560Ω
R202,235	40143681	〃 〃	〃 〃 680Ω
R204,205,211,215,221	40143102	〃 〃	〃 〃 1KΩ
R228,230,241,247		〃 〃	〃 〃
R208,210,217,223,248	40143222.	〃 〃	〃 〃 2.2KΩ
R227	40143272	〃 〃	〃 〃 2.7KΩ
R201,203,213,234,250	40143332	〃 〃	〃 〃 3.3KΩ
R225,239,240	40143392	〃 〃	〃 〃 3.9KΩ
R242	40143472	〃 〃	〃 〃 4.7KΩ
R206	40143682	〃 〃	〃 〃 6.8KΩ
R236	40143103	〃 〃	〃 〃 10KΩ
R233	40143153	〃 〃	〃 〃 15KΩ
R220	40143223	〃 〃	〃 〃 22KΩ
R207	40143273	〃 〃	〃 〃 27KΩ
R237	40143393	〃 〃	〃 〃 39KΩ
R232,238	40143473	〃 〃	〃 〃 47KΩ
R216,244	40143104	〃 〃	〃 〃 100KΩ
R222	40143474	〃 〃	〃 〃 470KΩ
R252	41143102	〃 〃	〃 TJ 1KΩ
		POTENTIOMETER	
VR201	49906102	EVL-SOAA-00B13	1KΩB
VR202,203	49906502	EVL-SOAA-00B53	5KΩB
		CAPACITOR	
C215	31820100	Ceramic Disc	50WV 10PF NPO
C214	31820200	〃 〃	〃 20PF NPO
C216,247	31820101	〃 〃	〃 100PFNPO
C241,248	30820102	〃 〃	〃 0.001μF
C201～204,210～213, C219,220,221,224, C226,227,236～240, C242,244	30820103	〃 〃	〃 0.01μF
C205～209,217,218	30820473	〃 〃	〃 0.047μF
C233	36825682	Mylar	〃 0.0068μF
C223,231,232	36825223	〃	〃 0.02μF
C222	36825104	〃	〃 0.1μF
C235	36526334	Tantalum	35WV 0.33μF
C229	34220105	Electrolytic	16WV 1μF
C230	34220475	〃	〃 4.7μF
C243	34220106	〃	〃 10μF
C245	34220226	〃	〃 22μF
C225,228,234	34220476	〃	〃 47μF

		INDUCTOR	
L201	53020032	Micro Inductor	FL-4H 3.9μH
L202	53020006	〃	〃 6.8μH
L203	53010004	〃	FL-5H 220μH
		TRANSFORMER	
T201,202	54140740	R12-4074	#220150
T203	54140730	R12-4073	#220149

FM IF unit

Symbol Number	Parts Number	Description
PB-1463C-3340	60414633	Printed Circuit Board
	014633AZ	PCB with components
		IC, FET & TRANSISTOR
Q302	25000111	IC μA703HC
Q308	25000099	〃 TA7061AP
Q303	22800195	FET 2SK19GR
Q301,304～307,309～Q311	22303724	Transistor 2SC372Y
		DIODE
D303～306	21001880	Germanium Diode 1S188FM
D301,302,307～310	21015550	Silicon 〃 1S1555
		THERMISTOR
RS301	29090001	SDT-250
		CRYSTAL
X301	71800061	HC-18/U 10.245MHz
		CERAMIC FILTER
CF302	71200009	CFM455F/LF-C12
CF303	71200010	10.7MF-BR
		RESISTOR
R304,305,326	40143101	Carbon Film ¼WVJ 100Ω
R325,327,337	40143221	〃 〃 〃 〃 220Ω
R324	40143471	〃 〃 〃 〃 470Ω
R303,342,346	40143561	〃 〃 〃 〃 560Ω
R308,319,328,329,336,347	40143102	〃 〃 〃 〃 1KΩ

PARTS LIST

R309	40143152	Carbon Film	¼W	VJ	1.5KΩ			IC. FET & TRANSISTOR	
R339,340	40143222	〃	〃	〃	2.2KΩ	Q415	25000111	IC	MC14011B
R311,313,314,321,343	40143332	〃	〃	〃	3.3KΩ	Q416,417	22800195	FET	2SK19GR
R349~356						Q412	22105641	Silicon Transistor	2SA564A
R301,330,331,335,344	40143472	〃	〃	〃	4.7KΩ	Q404	22106950	〃	2SA695
R322,338	40143562	〃	〃	〃	5.6KΩ	Q406	22205290	〃	2SB529
R302	40143103	〃	〃	〃	10KΩ	Q401,402,407,408,414	22303724	〃	2SC372Y
R315,316,345	40143153	〃	〃	〃	15KΩ	Q409,410,413,418	22303730	〃	2SC373
R323,334,341	40143223	〃	〃	〃	22KΩ	Q403	22307110	〃	2SC711
R320,332	40143473	〃	〃	〃	47KΩ	Q411	22307354	〃	2SC735Y
R348	40143563	〃	〃	〃	56KΩ	Q405	22403590	〃	2SD359
R306,307,310	40143104	〃	〃	〃	100KΩ				
								DIODE	
						D401~404,406	21015550	Silicon Diode	1S1555
						D405	29090013	Varistor	MV-5W
		CAPACITOR							
C312	31829050	Ceramic Disc	50WV		5PF SL				
C306,307	31829330	〃	〃		33PF SL				
C309,343	31829101	〃	〃		100PF SL			RESISTOR	
C301	31829221	〃	〃		220PF SL	R416	40143100	Carbon Film	¼W VJ 10Ω
C333	31820400	〃	〃		40PF CH	R414	40143220	〃	〃 〃 22Ω
C344	30820102	〃	〃		0.001μF	R456	40143680	〃	〃 〃 68Ω
C302~305,308,313,	30820103	〃	〃		0.01μF	R457	40143101	〃	〃 〃 100Ω
C315,316,319,336,						R420	40143121	〃	〃 〃 120Ω
C345~348						R403,417,449	40143221	〃	〃 〃 220Ω
C310,330,331,337,338	36825103	Mylar	〃		0.01μF	R425,454	40143471	〃	〃 〃 470Ω
C341						R406,407,428,430,434	40143102	〃	〃 〃 1KΩ
C328,329	36825223	〃	〃		0.02μF	R441			
C311,317,320~325	36825473	〃	〃		0.047μF	R412,413	40143152	〃	〃 〃 1.5KΩ
C339,340,349,350	36526105	Tantalum	25WV		1μF	R402,408,424,450,452,453	40143222	〃	〃 〃 2.2KΩ
C335	36824101	Styrol	50WV		100PF	R415	40143332	〃	〃 〃 3.3KΩ
C326,334	36824331	〃	〃		330PF	R401,440,443,445,446	40143472	〃	〃 〃 4.7KΩ
C327	36824102	〃	〃		1000PF	R448,455			
C332,342	34220475	Electrolytic	16WV		4.7μF	R429	40143562	〃	〃 〃 5.6KΩ
						R409	40143682	〃	〃 〃 6.8KΩ
						R404	40143822	〃	〃 〃 8.2KΩ
						R421,427,436,438,439	44143103	〃	〃 〃 10KΩ
						R444			
						R422,442	40143223	〃	〃 〃 22KΩ
		INDUCTOR				R447	40143333	〃	〃 〃 33KΩ
L301~303,306 ~308	53020001	Micro Inductor	FL5H		1mH	R405,426	40143393	〃	〃 〃 39KΩ
L305	53020002	〃	〃		2mH	R410	40143473	〃	〃 〃 47KΩ
L304	53010003	〃	EL0610		250μH	R435	40143563	〃	〃 〃 56KΩ
						R423	40143683	〃	〃 〃 68KΩ
						R411,437,451	40143104	〃	〃 〃 100KΩ
						R431,432	40143105	〃	〃 〃 1MΩ
		TRANSFORMER				R433	40143335	〃	〃 〃 3.3MΩ
T301,302	54140740	R12-4074			#220150	R418,419	40124029	Wire Wound	½W 0.22Ω
T303	54148614	R12-4861D			#220182				
T304	54148615	R12-4861E			#220183				
T305	55000278	7MC312162N			#220188				
								POTENTIOMETER	
TP301,302	91100008	Wrapping Terminal C				VR404	49906502	EVL-SOAA-00B53	5KΩB
						VR403	49906103	EVL-SOAA-00B14	10KΩB
						VR402	49907053	EVL-VOAA-00B54	50KΩB
						VR405	49906503	EVL-SOAA-00B54	50KΩB
						VR401	49907504	EVL-VOAA-00B55	500KΩB

AF AMP unit

Symbol Number	Parts Number	Description
PB-1764	60417640	Printed Circuit Board
	017640AZ	PCB with components

PARTS LIST

		CAPACITOR				
C438	31829151	Ceramic Disc	50WV	150PF	SL	
C404	31829221	〃	〃	〃	220PF	SL
C434	31829271	〃	〃	〃	270PF	SL
C409	33834331	〃	〃	〃	330PF	SL
C427	30820102	〃	〃	〃	0.001μF	
C401	30820473	〃	〃	〃	0.047μF	
C410,411	36825222	Mylar		〃	0.002μF	
C423,436,437	36825103	〃		〃	0.01μF	
C420	36825102	〃		〃	0.001μF	
C431～433	36825223	〃		〃	0.02μF	
C414,417	36825473	〃		〃	0.047μF	
C422	36526334	Tantalum		35WV	0.33μF	
C425	36526105	〃		〃	1μF	
C424	36526225	〃		〃	2.2μF	
C403,406,415,419,428 C430	34820105	Electrolytic		50WV	1μF	
C402,435	34220475	〃		16WV	4.7μF	
C416,418,421,426,429	34220106	〃		〃	10μF	
C439	34120475	〃		10WV	47μF	
C405,407	34220107	〃		16WV	100μF	
C408,412	34220227	〃		〃	220μF	

MIC AMP unit

Symbol Number	Parts Number	Description	
PB-1753	60417530	Printed Circuit Board	
	017530AZ	PCB with components	
		IC. FET & TRANSISTOR	
Q501	25000099	IC	TA7061AP
Q509	22800195	FET	2SK19GR
Q510	22800194	〃	2SK19Y
Q502,503	22310005	Silicon Transistor	2SC1000GR
Q504～508	22303724	〃 〃	2SC372Y
		DIODE	
D507～510	21010070	Germanium Diode	1S1007
D503 ～506	21015550	Silicon 〃	1S1555
D501	21090137	Varactor 〃	FC63- 4
D502	29090004	Varistor 〃	MV103
		CRYSTAL	
X501	71800062	HC18/U FM 10.7000	#210049-1
X502	71800065	〃 CW 10.6993	#210051-1
X503	71800064	〃 USB 10.6985	#210051-2
X504	71800063	〃 LSB 10.7015	#210051-3
		RESISTOR	
R504,512,521,530,531 R533,538,543～545, R549,550,551	40143101	Carbon Film ¼W VJ	100Ω
R503,537,541,542	40143221	〃 〃 〃 〃	220Ω
R514,520	40143471	〃 〃 〃 〃	470Ω
R502,505,515,527,534 R546	40143102	Carbon Film ¼W VJ	1KΩ
R511	40143122	〃 〃 〃 〃	1.2KΩ
R532	40143222	〃 〃 〃 〃	2.2KΩ
R524	40143272	〃 〃 〃 〃	2.7KΩ
R507,517,529	40143332	〃 〃 〃 〃	3.3KΩ
R547,553	40143392	〃 〃 〃 〃	3.9KΩ
R510,535	40143472	〃 〃 〃 〃	4.7KΩ
R536,539	40143562	〃 〃 〃 〃	5.6KΩ
R540	40143682	〃 〃 〃 〃	6.8KΩ
R508	40143822	〃 〃 〃 〃	8.2KΩ
R522,525	40143103	〃 〃 〃 〃	10KΩ
R513	40143183	〃 〃 〃 〃	18KΩ
R523,526	40143223	〃 〃 〃 〃	22KΩ
R528	40143273	〃 〃 〃 〃	27KΩ
R501,509,518	40143333	〃 〃 〃 〃	33KΩ
R516,519	40143683	〃 〃 〃 〃	68KΩ
R548	40143104	〃 〃 〃 〃	100KΩ
		POTENTIOMETER	
VR507	49906102	EVL SOAA 00B13	1KΩB
VR504	49906202	EVL SOAA 00B23	2KΩB
VR501～503,506	49906502	EVL SOAA 00B53	5KΩB
VR505	49916301	SR29R	300ΩB
		CAPACITOR	
C544	31829040	Ceramic Disc 50WV	4PF SL
C551	31829100	〃 〃 〃	10PF SL
C556	31829220	〃 〃 〃	22PF SL
C520	31829151	〃 〃 〃	150PF SL
C510,511	31829271	〃 〃 〃	270PF SL
C526	31820030	〃 〃 〃	3PF CH
C559	31820150	〃 〃 〃	15PF CH
C542	31820200	〃 〃 〃	20PF CH
C560	31820270	〃 〃 〃	27PF CH
C532～534,548	31820300	〃 〃 〃	30PF CH
C527,528,541	31820101	〃 〃 〃	100PF CH
C540	31820151	〃 〃 〃	150PF CH
C516,552	30820102	〃 〃 〃	0.001μF
C529～531,535～539, C543,545～547,549, C550,553,555	30820103	〃 〃 〃	0.01μF
C525	30820473	〃 〃 〃	0.047μF
C524	33824751	Dipped Mica 〃	750PF
C517	36825102	Mylar 〃	0.001μF
C508	36825103	〃 〃	0.01μF
C509	36825223	〃 〃	0.022μF
C558	36526474	Tantalum 35WV	0.47μF
C523	36526105	〃 〃	1μF
C501,512,515,518,521 C557	34220105	Electrolytic 16WV	1μF
C502,504～507,514, C519,522	34220106	〃 〃	10μF
C513	34220226	〃 〃	22μF
C503	34220476	〃 〃	47μF

PARTS LIST

		TRIMMER CAPACITOR			
TC501~504	39000007	ECV-1ZW 20×40	20PF		
		INDUCTOR			
L501	55003256	VXO Coil	#220319		
L502~504,506	53020001	Micro Inductor FL5H	1mH		
L507	53010003	〃 〃	250μH		
		TRANSFORMER			
T501	54140740	R12-4074	#220150		
T502,503	54140730	R12-4073	#220149		

EXCITER unit

Symbol Number	Parts Number	Description	
PB-1762	60417620	Printed Circuit Board	
	017620AZ	PCB with components	
		FET & TRANSISTOR	
Q601,602	22800195	FET	2SK19GR
Q603	22307842	Silicon Transistor	2SC784R
Q604,605	22320530	〃 〃	2SC2053
Q606	22307300	〃 〃	2SC730
Q607,610	22303730	〃 〃	2SC373
Q608	22303724	〃 〃	2SC372Y
Q609	22307354	〃 〃	2SC735Y
		DIODE	
D601~605	21022090	Varactor Diode	1S2209
D606~608	21015550	Silicon 〃	1S1555
		RESISTOR	
R617,622	40143100	Carbon Film ¼W VJ	10Ω
R623,626	40143560	〃 〃 〃 〃	56Ω
R613,618,637,639	40143101	〃 〃 〃 〃	100Ω
R612	40143221	〃 〃 〃 〃	220Ω
R630	40143471	〃 〃 〃 〃	470Ω
R615,620	40143561	〃 〃 〃 〃	560Ω
R635	40143821	〃 〃 〃 〃	820Ω
R633,641	40143102	〃 〃 〃 〃	1KΩ
R625	40143122	〃 〃 〃 〃	1.2KΩ
R634,636,640	40143222	〃 〃 〃 〃	2.2KΩ
R608,610	40143332	〃 〃 〃 〃	3.3KΩ
R616,621,638	40143472	〃 〃 〃 〃	4.7KΩ
R628	40143562	〃 〃 〃 〃	5.6KΩ
R632	40143103	〃 〃 〃 〃	10KΩ
R611,631	40143153	〃 〃 〃 〃	15KΩ
R629	40143273	〃 〃 〃 〃	27KΩ
R601,602	40143473	〃 〃 〃 〃	47KΩ
R605,614	40143105	〃 〃 〃 〃	1MΩ
R609	41143101	〃 〃 〃 TJ	100Ω
R603,604,606,607	41143105	〃 〃 〃 〃	1MΩ

C613,619,623,631	31829100	Ceramic Disc 50WV	10PF SL
C601	31829400	〃 〃 〃	40PF SL
C626	31829470	〃 〃 〃	47PF SL
C614,615	31820010	〃 〃 〃	1PF CH
C616,~618,622	31820050	〃 〃 〃	5PF CH
C611,612	31820100	〃 〃 〃	10PF CH
C606,607	31820200	〃 〃 〃	20PF CH
C603~605,620,621, C624,639~645	30820102	〃 〃 〃	0.001μF
C602,608~610,625 C627~630,637	30820103	〃 〃 〃	0.01μF
C632	36825473	Mylar 〃 〃	0.047μF
C633,636,638	34220106	Electolytic	16WV 10μF
C635	34220226	〃	〃 22μF
C634	34220336	〃	〃 33μF
		TRIMMER CAPACITOR	
TC601~606	39000006	ECV-1ZW10×40	10PF
TC607,608	39000011	ECV-1ZW20×53	20PF
TC609	39000002	ECV-1ZW20×32	20PF
		INDUCTOR	
L601,603	55003257		#220320
L602	55003258		#220321
L604	55003259		#220322
L606,608	55003260		#220323
L610	55033264		#220315
L605	55003254		#220310
L607	55003262		#220324
L609	55003263		#220311
		TRANSFORMER	
T601	54140730	R12-4073	#220149
T602	55003265		#220325

BOOSTER unit

Symbol Number	Parts Number	Description
PB-1744	60417440	Printed Circuit Board A
PB-1745	60417450	〃 〃 〃 B
	017440AZ	PCB with components

PARTS LIST

		TRANSISTOR			
Q701	22390005	Transistor	MRF212		
Q702	22390003	〃	2N5591		
		DIODE			
D711～713	21001880	Germanium Diode	1S188FM		
D702,703	21090011	Silicon 〃	10D1		
D704～710,714,715	21015550	〃 〃	1S1555		
D701	21090143	Zener 〃	1N4732		
		RESISTOR			
R708	40143222	Carbon Film	¼W VJ 2.2KΩ		
R709	40143105	〃 〃	〃 〃 1MΩ		
R701,702	42124100	〃 Composition	½W GK10Ω		
R704	42124470	〃 〃	〃 〃 47Ω		
R703	42124560	〃 〃	〃 〃 56Ω		
R710	43304390	Metalic Film	3W 39Ω		
		POTENTIOMETER			
VR701	49906501	EVL-SOAA-00B52	500ΩB		
VR702～704	49906103	EVL-SOAA-00B14	10KΩB		
		CAPACITOR			
C733	31829059	Ceramic Disc	50WV 0.5PFSL		
C725	31829010	〃 〃	〃 1PF SL		
C726	31829020	〃 〃	〃 2PF SL		
C727	31829030	〃 〃	〃 3PF SL		
C718	31829090	〃 〃	〃 9PF SL		
C701	31829100	〃 〃	〃 10PF SL		
C719,721,724	31829150	〃 〃	〃 15PF SL		
C708	31829180	〃 〃	〃 18PF SL		
C702	31829200	〃 〃	〃 20PF SL		
C717,720,722,723,748	31829330	〃 〃	〃 33PF SL		
C710	31829101	〃 〃	〃 100PFSL		
C709	31827100	〃 〃	〃 10PF UJ		
C703,707,713,714,728	30820102	〃 〃	〃 0.001μF		
C730,731,734～738,					
C745					
C706,712,715	30820103	〃 〃	〃 0.01μF		
C729	36825473	Mylar	〃 0.047μF		
C732,747	36526104	Tantalum	35WV 0.1μF		
C739～744,746,749	32821102	Feed Thru	50WV 0.001μF		
C704,705,711,716	34220106	Electrolytic	16WV 10μF		
		TRIMMER CAPACITOR			
TC701	39000006	ECV-1ZW 10× 44	10PF		
TC702～704	39000060	TSN-P-100D	20PF		

		INDUCTOR	
L701	55003266		#220326
L702～704	55003267		#220328
L713	55003273		#220327
L705,707	55003268		#220330
L706,708	55003269		#220329
L709,710	55003270		#220331
L711	55003272		#220334
L712	55003271		#220333
L714	53020014	Micro Inductor FL4H	1.8μH
		TRANSFORMER	
T701	55003274		#220335A
		RELAY	
RL701	70000031	BR-221D012	DC12V
		CONNECTOR	
J701	68000007		SO-239
J702	67090001		SI-8501

LOCAL unit

Symbol Number	Parts Number	Description
PB-1805	60418050	Printed Circuit Board
	018050AZ	PCB with components
		TRANSISTOR
Q801,802	22303724	Silicon Transistor 2SC372Y
Q803	22307842	〃 〃 2SC784R
		DIODE
D817	21001880	Germanium Diode 1S188FM
D801～812	21015550	〃 1S1555
D813	21090108	Varactor 〃 1SV50
D814～816	21022090	〃 〃 1S2209
		CRYSTAL
X801	71800100	HC-18/U 13.9MHz #210052-1
X802	71800101	〃 14.0111... #210052-2
X803	71800102	〃 14.1222... #210052-3
X804	71800103	〃 14.2333... #210052-4
X805	71500104	HC-25/U 13.8333... #210053-1
X806	71500176	HC-25/U 13.9444... #210053-2
X806	71500186	〃 14.0555... #210053-3
X808	71500187	〃 14.3000 #210053-4
X809	—	〃 Option #210053-5
X810	—	〃 〃 #210053-6
X811	—	〃 〃 #210053-7
X812	—	〃 〃 #210053-8

PARTS LIST

		CRYSTAL SOCKET								
XS801,802	69000006	S-14-12P								
		RESISTOR								
R819,823,829,831	40143101	Carbon Film			¼W	VJ	100Ω			
R828	40143221	〃	〃	〃	〃	220Ω				
R822	40143561	〃	〃	〃	〃	560Ω				
R818a	40143102	〃	〃	〃	〃	1KΩ				
R801~812	40143152	〃	〃	〃	〃	1.5KΩ				
R813,827	40143222	〃	〃	〃	〃	2.2KΩ				
R817,821	40143472	〃	〃	〃	〃	4.7KΩ				
R816,826	40143103	〃	〃	〃	〃	10KΩ				
R820	40143223	〃	〃	〃	〃	22KΩ				
R814,815	40143473	〃	〃	〃	〃	47KΩ				
R824,825,830	40143104	〃	〃	〃	〃	100KΩ				
		CAPACITOR								
C839	31829059	Ceramic Disc		50WV	0.5PF	SL				
C844,852	31829030	〃	〃	〃	3PF	SL				
C838,841	31829070	〃	〃	〃	7PF	SL				
C847	31829080	〃	〃	〃	8PF	SL				
C837,840	31829150	〃	〃	〃	15PF	SL				
C842	31829180	〃	〃	〃	18PF	SL				
C849	31829200	〃	〃	〃	20PF	SL				
C832	31829390	〃	〃	〃	39PF	SL				
C802~812	31827200	〃	〃	〃	20PF	UJ				
C801,833	31827330	〃	〃	〃	33PF	UJ				
C828	31827560	〃	〃	〃	56PF	UJ				
C830	31827221	〃	〃	〃	220PF	UJ				
C850	30820102	〃	〃	〃	0.001μF					
C813~827,831,834~836 C843,845,846,848	30820103	〃	〃	〃	0.01μF					
C851	30325103	Chip		25WV	0.01μF					
		TRIMMER CAPACITOR								
TC802~812	39000007	ECV-1ZW		20×40	20PF					
TC813,814	39000011	〃		20×53	20PF					
TC815	39000010	〃		10×53	10PF					
		INDUCTOR								
L801	54150999	R12-5099X			#220313					
		TRANSFORMER								
T801,802	54147970	R12-4797			#220110					
T803	54141020	R12-4102			#220111					
TP801,802	91100008	Wrapping Terminal C								

FIX unit

Symbol Number	Parts Number	Description					
PB-1750	60417500	Printed Circuit Board					
	017500AZ	PCB with components					
		TRANSISTOR					
Q901,902	22303724	Silicon Transistor				2SC372Y	
		DIODE					
D901~911	21015550	Silicon Diode				1S1555	
		CRYSTAL					
X901~905	—	HC-25/U Option				#210055	
		CRYSTAL SOCKET					
XS901	69000006	HC-25/U				12P	
		RESISTOR					
R905,908,909	40143101	Carbon Film			¼W	VJ	100Ω
R904	40143221	〃	〃	〃	〃	220Ω	
R901	40143152	〃	〃	〃	〃	1.5KΩ	
R902,907,910	40143562	〃	〃	〃	〃	5.6KΩ	
R906	40143822	〃	〃	〃	〃	8.2KΩ	
R903	40143223	〃	〃	〃	〃	22KΩ	
		CAPACITOR					
C930	31820080	Ceramic Disc		50WV	8PF	CH	
C931	31820200	〃	〃	〃	20PF	CH	
C917~927	31820300	〃	〃	〃	30PF	CH	
C929	31820101	〃	〃	〃	100PF	CH	
C928	31820201	〃	〃	〃	200PF	CH	
C932,933	31829201	〃	〃	〃	200PF	SL	
C901~916	30820103	〃	〃	〃	0.01μF		
		TRIMMER CAPACITOR					
TC901~911	39000007	ECV-1ZW			20×40	20PF	
		INDUCTOR					
L901~911	53020001	Micro Inductor			FL5H	1mH	
L912	53010003	〃				250μH	
L913	53020012	〃			FL4H	1.2μH	

PARTS LIST

PLL unit

Symbol Number	Parts Number	Description
		Printed Circuit Board
PB-1747	60417470	PD board
PB-1748	60417480	PLL board
PB-1830A	60418301	VCO board
	017480AZ	PLL unit with components
		IC, FET & TRANSISTOR
Q1008	25000164	IC μPC78L05
Q1009	25000135	〃 μPC1008C/MC4044
Q1014	25000130	〃 SN75450B
Q1001	22800196	FET 2SK19BL
Q1002,1004	23800401	〃 3SK40M
Q1006,1007,1011	22303724	Silicon Transistor 2SC372Y
Q1010	22303730	〃 〃 2SC373
Q1003,1005	22307842	〃 〃 2SC784R
		IC SOCKET
QS1001	68140008	116-14-30-114
		DIODE
D1004～1008	21015550	Silicon diode 1S1555
D1001,1002	21022080	Varactor 〃 1S2208
D1003	21022090	〃 〃 1S2209
		RESISTOR
R1003,1004,1008,1011 R1013,1014,1018,1019 R1024,1030,1033	40143101	Carbon Film ¼W VJ 100Ω
R1023,1028,1035,1041 R1045	40143102	〃 〃 〃 〃 1KΩ
R1036	40143152	〃 〃 〃 〃 1.5KΩ
R1032,1038 ,1039	40143222	〃 〃 〃 〃 2.2KΩ
R1025	40143272	〃 〃 〃 〃 2.7KΩ
R1029	40143332	〃 〃 〃 〃 3.3KΩ
R1012,1034,1040,1047	40143472	〃 〃 〃 〃 4.7KΩ
R1021,1027	40143103	〃 〃 〃 〃 10KΩ
R1010	40143223	〃 〃 〃 〃 22KΩ
R1022,1026	40143393	〃 〃 〃 〃 39KΩ
R1002	40143563	〃 〃 〃 〃 56KΩ
R1001,1005～1007, R1015～1017,1031, R1037,1043	40143104	〃 〃 〃 〃 100KΩ
		CAPACITOR
C1015	31820010	Ceramic Disc 50WV 1PF CH
C1002	31820020	〃 〃 〃 2PF CH
C1006	31820030	〃 〃 〃 3PF CH
C1001,1016	31820050	〃 〃 〃 5PF CH
C1018	31820060	〃 〃 〃 6PF CH
C1003～1005	31820070	〃 〃 〃 7PF CH
C1009,1027,1028	31820100	〃 〃 〃 10PF CH
C1007	31820120	Ceramic Disc 50WV 12PF CH
C1037,1044,1046,1047	31829470	〃 〃 〃 47PF SL
C1035	31829680	〃 〃 〃 68PF SL
C1032～1034	31829820	〃 〃 〃 82PF SL
C1029	31829101	〃 〃 〃 100PF SL
C1057	31829221	〃 〃 〃 220PF SL
C1045	31829271	〃 〃 〃 270PF SL
C1056	31827070	〃 〃 〃 7PF UJ
C1008,1011～1014, C1017,1019,1020, C1024～1026,1031, C1048,1054	30820102	〃 〃 〃 0.001μF
C1030,1036,1038,1052 C1053,1055	30820103	〃 〃 〃 0.01μF
C1042,1043	36526224	Tantalum 35WV 0.22μF
C1040	36526334	〃 〃 0.33μF
C1041	36326685	Noise limiter 20WV 6.8μF
C1049～1051	32821102	Ceramic feed thru 50WV 0.001μF
C1010,1039	34220106	Electrolytic 16WV 10μF
		TRIMMER CAPACITOR
TC1001	39000069	TZ01Y070A 7PF
TC1002	39000010	ECV-1ZW 10×53 10PF
		INDUCTOR
L1002	55003275	#220359A
L1004,1005	55003120	RFC #220206
L1003	53020031	Micro Inductor FL-4H 0.68μF
L1006,1007	53020005	〃 〃 〃 3.3μH
L1001	53020018	〃 〃 〃 10μH
L1008	53020026	〃 〃 FL-5H 47μH
L1009	53020017	〃 〃 FL-4H 1.5μH
L1010	53020027	〃 〃 FL-5H 270μH
		TRANSFORMER
T1001	54141029	R12-4102 #220111
	91100008	Wrapping terminal C
	91001102	Seal terminal A102

TONE BURST unit

Symbol Number	Parts Number	Description
PB-1752	60417520	Printed Circuit Board
	017520AZ	PCB with components
		IC & TRANSISTOR
Q1101	25000114	IC MC14011B
Q1102	25000155	〃 MSM5576
Q1103	22303724	Transistor 2SC372Y
Q1104,1105	22310005	〃 2SC1000GR

PARTS LIST

		DIODE	
D1101~1105	21015550	Silicon Diode	1S1555
		CRYSTAL	
X1101	71500174	HC-25/U (1800Hz Tone) 3.6864MHz	#210060-1
	71500188	〃 (1750Hz Tone) 3.584MHz	#210060-2
		〃 Option	#210060-3
		CRYSTAL SOCKET	
XS1101	69010012	HC-25/U SD0105	
		RESISTOR	
R1105,1122~1125	40143101	Carbon Film ¼W VJ	100Ω
R1117,1118	40143471	〃 〃 〃 〃	470Ω
R1106,1107,1119	40143102	〃 〃 〃 〃	1KΩ
R1121	40143332	〃 〃 〃 〃	3.3KΩ
R1108~1110,1113, R1114,1120	40143472	〃 〃 〃 〃	4.7KΩ
R1116	40143123	〃 〃 〃 〃	12KΩ
R1115	40143473	〃 〃 〃 〃	47KΩ
R1101,1111,1112	40143104	〃 〃 〃 〃	100KΩ
R1102~1104	40143105	〃 〃 〃 〃	1MΩ
R1126	41143105	〃 〃 〃 TJ	1MΩ
		POTENTIOMETER	
VR1101	49907205	EVL-VOAA00B26	2MΩB
VR1102	49907103	〃 〃 14	10KΩB
VR1103~1106	49906103	〃 SOAA00B14	10KΩB
		CAPACITOR	
C1106,1107	31829470	Ceramic Disc 50WV	47PF SL
C1120~1125	30820102	〃 〃 〃	0.001μF
C1101,1104,1105,1108	30820103	〃 〃 〃	0.01μF
C1113	36825222	Mylar 〃	0.002μF
C1114	36825472	〃 〃	0.0047μF
C1102,1109,1110,1117	36825103	〃 〃	0.01μF
C1103	36526474	Tantalum 35WV	0.47μF
C1111	34220105	Electrolytic 16WV	1μF
C1112,1116,1119	34220106	〃 〃	10μF
C1118	34220226	〃 〃	22μF
C1115	34220476	〃 〃	47μF
		RELAY	
RL1101	70000033	LZN2-1	
	91100008	Wrapping terminal C	

		CONNECTOR
J1101	68060013	3022-06A
		PLUG
P1101	67040006	3021-04

KEYING unit

Symbol Number	Parts Number	Description
PB-1751A	60417511	Printed Circuit Board
	017511AZ	PCB with components
		IC & TRANSISTOR
Q1201	25000114	IC MC14011B
Q1202	22303724	Transistor 2SC372Y
		DIODE
D1201~1208	21015550	Silicon Diode 1S1555
		RESISTOR
R1201,1203,1205	40143102	Carbon Film ¼W 1KΩ
R1202	40143562	〃 〃 〃 5.6KΩ
R1204	40143473	〃 〃 〃 47KΩ
		CAPACITOR
C1201~1210	30820102	Ceramic Disc 50WV 0.001μF
C1211	36526334	Tantalum 35WV 0.33μF
		POTENTIOMETER
VR1210	49906202	EVL-SOAA-B23 2KΩB
VR1201~1209	49906503	〃 〃 B54 50KΩB

VFO unit

Symbol Number	Parts Number	Description
PB-1774	60417740	Printed Circuit Board
	017740AZ	VFO unit assembly
		FET & TRANSISTOR
Q1302	22800195	FET 2SK19GR
Q1301,1303	22303724	Silicon Transistor 2SC372Y

PARTS LIST

		RESISTOR				
R1302	40143101	Carbon Film	¼W	VJ		100Ω
R1310	40143151	〃	〃	〃	〃	150Ω
R1307	40143471	〃	〃	〃	〃	470Ω
R1308	40143222	〃	〃	〃	〃	2.2KΩ
R1305	40143272	〃	〃	〃	〃	2.7KΩ
R1301	40143332	〃	〃	〃	〃	3.3KΩ
R1303	40143183	〃	〃	〃	〃	18KΩ
R1304	40143333	〃	〃	〃	〃	33KΩ
R1306,1309	40143104	〃	〃	〃	〃	100KΩ
		CAPACITOR				
C1302	31820040	Ceramic Disc	50WV	4PF	CH	
C1304	31820330	〃	〃	〃	33PF	CH
C1313	31820390	〃	〃	〃	39PF	CH
C1305	31820510	〃	〃	〃	51PF	CH
C1311	31820680	〃	〃	〃	68PF	CH
C1307,1310	31820221	〃	〃	〃	220PF	CH
C1306	31820271	〃	〃	〃	270PF	CH
C1301	31827040	〃	〃	〃	4PF	UJ
C1303	31827070	〃	〃	〃	7PF	UJ
C1308,1309,1312, C1314~1316	30820103	〃	〃	〃	0.01μF	
		VARIABLE CAPACITOR				
VC1301	39000027	C521-112A				
		TRIMMER CAPACITOR				
TC1301	39000070	TSN-100D15				15PF
TC1302	39000005	ECV-1ZW	50×32			50PF
		INDUCTOR				
L1301	55003276					#220314
L1303	53010001	Micro Inductor				10μH
L1302	53030001	〃	〃			1mH
		CONNECTOR				
J1301		SI-6303				
	91100008	Wrapping terminal C				
	91001102	Seal terminal A102				

REG board

Symbol Number	Parts Number	Description
PB-1756A	60417561	Printed Circuit Board
	017561AZ	PCB with components
		IC & TRANSISTOR
Q1404	25000116	IC μPC14308S
Q1401	22402350	Silicon Transistor 2SD313
Q1402,1403	22303724	〃 〃 2SC372Y

		DIODE		
D1401	21015550	Silicon Diode		1S1555
D1402	21090043	Zener	〃	WZ090
		RESISTOR		
R1401	40143331	Carbon Film	¼W VJ	330Ω
R1406	40143471	〃	〃 〃 〃	470Ω
R1402	40143561	〃	〃 〃 〃	560Ω
R1403	40143821	〃	〃 〃 〃	820Ω
R1404	40143272	〃	〃 〃 〃	2.7KΩ
R1405	44144059	Wire Wound	〃	0.05Ω
		POTENTIOMETER		
VR1401	49905471	SR19R		470ΩB
		CAPACITOR		
C1402	30820102	Ceramic Disc	50WV	0.001μF
C1404	34220476	Electrolytic	16WV T	47μF
C1403	34220227	〃	〃	220μF
C1401	35320108	〃	25WV	1000μF
	91100008	Wrapping terminal C		
	91100012	Wrapping terminal D		

LEVER SWITCH board

Symbol Number	Parts Number	Description
PB-1777	60417770	Printed Circuit Board
	017770AZ	PCB with components
		RESISTOR
R1502	41143153	Carbon Film ¼W TJ 15KΩ
R1501	41143223	〃 〃 〃 〃 22KΩ
R1503,1504	42124331	〃 Composition ½W GK 330Ω
		SWITCH
S1501,1505	64000101	SLE 62301
S1502~1504	64000103	〃 62251

PARTS LIST

PUSH SWITCH board

Symbol Number	Parts Number	Description
PB-1832A	60418321	Printed Circuit Board
	018321AZ	PCB with components
		DIODE
D1601~1603,1605	21090140	LED GD4 203SRD
D1604	21090011	Silicon Diode 10D1
		RESISTOR
R1604	42124221	Carbon Composition ½WGK 220Ω
R1601~1603	42124331	〃 〃 〃 〃 330Ω
		POTENTIOMETER
VR1601	49906104	EVL-SOAA 00B15 100KΩB
		SWITCH
S1601~1604	65000036	MB-0202AA2060 B-2U-EE
S1605	65000037	MB-0201AA2060 B-2U-OA

OSC (COUNTER LOCAL) unit

Symbol Number	Parts Number	Description
PB-1761	60417610	Printed Circuit Board
PB-1804	60418040	Connector Board
	017610AZ	OSC unit with components
		TRANSISTOR
Q1701	22303730	Silicon Transistor 2SC373
Q1702,1703	22307104	〃 〃 2SC710
		DIODE
D1701~1704	21090142	Silicon Diode MC301
		CRYSTAL
X1701	71800099	HC-18/U 14.3667MHz #210054
		RESISTOR
R1712,1713,1717	40143101	Carbon Film ¼W VJ 100Ω
R1716	40143221	〃 〃 〃 〃 220Ω
R1711	40143561	〃 〃 〃 〃 560Ω
R1701~1705,1708	40143102	〃 〃 〃 〃 1KΩ
R1715	40143222	〃 〃 〃 〃 2.2KΩ
R1710	40143472	〃 〃 〃 〃 4.7KΩ
R1707,1714	40143103	Carbon Film ¼W VJ 10KΩ
R1706,1709	40143223	〃 〃 〃 〃 22KΩ
		CAPACITOR
C1709~1712	31820470	Ceramic Disc 50WV 47PF CH
C1720,1726	31829059	〃 〃 〃 0.5PF SL
C1728	31829050	〃 〃 〃 5PF SL
C1725	31829070	〃 〃 〃 7PF SL
C1727	31829090	〃 〃 〃 9PF SL
C1716	31829220	〃 〃 〃 22PF SL
C1719	31829270	〃 〃 〃 27PF SL
C1721,1722	31829300	〃 〃 〃 30PF SL
C1723,1724	30820102	〃 〃 〃 0.001μF
C1705~1708,1713, C1717,1718	30820103	〃 〃 〃 0.01μF
C1729~1733	32821102	Feed Thru 〃 1000PF
C1715	36824101	Styrol 〃 100PF
C1714	36824221	〃 〃 220PF
C1701~1704	34220106	Electrolytic 16WV 10μF
		TRIMMER CAPACITOR
TC1701~1704	39000070	ECV-1ZW 30×40 30PF
		INDUCTOR
L1701~1705	53020001	Micro Inductor FL5H 1mH
		TRANSFORMER
T1701,1702	54147970	R-12 4797 #220110
T1703,1704	54141020	R-12 4102 #220111
		MINI CONNECTOR
J1701	67130001	5048-13A
TP1701~1707	91100008	Wrapping terminal C

COUNTER unit

Symbol Number	Parts Number	Description
PB-1734	60417340	LED board
PB-1735	60417350	Counter board
PB-1803	60418030	Connector board
	017350AZ	Counter unit Assembly
		IC FET & TRANSISTOR
Q1802	25000104	IC SN76514
Q1805	25000054	〃 MSM5564
Q1806	25000153	〃 F4011
Q1807	25000114	〃 MC14011B
Q1808	25000148	〃 TC5032

PARTS LIST

Q1818	25000085	IC	MSM561	C1843	34120477	Electrolytic 16WV	470μF
Q1819~1821	25000154	〃	SN75453				
Q1801	22800195	FET	2SK19GR				
Q1803	22307842	Transistor	2SC784R				
Q1804,1809	22303724	〃	2SC372Y				
Q1810	22104963	〃	2SA496				
Q1811~1817	22304960	〃	2SC496			TRIMMER CAPACITOR	
Q1822~1828	21090135	7 Segment LED	5082-7740	TC1801	39000011	ECV-1ZW 20×53	20PF
		IC SOCKET				INDUCTOR	
DS1801	68140008	116-14-30-114	14P	L1801,1802	53020014	Micro Inductor	FL4H 1.8μH
DS1802	68280001	116-28-30-114	28P				
						MINI CONNECTOR	
					67100007	5048-10A	
						TRANSFORMER	
		DIODE		T1801,1802	55003261		#220312
D1801	21090011	Silicon Diode	10D1	T1803	55003174		#220209
					91001102	Seal terminal A-102	
		CRYSTAL		TP1801~1806	91100008	Wrapping terminal C	
X1801	71600033	HC-6/W 1.31072MHz	#210056				
					67200003	Board joint 163740	
		RESISTOR				LED board	
R1833,1835	40143470	Carbon Film ¼W VJ	47Ω	Symbol Number	Parts Number	Description	
R1845	40143560	〃 〃 〃 〃	56Ω	PB-1801	60418010	Printed Ciruit Board	
R1824,1834	40143820	〃 〃 〃 〃	82Ω		018010AZ	PCB with components	
R1805,1806,1836~1842	40143101	〃 〃 〃 〃	100Ω				
R1809	40143221	〃 〃 〃 〃	220Ω				
R1813,1823	40143471	〃 〃 〃 〃	470Ω				
R1803,1810	40143102	〃 〃 〃 〃	1KΩ			DIODE	
R1807	40143392	〃 〃 〃 〃	3.9KΩ	D1901~1907	21090140	LED GD-4 203SRD	
R1815,1817,1818, R1820~1822,1843	40143103	〃 〃 〃 〃	10KΩ				
R1808,1811,1812	40143153	〃 〃 〃 〃	15KΩ				
R1816,1819	40143563	〃 〃 〃 〃	56KΩ			RESISTOR	
R1802,1814	40143104	〃 〃 〃 〃	100KΩ	R1901~1905	42124331	Carbon Composition ½W	330Ω
R1844	40143224	〃 〃 〃 〃	220KΩ				
R1832	40143564	〃 〃 〃 〃	560KΩ				
R1825~1831	42124330	〃 composition ½WGK	33Ω				
						BUFFER AMP board	
				Symbol Number	Parts Number	Description	
				PB-1671A·	60416711	Printed Circuit Board	
		CAPACITOR			016711AZ	PCB with components	
C1824,1825	31820510	Ceramic Disc 50W	51PF CH				
C1806	31829059	〃 〃 〃	0.5PFSL				
C1801,1805,1807,1808	31829050	〃 〃 〃	5PF SL				
C1811	31829270	〃 〃 〃	27PF SL			FET	
C1827~1831	31829221	〃 〃 〃	220PFSL	Q2001	22800195	FET	2SK19GR
C1802,1804,1809,1810 C1812~1816,1819, C1844~1848	30820102	〃 〃 〃	0.001μF				
C1817,1818,1820~ C1823,1826,1832,1836 C1837	30820103	〃 〃 〃	0.01μF			RESISTOR	
				R2002,2003	41143101	Carbon Film ¼W TJ	100Ω
				R2004	41143102	〃 〃 〃 〃	1KΩ
C1734	36916337	Tantalum 〃 6.3WV	330μF	R2001	41143104	〃 〃 〃 〃	100KΩ
C1839~1842	32821102	Feed Thru 50WV	0.001μF				
C1833,1838	34220106	Electrolytic 16WV R	10μF				
C1803	34120107	〃 10WV R	100μF				

PARTS LIST

		CAPACITOR						
C2004	31829060	Ceramic Disc	50WV	6PF	SL			
C2001	31829470	〃	〃	〃	47PF	SL		
C2002,2003	30820102	〃	〃	〃	0.001μF			
		TRANSFORMER						
T2001	54141020	R12-4102				＃220111		

MARKER unit

Symbol Number	Parts Number	Description						
		Printed Circuit Board						
PB-1802	60418020	Marker board						
PB-1804	60418040	Connector board						
	018020AZ	Marker unit with components						
		IC & TRANSISTOR						
Q2103	25000108	IC	34024PC					
Q2101,2102,2104	22303724	Transistor	2SC372Y					
		DIODE						
D2101	21090139	Zener	RD8.2EB					
		CRYSTAL						
X2101	71800060	HC-18/U	12.8MHz					
		RESISTOR						
R2109	40143271	Carbon Film	¼W	VJ	270Ω			
R2103,2105	40143102	〃	〃	〃	〃	1KΩ		
R2108	40143222	〃	〃	〃	〃	2.2KΩ		
R2102	40143103	〃	〃	〃	〃	10KΩ		
R2101,2107	40143223	〃	〃	〃	〃	22KΩ		
R2106	40143104	〃	〃	〃	〃	100KΩ		
R2104	40143224	〃	〃	〃	〃	220KΩ		
		CAPACITOR						
C2101,2107	31820270	Ceramic Disc	50WV	27P	CH			
C2102,2103	31820221	〃	〃	〃	220PFCH			
C2108	31829030	〃	〃	〃	3PF	SL		
C2104～2106,2110	30820103	〃	〃	〃	0.01μF			
C2111	32821102	Feed Tnru	50W	1000PF				
C2109	35220106	Electrolytic	16W	10μF				

		TRIMMER CAPACITOR		
TC2101	39000007	ECV 1ZW	20×40	
		INDUCTOR		
L2101	53010002	Micro Inductor		22μH
L2102	53010003	〃	〃	250μH
	91100008	Wrapping terminal C		

RELAY board

Symbol Number	Parts Number	Description		
PB-1829	60418290	Printed Circuit Board		
	018290AZ	PCB with components		
		RELAY		
RL2301	70000031	BR-211	D012M	

ACCESSORIES

Symbol Number	Parts Number	Description	
	77000011	Microphone Assembly YE-11	
		with Microphone hanger, Screws	
	67040001	Microphone Plug FM-144P	
	67020005	Antenna plug	PL-259
	67050003	Accessory plug	CP-0084
	67020002	Key plug	SH-3001
	67020003	External Speaker plug	P-2240
	67020003	Headphone plug	P-2240
	67030002	Plug adaptor	KA-409
	67020001	RCA plug	CN-7017P
	73000003	Fuse 3A (AC)	
	73000005	Fuse 10A (DC)	
	96000001	AC power cord	＃240011
	68040005	Power plug	QMSP4FK
	96000003	DC power cord	＃240068
	68040005	Power plug	QMSP4FK
	69000002	Fuse holder	SN1102
	67020008	Cigarette lighter adaptor	