

INSTRUCTION MANUAL FT-221R

YAESU MUSEN CO., LTD.

TOKYO JAPAN

TABLE OF CONTENTS

	(Page)
GENERAL DESCRIPTION	1
SPECIFICATION	2
INSTALLATION	4
CONTROLS AND SWITCHES	6
REAR PANEL CONNECTIONS	8
OPERATION	9
BLOCK DIAGRAM	13
CIRCUIT DESCRIPTION	14
ALIGNMENT AND MAINTENANCE	25
RESISTANCE VOLTAGE CHART	32
PARTS LIST	38

This manual is revised for the units produced starting with Lot No. 009 and the lots produced subsequently.

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FT-221R VHF TRANSCEIVER



GENERAL DESCRIPTION

The model FT-221R two meter transceiver is a precision built, compact, high performance transceiver of advanced design, providing all mode operation: SSB (LSB or USB selectable), AM, CW and FM with repeater offset capability. Advanced PLL (Phase-Lock Loop) circuitry offers unsurpassed stability and clean, spurious free signals. The transceiver operates at an input of 20 watts on 144 through 148 MHz, in eight 500 kHz segments permitting 1 kHz accurate dial readout. All circuits are fully transistorized and computor type plug-in modules are used for increased reliability and service ability.

Adoption of pre-set passband tuning and wide band amplifier techniques, provide the optimum selectivity and performance needed on today's active 2 meter band.

The transceiver is self contained, requiring only an antenna and power source for home, portable or mobile operation. The transceiver may be operated from 100/110/117/200/220 or 234 volt AC when the power transformer is appropriately wired. The FT-221 is normally supplied for 117 volt AC and 12 volt DC operation. Two power cords are

supplied with the transceiver. Selection of AC or DC operation is automatically made when the proper line cord plug is inserted into the receptacle on the rear panel.

Deluxe features such as VOX, break-in CW with side tone, 100 kHz calibrator, noise blanker and squelch are built-in. In addition to continuous VFO coverage, 88 crystal-controlled channels (11 channels x 8 bands = 88 channels), clarifier and speaker are all integral parts of the unit. For "tone burst" actuated repeater operation, an adjustable "tone burst" generator with automatic tone actuation circuit (patent pending) is included.

The entire transceiver weighs approximately 8.5 kg, and is 280 m/m wide, 125 m/m high, and 295 m/m deep. Construction of heavy-gage steel provides an extremely rugged package, virtually immune to the effects of vibration and shock encountered in rugged mobile service.

SPECIFICATIONS

GENERAL

Frequency Range:

 $144.0 \sim 144.5 \text{ MHz}$

 $144.5 \sim 145.0 \text{ MHz}$

 $145.0 \sim 145.5 \text{ MHz}$

145.5 ~ 146.0 MHz

 $146.0 \sim 146.5 \text{ MHz}$

 $146.5 \sim 147.0 \text{ MHz}$

 $147.0 \sim 147.5 \text{ MHz}$

 $147.5 \sim 148.0 \text{ MHz}$

Frequency Readout:

Better than 1 kHz

Emission:

SSB (LSB or USB selectable), AM, FM and

CW.

Power Output:

SSB

12 Watts PEP

FM, CW

14 Watts

AM

2.5 Watts

Frequency Stability:

Within 100 Hz during any 30 minute period after warm up. Not more than 20 Hz with a

10% line voltage variation.

Antenna Impedance:

50 ohms unbalanced

Repeater Burst Signal:

1500 to 2000 Hz adjustable

Repeater Split

600 kHz and any frequency up to 1 MHz

Power Requirement:

AC 100/110/117/200/220/234 volts

50/60 Hz

DC $+12 \sim 14.5$ Volts, negative ground

Power Consumption:

AC Receive 30VA

Transmit 90VA at 10 watts output

DC Receive 0.6A

Transmit 3A at 10 watts output

Size:

280 (W) x 125 (H) x 295 (D) m/m

Weight:

Approx. 8.5 kg

RECEIVER

Sensitivity:

SSB/CW $0.5 \mu V$ for 10 dB S/N

FM

 $0.75 \,\mu\text{V}$ for 20 dB QS

AM

 $1.0 \,\mu\text{V}$ for $10 \,\text{dB S/N}$

Selectivity:

SSB/CW/AM 2.4 kHz at 6 dB

4.1 kHz at 60 dB

FM

±6 kHz at 6 dB

±12 kHz at 60 dB

Image Ratio:

Better than - 60 dB

Spurious Response:

Better than 1 μ V at antenna input

Speaker Impedance:

4 ohms

Audio Output:

2 Watts at 10% distortion

TRANSMITTER

Audio Response:

 $300 \sim 2700 \text{ Hz } \pm 3 \text{ dB}$

Carrier Suppression:

40 dB or better

Unwanted Sideband Suppression:

40 dB or better at 1 kHz

Spurious Radiation:

Down 60 dB or better

FM Deviation:

Maximum 12 kHz: Factory set at ±5 kHz

SEMICONDUCTOR COMPLEMENT

Transistors:				Programmable Uni	ijunction	Transistor:	
2SD114	1	2SC735Y	3	N13T1	1		
2SD313D	3	2SC711	1				
2SC372Y	35	2SA695	1	Diodes:			
2SC784R	5	2SD359	1	DS-130YD	1	WZ-110	2
2SC373	3	2SB529	1	1S1555	57	1N4740	1
MPSA13	2	2SC1000GR	2	10D1	7	GD-1	1
2SC741	1	2N5590	1	M4B-5	1	RD-1	1
2SC730	1	2N5591	1	1S188FM	13	TLR-108	1
				1S1007	12	1SV50	3
FETs:				WZ-061	2	1S2209	12
2SK19GR	15	3SK51	1	WZ-090	1		
2SK19Y	2						
				Thyristor:			
Integrated Circui	ts:			CW-01B	1		
μA703HC	2	TP4011AN	5				
LD3001	2	34024PC	1	Varistor:			
TA7061AP	1	TA7045M	1	MV-5W	1		
TP4049AN	1	TP4027AN	1				

The FT-221R is supplied complete with all cables, connectors, fuses and microphone as shown below.



Figure 1

INSTALLATION

GENERAL

The FT-221R transceiver has been designed primarily for base service, requiring only an antenna. However, the transceiver provides for efficient mobile service. The transceiver has been factory pre-tuned and requires no adjustment for normal operation into a matched 50 ohm load.

The antenna and its location are the most important consideration in both base and mobile installations, where effective communication range is directly related to antenna height. The antenna should always be as high and in the clear as possible, and a minimum distance of 5 feet should be maintained between the VHF and other antennas. In a mobile installation, it is advisable to locate the antenna as far from the engine as practical in order to minimize any ignition noise pickup. In all installations, the most popular antenna types are either a 1/4 wave length whip with unity gain or a 5/8 wave length whip with a base matching device affording approximately 3.5 dB gain. Our mobile antenna, RSL-145, is available through your dealer.

To minimize loss in the antenna system, use the shortest length of coaxial cable that is practical, avoiding any sharp angles or kinks. Use type RG-8/U cable if the transmission line length exceeds 25 feet, while RG-58/U may be used for shorter lengths.

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 sure that the voltage marked on the rear of the transceiver agrees with the local AC supply voltage. If not, please refer to Page 5 for rewiring of the transformer primary 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 according to the local supply voltage: 2 amps for 117 volts and 1 amp for 220 volts. The transceiver should be connected to a good ground. The ground lead should be connected to the terminal marked GND located on the rear panel of the transceiver.

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.

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 space is available. A minimum of two inches air space above the cabinet top and on all sides is recommended to allow proper air flow around the cabinet. You may put it on the seat but be sure that there is clearance between the transceiver bottom and seat. Since the transceiver requires an average of 3 amps on transmit, the fuse in the DC power cable should be rated at 5 amps.

When making connections to the car battery, be certain that the RED lead is connected to the positive (+) terminal and the BLACK lead to the negative (-) terminal of the battery. Reversed connection could permanently damage the transceiver. The BLACK lead should run directly to the negative terminal of the battery. The power cable should be kept away from ignition wires and be as short as possible to minimize voltage drop and to provide a low impedance path from the transceiver to the battery.

Prior to operating the transceiver in a mobile installation, the voltage regulator setting should be checked. In many vehicles, the voltage regulators are very poor and in some cases the regulator may be adjusted for an excessively high charging

voltage. As the battery and regulator age, the maximum voltage while charging can increase to a very high level which is not only detrimental to the battery but could cause damage to the transceiver.

The transceiver is designed to operate from a source voltage range of 11 to 14 volts. It is necessary to carefully set the regulator so that the highest charging voltage does not exceed 14 volts. The transceiver should be switched "OFF" when the vehicle is started in order to prevent voltage transients from damaging the transistors.

It is recommended that the microphone furnished with this transceiver be used, however any other microphone of $500 \sim 600$ ohm impedance may be used. Refer to Figure 2 for the microphone plug connections. The microphone bracket may be put on the side of the cabinet. It may also be put at any convenient place by making two $2.5 \, \text{m/m}$ holes spaced $14 \, \text{m/m}$.

A speaker is built into the transceiver, however the audio output is also available for an external speaker use. Any speaker having a 4 ohm impedance may be used and when the external speaker plug is plugged into the EXT SP jack on the rear panel, the built-in speaker is disabled.

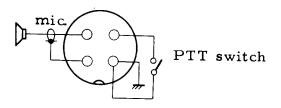






Figure 2: Connection

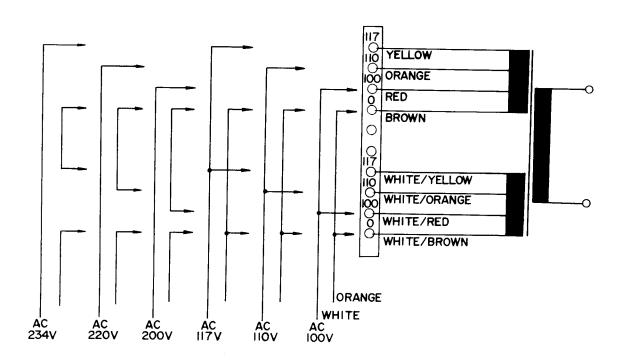


Figure 3: Transformer Primary Wiring

CONTROLS AND SWITCHES

The transceiver has been specifically designed for flexible operation and versatility. All internal controls have been preset at factory. Several of the controls are unusual in operation, and improper adjustment may result in poor quality signals. The

various front panel controls and their functions are described in the following section. Be certain that you thoroughly understand the function of each control before operating the transceiver.

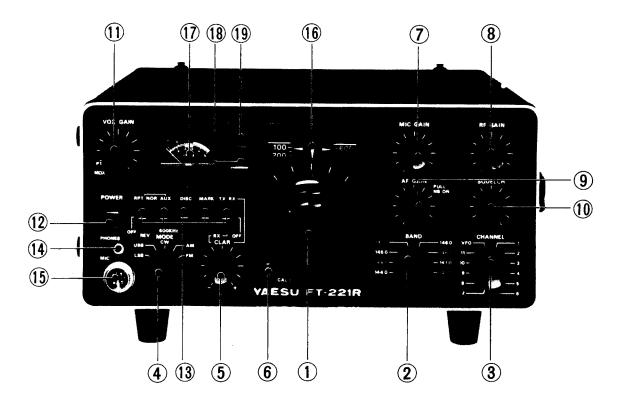


Figure 4: Front Panel Controls & Switches

(1) MAIN TUNING control

The tuning knob, located below the dial window, determines the actual frequency of operation in combination with the BAND switch. A dual rate, concentric dial drive system is employed for a coarse and fine setting of the operating frequency.

(2) BAND switch

The BAND switch is an eight-position switch that selects one of the 500 kHz segments in two meter amateur band.

These segments are:

144.0	:	$144.0 \sim 144.5 \text{ MHz}$
144.5	:	$144.5 \sim 145.0 \text{ MHz}$
145.0	:	145.0 ~ 145.5 MHz
145.5	:	$145.5 \sim 146.0 \text{ MHz}$
146.0	:	$146.0 \sim 146.5 \text{ MHz}$
146.5	:	$146.5 \sim 147.0 \text{ MHz}$
147.0	:	$147.0 \sim 147.5 \text{ MHz}$
147.5	:	147.5 ~ 148.0 MHz

(3) CHANNEL switch

The CHANNEL switch selects one of 11 crystals for crystal controlled operation. This switch also selects the VFO for continuous tuning with the main tuning knob.

(4) MODE switch

The MODE switch is a five-position switch. This switch selects the mode of operation: LSB (lower side band SSB), USB, (upper side band SSB), CW (code operation), AM (amplitude modulation) and FM (frequency modulation).

(5) CLARIFIER control

The CLARIFIER control provides a means of OFF setting the receiver frequency approximately 4 kHz to either side of the transmitting frequency. Thus it is possible to set the pitch of the voice or signal you are receiving to the most readable point without affecting your transmitting frequency. Its

use is particularly valuable in "net" operation when several participants may be transmitting slightly off frequency. The CLARIFIER control may be switched off with CLARIFIER switch and the receiver locked to the transmitting frequency. Normally you will want to keep the CLARIFIER in the OFF position until the initial contact is made. The CLARIFIER switch may also be used to change both transmitting and receiving frequencies simultaneously when the CLARIFIER switch is put in the TX-RX position.

(6) CALIB.

When depressed, this button locks the 1 kHz dial for dial calibration.

(7) MIC GAIN control

The MIC GAIN control varies the audio level from the microphone amplifier stages. The control has sufficient range to permit the use of any 600 ohm dynamic microphone.

(8) RF GAIN control

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

(9) AF GAIN control & switch

The AF GAIN control adjusts the audio output level to the speaker and phone jack. Clockwise rotation increases the audio output. When the knob is pulled out, the noise blanker is activated in order to minimize pulse type noises.

(10) SQUELCH control

This control adjusts the receiver squelch threshold level.

(11) VOX GAIN control & switch

This controls the VOX gain and functions for push to talk, stand-by or manual operation.

(12) POWER switch

The POWER switch turns transceiver "ON" and "OFF" for both AC and DC operation.

(13) FUNCTION switches

RPT

This switch is used for repeater operation.

In the NOR (normal) position, the transmitter frequency shifts 600 kHz down and in the REV (reverse) position, the receiver frequency shifts 600 kHz up.

AUX/600 kHz

Selects the repeater shift frequency. In the 600 kHz position, the TX or RX frequency shifts 600 kHz with the REPEATER switch ON. Any split within 1 MHz can be installed as option. Refer to Repeater Operation paragraph on Page 12.

DISC

This switch selects the meter to read discriminator center current for FM reception.

MARK

100 kHz calibrator switch.

CLAR

Clarifier switch. Turns the CLARIFIER on in upper position, and off in middle position. In the TX-RX position, the CLARIFIER works for both transmit and receive.

(14) PHONE jack

Phone jack for an external headphones or speaker. The internal speaker is disconnected wher the headphone plug is inserted.

(15) MIC jack

The microphone supplied is the recommended one for use with the transceiver, however any microphone having a 500 to 600 ohm impedance may be used.

(16) **DIAL**

Dial window for frequency readout. The coarse scale indicates 100 kHz increments and fine scale indicates 1 kHz increments.

(17) **METER**

The meter indicates signal strength, FM discriminator center current in receive and relative power output in transmit.

(18) CLAR lamp

This lamp lights when the CLARIFIER is in use.

(19) RPT lamp

This lamp lights when the repeater switch is ON.

REAR PANEL CONNECTIONS

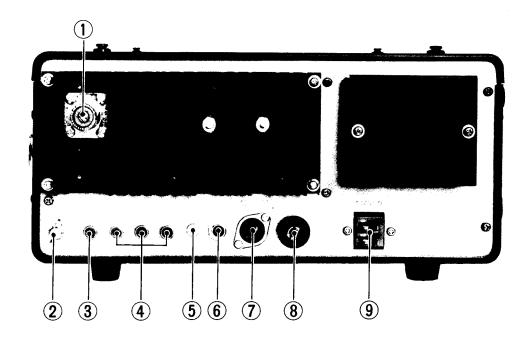


Figure 5: Rear Panel Connections

(1) ANT

Coaxial connector for an antenna.

(2) GND

Ground connection.

(3) ALC

ALC (automatic level control) input.

(4) RL

Relay contacts for the control of external equipment.

(5) SP jack

External speaker audio output.

(6) KEY jack

Key jack for code operation.

(7) TONE-IN

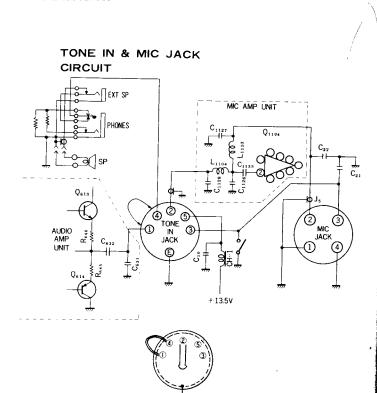
Tone-pad input jack.

(8) FUSE

Fuse holder. For AC operation, a 2 amp fuse is used on 100/117 volts and, a 1 amp fuse on 200/234 volts.

(9) POWER receptacle

Both AC and DC cables are supplied with the transceiver.



Tone in Plug

Figure 6

OPERATION

The tuning procedure of the transceiver is not complicated, however care should be exercised when tuning to insure peak performance of the equipment. The following paragraphs describe the procedure for receiver and transmitter tuning.

INITIAL CHECK

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

DIAL READOUT

The main tuning dial is color coded with the band selector switch for proper frequency readout. When the band selected is marked in white on the transceiver front panel, the operator reads the white scale on the main tuning drum. When the band selected is marked in amber the operator reads the amber scale. The main tuning drum is marked in 50 kHz increments. This provides a coarse frequency setting within the band. The round subdial on the dial window surrounding the tuning knob is scaled in 1 kHz increments and provides fine settings of the transceiver operating frequency. The following example will familiarize yourself with the relationship of main and subdial frequency readout.

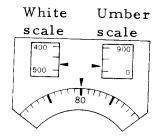


Figure 7

Read the white scale on main dial for the bands 144.0, 145.0, 146.0 and 147.0, and amber scale for 144.5, 145.5, 146.5 and 147.5.

Then the setting shown in the example would be 144.480 MHz on 144.0 BAND switch setting, and 145.480 MHz on 145.0. And also the frequency would be 144.980 MHz on 144.5 BAND switch setting, and 145.980 MHz on 145.5.

RECEIVER

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

POWER · · · · · · · Down to "OFF" position. MODE · · · · · · · · Desired mode. BAND · · · · · Desired band. RPT · · · · · · Lever position horizontal to OFF position. AUX-600 kHz Lever position horizontal to 600 kHz shift $DISC {\cdots} {\cdots} {} Lever \ position \ horizontal$ to OFF position. MARK Lever position horizontal to OFF position. CALR · · · · · · Lever position horizontal to OFF position. NOR-REV. "NOR" position. MAIN TUNING DIAL · · Desired operating frequency. VOX GAIN······PTT. AF GAIN · · · · · · · Desired audio level. RF GAIN · · · · · · · Fully clockwise position. CHANNEL · · · · · · · · · VFO. SQUELCH · · · · · · · Fully counter-clockwise

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

position.

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 should light up, and the transceiver is now ready to operate.

(1) SSB and AM Modes

Using the main tuning control (VFO), tune in an incoming signal. USB (upper side band) is mostly used for 2 meter SSB operation. When the received signal can not be heard clearly, then change to the opposite side band. The RF GAIN control is normally set to the fully clockwise position, but if the incoming signal is extremely strong, it is recommended to turn this control back to prevent overload of the front end. When there is noise caused by automobiles, pull the AF GAIN control out to switch on the NB (noise blanker) in order to eliminate these pulse type noises.

(2) CW Mode

With the CLARIFIER switch in the OFF position, tune in a signal until an 800 Hz beat tone is heard. Under this condition, your transmitting frequency coincides with the received signal. If you desire to hear a beat tone of your choice, then use the CLARIFIER control.

Using the tuning control, tune in an incoming

(3) FM Mode

signal for a maximum and steady S-Meter reading where a natural voice is heard. For accurate tuning, set the DISC switch to the upper ON position. Carefully readjust the tuning control until the meter indicates zero (half way of the full scale). If the S-Meter indication wabbles or if a clean audio output is not available, it is very likely that the signal is in the SSB mode. In this case, turn the MODE switch to USB or LSB position, and carefully tune the tuning control until a clear voice is heard. It is important that the CLARIFIER switch be set to the OFF position when calling the another station. After the initial contact is made, then the CLARIFIER may be used for the desired listening sound.

FREQUENCY CALIBRATION

(1) SSB Mode

Set the CLARIFIER to the OFF position, and the tuning control to the 100 kHz point on the dial nearest to the desired frequency. Set the MARK switch to the upper position. While pressing the CALIB knob to lock the dial, tune the tuning control for a zero beat. The transceiver must be recalibrated when changing the mode of operation: USB, LSB, AM or CW.

(2) FM Mode

Set the CLARIFIER to the OFF position, and the tuning control to the 100 kHz point in the round dial nearest to the desired operating frequency. Set the MARK switch and DISC switch to ON position. While pressing the CALIB knob down to lock the dial, tune the main tuning control until the meter indicates the green portion of its scale.

NOTE: WHEN THE MARKER SWITCH IS IN THE "ON" POSITION, THE ANTENNA IS DISCONNECTED FOR EASIER CALIBRATION.

TRANSMITTER

Connect a 50 ohm dummy load or a matched antenna to the coaxial fitting on the rear panel. Since the transmitter section utilizes wide band techniques no tuning control is necessary except the main tuning control to select the operating frequency. Plug the microphone into the MIC jack and select the desired mode. Push down the PTT (push-to-talk) switch on the microphone and speak into the microphone.

(1) SSB Mode

The meter indicates maximum deflection on voice peak and zero with no microphone input. Release the PTT switch for receive. Excessive setting of the MIC GAIN will result in poor quality transmitted signals.

(2) AM Mode

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

(3) CW Mode

Plug the key into the KEY jack on the rear panel. In the key down condition, the meter will show a 6 to 8 relative power output, and with the key up, the receiver will recover. The break-in delay time may be adjusted with VR_{601} , under the top cover.

(4) FM Mode

Set the MIC GAIN control to the 12 o'clock position and push the PTT switch on the microphone while speaking normally into the microphone. The meter will show a 6 to 8 relative power output. Release the PTT switch on the microphone for receive.

(5) VOX (Voice Controlled) Operation

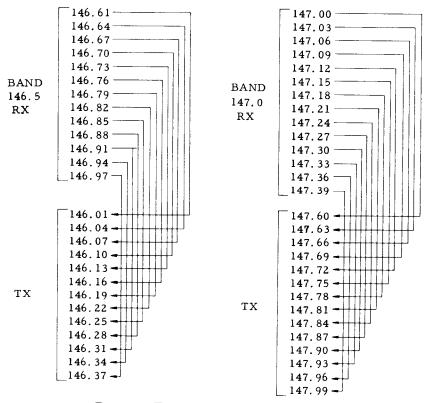
Adjust the VOX GAIN control on the front panel until your voice actuates the transmitter while speaking normally into the microphone. Set the ANTITRIP control to the minimum point in order to prevent the speaker output from tripping the VOX circuit. Do not use more VOX GAIN or ANTITRIP GAIN than necessary. Adjust the DELAY control for a suitable release time. The RELAY control provides coarse adjustment for

relay sensitivity and this control has been preset at factory. These controls are located on the AF AMP UNIT under the top cover.

REPEATER OPERATION

Transmitting and receiving frequencies may be shifted 600 kHz for repeater operation. When the REPEATER switch is ON (upward position) with NOR-REV switch in the NOR (normal) position, the transmitted frequency is shifted 600 kHz down from the dial readout. With the NOR-REV switch at REV position, the received frequency is shifted 600 kHz down from the dial readout. The U.S. model has an automatic cross-over system in which this shift is automatically reversed from 147.0 to 148.0 MHz.

In NOR operation, the transmitting frequency is shifted 600 kHz down for the frequency range of 146.61 through 146.97 MHz and shifted 600 kHz up for the frequency range of 147.00 through 147.39. This is shown on the chart on Figure 8. These relations are reversed with the NOR-REV switch in the REV position. Extreme caution should be observed so as not to transmit outside



Repeater Frequency Chart for U.S. Model

Figure 8

the amateur bands with repeater switch ON. The most repeaters use 600 kHz split between transmitter and receiver frequencies, however, other split than 600 kHz has been adopted in some areas.

When the AUX/600 kHz switch is in the AUX position, the frequency is shifted to any frequency within 1 MHz determined by the optional crystal installed in the local unit. The RPT lamp lights up when the repeater switch is ON.

Tone actuated repeaters can be operated with the built-in tone burst signal which is automatically inserted by the push-to-talk switch at the start of a transmission. When the microphone PTT switch is depressed for 0.2-0.5 seconds before the voice transmission, the burst tone signal is inserted at the beginning of the transmission. Normal operation of the PTT switch does not generate the burst signal. The frequency of the burst signal may be adjusted from 1500 to 2000 Hz with VR_{1002} under the top cover.

AUX crystal specification is calculated as follows:

BAND 146.5; X MHz =

 $(127.8 - shift frequency) \div 9$

BAND 147.0; X MHz =

 $(128.3 + \text{shift frequency}) \div 9$

Example 1

Calculate crystal frequency for $-800\ kHz$ shift in 146.5 MHz segment.

(TX frequency 800 kHz lower)

 $X \text{ MHz} = (127.8 - 0.8) \div 9 = 14.111 \text{ MHz}$

Example 2

Calculate crystal frequency for +800 kHz shift in 147.0 MHz segment.

(TX frequency 800 kHz higher)

 $X \text{ MHz} = (128.3 + 0.8) \div 9 = 14.344 \text{ MHz}$

CRYSTAL CONTROLLED OPERATION

In addition to the normal VFO controlled operation, eleven crystals may be selected by the channel switch on the front panel for crystal controlled operation. This crystal controlled operation is of great advantage when the transceiver is operated on the preset frequencies. Since the entire 2 meter band has been split into eight bands, eleven crystals can be used as 88 crystal controlled channels.

The crystal holders accept standard, HC-25/U type crystals. All crystal frequencies must fall between 8,000 kHz and 8,500 kHz. A trimmer capacitor has been connected in series with each crystal to permit proper frequency adjustment. Adjustment of this trimmer will change the crystal frequency approximately 1 kHz. The correct crystal frequency for any desired operating frequency may be determined by using the following formula:

$$fx = fo - f_1$$

where fx: crystal frequency

fo : operating frequency f₁ : given from Table 1

BAND (MHz)	LSB (kHz)	USB (kHz)	FM (MHz)
144.0-144.5	136001.5	135998.5	136.0
144.5-145.0	136501.5	136498.5	136.5
145.0-145.5	137001.5	136998.5	137.0
145.5-146.0	137501.5	137498.5	137.5
146.0-146.5	138001.5	137998.5	138.0
146.5-147.0	138501.5	138498.5	138.5
147.0-147.5	139001.5	138998.5	139.0
147.5-148.0	139501.5	139498.5	139.5

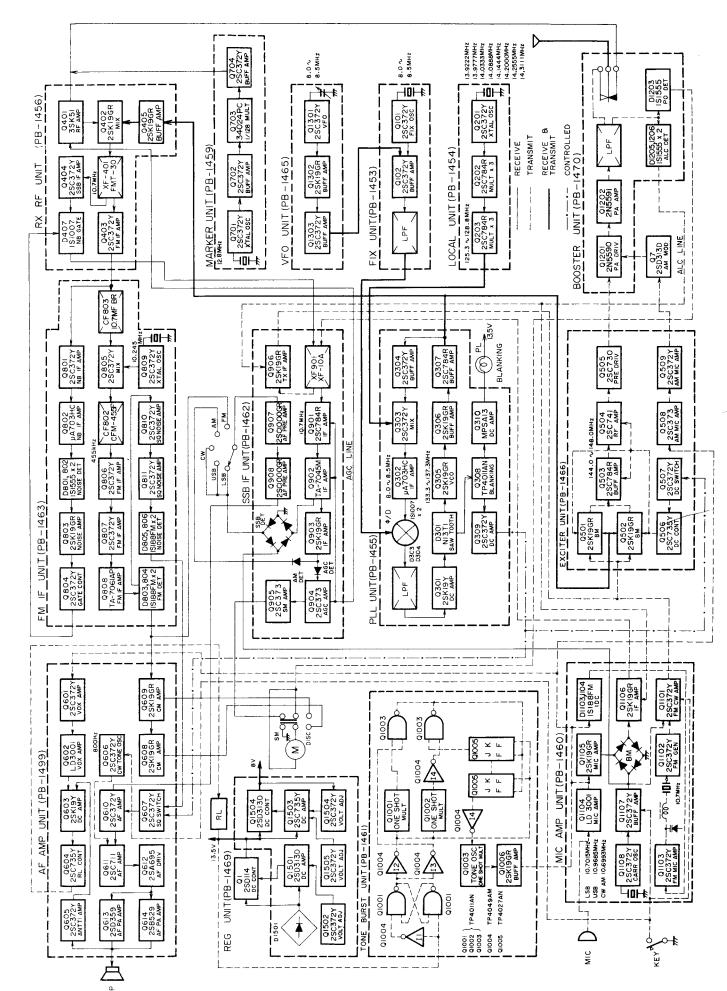
Table 1

Example (1)— Find the proper crystal frequency for 144.15 MHz USB operation

From the Table 1, f_1 for USB is 135998.5. Therefore, $f_X = 144.15 - 135.9985 = 8151.5$ kHz

Example (2) - 144.72 MHz FM operation

fx = 144.72 - 136.5 = 8220 kHz



CIRCUIT DESCRIPTION

GENERAL

The block diagram and the circuit description that follows with provide you will a better understanding of this transceiver. Computor type plug-in modules have been adoped throughout the transceiver.

The transceiver consists of 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 455 kHz second IF for FM. A single conversion transmitter, utilizing a 10.7 MHz high frequency crystal filter for SSB generation and varactor diode frequency modulation on 10.7 MHz crystal oscillator is incorporated.

NOTE:

The parts number starts with the number shown below the printed board designation. For example, the field effect transistor 3SK51 in RX RF unit PB-1456 is Q_{401} .

RECEIVER

RX RF UNIT (PB-1456)

The 144 MHz input signal from the antenna is fed through the antenna relay, RL_{1201} , to pin 5 of the RX RF unit. The signal is amplified by the RF amplifier Q_{401} , 3SK51 field effect transistor, and then fed to the gate of the first mixer Q_{402} , 2SK19GR, where the input signal is heterodyned with a 133.3 MHz to 137.3 MHz signal, delivered

from phase-lock-loop unit, and thus produces an IF signal of 10.7 MHz at the drain circuit of Q_{402} .

The input and output circuits of the RF amplifier utilize a double tuned circuit, which is sharply tuned to the center of the band with the varactor diodes, D_{401} through D_{404} , thus eliminating cross modulation and intermodulation effects.

The IF signal passes through crystal filter XF401, FMT-30, and the SSB, AM and CW signal is then fed to the first IF amplifier Q_{404} , 2SC372Y, while the FM signal is fed to Q_{403} , 2SC372Y.

The SSB, AM and CW signal amplified by Q_{404} is fed through a noise blanker gate diode D_{407} , 1S1007, to pin 14, and the FM signal amplified by Q_{403} is fed to pin 9.

SSB IF UNIT (PB-1462)

The SSB, AM and CW signal from pin 14 of the RX RF unit is fed through pin 3 to the SSB IF unit. The signal is fed through the diode switch and a crystal filter, XF-9, to the IF amplifier Q_{901} , 2SC784R. The signal is amplified by Q_{901} and Q_{902} , TA7045M, and then fed to the ring demodulator consisting of D_{904} through D_{907} , 1S1007, 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 28 of the same unit. The IF signal is further amplified by Q_{903} , 2SK19GR, and detected by the AM detector D_{910} , 1S188FM, for AM mode. Then the audio signal is fed through pin 25 to the MODE switch S3D.

A part of the IF signal output from Q_{903} is rectified by D_{908} , 1S1007, and D_{913} , 1S1555, for AGC (automatic gain control). The AGC voltage is amplified by Q_{904} and Q_{905} , 2SC373 and controls the gain of IF amplifier Q_{901} and Q_{902} . A part of

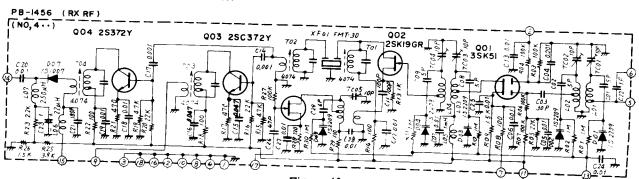


Figure 10

it is fed through pin 17 to the RX RF unit to control the gain of the RF amplifier Q_{401} . The AGC voltage is amplified by the S-meter amplifier Q_{905} , 2SC373, and fed to the S-meter through the DISC/SM switch on the front panel.

The audio signal from the MODE switch is preamplified by Q_{907} and Q_{908} , 2SC1000GR and fed through pin 29 to the AF AMP unit.

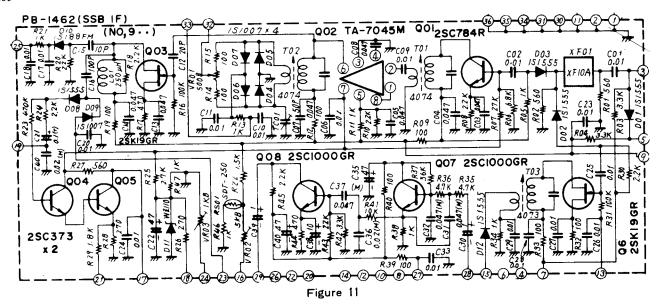
FM IF UNIT (PB-1463)

The FM IF signal from pin 17 of this unit is fed through a ceramic filter CF_{803} , 10.7 MFBR to the second mixer Q_{805} , 2SC372Y, where the 10.7 MHz signal is mixed with the 10.245 MHz signal generated by the second heterodyne oscillator Q_{809} , 2SC372Y, producing a 455 kHz second IF signal. The 455 kHz IF signal is fed through the ceramic filter, CF_{802} , to the second IF amplifier Q_{806} and Q_{807} , 2SC372Y, and the amplifier limitter

 Q_{808} , TA7061AP, which removes any amplitude modulation component on the signal. The output from Q_{808} is applied to the dsicriminator D_{304} and D_{305} , 1S188FM. The discriminator produces an audio output in response 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 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 potentiometer, VR_6 , to the noise amplifier Q_{810} and Q_{811} , 2SC372Y, and detected by D_{805} and D_{806} , 1S188FM. The DC voltage is applied from pin 8 to the squelch controller Q_{607} , 2SC372Y, in the AF AMP unit.

The 10.7 MHz signal is also applied to the noise blanker amplifier Q_{801} , 2SC372Y. The signal is amplified by Q_{801} , 2SC372Y, and Q_{802} , μ A703HC.



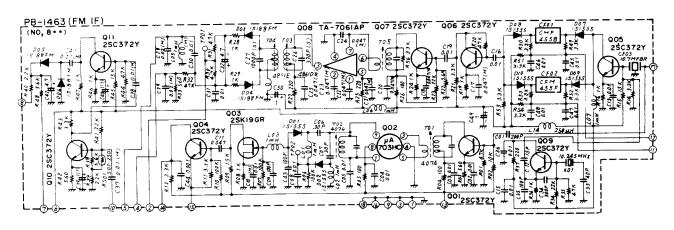


Figure 12

The noise rectifier diodes D_{801} and D_{802} , 1S1555, produce a DC voltage which is amplified by following noise pulse amplifier Q_{803} , 2SK19GR.

Under normal conditions, Q_{803} conducts producing the cut-off voltage to the base of the gate controller Q_{804} , 2SC372Y, in turn the high collector voltage of Q_{804} is supplied from pin 15 to the gate diode D_{407} , 1S1007, in the RX RF unit which conducts to pass the signal freely. With pulse noise, Q_{804} conducts and its collector voltage drops causing the gate diode D_{407} to disconnect the IF signal during the noise pulse exists.

AF AMP UNIT (PB-1499)

The audio signal pre-amplified in the SSB IF unit is fed through pin 13 to the audio amplifier stage consisting of Q_{610} , 2SC372Y, Q_{611} , 2SC711, Q_{612} , 2SA695, Q_{613} , 2SD359 and Q_{614} , 2SB529. The audio power amplifier circuit utilizes the OTL (output transformer less) 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_{607} , 2SC372Y, which conducts with noise when the signal is not present, in turn the audio input is grounded to quiet the audio amplifier. When the signal is present, the Q_{607} is cut-off and permits normal operation of the audio amplifier.

The DC voltage is also applied from pin 12 to quiet the audio amplifier when the phase lock loop circuit is unlocked.

The speech output from the first microphone amplifier is fed through the VOX GAIN control potentiometer, VR_7 , to the VOX amplifier Q_{601} , 2SC372Y, and Q_{602} , LD-3001, from pin 2.

The amplified signal is fed to the VOX rectifier, D_{601} and D_{602} , 1S1555. The rectified DC voltage is applied to the gate of the VOX relay controllers Q_{603} , 2SK19Y, and Q_{604} , 2SC735Y, causing them to conduct and actuate the VOX relay, RL_1 , on the main chassis.

The ANTITRIP circuit provides a threshold voltage to prevent the speaker output from tripping the transceiver into the transmit mode. The receiver audio output voltage is connected through the ANTITRIP potentiometer, VR₆₀₃, to the antitrip amplifier Q₆₀₅, 2SC372Y, and fed to rectifiers, D_{603} and D_{604} , 1S1555. The negative DC output voltage from the rectifier is connected to the gate of Q₆₀₃, and reduces the gain of the VOX control transistor, thus providing the necessary antitrip threshold. The ANTITRIP control, VR₆₀₃, adjusts the value of the antitrip voltage threshold so that the speaker output will not produce an excessive positive voltage from the VOX rectifier that exceeds the negative voltage from the antitrip rectifier causing the controller transistor to actuate the relay. When speaking into the microphone, the

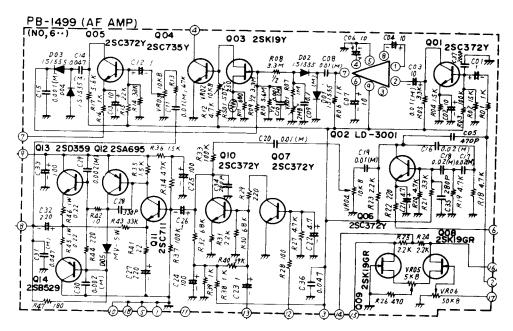


Figure 13

positive voltage will exceed the negative antitrip voltage and actuate the relay. VR₆₀₂ provides coarse adjustment for relay sensitivity.

Relay hold tone will be determined by the DELAY control potentiometer, VR_{601} .

The tone oscillator Q_{606} , 2SC372Y, 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_{606} and coupled through sidetone level control, VR_{604} , to the receiver audio amplifier, Q_{601} , for sidetone monitoring in CW operation. The output from Q_{606} is also coupled to the VOX amplifier, Q_{602} , for breakin CW operation. In the FM mode, a DC voltage at the discrimination output is applied from pin 17, to the differential amplifier Q_{608} and Q_{609} , 2SK19GR.

When the frequency of received signal is shifted from the discriminator center, the resulting DC voltage causes either Q_{608} or Q_{609} to conduct indicating the amount of shift on the meter with the DISC switch in the ON position. VR_{605} balances the differential amplifier and VR_{606} calibrates the sensitivity of the meter.

TRANSMITTER

MIC AMP UNIT (PB-1460)

The speech signal from the microphone is fed from pin 31 to the first microphone amplifier, half of Q_{1104} , LD-3001. The input impedance of the microphone amplifier is 600 ohms. This signal is controlled in amplitude by the MIC GAIN control between pins 29 and 31, and is amplified by the second microphone amplifier, the other half of Q_{1104} , and applied to the source follower Q_{1105} , 2SK19GR, to be delivered to the ring modulator D_{1108} through D_{1111} , 1S1007.

The carrier oscillator Q_{1108} , 2SC372Y, oscillates at 10.7015 MHz for LSB, 10.6985 MHz for USB and 10.6993 MHz for AM/CW depending upon the MODE switch position. In the CW mode, 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 while receiving. The MODE switch selects the crystal by means of a diode switch. The output from the oscillator is fed through the buffer amplifier Q_{1107} , 2SC372Y to the balanced ring modulator D_{1108} through D_{1111} , 1S1007. The

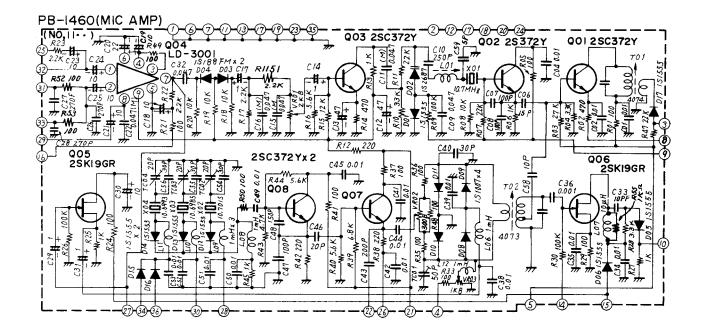


Figure 14

carrier signal output from the buffer amplifier, Q_{1107} , is fed from pin 22 to the SSB IF unit for SSB and CW reception. Carrier balance is obtained with potentiometer, VR_{1002} , and the trimmer capacitor, TC_{1101} . The double side band, suppressed carrier signal is amplified by Q_{1106} , 2SK19GR, and fed from pin 10 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 4 and the carrier signal is fed through T_{1102} to carrier amplifier Q_{1101} , 2SC372Y. The amplified carrier is fed from pin 3 to the EXCITER unit.

The audio signal output from Q_{1104} is fed from pin 27 to pin 12 of the EXCITER unit to be amplified to a sufficient level for low level AM modulation.

In the FM mode, a crystal oscillator Q_{1102} , 2SC372Y, generates a 10.7 MHz signal which is shifted by the varactor diode D_{1102} , 1S2687, in accordance with the speech voltage. The audio signal from the microphone amplifier, Q_{1104} , is applied to the IDA (instantaneous deviation adjustment) circuit. The IDA circuit, composed of diodes D_{1103} and D_{1104} , 1S188FM, clips both positive and negative peaks when they exceed a predetermined level in order to limit the maximum deviation of the transmitter.

The limited audio signal is applied through a low pass filter and deviation potentiometer, VR_{1101} , to the audio amplifier Q_{1103} , 2SC372Y, where it is

amplified and applied to the modulator, varactor diode D_{1102} . The low pass filter limits the transmitter modulation spectrum by attenuating the frequencies above the speech range.

The frequency modulated signal is then amplified by Q_{1101} , 2SC372Y, and fed through the output transformer T_{1101} to pin 5 of the EXCITER unit.

When the MODE switch is in the CW position, the emitter circuit of Q_{1107} and Q_{1101} are connected to the key jack through pin 8 and pin 26.

EXCITER UNIT (PB-1466)

The SSB, AM, CW and FM output signal (10.7 MHz) from the MIC AMP unit is fed to the EXCITER unit from pin 3 and pin 5.

The 10.7 MHz signal is fed to the balanced mixer, consisting of Q_{501} and Q_{502} , 2SK19GR, where the signal is mixed with the 133.3 to 137.3 MHz heterodyne signal delivered from pin 4, producing a 144 to 148 MHz signal. The output signal from the balanced mixer passes through the tuned circuits consisting of L_{501} through L_{504} , which are tuned by the varactor diodes D_{501} through D_{504} , 1S2209, in which voltages are preset in accordance with the band switch position. Thus the circuit is tuned exactly to the operating frequency com-

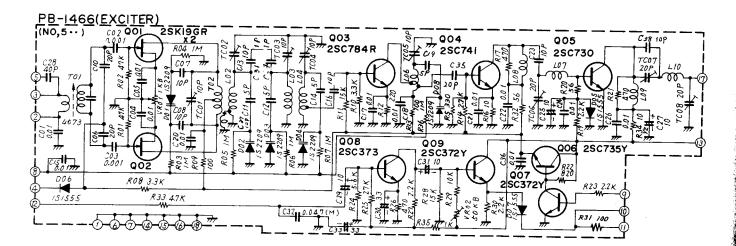


Figure 15

pletely reducing any spurious radiation. The signal is then amplified by the amplifier chain Q_{503} , 2SC784R, Q_{504} , 2SC741, and Q_{505} , 2SC730, and delivered from pin 17 to the BOOSTER unit.

The DC voltage for Q_{501} through Q_{504} is supplied through Q_{506} , 2SC735Y. When the phase lock loop circuit is unlocked, the controller transistor Q_{507} , 2SC372Y, stops conducting and in turn Q_{506} stops supplying the DC voltage for Q_{501} through Q_{504} .

The speech signal from pin 27 of the MIC AMP unit is fed through the AM amplifier Q_{508} , 2SC373, and emitter follower Q_{509} , 2SC372Y, to the AM modulator Q_7 , 2SD313D, which controls the supply voltage for Q_{1201} , 2N5590, in the BOOSTER unit.

BOOSTER UNIT (PB-1470)

The signal from EXCITER unit is fed to the BOOSTER unit and amplified by the driver amplifier Q_{1201} , 2N5590, and the final amplifier Q_{1202} , 2N5591, which delivers 10 watts of RF power to the antenna through a two stage, low-pass filter. The DC voltage to Q_{1201} is supplied through the AM modulator Q_7 , 2SD313D.

The bias voltage is stabilized at 9 volts by a zener diode D_{1209} , 1N4740. Two diodes D_{1201} and D_{1202} , 10D1, are used to protect the power 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_{1203} , 1S188FM, which delivers a resulting DC voltage to the meter where it provides an indication of relative power output from the transceiver.

The DC voltage obtained from rectifying a small portion of the RF output by the ALC diodes D_{1205} and D_{1206} , 1S1555, which are biased by the ALC threshold control VR_{1201} , is applied to the gate of Q_{906} in the SSB IF unit and Q_{1106} in the MIC AMP unit. This controls their gain in order to automatically control the driving level to the PA transistors in order to prevent any distortion caused by overdrive.

Block diodes D_{1207} and D_{1208} disconnect the supply voltage to Q_{1202} while the antenna is disconnected for marker calibration.

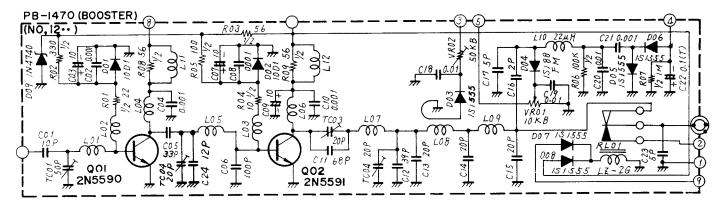


Figure 16

OTHER CIRCUITS

Some circuits work for both transmitting and receiving and are described as follows:

PLL CIRCUIT: VFO unit PB-1465

FIX unit PB-1453 LOCAL unit PB-1454 PLL unit PB-1455

The FT-221R utilizes a phase lock loop system for the heterodyne oscillator providing a stable signal varying from 133.3 through 137.3 MHz to cover the entire 2 meter band.

VFO UNIT (PB-1465)

The VFO module board is installed in the VFO chassis. The VFO (variable frequency oscillator) Q_{1301} , 2SC372Y, generates an 8,000 to 8,500 kHz signal and produces a 500 kHz main tuning dial 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 11 of the FIX oscillator board. The buffer amplifier provides isolation and amplification of the VFO signal.

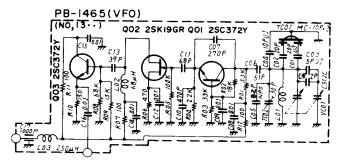


Figure 17

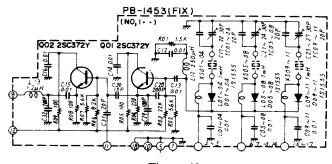


Figure 18

FIX UNIT (PB-1453)

In addition to normal VFO operation, 11 crystals may be selected for crystal controlled operation with the selector switch located on the front panel of the transceiver.

The FIX channel crystal oscillator Q_{101} , 2SC372Y, oscillates at the frequency of the crystal selected by the diode switch D_{101} through D_{111} , 1S1555. The output is fed from pin 8 through the buffer amplifier Q_{102} , 2SC372Y, to the PLL unit.

The signal from the VFO also passes through this buffer stage to the PLL unit.

The crystal frequency falls between 8,000 and 8,500 kHz and is determined as follows.

$$fx = f_0 - f_1$$

where f_1 is given in Table 1 on page 12 and f_0 is the operating frequency.

LOCAL UNIT (PB-1454)

This oscillator generates a heterodyne signal which is used to convert the VCO (voltage controlled oscillator) signal to an 8,000 to 8,500 kHz signal, which is used for the comparison of the phase with that of the reference (VFO) signal.

The crystal controlled oscillator Q_{201} , 2SC372Y, oscillates at the fundamental frequency of the crystal. A varactor diode D_{226} , 1SV50, connected to the base of Q_{201} , is used as a clarifier to shift the oscillator frequency for receiver off-set tuning.

The output from the oscillator is fed to the frequency multiplier stage, Q_{202} and Q_{203} , 2SC784R, producing the ninth harmonic at its output. The crystal is selected by the diode switch connected to the band switch. The relation between the frequency and band is shown on Table 2. The multiplied signal is then fed from pin 3 to the PLL unit.

For repeater operation, a fundamental crystal at 14.1333 MHz, X210, is used to generate a heterodyne signal of 127.2 MHz which is 600 kHz higher than the normal heterodyne signal when the band switch is set to the 146.5 MHz segment and X211 (fundamental frequency 14.3222 MHz) is used to generate 128.3 MHz signal which is 600

kHz higher than the normal heterodyne signal when the band switch is set to the 147.0 segment. A relay, RL_{1001} in the tone burst unit is used to select the above crystals with the Repeater switch, S_8 , in the ON position. When the Normal-Reverse switch, S_9 , is set to the NOR position, the relay selects the repeater crystal on transmit that shifts the transmitting frequency down 600 kHz in the 146.5 MHz segment and shifts up 600 kHz in the 147.0 MHz band. The main VFO tuning dial indicates the received frequency.

With S₉ in the REV position, the relay selects the repeater crystal on receive that shifts the receiver frequency down 600 kHz in the 146.5 MHz segment and shifts up 600 kHz in the 147.0 MHz segment. The main tuning dial now indicates the transmitted frequency.

BAND	Crystal No.	Crystal Frequency	Local Frequency
		MHz	MHz
144.0	X ₂₀₁	13.9222	125.3
144.5	X202	13.9777	125.8
145.0	X ₂₀₃	14.0333	126.3
145.5	X ₂₀₄	14.0888	126.8
146.0	X ₂₀₅	14.1444	127.3
1465	X ₂₀₆	14.2000	127.8
146.5	X ₂₁₀	*14.1333	127.2
1.45.0	X ₂₀₇	14.2555	128.3
147.0	X ₂₁₁	*14.3222	128.9
147.5	X ₂₀₈	14.3111	128.8

^{*}Repeater for US Model.

Table 2

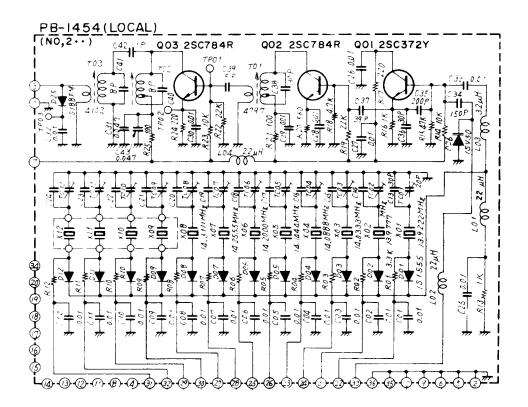


Figure 19

PLL UNIT (PB-1455)

This unit generates a heterodyne signal for the transmitter and receiver mixer in conjunction with the Phase Lock oscillator.

A voltage controlled oscillator Q_{305} , 2SK19GR, generates a signal between 133.3 MHz and 137.3 MHz which is determined by L_{301} , TC_{301} , C_{324} , D_{305} and D_{306} . The varactor diode, D_{305} , changes the frequency by the DC voltage which is delivered from the phase detector amplifier Q_{301} , 2SK19GR. The varactor diode, D_{306} , is used to shift the oscillating frequency in accordance with the band switch setting for a stable lock of the VCO. The output from the VCO, Q_{305} , is fed through a two stage buffer amplifier Q_{306} , 2SK19GR, Q_{307} , 2SC784R, to the mixers, Q_{405} in receive, Q_{501} and Q_{502} in transmit.

A portion of the output from Q_{306} is amplified through the buffer amplifier Q_{304} , 2SC372Y, and is fed to the mixer Q_{303} , 2SC372Y, where the signal from local oscillator unit is converted into a 8,000 to 8,500 kHz comparison signal.

This comparison signal is amplified by the amplifier Q_{302} , $\mu A703HC$ and fed to the phase detector circuit consisting of diodes, D_{303} and D_{304} , 1S-1007.

The phase detector compares the phase of the comparison signal with that of the reference signal which is fed through pin 17 from the FIX unit (VFO or FIX crystal signal), and any phase difference is converted into an error correcting voltage. This error voltage is amplified by Q_{301} , 2SK19GR, and fed to the varactor diode D_{305} , 1SV50, which changes the output signal phase to track the input.

The programmable unijunction transistor D_{301} , N13T1, generates a sawtooth wave when the VCO is unlocked. The sawtooth wave is used to lock the VCO. A portion of it is fed to the inverter Q_{308} , and rectified by Q_{310} 1S1555.

The rectified voltage causes Q_{309} , 2SC372Y, to conduct and its emitter voltage is used to conduct Q_{607} in the AF unit thus shorting the audio input to quiet the receiver when the PLL is unlocked.

In transmit, this voltage controls Q_{507} in the EXCITER unit causing Q_{506} cut off to disable the exciter stages. Thus, the transmitter and receiver stop functioning when the VCO is unlocked. With this voltage, a multivibrator Q_{308} , TP4011AN, produces a blanking pulse which controls the pilot lamp driver Q_{310} , MPSA13, causing the pilot lamp to flicker indicating VCO unlock.

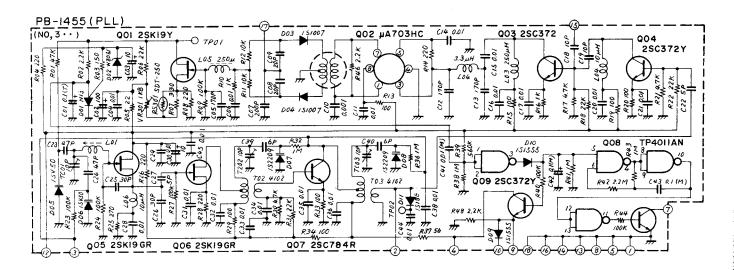


Figure 20

MARKER UNIT (PB-1459)

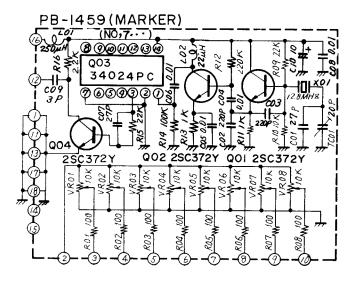


Figure 21

The crystal marker generator Q_{701} , 2SC372Y, generates a 12.8 MHz signal, and its output is fed through the buffer amplifier Q_{702} , 2SC372Y, to the frequency divider Q_{703} , 34024PC, where the 12.8 MHz signal generates a 100 kHz marker signal. The marker signal is fed through a buffer amplifier Q_{704} , 2SC372Y to the RX RF unit. When the marker switch is ON, the antenna relay is activated to disconnect the antenna.

Potentiometers VR_1 through VR_8 are installed in this board. These potentiometers are set to change the tuning frequency of the VCO and the exciter tuning circuits.

TONE BURST UNIT (PB-1461)

The tone burst signal is automatically transmitted in the following manner. When the PTT switch of the microphone is pressed momentarily before a normal transmission, the rapid voltage change in the PTT circuit causes a pulse to be fed to the tone burst control circuit consisting of Q_{1001} , Q_{1002} , Q_{1003} , TP4011AN, and Q_{1004} , TP4049AN, thus activating the tone burst oscillator Q_{1003} , TP4011AN.

Normal push-to-talk operation does not produce a pulse to activate the tone burst oscillator.

The tone frequency may be adjusted to any frequency between 1000 to 2000 Hz with VR_{1002} and the tone burst duration may be adjusted with VR_{1001} . The tone signal output level may be adjusted with VR_{1003} . The output from the tone burst oscillator is fed through the buffer Q_{1006} , 2SK19GR, to pin 29 in the MIC AMP unit.

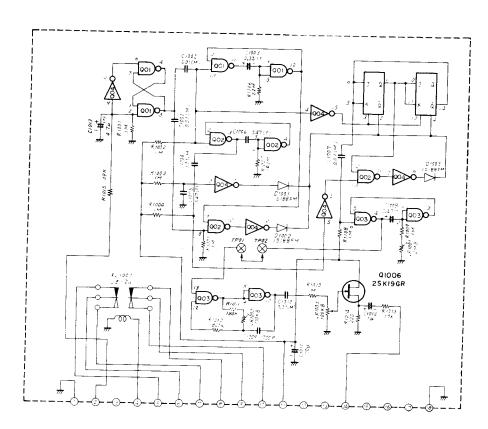


Figure 22 TONE BURST UNIT PB-1461

POWER SUPPLY & REGULATOR UNIT (PB-1469)

The power supply has been designed to operate from 100/110/117/200/220 or 234 volts AC 50/60 Hz, or 12 volts DC, negative ground. Inserting the appropriate power plug into the rear panel receptacle makes the necessary connections to operate the supply in either mode, AC or DC.

For AC operation, the DC voltage is supplied from the bridge connected rectifier unit D_{150} , M4B-5, which is connected to a 20 volt, 3.5 amps secondary winding of the power transformer. The DC voltage is regulated at 13.5 volts by the voltage regulator circuit consisting of Q_{1501} , 2SD313D, and Q_1 , 2SD114.

Since such circuits as the VFO, local oscillator PLL circuit, require an extremely stabilized voltage, the 13.5 volts DC voltage is further stabilized at 8 volts by the voltage regulator Q_{1503} , 2SC735Y, Q_{1504} , 2SD313D, and Q_{1505} , 2SC372Y.

For DC operation, the positive voltage is connected to pin 3 and the negative voltage to pin 4, of the power receptacle, J_1 . To protect the circuits from any reverse connection of the DC voltage, D_1 , DS130YD, conducts heavily in the reverse polarity connection to blow the line fuse in the DC cord. It is placed between pin 3 and ground on J_1 .

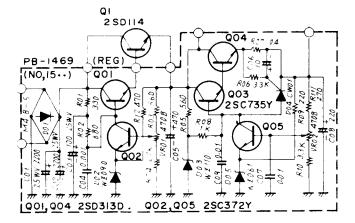
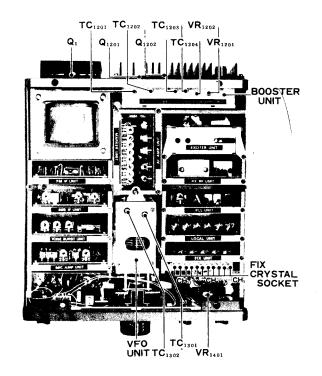
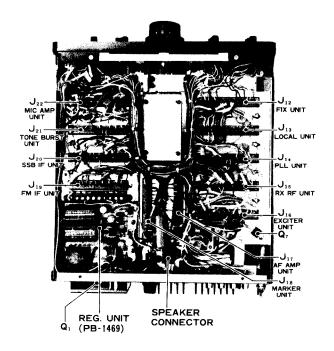


Figure 23



TOP VIEW

Figure 24



BOTTOM VIEW

Figure 25

MAINTENANCE & ALIGNMENT

GENERAL

Your model FT-221R transceiver has been carefully aligned and tested at factory prior to shipment. The reliability of the solid-state devices used in the FT-221R should provide years of trouble free service if the transceiver is not abused and normal, routine maintenance is carried out.

The following precautions should be observed 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 the voltage determined by the transformer wiring.
- (3) Do not exceed 14 volts DC, at the POWER receptacle, on DC operation. When operating mobile, check the battery voltage under the load (transmitter "keyed" in FM mode) with the engine running fast enough so the ammeter shows a "charge". In addition, do not operate the FT-221R if the supply voltage is below 12 volts DC.
- (4) Avoid direct exposure to sunshine or water.

ROUTINE MAINTENANCE

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

Cleaning:

When the transceiver has been used in dusty or sandy areas, the interior should be periodically cleaned. A vacuum-cleaner, or low pressure air source should be used, while any accumulated dirt may be removed with a soft brush. Check that the interior is thoroughly dry before replacing the case and/or operating the equipment. Wipe the exterior with a damp cloth whenever required.

PERFORMANCE CHECKS

Make all performance checks at 13.5 volts DC (under load) or AC with the appropriate voltage as determined by the transformer wiring.

Check the transmitter output as follows:

- (a) Connect a suitable 50 ohm dummy load/RF wattmeter to the ANT receptacle.
- (b) Set the MODE switch to FM and key the transmitter while observing the power output. The power should be approximately 10 watts, and the S-meter should read between 6 and 8.
- (c) Set the MODE switch to SSB and key the transmitter. Speak normally into the microphone. The output meter should show 3 to 5 watts mean value.

Check the receiver sensitivity as follows:

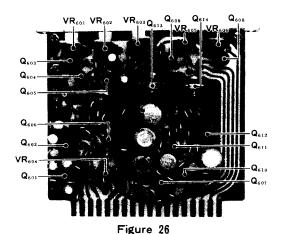
- (a) Connect an AC VTVM to the SP receptacle, set the MODE switch to FM and set the SQUELCH control fully counter-clockwise.
- (b) Connect the RF output of a precision, VHF signal generator to the ANT receptacle and with no signal input note the VTVM reading. Adjust the VOLUME control and VTVM range, as required, to obtain an approximate full scale reading. (DO NOT change the VOLUME control setting after this adjustment is 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 1/10th (20 dB decrease) of the reading in step (b). The signal generator output voltage at this point is the 20 dB quieting sensitivity, and should be approximately $0.3\mu V$.
- (d) Set the MODE switch to SSB position and connect the AC VTVM to the speaker output. Apply an unmodulated, 0.5μV signal, from the standard signal generator and tune the transceiver for a maximum VTVM reading.
- (e) Set the RF GAIN control to the fully clockwise position and adjust the AF GAIN control for a 450 mV VTVM reading.
- (f) Reduce the signal generator output and read the VTVM reading. The VTVM reading should be less than 45 mV for a 10 dB S/N ratio.

If the above performance checks indicate a need for realignment it is recommended that the transceiver be returned to the dealer for alignment. The alignment procedures require special test equipment and techniques not normally available to the average owner. Attempts to realign the tuned circuits without proper test equipment will result in degraded performance of the transceiver.

ALIGNMENT

SOME OF THE FOLLOWING ALIGNMENT PROCEDURES REQUIRE SPECIAL TEST EQUIPMENT AND TECHNIQUES AND SHOULD ONLY BE DONE BY AN EXPERT TECHNICIAN.

AF AMP UNIT



(1) CW Break-In

Adjust VR_{601} , DELAY control, for a suitable release time.

(2) CW Sidetone Level

Adjust VR₆₀₄ for a suitable side tone level.

(3) Relay Sensitivity & Antitrip

Set the controls as follows:

 VR_{602} RELAY· · · · · Fully CCW MIC GAIN · · · · · · Fully CCW VOX GAIN · · · · · · PTT MODE · · · · · · LSB or USB

Slowly rotate the RELAY control, VR₆₀₂, until the relay activates, then return the control carefully counter clockwise until the relay releases. This release point is the proper setting for the RELAY sensitivity control. Set the MIC GAIN control to the 2 o'clock position and the VOX control on the front panel to the 12 o'clock position. Speaking normally into the microphone, make sure that your voice activates the relay. Tune in a signal and adjust the AF GAIN on the front panel to a comfortable listening level. Set the ANTITRIP

control, VR_{603} , to the minimum point that will prevent the speaker output from tripping the VOX. Adjust the DELAY control, VR_{601} , for a suitable relay release time.

(4) Discriminator Meter Center

Set the controls as follows:

CHANNEL · · · VFO MODE · · · · · · FM

DISC · · · · · · · OFF (down position)

 $RF\;GAIN\;\cdots\cdot Fully\;CW$

MARKER · · · · ON (up position)

Tune the transceiver for maximum S-meter reading at a marker signal. This maximum reading has a 3 kHz width and the VFO should be set to the center of the signal. Turn the DISC switch on and adjust the center potentiometer, VR_{605} , until the meter indicates mid point on the scale. Check that the meter moves equally toward both ends when the VFO frequency is shifted equally up or down. Shift the VFO frequency 10 kHz lower than the zero center meter indication, and adjust the DISC potentiometer, VR_{606} , until the meter indicates 2.

MARKER UNIT

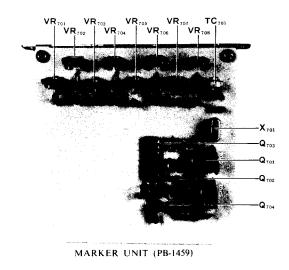


Figure 27

(1) Frequency Adjustment

Connect a frequency counter, through a 100 PF capacitor, to the collector of Q_{702} , 2SC372Y. Adjust TC_{701} to set the crystal frequency to 12.8MHz.

When the counter is not available, use another H.F. receiver and calibrate the 100kHz signal against WWV or JJY.

(2) Voltage Adjustment for the Varicap Tuning Circuit

Measure the voltage at pins 3, 4, 5, 6, 7, 8, 9 and 10 with a VTVM connected between the pins and ground.

Adjust the appropriate potentiometer, VR_{701} to VR_{708} , for following pin voltages:

Pin No.	3	4	5	6	7	8	9	10
Adjust. VR No.	701	702	703	704	705	706	707	708
Volt. DC. V.	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5

Table 3

SSB IF UNIT

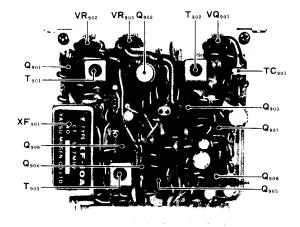


Figure 28

(1) S Meter Setting

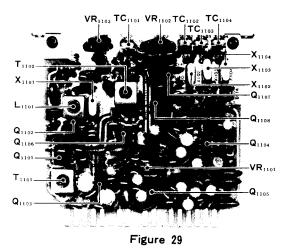
Disconnect the antenna from the coax receptacle. Set the MODE switch to the AM mode. Set the RF GAIN control on the front panel to the fully clockwise position. Adjust VR₉₁₃ (ZERO) until the meter indicates zero. Then set the RF GAIN control to the fully counter clockwise position. Adjust VR₉₀₂ (FULL SCALE) until the meter indicates full scale. Repeat above procedures until the meter indicates zero and full scale with above mentioned RF GAIN settings.

(2) Carrier Balance (SSB Receive)

Disconnect the antenna.

Set the MODE switch to either the LSB or USB modes, and the RF GAIN control fully counter clockwise. Adjust VR₉₀₁ and TC₉₀₁ (CARRIER BALANCE) alternately until the S-meter indicates full scale. Change the MODE switch to CW position and check if the S-meter indicates exactly full scale.

MIC AMP UNIT



(1) SSB Carrier Frequency

Connect a dummy load, such as the YAESU YP-150, to the antenna receptacle and the output of an audio oscillator to the microphone input. Set the MODE switch to an SSB mode. Apply 1 kHz audio signal to the microphone input and adjust the MIC GAIN control or the output level from the audio oscillator for 10 watts RF output on the dummy load. Change the audio frequency to 350 Hz, and adjust TC₁₁₀₂ for LSB and TC₁₁₀₃ for USB to obtain 2.5 watts output. Check if the power output decreases to 2.5 watts when the audio frequency is moved to approximately 2600 Hz.

(2) AM and CW Carrier Frequency

Tune the transceiver in the USB mode and monitor the transmitted USB signal for the most natural voice quality while using another receiver. Change the mode of the transceiver to AM (with the monitor receiver in the USB mode), and adjust TC_{1104} for a zero beat against a carrier signal.

(3) Carrier Balance (SSB Transmit)

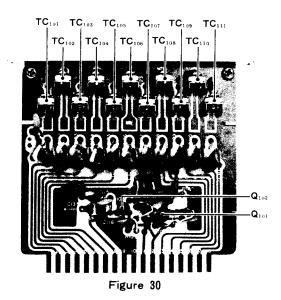
Connect a dummy load to the antenna receptacle and the RF probe of a VTVM to the inner conductor of coax cable at the antenna receptacle. Set the MODE switch to the LSB mode. Set the MIC GAIN control to the fully CCW position. Set the VOX switch to MOX position. Adjust VR₁₁₀₂ and TC₁₁₀₁ (CARRIER BALANCE) alternately to minimize the VTVM reading.

Repeat this procedure until a minimum reading is obtained equally for both side bands.

(4) CW Carrier Level

Set the CW level control, VR_{1105} , to the point where the output power starts to saturate.

FIX UNIT



The crystal frequency may be precisely adjusted with TC_{101} to TC_{111} for on-frequency crystal controlled operation.

LOCAL UNIT

Set the MODE switch to USB, the BAND switch to 144.0, the CHANNEL switch to VFO, the MARK switch to OFF and the RPT switch to the OFF position. Connect a frequency counter to TP₂₀₁ and adjust the oscillator frequency to 41.7666 MHz with TC₂₀₁. Set the MARK switch to the ON position and zero beat against the marker signal at 144.0 MHz on the VFO tuning

dial. Set the BAND switch to 144.5 MHz and adjust TC_{202} to zero beat, then adjust TC_{203} for 145.0 MHz, TC_{204} for 145.5 MHz, TC_{205} for 146.0 MHz, TC_{206} for 146.5 MHz, TC_{207} for 147.0 MHz and TC_{208} for 147.5 MHz for a zero beat against the marker signal.

For the U.S. model, set the RPT switch to REV, the AUX/600 kHz switch to 600 kHz and the BAND switch to 146.5. Adjust TC_{210} for zero beat. Change the BAND switch to 147.0 and adjust TC_{211} for zero beat. For the European model, set the BAND switch to 145.0 and adjust TC_{210} for zero beat. During the above repeater frequency adjustment, the VFO dial is set to the zero beat obtained in the preceding adjustment.

For the frequency split other than 600 kHz, the crystal calculated by the formular in page 12 is installed in X_{209} socket for 146.5 MHz band and in X_{212} socket for 147.0 MHz band. Set the AUX/ 600 kHz switch to AUX position.

For the split frequency in 100 kHz order, such as 800, 900 or 1000 kHz, use the internal marker signal to calibrate as described in 600 kHz procedures. Adjust TC_{209} for zero beat on 146.5 MHz band and TC_{212} on 147.0 MHz band.

When the split frequency is not in 100 kHz order, such as 850 kHz or 940 kHz, the internal marker signal can not be used. In such a case, connect a precise frequency counter between TP_{201} and ground and adjust TC_{209} or TC_{212} for exact frequency which is 3rd harmonics of the crystal frequency given from the formular. For example, the counter frequency should be 42.31666 MHz for 850 kHz split on 146.5 MHz band, as the crystal frequency is $(127.8 - 0.85) \div 9 = 14.1055$ MHz.

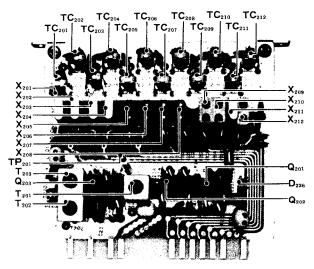


Figure 31

PLL UNIT

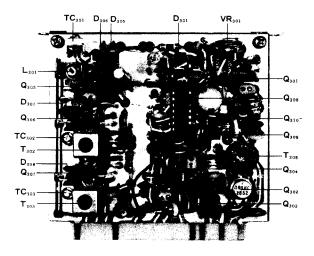


Figure 32

This unit does not require any adjustment unless major components are changed, and, as such, requires precise measuring equipment for alignment. When the PLL circuit is unlocked, the pilot lamps start flikering. Adjust VR₃₀₁ until the circuit locks and the pilot lamps stop flikering. Check that the circuit locks at all segments and entire VFO range.

RX RF UNIT

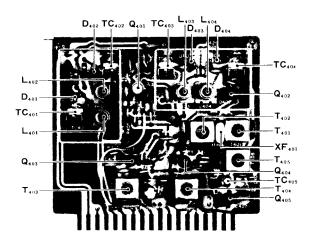


Figure 33

Set the BAND switch to 144.0, the CHANNEL switch to VFO, the RF GAIN control fully clockwise and the MODE switch to the USB mode. Tune the VFO to a signal (144.20 MHz, 10dB) from a signal generator connected to the antenna receptacle. Peak TC₄₀₁, TC₄₀₂, TC₄₀₃ and TC₄₀₄ for a maximum S-meter reading. In areas that use the high side of the band, 146 to 148 MHz, it is recommended to perform above procedures on 146.20 MHz.

EXCITER UNIT/BOOSTER UNIT

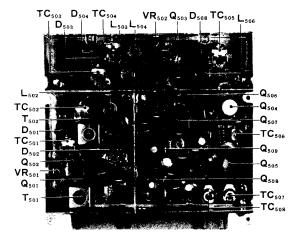


Figure 34

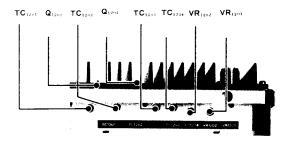


Figure 35

(1) Power Output

It is recommended that an insulated wand be used for the alignment of the booster unit. Connect a dummy load to the antenna receptacle. Set the BAND switch to 145.0, the CHANNEL switch to VFO and the MODE switch to FM. Set the VFO to 145.0 MHz. Set the VOX control to the MOX position. Peak TC₅₀₁ through TC₅₀₈ and TC₁₂₀₁ through TC₁₂₀₄ for maximum power output.

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

Repeat the procedures alternately on 144.1 MHz, 145.0 MHz and 147.9 MHz until unity power output is obtained over 144 to 148 MHz.

(2) PO Meter Set

The PO (Power Output) meter indicates relative power output. After the completion of the above power output alignment, set the meter control, VR_{1202} , to the point where the meter indicates 80% of full scale.

(3) AM Carrier Level

Set the MODE switch to the AM position. Adjust VR_{502} , in the EXCITER UNIT, for 2.5 watts unmodulated carrier output on the dummy load.

(4) ALC Threshold

Connect the output from a two-tone signal generator to the microphone input and dummy load to the antenna receptacle. Set the BAND switch to 145.0, the CHANNEL switch to VFO, the MODE to USB and the MIC GAIN to the 12 o'clock position. Set the VOX GAIN control to the MOX position. Apply a 1 kHz single tone signal at first and adjust the signal generator output until the power meter shows 2.5 watts. Then apply a 1.5 kHz single tone signal and adjust its output for 2.5 watts output. Then leave the output levels of both tones at the set level and apply a 1 kHz/1500 kHz, two tone signal, of the above set level. Adjust VR₁₂₀₁ until the power meter indicates 3 watts.

SOUELCH THRESHOLD

Disconnect the antenna. Set the BAND switch to 144.0, the CHANNEL switch to VFO, the RF GAIN to the fully CW position, the MODE switch to FM and SQUELCH control to the 9 o'clock position. Adjust VR₁₄₀₁ to the point where the receiver is just silenced. Do not go beyond this threshold point or the SQUELCH control on the front panel will not function properly.

FM DEVIATION ADJUSTMENT

Connect a dummy load and FM deviation meter to the antenna receptacle. Set the MODE switch to FM and the MIC GAIN control to the 2 o'clock position. Apply a 20 mV, 1 kHz audio signal to the microphone input, and set the VOX control to the MOX position. Adjust VR₁₁₀₁ in the MIC AMP UNIT for a deviation of ±5 kHz.

TONE BURST UNIT

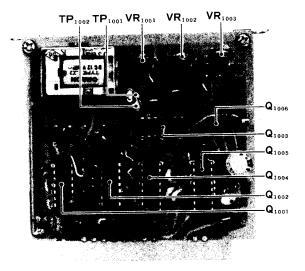


Figure 36

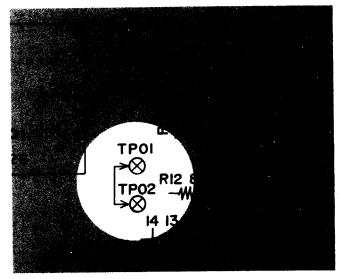


Figure 37

The adjustment of this unit should be done after the above FM deviation alignment has been completed. Set the controls, switches and the deviation meter as described in the deviation adjustment. Remove the tone burst unit from the chassis and disconnect the connection of the two test points as illustrated in order to obtain a continuous tone signal during the alignment. Insert the unit into its socket.

Set the MIC GAIN control to the 2 o'clock position and the VOX GAIN control to the MOX position. Measure the burst tone signal frequency at the deviation meter output. Adjust VR_{1002} to the desired frequency. Adjust VR_{1003} for ± 3.5 kHz deviation.

Set the VOX GAIN control to the PTT position and remove the unit from its socket. Reconnect the disconnected test points and reinstall it into its socket.

The burst signal is automatically transmitted when the PTT switch on the microphone is keyed twice as, i.e., key 0.5 second, receive 0.5 second and then transmit. The deviation of the burst signal is preset at the factory to approximately 0.5 second. It may be adjusted with VR_{1001} . A clockwise rotation produces a longer deviation.

REGULATOR UNIT

Use an AC supply for this alignment. Connect a VTVM DC probe to the 13.5 volt line of the power supply unit. Adjust VR_{150} for a 13.5 volt VTVM reading. Connect the VTVM to the 8 volt line and adjust VR_{1502} for a 8 volt VTVM reading.

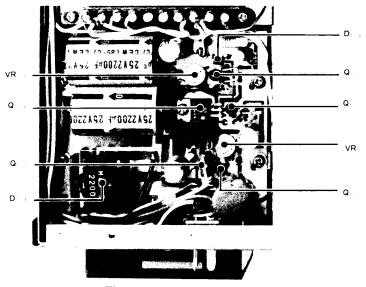


Figure 38

FM IF UNIT

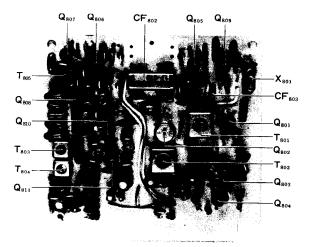


Figure 39

CONNECTOR RESISTANCE CHART

UNIT	FIX	LOCAL	PLL	RX RF	EXCITER	AF AMP	MARKER	FM IF	SSB IF	TONE BURST	MIC AM
	J_{12}	J ₁₃	J ₁₄	J ₁₅	J ₁₆	J ₁₇	J ₁₈	\mathbf{J}_{19}	J ₂₀	J_{21}	J_{22}
<u>'</u>	E	E	E	Е	Е	E	Е	E	Е	E	E
1		E	0	2.6 K	250	0	53 ₩	5.5 K	Е	1.7 K	E
2		0	2.3 K	_	250	53 ₩	2.4 K	Е	3.5 K		6K
3		_	53*	E	o	74 *	2.5 K	500	_	450	3.2K
4		E	E	0	6K	_	2.5 K	10	700	53	300
5	8	E	45**	∞	E	∞	3 K	1 K	_	53	E
6		53	160*€	0	E	0	3 K	300	250	∞	Е
7			E	E	2.4 K	0	3 K	1.6K	_	2.4 K	0
8	E	E	2 K	0	2K	40 **	2.7 K	Е	53₩	2.4 K	12K
9	E	E	160 ₩	E	2.6K	Е	2.3 K	2.5K	_	∞	700
10	<u>E</u> ∞		-	53 ※	2.6K	_	Е	Е	Е	350	Е
11	53*≪		53 ₩	Е	100K	1.6K	∞	_		-	E.
12	∞	_	E	2.4 K	1.1 K	850	E	53₩	700K		E
13		_	E	3.5 K	Е	1 K		3.3 K	_	850	700K
14	~	_	0	3.3 K	E	2.1 K	_	100 K	250	_	250
15			_	E	E	1.5 K	2.4 K	Е	500	_	250
16	<u> </u>			0		5.5K	E	0	2.6 K	_	Е
17	E E	_	E	E	E	E	E	E	46※	E	E
18	E	_							-		Е
19			-						_		650
	<u> </u>		 			-			300		53 %
21		54 **	-								500
		J4 xx							400		Е
23	ļ			-					400		E
24		_	-						∞		9K
25									_		0
26	+								53₩		9 K
27	-			+					500		∞
28									4.5 K		850
29	+								E		2.21
30	-								Е		∞
31		_							500		5K
32		17K							1.9K		∞
33	-	- 17K							E		1K
34	-	E			_				Е		Е
35		E	-						E		Е

Switch, Knob Position

POWER-OFF MODE-FM BAND-144.0 CHANNEL-VFO RF GAIN-MAX VOX GAIN-PTT

AF GAINCENTER SQUELCH FUNCTION SW ··· OFF Measured with $20K\,\Omega\,/V$ Values are in OHMS

CONNECTOR VOLTAGE CHART

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		AM	~	F	Э	0	0	ء اد	2 (2	1 E	0	0	1.8	म	E	Э	0	0	0	ы	ы	ы	0	8.0	0	Э	ъ	0	0	6.0	0	0	0	0	0	0	0	ഥ	ш
	AMP	8	L	F	ন	0	7.3	0 0		1 1	0	0	1.6	ы	ы	ы	0	0	8.0	H	Э	ы	0	8.0	0	ध	ш	0	0	6.0	0	0	0	0	0	0	7.3	ш	ь
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\mathbf{J}_{20}	SSB		Ж	ы	ы	0	0	1.8	0	0	0	8.0	0	ы	0	0	0	0	1.6	7.0	13.5	0	0	0	0	0.85	0.85	0	0	8.0	0	0	ы	ध	0	0	ы	দ্র	ഥ
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		3. LSB	⊢	ы (0. 0.	8.0	0	0	Э	_		0	13.0	13.0	6.6	13.5	EJ [1	1) L	4																	T	1
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J ₁₂	FIX	-		-) (0 (0	0	0	0	0 1	1	ı c	_	0.0		> <		9	E	1	1	-						_										
J			ا ۳	<u>म</u>		0 0	0	0	0	0 (0 [피	1 0		9.0				0) E		\perp	_																
	UNIT		,	- c	7 6	ر د	4	വ	9	~	χ c	ي ج	3 :	- 6	13	3 -	1 2	9	2	18	16	202	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	
													-										_		_		_		-	_	_	_	_		1				

Measured with VTVM. Values are in VOLTS DC.

VOLTAGE CHART

FIX Unit

	E	В	С		E	В	С
Q 101	0.9	1.4	7.7	Q 102	2.2	2.9	5.8

LOCAL Unit

[Е	В	С		E	В	С		E	В	С
	Q 201	2.4	2.5	7.6	Q 202	1.1	1.3	7.9	Q 203	0.9	1.4	7.6

PLL Unit

	E(S)	B(G)	C(D)		E(S)	B (G)	C(D)		E(S)	B(G)	C(D)
Q 301	1.6	0	4.5	Q 305	0.9	0	5.4	Q 309	0	0	8.0
Q 303	0.9	1.4	8.0	Q 306	1.0	0	5. 9	Q 310	0	0.7	1.3
Q 304	0.5	1.1	7.5	Q 307	0.5	0.8	7.2				

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Q 30	2	7.2	_	1.5	E	1.5	_	7.2	7.5						
Q 3	08	4.9	4.9	0.2	8.0	0	1.9	E	8.0	8.0	0	8.0	0	0	8.0

RX RF Unit

	E (S)		B (G)		C (D)		G ₂			E (S)		B (G)		C (D)	
	R	Т	R	T	R	Т	R	Т		R	Т	R	Т	R	T
Q 401	1.5	0	1.6	0	8.0	0.1	3.9	0	Q 404	0.7	0	1.4	0	7.9	0.1
Q 402	1.6	1.1	0	0	7.9	0.1			Q 405	1.0	0	0	0	7.7	0
Q 403	1.2	0	1.8	0	7.8	0.1									

EXCITER Unit (on Transmit)

	LSB.USB.CW			AM.FM			LSB.USB.CW			AM.FM				LSB.USB.CW			AM.FM			
	E (S)	B (G)	C (D)	E(S)	B (G)	C (D)		E (S)	B (G)	C (D)	E (S)	B (G)	C (D)		E(S)	B (G)	C (D)	E(S)	B (G)	C (D)
Q 501	1.3	0	12.1	1.4	0	11.8	Q 504	0.4	1.2	10.1	0.4	1.2	10.0	Q 507	0	0	13.3	0	0	13.3
Q 502	1.3	0	12.1	1.4	0	11.7	Q 505	0	0.7	13.4	0	0.7	13.4	Q 508	1.1	1.8	5.4	1.1	1.8	5.4
Q 503	1.2	1.9	12.0	1.2	1.9	11.9	Q 506	12.5	13.3	13.5	12.5	13.3	13.5	Q 509	4.9	5.5	13.5	4.9	5.5	13.5

Receive ······ 0 V

AF AMP Unit

	LSB AM	.USB	.cw		FM			LSE AM	USB.	.CW		FΜ			LSE AM	USB.	.cw		F M	
	E(S)	$\mathbf{B}(G)$	C (D)	E(S)	B (G)	C (D)		E(S)	B (G)	C (D)	E(S)	B (G)	C(D)		E (S)	B (G)	C (D)	E (S)	B (G)	C (D)
Q 601	0.4	1.0	7.0	0.4	1.0	7.0	Q 607	0	0	0.6	0	0	0.6	Q 612	13.5	12.9	7.5	13.5	12.9	7.5
Q 603	0.4	0	0.6	0.4	0	0.6	Q 608	0	0	0	1.9	0	★ 5. 7	Q 613	6.8	7.4	13.5	6.8	7.4	13.5
Q 604	0	0.6	12.9	0	0.6	12.9	Q 609	0	0	0	2.6	0	6.3	Q 614	6.8	6.2	0	6.8	6.2	0
Q 605	0.4	1.0	5.8	0.4	1.0	5.8	Q 610	0	0.6	3.8	0	0.6	3.8							
Q 606	2.9	1.0	8.0	2.9	1.0	8.0	Q611	8.5	9.1	12.9	8.5	9.1	12.9							

★ F M Transmit ······0 V

	1	2	3	4	5	6	7	8	9
Q 602	4.7	2.8	2.2	2.1	0	0.5	0.7	1.1	8.0

MARKER Unit (Marker SwitchON)

	Е	В	С		Е	В	С		E	В	С
Q 70	1.8	2.4	8.0	Q 702	2.1	3.7	7.7	Q704	E	0.6	0.9

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Q 703	1.8	E	3.8	4.0	4.0	4.0	E	0	4.0	0	3.7	3.0	0	0.8

FM Unit

	LSB AM	.USB.	CW		FM			LSE AM	3.USB	.cw		FΜ			LSE AM	.usb	.cw		FM	
	E (S)	B (G)	C (D)	E(S)	B (G)	C(D)		E(S)	B(G)	C (D)	E(S)	B (G)	C (D)		E (S)	B (G)	C (D)	E(S)	B (G)	C (D)
Q 801	1.8	2.5	7.7	1.8	2.5	7.7	Q 805	0	0	0	1.3	★ 0.7	★ 7.2	Q 809	0	0	0	0.6	1.3	7.0
Q 803	0	1.9	5.1	0	1.9	5.1	Q 806	0	0	0	1.4	2.1	2.5							
Q 804	5.8	5.8	5.3	5.8	5.8	5.3	Q 807	0	0	0	0.7	* 1.4	7.0							

★FM Transmit……0V

		1	2	3	4	5	6	7	8
Q 802	Τ·R	7.0	_	1.5	0	1.5	_	7.0	7.5
0.000	FM·R	1.8	1.8	6.8	0	5.5	1.8	1.8	
Q 808	T · R	0	0	0	0	0	0	0	

SSB IF Unit

	E	(S)	В	(G)	С	(D)		Е	(S)	В	(G)	С	(D)		E	(S)	В	(G)	С	(D)
	R	Т	R	Т	R	Т		R	Т	R	Т	R	Т		R	Т	R	Т	R	Т
Q 901	0.7	0	0.7	0	7.3	0	Q 905	0	0	0.7	0	7.2	0	Q 908	0.3	0.3	1.0	1.0	5.8	5.8
Q 903	1.1	0	0	0	7.8	0	Q 906	0	0.6	0	0	0	7.0							
Q 904	0.7	0	0.7	0	7.3	0	Q 907	5.3	5.3	5. 9	5.9	6.8	6.8							

		1	2	3	4	5	6	7	8
0.000	R	0	1.2	0	1.8	5.5	7.6	7.3	0
Q 902	Т	0	0	0	0	0	0	0	0

TONE BURST Unit

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Q 1001	R	0	0	8.0	0	8.0	8.0	0	0	0	8.0	0	8.0	7.2	8.0		
Q 1001	Т	8.0	8.0	0	8.0	0	0	0	0	0	8.0	0	8.0	7.2	8.0		
Q 1002	R · T	7.2	8.0	0	8.0	0	0	0	0	8.0	8.0	8.0	0	0	8.0		
Q 1003	R · T	0	0	8.0	0	8.0	7.3	0	8.0	8.0	0	8.0	7.2	0	8.0		
0.1004	R	8.0	0	7.2	0	7.3	0	8.0	0	0	8.0	8.0	0	0	7.2	0	8.0
Q 1004	Т	8.0	0	7.2	0	7.3	0	8.0	0	8.0	0	8.0	0	0	7.3	0	8.0
Q 1005	R·T	0	8.0	0	0	8.0	8.0	0	0	0	0	0	0	0	8.0	0	8.0

	S	G	D
Q 1006	0.9	0	8.0

BOOSTER Unit (on Transmit)

	LSE	.USB	.CW		A M			FM			LSE	.USB	.CW		A M			FM	
	E(S)	B(G)	C (D)	E(S)	B (G)	C (D)	E(S)	B (G)	C(D)		E(S)	B(G)	C(D)	E(S)	B(G)	C(D)	E(S)	B(G)	C(D)
Q 1201	0	0.7	12.3	0	0.6	3.6	0	0.6	11.7	Q 1202	0	0.7	13.5	0	0.4	13.3	0	0.2	13.1

Receive ······ 0 V

VFO Unit

	E(S)	B(G)	C(D)		E(S)	B(G)	C(D)		E(S)	B(G)	C(D)
Q 1301	2.1	2.7	4.4	Q1302	1.6	0	7.6	Q 1303	1.6	2.1	6.9

MIC AMP Unit

		LSB. USB CW				W					A	M					F!	M						
	Е	(S)	В	(G)	С	(D)	E	(S)	В	(G)	C	(D)	Е	(S)	В	(G)	С	(D)	E	(S)	В	(G)	С	(D)
	R	Т	R	T	R	Т	R	Т	R	Т	R	Т	R	Т	R	Т	R	Т	R	Т	R	Т	R	Т
Q 1101	0	0	0	0	0	0	0	4.9	0	2.6	0	8.0	0	1.9	0	2.6	0	7.8	0	2.2	0	2.6	0	7.8
Q 1102	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.6	0	2.2	0	7.2
Q 1103	1.5	1.5	2.1	2.1	3.9	3.9	1.5	1.5	2.1	2.1	3.9	3.9	1.5	1.5	2.1	2.1	3.9	3.9	1.5	1.5	2.1	2.1	3.9	3.9
Q 1105	0	2.2	0	0	0	7.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Q 1106	0	0.7	0	0	0	7.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Q 1107	3.0	3.0	3.4	3.4	6.8	6.8	3.0	4.9	3.4	3.4	6.8	8.0	2.7	3.0	3.4	3.4	6.8	6.7	2.7	2.7	3.4	3.4	6.8	6.8
Q 1108	2.5	2.5	1.9	1.9	6.8	6.8	2.5	2.5	2.1	2.3	6.8	6.8	2.3	2.5	1.4	1.8	6.9	6.8	2.3	2.3	1.3	1.4	6.9	6.9

		1	2	3	4	5	6	7	8	9
Q 1104	R	4.1	2.4	1.8	1.7	0	0	0	0.7	6.2
	Т	4.1	2.4	1.8	1.7	0	0.5	3.3	1.2	6.9

REG Unit

	Е	В	С		E	В	С		Е	В	С
Q 1501	14.1	14.6	22.6	Q 1503	8.7	9.3	13.5	Q 1505	6.1	6.7	9.3
Q 1502	9.0	9.7	14.6	Q 1504	8.0	13.5	8.7	Q ₁	13.5	14.1	22.5

AM Mod(Q7)

	3	Ε]	В	С		
	R	Т	R	Т	R	Т	
USB USB CW	0	12.3	0	12.9	0	13.5	
A M	0	3.6	0	4.2	0	13.4	
FM	0	11.7	0	12.3	0	13.2	

PARTS LIST

MAIN CHASSIS		6, 7		SIE 19951	
PB PRINTED CIRCUIT BOA	RD	8		SLE-12251 SLE-14201	
1471 (A~Z) LED	BOARD	9		SLE-14301	
1552 (A~Z) SWITCH	BOARD	J	JACK		
Q TRANSISTOR		1		QMS-AB4	M
7	2SD114	2		CS-250	
D DIODE	2SD313D	3		SG-7615	
	DG 100 110	4		SG-8050	
1 Si Bridge 6~10 Si	DS-130-YD	5		FM-144J	
11 LED	10D-1 GD-4	6		XG-8018	
12 LED	RD-4	7~1	0	CN-7017J	
13	TLR-108	11	4 10 01	SO-239	
R RESISTOR	115R 108		$\frac{4-19, 21}{0, 22}$	3305-018-0	
CARBON COMPOSITI	ON	25	0, 22	1150-036-0 CN-1463	09
16 ½W	10ΚΩ	24		SI-3101	
15 ½W	100Κ Ω	Р	PLUG	51 3101	
19 ½W	10 Ω	24		SI-8501	
17 ½W	56 Ω			3. 333.	
18 ½ W	100Ω	F	FUSE		
14, ½W	220Ω	1		2A 100	V~117V
13, 21 ½ W 23 ½ W	470Ω				V~234V
23 ½W 11 ½W	5.6KΩ	<u> </u>			
11 ½W 12 ½W	22K Ω	FS	FUSE I	HOLDER	
VR POTENTIOMETER	27ΚΩ	1		SN-1001 #	2
4 EWK-DOAS 15023	500 OR /500 OC	PL	DII 07	1 4445	
5 VM13A-5M3121	5KA	1~3	PILOT		
8 EVH-BOAS-15A53	5KA	1 -3	-	14V	40mA
6 VM20A	5KB				
7 VM11A5M	10KA			X UNIT	
3 EVH-BOAS-15B54	50KB	PB	PRINTE	D CIRCUIT BOARD	
10 EVH-BOAS-15B53	5KB	1453	$(A\sim Z)$	FIX OSC CIRCUI	rr
9 EVL-SOAA-00B54	50KB	1500	$(A \sim Z)$	CRYSTAL BOAR	D
C CAPACITOR				ORIGINE BOAR	<u> </u>
DIPPED MICA		Q	TRANS	STOR	
16, 17, 18 50WV 22 50WV	100PF	101, 1	02	2SC372Y	
3011	300PF				
CERAMIC DISC 14, 28~32 50WV	0.001	D	DIODE		
14, 28~32 50WV 33, 13 50WV	0.001µF	101~	111	Si 1S1555	
11~12, 15, 19~21, 23, 27 50WV	0.01μF 0.047μF		051/05		
24 ~ 26 500WV	$0.047 \mu F$ $0.01 \mu F$	101~	CRYSTA		
1, 2 1.4KV	0.0047μF	101~	111	HC-25/U (OPTION)
ELECTROLYTIC	0.0017/21	XS	CDVSTA	L SOCKET	
10 16WV	2200μF	101~	111	S2-101P	
PT POWER TRANSFORMER				32-101P	
1 52-36		R	RESIST	OR	
				CARBON FILM	
CH CHOKE COIL		105, 10		1/4 W	100 Ω
1 SN-8S-5	00	104		1/4 W	220 Ω
M METER		101		1/4 W	1.5ΚΩ
M METER 1 SP-384		102, 10	07	½ W	5.6KΩ
1 SP-38A		106		1/4 W	8.2KΩ
SP SPEAKER		103		1/4 W	22K Ω
1 SA-70H			C4545		
5A 70H		_c	CAPACIT		
RL RELAY	<i></i>	130	1	DIPPED MICA	
1 AE-3171		131		50WV 50WV	15PF
		$\frac{131}{117 - 1}$	27	50W V	20PF
RLS RELAY SOCKET		129		50W V	30PF 100PF
1 AE-3860		128, 13	2	50W V	200PF
				CERAMIC DISC	2001 F
SWITCH.		$101 \sim 1$	16	50 W V	0.01µF
S SWITCH					
1 ESR E22					
1 ESR E22 2 ESR 4481	R15A	тс		R CAPACITOR	
1 ESR E22 2 ESR 4481 3 ESR 4851	R15A	TC 101 ~ 1		R CAPACITOR ECV-1ZW 20×40	20PF
1 ESR E22 2 ESR 4481	RI5A RI5A	101 ~ 1		ECV-1ZW 20×40	20PF

101~111	EL0610-10	01/2 1 17			
112	EL0610-10			PLL UNIT	
113	FL-3H 1R		PB PRI	NTED CIRCUIT BOA	ARD
	TL-3H IK	$\frac{2M}{1.2\mu H}$	1455 (A~Z) PLL CIRCUIT	
			+ 0 10 5		
	LOCAL UNIT		Q IC F	ET & TRANSISTO	
PB PRINTED	CIRCUIT BOARD	`	302	IC	μ A703H C
1454 (A~Z)			308		TP4011AN
1404 (N 2)	LOCAL OSC CI	RCUII	301	FET	2SK19Y
Q TRANSIS	TOB		305, 306	"	2SK19GR
201	I OR	0000000	303, 304, 309		2SC372Y
202, 203		2SC372Y	307		2SC784R
202, 203		2SC784R	310		MPSA13
D DIODE			D DIOE	DE	
201~212	Si	10155	301	PUT	N13T1
225		1S1555	309, 310	Si	1S1555
226	Ge	1S188FM	311	Ge	1S188FM
220	Varactor	1SV50	303, 304		1S1007
Y CDVCTAL			302	Zener	WZ061
X CRYSTAL			305, 306	Varactor	1SV50
201		3.92222MHz	307, 308	Varactor	1S2209
202		3.97777MHz	R RES	ISTOR	
203		4.03333MHz		CARBON FILM	
204		4.08888MHz	305	1⁄4 W	22 Ω
205	1	4.1444MHz	337	1/4 W	56 Ω
206	<u>"</u> 1	4.20000MHz		20,329,333, 334 ¼W	100 Ω
207		4.25555MHz	303	1/4 W	150 Ω
208	″ 1	4.31111MHz	304, 308, 314,	326, 328 ½W	220 Ω
210 (Repeater)	HC-25/U ★(1	4.13333MHz)	325	1/4 W	
211 (Repeater)	" ★(1	4.32222MHz)	307	1/4 W	270Ω
★US Model★★Eur	opeanModel * *(14	1 02222MH ₂)	310, 316,		330 G
XS CRYSTAL	SOCKET		302, 345, 346	1/4 W	1K92
201	S-14			1/4 W	2.2ΚΩ
	<u> </u>		317, 321, 330	1/4 W	4.7K Ω
R RESISTOR			311, 312	1/4 W	10K Ω
	RBON FILM		306, 318, 322,		22K Ω
221, 225	¹ / ₄ W	1000	301	½ W	47Κ Ω
217, 224		100 Ω	309, 323, 324, 3	$\frac{27,340,344}{4}$ W	100 K Ω
220	1/4 W	220 Ω	339	1⁄4 W	560K Ω
	1/4 W	560 Ω	332, 336, 338,		1M Ω
213, 216, 226	1/4 W	1 K Ω	C	ARBON COMPOSIT	ION
222	1⁄4 W	2.2KΩ	342	1/4 W	2.2MΩ
201 ~ 212	1∕4 W	3.3KΩ	RS THE	RMISTOR	
215, 218	1/4 W	$\mathbf{4.7K}\Omega$	301	SDT-250	
214, 223	1/4 W	10K Ω	VR POTE	NTIOMETER	
219	1∕4 W	22K Ω		L SOAA 00B13	1KB
					110
C CAPACITO	R		C CAPA	CITOR	
DIF	PPED MICA			DIPPED MICA	
242	50W V	1PF	322, 327	50WV	FDD
239	50WV	5PF	339, 340	50W V	5PF
240, 241	50W V	8PF	318, 319	50WV	6PF
213 ~ 224, 236, 238	50WV	30PF	308, 309	50W V	10PF
237	50W V	39PF	325, 326		20PF
234	50W V	150PF	323, 326	50WV	30PF
235	50W V	200PF	305, 312, 313	50WV	47PF
	RAMIC DISC	200 F F	305, 312, 313	50W V	170PF
201-212, 225-230,		0.01 E	307	50WV	200PF
231, 243	50WV	$0.01 \mu F$	204 202 212 ==	CERAMIC DISC	
	30 W V	0.047μF	304, 306, 310, 31		
TC TRIMMER	CAPACITOR		320, 321, 328, 32	9,331 - 336,344,345,3	338
	CCV-1ZW 20×40	0055	0.41	MYLAR	
201 212 F	20 V - 12 VV 20 × 40	20PF	341	50 W V	0.01µF
L INDUCTOR			343	50WV	0.1µF
203	# 001000		004	TANTALUM	
202, 204, 201	# 221026	3.2µH	301, 342	35WV	0.1µF
202, 204, 201	EL0610-220K	22µH		ELECTROLYTIC	
			303, 330	16W V	10μF
T TDANICEOR	MED.		302	16W V	100μF
T TRANSFOR					
	R-12 #4797				
202, 203	R-12 #4102				

Signature	TC TRIMMER	CAPACITOR	······ , <u></u>	404, 414, 417	50WV	0.001µF
15,116 50WV 0.047 F	301	ECV-1ZW 1	0×40 10PF	405~407, 412	2, 413, 50WV	0.01µF
INDUCTOR	302, 303	ECV-1ZW 1	0×51 10PF	418~420,424		
304, 306				415,416	50W V	$0.047 \mu F$
304, 396	L INDUCTOR					
303 Sec 250		,				$1\mu F$
T TRANSFORMER						
T TRANSFORMER L INDUCTOR 309						
309	301	OSC #2210	13A	405	ECV-1ZW 10×53	10PF
309						
102, 303 R-12 4102 402						
403						
404	302, 303	R-12 4102				
406 EL0610-220K 22µH						
407 EL.0610-102K 1mH						00. 11
Mode						
T TRANSFORMER 401 - 404 R-12 4074 405 R-12 4074						
A01 - 404 R-12 4074 405 R-12 4102 405 R-12 4166 (A-Z) EXCITER (IRCUIT LACK LAC				403	ELOOIO 102K	111111
A01 - 404 R-12 4074 405 R-12 4102 405 R-12 4166 (A-Z) EXCITER (IRCUIT LACK LAC			P44	T TRA	NSFORMER	
RX RF UNIT						
Part						
PB PRINTED CIRCUIT BOARD 1466 (A-Z) EXCITER CIRCUIT 1456 (A-Z) RX RF CIRCUIT 1466 (A-Z) EXCITER 1507					11 12 7100	
PB PRINTED CIRCUIT BOARD 1466 (A-Z) EXCITER CIRCUIT 1456 (A-Z) RX RF CIRCUIT 1466 (A-Z) EXCITER 1507						
PB PRINTED CIRCUIT BOARD 1466 (A-Z) EXCITER CIRCUIT 1456 (A-Z) RX RF CIRCUIT 1466 (A-Z) EXCITER 1507		·			EXCITER UNIT	
1456 (A~Z) RX RF CIRCUIT					TED CIRCUIT BOARD	
Q FET & TRANSISTOR 501, 502 FET 25K19GR 401 FET 35K51 507, 509 25C372Y 402, 405 25C372Y 506 25C730 25C730 25C730 25C730 25C730 25C730 25C730 25C730 25C730 25C735Y 506 25C735Y 507						· · ·
Q FET & TRANSISTOR 501,502 FET 25K19GR 401 FET 35K51 507,509 25C372Y 402,405 7 25K19GR 508 25C373 403,404 25C372Y 505 25C730 25C730 506 25C735Y 507 503 25C784R 507 503 25C784R 507	1456 (A~Z) RX	RF CIRCUIT				
401					777	
402, 405 " 2SK19GR 508 2SC373 403, 404 2SC372Y 505 2SC730 D DIODE 504 2SC741 407 G.B 1S1007 503 2SC784R 401 ~ 404, 408 Varactor 1S2209						
403,404 2SC372Y 505 2SC730 2SC735Y 506 2SC735Y 506 2SC735Y 506 2SC735Y 507 504 2SC741 407 G.B 1S1007 503 2SC784R 401 ~ 404, 408 Varactor 1S2209	401	FET			2SC	372Y
D DIODE 504 2SC735Y		"			2SC	373
Diode 504 2SC741 407 G.B 1S1007 503 2SC784R 401~404, 408 Varactor 1S2209 TS209 Diode XF CRYSTAL FILTER 505~507 Si 1S1555 401 FMT-30 501~504, 508 Varactor 1S2209 CARBON FILM 501~504, 508 Varactor 1S2209 CARBON FILM 516 ½W 10Ω CARBON FILM 509,513,531 ½W 10Ω 408,414,418,422,429 ½W 100Ω 512 ½W 220Ω 428 ½W 220Ω 515 ½W 330Ω 417,421 ½W 470Ω 526 ½W 820Ω 413 ½W 15KΩ 522 ½W 820Ω 413 ½W 15KΩ 525 ½W 1KΩ 423 ½W 15KΩ 535 ½W 1KΩ	403, 404		2SC372Y		2SC	730
407 G.B 1S1007 503 2SC784R					2SC	735Y
A01 - 404, 408	D DIODE			504	2SC	741
Name	L			503	2SC	784 R
XF CRYSTAL FILTER 505-507 Si 1S1555 401 FMT-30 501-504, 508 Varactor 1S2209 R RESISTOR CARBON FILM 516 ½W 10Ω R RESISTOR 520, 532 ½W 56Ω CARBON FILM 509, 513, 531 ½W 100Ω 408, 414, 418, 422, 429 ½W 100Ω 512 ½W 220Ω 428 ¼W 220Ω 515 ½W 330Ω 417, 421 ½W 470Ω 526 ½W 470Ω 413 ¼W 1.5KΩ 535 ½W 1KΩ 423 ½W 2.2KΩ 519, 523, 527, 530 ½W 2.2KΩ 423 ½W 2.2KΩ 519, 523, 527, 530 ½W 2.2KΩ 425 ½W 3.9KΩ 514 ½W 2.7KΩ 415, 419 ¼W 4.7KΩ 508, 510 ½W 3.3KΩ 416 ½W 15KΩ 533 ½W 4.7KΩ 405, 420 ½W 22KΩ 524 ½W 5.6KΩ 403, 404, 406, 407, 427 ½W 100KΩ 529 ½W 10KΩ CARBON COMPOSITION 511, 528 ½W 15KΩ 401, 402, 410, 411, 430 ½W 1MΩ 525 ½W 15KΩ 401, 402, 410, 411, 430 ½W 1MΩ 525 ½W 47KΩ 402 50WV 1PF 534 ½W 10Ω 401, 402, 408, 409 50WV 5PF 429 50WV 4PF 502 EVL-SOAA-00B13 1KB 426 50WV 47PF 502 EVL-SOAA-00B13 1KB 421 50WV 180PF C CAPACITOR	401~404, 408	Varactor	1S2209			
R RESISTOR		· · · · · · · · · · · · · · · · · · ·				
R RESISTOR S16						
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	401	FMT-30		501 - 504, 50	8 Varactor 1S22	209
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$						· · · · · · · · · · · · · · · · · · ·
R RESISTOR 516				R RES		· · · · · · · · · · · · · · · · · · ·
R RESISTOR 520, 532 ¼W 56 Ω CARBON FILM 509, 513, 531 ¼W 100 Ω 408, 414, 418, 422, 429 ¼W 100 Ω 512 ¼W 220 Ω 428 ¼W 220 Ω 515 ¼W 330 Ω 417, 421 ¼W 470 Ω 526 ¼W 470 Ω 413 ¼W 1 KΩ 522 ¼W 820 Ω 409, 426 ¼W 1.5 KΩ 535 ¼W 1 KΩ 423 ¼W 2.2 KΩ 519, 523, 527, 530 ¼W 2.2 KΩ 425 ¼W 3.9 KΩ 514 ¼W 2.7 KΩ 415, 419 ¼W 4.7 KΩ 508, 510 ¼W 3.3 KΩ 416 ¼W 15 KΩ 533 ¼W 4.7 KΩ 403, 404, 406, 407, 427 ¼W 10 KΩ 529 ¼W 10 KΩ 401, 402, 410, 411, 430 ¼W 1MΩ 525 ¼W 27 KΩ 422 50WV 1				E16		100
CARBON FILM 509, 513, 531 $\frac{1}{2}$ W 100 Ω 408, 414, 418, 422, 429 $\frac{1}{2}$ W 100 Ω 512 $\frac{1}{2}$ W 220 Ω 428 $\frac{1}{2}$ W 220 Ω 515 $\frac{1}{2}$ W 330 Ω 417, 421 $\frac{1}{2}$ W 470 Ω 526 $\frac{1}{2}$ W 470 Ω 413 $\frac{1}{2}$ W 1.5K Ω 522 $\frac{1}{2}$ W 1K Ω 409, 426 $\frac{1}{2}$ W 1.5K Ω 535 $\frac{1}{2}$ W 1K Ω 423 $\frac{1}{2}$ W 2.2K Ω 519, 523, 527, 530 $\frac{1}{2}$ W 2.2K Ω 425 $\frac{1}{2}$ W 3.9K Ω 514 $\frac{1}{2}$ W 2.7K Ω 416 $\frac{1}{2}$ W 15K Ω 533 $\frac{1}{2}$ W 4.7K Ω 405, 420 $\frac{1}{2}$ W 100K Ω 529 $\frac{1}{2}$ W 10K Ω 401, 402, 410, 411, 430 $\frac{1}{2}$ W 10K Ω 529 $\frac{1}{2}$ W 15K Ω 401, 402, 410, 411, 430 $\frac{1}{2}$ W 1M Ω 5525 $\frac{1}{2}$ W 1M Ω	D DESISTOR					T ACCOUNT AND THE PARTY OF THE
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415, 419 ¼W 4.7KΩ 508, 510 ¼W 3.3KΩ 416						
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$						
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403, 404, 406, 407, 427 ½ W 100 KΩ 529 ½ W 10 KΩ CARBON COMPOSITION 511,528 ½ W 15 KΩ 401, 402, 410, 411, 430 ½ W 1MΩ 525 ½ W 27 KΩ 501,502 ½ W 47 KΩ C CAPACITOR CARBON COMPOSITION DIPPED MICA 503~507,536 ½ W 1MΩ 422						
CARBON COMPOSITION 511,528 ¼W 15KΩ 401,402,410,411,430 ¼W 1MΩ 525 ¼W 27KΩ 501,502 ¼W 47KΩ C CAPACITOR CARBON COMPOSITION DIPPED MICA 503~507,536 ¼W 1MΩ 422 50WV 1PF 534 ½W 10Ω 401,402,408,409 50WV 5PF VR POTENTIOMETER 403 50WV 30PF 501 EVL-SOAA-00B13 1KB 426 50WV 47PF 502 EVL-SOAA-00B54 50KB 411 50WV 100PF 421 50WV 180PF C CAPACITOR						
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			TO 11. TO 2011/1 W			
Sol, 502						
C CAPACITOR CARBON COMPOSITION DIPPED MICA 503~507,536 ¼W 1MΩ 422 50WV 1PF 534 ½W 10Ω 401,402,408,409 50WV 5PF VR POTENTIOMETER 429 50WV 30PF 501 EVL~SOAA-00B13 1KB 426 50WV 47PF 502 EVL~SOAA-00B54 50KB 411 50WV 100PF 421 50WV 180PF C CAPACITOR						
DIPPED MICA 503~507, 536 ½W 1MΩ	C CAPACITO	R				
422 50WV 1PF 534 ½W 10 Ω 401, 402, 408, 409 50WV 5PF 429 50WV 6PF VR POTENTIOMETER 403 50WV 30PF 501 EVL-SOAA-00B13 1KB 426 50WV 47PF 502 EVL-SOAA-00B54 50KB 411 50WV 100PF 421 50WV 180PF C CAPACITOR	DII	PPED MICA				1 M Ω
401, 402, 408, 409 50WV 5PF 429 50WV 6PF VR POTENTIOMETER 403 50WV 30PF 501 EVL-SOAA-00B13 1KB 426 50WV 47PF 502 EVL-SOAA-00B54 50KB 411 50WV 100PF 421 50WV 180PF C CAPACITOR	422	50WV	1PF	534		
403 50WV 30PF 501 EVL-SOAA-00B13 1KB 426 50WV 47PF 502 EVL-SOAA-00B54 50KB 411 50WV 100PF 421 50WV 180PF C CAPACITOR	401, 402, 408, 409	50 W V				
426 50WV 47PF 502 EVL-SOAA-00B54 50KB 411 50WV 100PF 421 50WV 180PF C CAPACITOR	429				ENTIOMETER	
411 50WV 100PF 421 50WV 180PF C CAPACITOR						1KB
421 50WV 180PF C CAPACITOR	426		47PF	502	EVL-SOAA-00B54	
CERAMIC DISC DIPPED MICA			180PF	C CAPA	· · · · · · · · · · · · · · · · · · ·	
	CEI	RAMIC DISC			DIPPED MICA	

511 510 51 510	F 0.1****		604 616	1/447	40 25 15
511, 512, 514, 519	50WV	5PF	634, 613	1/4 W	47KΩ
507, 508, 516 , 523, 537 ,		10PF	603, 633, 637	1/4 W	100KΩ
510, 506, 535	50WV	20PF	607	1⁄4 W	1 M Ω
528	50WV	27PF		DECLI COMPOSITION	
	AMIC DISC	# m		RBON COMPOSITION	0 0576
513, 534	50W V	1PF	608, 609	½ W	3.3MΩ
502, 503	50W V	0.001µF	610	½ W	5.6MΩ
501, 504, 505, 509, 515		0.01µF		WIRE WOUND	
517, 518, 520 - 522, 52			645, 646	½W	0.22Ω
1	MYLAR	<u> </u>			
532	50W V	$0.047 \mu F$	RS THER	MISTOR	
ELE	CTROLYTIC		601	SDT-250	
525, 527, 529, 531	16W V	10μF			
530	16W V	22 μF	VR POTE	NTIOMETER	
533		33µF	605	EVL-SOAA-00B53	5KB
TC TRIMMER	CAPACITOR		602, 603	EVL-VOAA-00B14	10KB
501 505 E	$CV-1ZW 10\times4$	0 10PF	604	EVL-SOAA-00B14	10KB
506 E	$CV 1ZW 20 \times 5$	1 20PF	606	EVL-SOAA-00B54	50KB
507, 508 E	$CV 1ZW 20 \times 3$	2 20PF	601	EVL-VOAA-00B26	2MB
			C CAPACI	TOR	
L INDUCTOR				DIPPED MICA	
503	# 221008		637	50W V	200PF
504, 502	# 221009		635	50 W V	280PF
507, 510	# 221018		628	50W V	330PF
508, 509	# 221017		<u> </u>	CERAMIC DISC	
506	# 221036		605	50WV	470PF
	TT C21000		636	50WV	0.047μF
T TRANSFOR	MED		000	MYLAR	0.011,21
501	R-12 4073		610, 615	50WV	0.001µF
502	# 221035		629, 630	50W V	0.001µI
302	# 221033		608, 611, 619, 62		0.002μ F
			616 - 618	50W V	0.01μ F 0.02μ F
AF UN			614, 631	50W V	
	IRCUIT BOAR	<u> </u>			$0.047 \mu F$
1499 (A~Z) AF C	IRCUIT		609	50WV	$0.1\mu F$
			601 610 600 6	ELECTROLYTIC	
	TRANSISTOR		601, 612, 623, 62		1µF
602		0-3001	621, 622	16W V	4.7µF
603		K19Y	602 ~ 604,606,6		10μF
608, 609		K19GR	624	10WV	100μF
612		A695	625, 633	16WV	100µF
614		B529	627, 632	16WV	220µF
601, 605, 606, 607, 610	7	C372Y			
611		C711		ARKER UNIT	
604	2S	C735Y		ED CIRCUIT BOARD	A
613	2S	D359	1459 (A~Z)	MARKER CIRCUIT	
D DIODE			Q C&1	RANSISTOR	
601 - 604	Si 1S	1555	703	IC 34024PC	2
605	Varistor MV	√-5 W	701, 702, 704	Tr 2SC372	Y
R RESISTOR	1		X CRYS	ΓAL	
	RBON FILM		701	HC-18/U 12.81	МНz
642	1/4 W	10 Ω			
641	1/4 W	22 Ω	R RESIS	TOR	
628	¼W	100 Ω		CARBON FILM	
647	1⁄4 W	180 Ω	$701 \sim 708$	¼ W	100 Ω
	1/4 W	220 Ω	711, 713	¼ W	1ΚΩ
622, 629, 644		22030			0.017.0
622, 629, 644 626	1/4 W	470 Ω	716	¼ W	2.2K Ω
			716 710		2.2K Ω 10K Ω
626	½ W ½ W	470 Ω 680 Ω		½ W	10K Ω
626 611	1/4 W 1/4 W 1/4 W	$\begin{array}{c} \textbf{470}\Omega\\ \textbf{680}\Omega\\ \textbf{1K}\Omega \end{array}$	710	1/4 W 1/4 W	
626 611 601, 616, 638, 639 604, 635, 636	1/4 W 1/4 W 1/4 W 1/4 W	$\begin{array}{c} \textbf{470}\Omega\\ \textbf{680}\Omega\\ \textbf{1K}\Omega\\ \textbf{1.5K}\Omega \end{array}$	710 709, 715	½ W	10K Ω 22K Ω
626 611 601, 616, 638, 639 604, 635, 636 623, 624, 625, 631	1/4 W 1/4 W 1/4 W 1/4 W 1/4 W	$\begin{array}{c} \textbf{470}\Omega\\ \textbf{680}\Omega\\ \textbf{1K}\Omega\\ \textbf{1.5K}\Omega\\ \textbf{2.2K}\Omega \end{array}$	710 709, 715 714	½ W ½ W ¼ W	10ΚΩ 22ΚΩ 100ΚΩ
626 611 601, 616, 638, 639 604, 635, 636 623, 624, 625, 631 605, 614, 643	1/4 W 1/4 W 1/4 W 1/4 W 1/4 W 1/4 W	470 Ω 680 Ω 1 K Ω 1.5 K Ω 2.2 K Ω 3.3 K Ω	710 709, 715 714 712	1/4 W 1/4 W 1/4 W 1/4 W	10ΚΩ 22ΚΩ 100ΚΩ
626 611 601, 616, 638, 639 604, 635, 636 623, 624, 625, 631 605, 614, 643 606, 612, 618, 619, 620	¼W ¼W ¼W ¼W ¼W ¼W 0,627 ¼W	470 Ω 680 Ω 1 Κ Ω 1 . 5 Κ Ω 2 . 2 Κ Ω 3 . 3 Κ Ω 4 . 7 Κ Ω	710 709, 715 714 712 VR POTEI	1/4 W 1/4 W 1/4 W 1/4 W 1/4 W	10ΚΩ 22ΚΩ 100ΚΩ 220ΚΩ
626 611 601, 616, 638, 639 604, 635, 636 623, 624, 625, 631 605, 614, 643 606, 612, 618, 619, 620	1/4 W 1/4 W 1/4 W 1/4 W 1/4 W 1/4 W 1/4 W 1/4 W 1/4 W	470 Ω 680 Ω 1 Κ Ω 1.5 Κ Ω 2.2 Κ Ω 3.3 Κ Ω 4.7 Κ Ω 5.6 Κ Ω	710 709, 715 714 712 VR POTEI 701~708	1/4 W 1/4 W 1/4 W 1/4 W NTIOMETER EVL-SOAA-OOB14	10ΚΩ 22ΚΩ 100ΚΩ
626 611 601, 616, 638, 639 604, 635, 636 623, 624, 625, 631 605, 614, 643 606, 612, 618, 619, 620 617 630, 632	1/4 W	470 Ω 680 Ω 1 Κ Ω 1.5 Κ Ω 2.2 Κ Ω 3.3 Κ Ω 4.7 Κ Ω 5.6 Κ Ω 6.8 Κ Ω	710 709, 715 714 712 VR POTEI	1/4 W 1/4 W 1/4 W 1/4 W 1/4 W 1/4 W NTIOMETER EVL-SOAA-OOB14 DITOR	10ΚΩ 22ΚΩ 100ΚΩ 220ΚΩ
626 611 601, 616, 638, 639 604, 635, 636 623, 624, 625, 631 605, 614, 643 606, 612, 618, 619, 620 617 630, 632 602	14 W 14 W 14 W 14 W 14 W 14 W 14 W 14 W 14 W	470 Ω 680 Ω 1 Κ Ω 1.5 Κ Ω 2.2 Κ Ω 3.3 Κ Ω 4.7 Κ Ω 5.6 Κ Ω 6.8 Κ Ω 15 Κ Ω	710 709, 715 714 712 VR POTEI 701~708 I	1/4 W 1/4 W 1/4 W 1/4 W 1/4 W NTIOMETER EVL-SOAA-OOB14 DITOR DIPPED MICA	10ΚΩ 22ΚΩ 100ΚΩ 220ΚΩ
626 611 601, 616, 638, 639 604, 635, 636 623, 624, 625, 631 605, 614, 643 606, 612, 618, 619, 620 617 630, 632 602 615	14 W 14 W 14 W 14 W 14 W 14 W 14 W 14 W 14 W 14 W	470 Ω 680 Ω 1 Κ Ω 1 .5 Κ Ω 2 .2 Κ Ω 3 .3 Κ Ω 4 .7 Κ Ω 5 .6 Κ Ω 6 .8 Κ Ω 15 Κ Ω 22 Κ Ω	710 709, 715 714 712 VR POTEI 701~708 I C CAPAC	1/4 W 1/4 W 1/4 W 1/4 W 1/4 W NTIOMETER EVL-SOAA-OOB14 CITOR DIPPED MICA 50WV	10ΚΩ 22ΚΩ 100ΚΩ 220ΚΩ 10KB
626 611 601, 616, 638, 639 604, 635, 636 623, 624, 625, 631 605, 614, 643 606, 612, 618, 619, 620 617 630, 632 602	14 W 14 W 14 W 14 W 14 W 14 W 14 W 14 W 14 W	470 Ω 680 Ω 1 Κ Ω 1.5 Κ Ω 2.2 Κ Ω 3.3 Κ Ω 4.7 Κ Ω 5.6 Κ Ω 6.8 Κ Ω 15 Κ Ω	710 709, 715 714 712 VR POTEI 701~708 I	1/4 W 1/4 W 1/4 W 1/4 W 1/4 W NTIOMETER EVL-SOAA-OOB14 DITOR DIPPED MICA	10ΚΩ 22ΚΩ 100ΚΩ 220ΚΩ

	RAMIC DISC		810,830,831,837,838	· · · · · · · · · · · · · · · · · · ·	
704~706,708	50WV	0.01μF	828, 829	50WV	
			811,817,818,820~82		$0.047 \mu F$
	CTROLYTIC	40.5		STYROL	
710	16W V	10μF	826	50WV	
			827	50W V	
TC TRIMMER CA			<u></u>	ANTALUM	
701 EC	$CV-1ZW 20\times4$	0 20PF	839, 840	25WV	
				ECTROLYT	
L INDUCTOR			849, 850	16WV	
702	RFC	22μH	832, 842	16WV	4.7μF
701	RFC	$250 \mu H$			
	IF UNIT		L INDUCTOR		
	RCUIT BOARD		804		10-251K 250μH
1463 (A~Z) FM I	F CIRCUIT		801 ~ 803, 806, 807		10-102K 1mH
			805	EL061	10-202K 2mH
Q IC FET & T					
802	IC μA703	знс	T TRANSFOR		
808	" TA706 FET 2SK19		801, 802	R-12	4074
803			803		4861D
801,804 - 807,809 - 81	1 2SC37	7 Z Y	804		4861E
			805		3004
D DIODE	G: 10177	r			
801, 802, 807 ~ 810	Si 1S155				
803 - 806	Ge 1S188	F'M		SB IF UNI	
			PB PRINTED C		
X CRYSTAL			1462 (A~Z) SS	B IF CIRC	UIT
801	HC-18/U	10.245MHz			
			Q IC FET &		
CF CERAMIC FI			902	IC	TA7045M
802	CFM 455F		903, 906	FET	2SK19GR
803	10.7MF-BR		904, 905		2SC373
			901		2SC784R
R RESISTOR	n n 1 1		907, 908		2SC1000GR
CARI		1000			
804, 805, 826	1/4 W	100Ω	D DIODE		
825, 827, 837	1/4 W	220 Ω	901~903, 912, 913	Si	1S1555
824	1/4 W	470Ω	910	Ge	1S188FM
803, 833, 842	1/4 W	560 Ω	904~907, 909	G.B	1S1007
808, 816, 819, 828, 829,	½ W	1K Ω	911	Zener	WZ110
836, 846, 847					
809	½W	1.5ΚΩ	XF CRYSTAL		
839, 840	1/4 W	2.2ΚΩ	901	XF-10A	1
811, 813, 814, 821, 843,	½ W	3.3KΩ			
849 ~ 856	1/		R RESISTOR		
801, 830, 831, 835, 844	1/4 W	4.7ΚΩ		RBON FILM	
822, 838	1/4 W	5. 6KΩ	909, 912, 914, 915, 919	9, ½W	100 Ω
802	1/4 W	10KΩ	932, 933, 939, 940		
815, 845	1/4 W	15 K Ω	926, 928	1∕4 W	270Ω
823, 834, 841	1/4 W	22K Ω	917, 944	1/4 W	470Ω
820, 832	1/4 W	47KΩ	901, 902, 927	1∕4 W	560 Ω
848	½ W	56 K Ω	934, 938, 946, 947, 90	5 ½W	1K Ω
806, 807, 810	½ W	100Κ Ω	911, 913, 921		
			922	1/4 W	1.5KΩ
RS THERMISTO			929	1∕4 W	1.8KΩ
801	SDT-250		908, 910, 918, 930, 945		2.2K Ω
			925	1∕4 W	2.7ΚΩ
C CAPACITOR			903, 904, 942	1∕4 W	3.3KΩ
	PED MICA		935, 936	½ W	4.7KΩ
812	50WV	15PF	906	1/4 W	6.8K Ω
806, 807	50WV	30PF	941	1∕4 W	10Κ Ω
833	50W V	40PF	920, 943	1∕4 W	22K Ω
809, 835, 843	50WV	100PF	907	½ W	27ΚΩ
801	50WV	200PF	937	½ W	56Κ Ω
834	50W V	300PF	916, 931	½ W	100Κ Ω
	MIC DISC		923	¼ W	470Κ Ω
844	50WV	0.001µF			
802 - 805, 808, 813, 815,		0.01µF	RS THERMIST		
816, 819, 836, 845 ~ 848			901	SDT-2	50
N	IYLAR				

VR POTEN	TIOMETER		1010	101111	
901	EVL-SOAA-0	0B52 500B	1012	16WV	$\frac{1\mu F}{4.7 - F}$
903	EVL-SOAA-0		1011	16WV 16WV	$\frac{4.7 \mu F}{100 F}$
902	EVL-SOAA-0		1011	16 W V	100μF
		UDOU UND	RL RE	ELAY	
C CAPAC	ITOR		1001	LZ-2G	
	DIPPED MICA			LZ 20	
915	50WV	10PF			
912	50WV	20PF		MIC AMP UNIT	
916	50WV	100PF	PB PF	RINTED CIRCUIT BOARD	
	CERAMIC DISC		1460 (A~	Z) MIC AMP CIRCUIT	
901, 902, 909~9	11,906 50WV	0.01μF		Z, me mm chteerr	
917, 918, 920, 92	3~929,933		Q ICF	ET & TRANSISTOR	
	8,913,914 50W V	0.047μF	1104	IC LD-3	2001
	MYLAR		1105, 1106	FET 2SKI	
932	50 W V	0.0047µF		3, 1107, 1108 2SC3	
936, 940	50 W V	$0.02 \mu F$		2500	7721
931, 937	50WV	$0.047 \mu F$	D DIG	ODE	
	ELECTROLYTIC	······································		1106, 1112~1114, 1117 Si	1S1555
930,939	16W V	$1\mu F$	1103, 1104	Ge	1S188FM
938	16W V	10μF	1108~1111		1S1007
934, 935, 922	16W V	47μF	1102	Varactor	
	TANTALUM				
921	35W V	0.1μF	X CR	YSTAL	
	ER CAPACITOR		1101	HC-18/U 10.70	000MHz
901	ECV-1ZW 5	0×40 50PF	1102	HC-18/U 10.70	
L INDUCT			1103	HC-18/U 10.69	
901	EL0610-2511	C 250μH	1104	HC-18/U 10.69	
	7				
	FORMER		R RE	SISTOR	
901, 902		4074		CARBON FILM	
903	R-12	4073		121,1124,1129 ½W	100Ω
				148,1149, 1150, 1152, 1153	
	ONE BURST UNIT			136,1138,1142, 1137 ¼W	220Ω
	D CIRCUIT BOAF		1114,1102		470 Ω
1401 (A~Z)	TONE BURST CI	RCUIT	1106,1113,1	125,1127,1145 ¼W	1Κ Ω
				1123, 1147, 1151 ¼W	2.2KΩ
Q IC & FI		DD1011.151	1104, 1128	1/4 W	3.3K Ω
		ΓP4011AN	1143	1⁄4 W	4.7KΩ
1005 1004		ΓP4027AN	1116, 1140,		5.6KΩ
1004		ΓP4049AN	1139	1∕ ₄ W	6.8K Ω
1000	FET 2	2SK19GR	1108, 1118,		10K Ω
D DIODE			1115,	1⁄4 W	12K Ω
1001 ~ 1003	C -	C100EM	1107, 1111	1/4 W	22K Ω
R RESIST	Ge 1	S188FM	1103	1/4 W	27K Ω
	CARBON FILM		1110, 1119	1/4 W	33KΩ
1014	1/4W	220 Ω	1109, 1126, 1		100KΩ
1013	1/4 W			TENTIOMETER	
1015	/4 W	10KΩ 39KΩ	1102	EVL SOAA 00B32	
1011			1103	EVL SOAA 00B13	
1012		820KΩ	1101 C CAI	EVL-SOAA-00B23	2KB
1001~1005,1008	$\frac{74 \text{ W}}{-1010}$	$\frac{820 \text{K}\Omega}{1 \text{M}\Omega}$	C CAI	PACITOR DIPPED MICA	
		1 141 25	1159	50WV	5PF
CAR	BON COMPOSITION	ON	1158, 1133	50W V	10PF
1006, 1007	1/4 W	2.2ΜΩ	1106	50W V	15PF
	TIOMETER		1146	50W V	20PF
1002, 1003	EVL-SOAA 001	315 100KB	1140, 1154~		30PF
1001	EVL SOAA-001			50WV	
			1107, 1108, 1		100PF
C CAPACI	TOR		1148	50WV	150PF
	DIPPED MICA		1143	50W V	200PF
1009	50W V	1000PF	1110	50WV	250PF
	MYLAR		1126~1128	50WV	270PF
1001,1002,1004,1		0.01µF		CERAMIC DISC	
1007, 1010			1136	50WV	0.001µF
	TANTALUM		1101, 1102, 1	104, 50WV	$0.01\mu F$
1003	35 W V	0.33µF	$1134 \sim 1135$,	1138, 1139, 1141,	
1006, 1008	35WV	$0.47 \mu F$	1149 1144 1	145 1140 1150	
<u> </u>		υ.41μΓ	1142, 1144, 1	$145, 1149 \sim 1153$	1
• · · · · · · · · · · · · · · · · · · ·	ELECTROLYTIC	0.47μΓ	1142, 1144, 1	145, 1149~1153 50WV	0.047μF

	3.73	YLAR		1000	1907 1900	1631777	10 13
1111 1	м 1115, 1116, 1122, 1		V 0.047μF	1203,	1207, 1209	16WV	10μF
1111,		TROLYTIC	τ 0.047μΓ	тс	TRIMMER CA	APACITOP	
1114	1117, 1129, 1131		$1\mu F$	1201		ECV-1ZW 50×	40 50PF
1118	$\frac{1117,1129,1131}{1119,1121,1123}$	1125. 16	$\frac{1\mu F}{WV}$ $\frac{10\mu F}{}$			TSN-P-100DS	20PF
1130	,,			1202		1511 1 10005	2011
1120		16WV	22μF	L	INDUCTOR		
1112, 1	1113	16WV	47μF	1201,		# 221019	
		·			1206, 1208, 1209		
TC	TRIMMER CA	PACITOR		1211,		# 221021	
1102~		ECV-1ZW 2	0×40 20PF	1202,		# 221022	
1101		ECV-1ZW 5	0×40 50PF	1205		# 221037	
				1210		EL0610-220K	22μH
L	INDUCTOR						
1101		# 221024		RL	RELAY		
1107		EL0610-100		1201		LZ-2G I	OC12 450Ω
1106,1	108~1112 F	EL0610-102	K 1mH				
					VFO UNI		
T	TRANSFORM		# 4074	PB		CUIT BOARD	
1101			# 4074	1465	$(A \sim Z)$ VFO	CIRCUIT	
1102		R-12	# 4073	 _ _ _ _ _ _ _ _ _ _ _	CET 0 TO 1	ICICTOD	
	BOOSTER	O LINIT		Q 1302	FET & TRAN		10CP
PB	PRINTED CIR		PD	1302	1303		19GR 372Y
	$(A\sim Z)$ BOOS			1301,	1303	280	3/21
14/0	(A L) BOOS	ILK CIRC	011	R	RESISTOR		
Q	TRANSISTOR		·	-		ON FILM	
1201	- I CAITOIS I OR	2N5590	· · · · · · · · · · · · · · · · · · ·	1307	1311, 1312	¹ / ₄ W	100Ω
1202		2N5591		1310	1311, 1312	1/4 W	150 Ω
1202		240001		1306		14 W	470Ω
D	DIODE		<u> </u>	1304		1/4 W	2.2ΚΩ
1201, 1		Si	10D-1	1301	· · · · · · · · · · · · · · · · · · ·	1/4 W	3.3KΩ
	1205~1208	<u> </u>	1S1555	1308		14 W	6.8KΩ
1204		Ge	1S188FM	1309		1/4 W	15KΩ
1209		Zener	1N4740	1302		1/4 W	18ΚΩ
1200	·	2011CI		1303		14 W	33KΩ
R	RESISTOR			1305		1/4 W	100ΚΩ
	CARBON C	COMPOSIT	ION	1			
1204		½W	10Ω	С	CAPACITOR		
1201		½ W	22 Ω			ED MICA	
1203	***	½ W	56 Ω	1318	· · · · · · · · · · · · · · · · · · ·	50WV	2PF
1205		½ W	100 Ω	1302		50WV	20PF
1202		½ W	330 Ω	1313		50WV	39PF
1206		½ W	100Κ Ω	1306		50WV	51PF
1207		½ W	1M Ω	1311		50 W V	68PF
				1307		50WV	270PF
VR	POTENTIOME	TER		1310		50WV	470PF
1201		-SOAA-00I				MIC DISC	
1202	EVL-	-SOAA-00E	354 50KB		1309, 1312,	50 W V	$0.01 \mu F$
				1314~			
	CAPACITOR				CER	AMIC TC	
	DIPPE	D MICA		1303		500 W V	5PF UJ
1216		50WV	2PF	1304		500WV	10PF UJ
1217,	1,223	50WV	5PF	1301		500WV	20PF UJ
1201		50WV	10PF	1305		500WV	82PF NPO
1224	1015	50W V	12PF	100-		FEED THRU	
1213~	- 1215	50WV	20PF	1317	E	CK-L1H102PE	1000PF
1205		50W V	33PF		V/A = 1.4 = 1		
1212		50W V	39PF	VC	VARIABLE C		
1211		50WV	68PF	1301		C521	
1206		50W V	100PF		TD1040455 5 :	0.401767	
<u> </u>	CED	MIC DICC		TC	TRIMMER CA		
1000		MIC DISC	0.001 77	1301	· · · · · · · · · · · · · · · · · · ·	MC10P×2	
	1204, 1208, 1210	50WV	$0.001 \mu F$	1302		KC-30P	
1218~		50W V	$0.01 \mu F$		15101 10200		·
1001	M	YLAR	0.001 77	L	INDUCTOR	U 001007 A	
1221	The same	50WV	$0.001 \mu F$	1301		# 221025 A	20
1000	IAN	TALUM	A 1 E	1302		EL0610-680K	68µH
1222	FLECT	35WV	0.1μF	1303		EL0610-251K	250µH
I	ELECT	ROLYTIC					

			VR	POTE	NTIOMETER	
			1501, 1	502	SR-19R	470ΩB
			С	CAPA	CITOR	
					CERAMIC DISC	
REG UNIT			1504		50W V	$0.001 \mu F$
PB PRINTED CIRC	CUIT BOAF	₹D	1507,	1509	50WV	$0.01 \mu \mathrm{F}$
1469 (A~Z) REG C	IRCUIT BO	DARD			ELECTROLYTIC	
1409 (A 2) 1120 S			1506		16W V	10μF
Q TRANSISTOR			1503		16W V	100μF
1502, 1505	2SC372Y		1508		16W V	$220 \mu \mathrm{F}$
1503	2SC735Y		1505		16WV	470μF
1501, 1504	2SD313D		1501,	1502	25W V	2200µF
1001, 1001						
D DIODE						
	i Bridge	M4B-5				
	ener	WZ-061				
1502		WZ-090				
1503		WZ-110				
	hyristor	CW-01B				
R RESISTOR						
CARBO	ON FILM					
1509	⅓ W	220 Ω				
1511	1⁄4 W	270 Ω				
1501	1/4 W	330 Ω				
1512	1/4 W	470Ω				
1505	1/4 W	560 Ω	-			
1502	1/4 W	680 Ω				
1503	1/4 W	820 Ω				
1508	1/4 W	1 K Ω				
1504	1/4 W	2.7KΩ 2.2KΩ	1			
1510	1/4 W		<u> </u>			
1506	¼ W	3.3KΩ				
	WOLIND					
	WOUND	0.4Ω				
1507	1_W	0.4.52	<u> </u>			



