

**INSTRUCTION
MANUAL
FL-101**

YAESU MUSEN CO., LTD.

TOKYO JAPAN

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SSB TRANSMITTER

FL-101



GENERAL DESCRIPTION

The model FL-101 is a precision built, compact, high performance, all amateur band transmitter of advanced design, providing SSB (USB or LSB selectable), CW, AM, and FSK mode operation. The transmitter operates at an input of 200 watts DC SSB/CW, and 80 watts DC AM/FSK on all amateur bands from 160 through 10 meters with provision for two auxiliary bands.

All circuits, except the linear amplifier stages, are solid-state and composed of standard, computer type, plug-in modules, offering dependable performance and easy maintenance.

The FL-101 is self-contained, requiring only an antenna, microphone and AC source. The transmitter may be operated from 100/110/117/200/220 or 234 volts AC 50 or 60 Hz.

All accessories, such as VOX (voice operated relay), break-in CW, FSK (frequency shift keying) and provisions for transceive operation are built-in. In addition, an RF processor may be installed as an option to double the talk power.

The FL-101 may be operated as a transceiver in combination with our FR-101 all solid-state receiver. The FTV-250 and FTV-650B 2 meter and 6 meter transverters are useful accessories for VHF band operation.

The entire transmitter weighs approximately 14 kg and is 340 mm wide, 153 mm high and 285 mm deep. Construction is of heavy-gauge steel which provides an extremely rugged package, virtually immune to the effects of vibration and shock.

SPECIFICATIONS

Frequency Range	160m	1.8 – 2.0 MHz
	80m	3.5 – 4.0 MHz
	40m	7.0 – 7.5 MHz
	20m	14.0 – 14.5 MHz
	15m	21.0 – 21.5 MHz
	10mA	28.0 – 28.5 MHz
	10mB	28.5 – 29.0 MHz
	10mC	29.0 – 29.5 MHz
	10mD	29.5 – 29.9 MHz
	AUX 1	
AUX 2		
Type of Emission	CW, AM, SSB (USB or LSB selectable) and FSK (170 Hz)	
Power Input	CW, SSB 200 watts DC AM, FSK 80 watts DC	
Carrier Suppression	Better than -40 dB	
Sideband Suppression	Better than -40 dB at 1000 Hz	
Spurious Radiation	Better than -40 dB	
Frequency Response	300 Hz ~ 2700 Hz, -6 dB	
Stability	Less than 100 Hz per 30 minutes after warm-up	
Antenna Impedance	50 ohms ~ 75 ohms unbalanced	
Microphone	High Impedance 10k ohms ~ 50k ohms	
Power Requirement	100/110/117/200/220/234 volts AC, 50/60 Hz	
Size	340(W) x 153(H) x 285(D) mm	
Weight	Approx. 14 kg	

TUBES & SEMICONDUCTORS

Tube	12BY7A	1
	6JS6C	2
Integrated Circuit	LD3141	2
	SN76514	2
	MFC6034A	1
FET	2SK19GR	3
	2SK19Y	2
Silicon Transistor	2SC372Y	8
	2SC373	1
	2SC828P	1
	2SC784R	1
Germanium Diode	1S1007	7
Silicon Diode	1S1555	6
	1S1942	2
	10D10	8
	V06B	2
Varicap Diode	1S2236	1
	1S2689	1
Zener Diode	WZ090	2
Illumination Diode	TLR104	1

INSTALLATION

The FL-101 transmitter is designed for use in many areas of the world where supply voltages may differ from the operator's local supply voltage. Therefore, be sure that the voltage marked on the rear of the transmitter agrees with the local supply voltage.

CAUTION

PERMANENT DAMAGE WILL RESULT IF IMPROPER AC SUPPLY VOLTAGE IS APPLIED TO THE TRANSMITTER.

It is recommended to avoid an excessively warm location. The transmitter should be placed with adequate space around it permitting free air circulation through the cabinet openings.

The FL-101 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 transmitter.

The transmitter is designed for use with a resonant

antenna having an impedance of 50 to 75 ohms, resistive load.

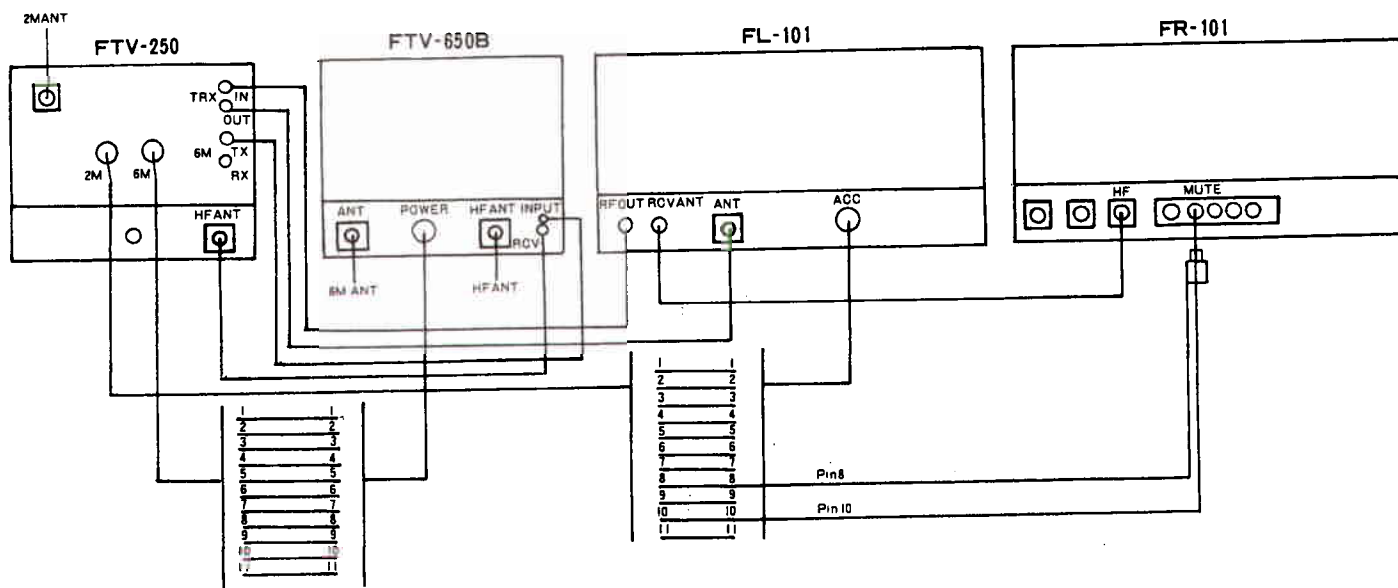
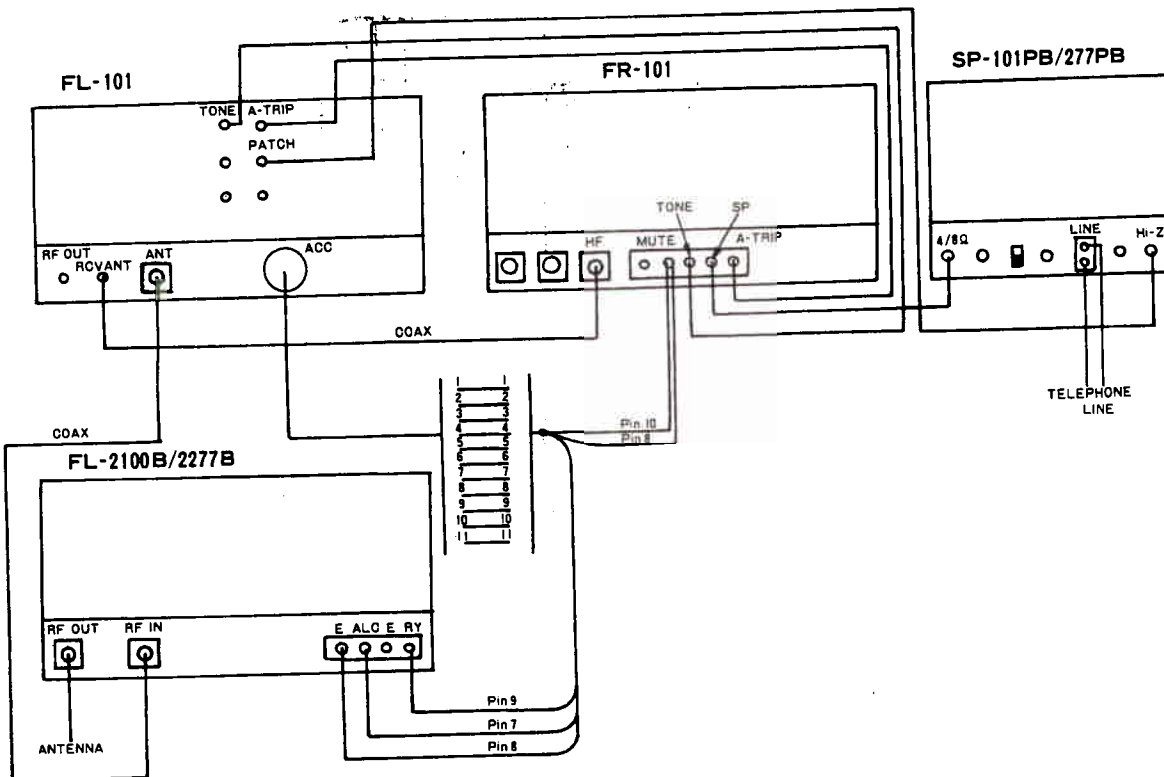
CAUTION

NEVER TRANSMIT WITHOUT HAVING PROPER ANTENNA OR DUMMY LOAD CONNECTED TO THE TRANSMITTER.

The antenna is usually the most critical part of the station installation. Results will depend on how well the antenna is installed and adjusted. Any of the common antenna systems designed for use on the high frequency amateur bands may be used with the FL-101 transmitter, provided the input impedance of the antenna system is within the capability of the transmitter pi matching network (50 ~ 75 ohms).

If a tuned open wire transmission line, or a long wire antenna is used, a suitable antenna tuner must be used between the antenna and transmitter to provide an impedance match.

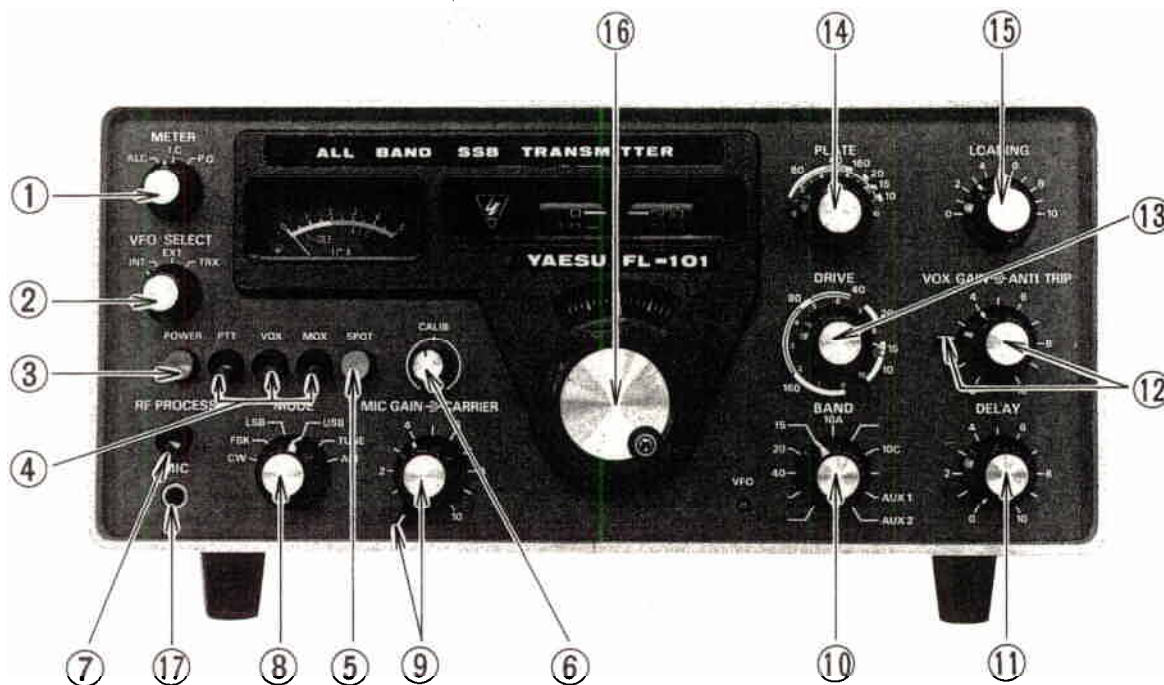
INTERCONNECTIONS



CONTROLS AND SWITCHES

The FL-101 transmitter has been specifically designed for ease of operation and versatility. All 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 and rear 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 transmitter.



FRONT PANEL

(1) METER switch

The METER switch selects the meter mode to read PA cathode current (IC), relative power output (PO) or ALC feed back voltage (ALC).

(2) VFO SELECT switch

The VFO SELECT switch provides selection of the companion external VFO, FV-101B/277B, or companion receiver, FR-101, VFO for transceive operation. Normal operation of the transmitter VFO requires that this switch be placed in the INT position. In the EXT position, the transmitter VFO controls the FR-101 receiver. The TRX position is used for the transceive operation. The detailed use of this switch is described in the "OPERATION" section of this manual.

(3) POWER switch

Main power switch.

(4) OPERATION switches

PTT

With this switch in the depressed position, the transmitter is activated by the PTT (push-to-talk) switch on the microphone.

VOX

With this switch in the depressed position, the transmitter is actuated by simply speaking into the microphone, and the receiver recovers automatically when the operator stops speaking.

MOX

Locks transmitter "ON" when this switch is depressed. For transmitter release, PTT switch should be depressed.

(5) SPOT switch

By pressing this switch, the blocking bias, except

to the final stages, is removed and a weak signal is transmitted to spot the transmitting frequency on the station received.

(6) CALIB (calibration) control

The CALIB control is used for dial calibration.

(7) RF PROCESS switch

An optional RF processor is placed into the circuit when this switch is depressed.

(8) MODE switch

The MODE switch is six position switch. This switch is used to select the mode of operation; CW, FSK, LSB, USB, TUNE or AM.

(9) MIC GAIN/CARRIER controls

The MIC GAIN/CARRIER controls are mounted on concentric shaft. The MIC GAIN control (knob) varies the level from the microphone speech amplifier stage. The control has sufficient range to permit the use of any high impedance crystal or dynamic microphone. The CARRIER control (lever) varies the amount of the carrier in the CW, FSK, TUNE and AM modes of operation. Both controls have maximum gain with the control set at 10 (fully clockwise).

(10) BAND switch

The BAND switch is an eleven position switch and is used to select the desired band. The band indication is color coded to guide the operator selection in the proper frequency scale for each band.

(11) DELAY control

The DELAY control is used to adjust the holding time of the relay for VOX and break-in CW operation. The hold time increases with clockwise rotation.

(12) VOX GAIN/ANTI TRIP controls

These controls set the operation level of the VOX circuit. VOX GAIN control (knob) controls input voltage for the VOX amplifier and the ANTI TRIP control (lever) varies the gain of ANTI TRIP amplifier which prevents the station receiver speaker output from tripping the transmitter.

(13) DRIVE control

The DRIVE control tunes the driver stages and provides continuous permeability tuning throughout the frequency range of transmitter.

(14) PLATE control

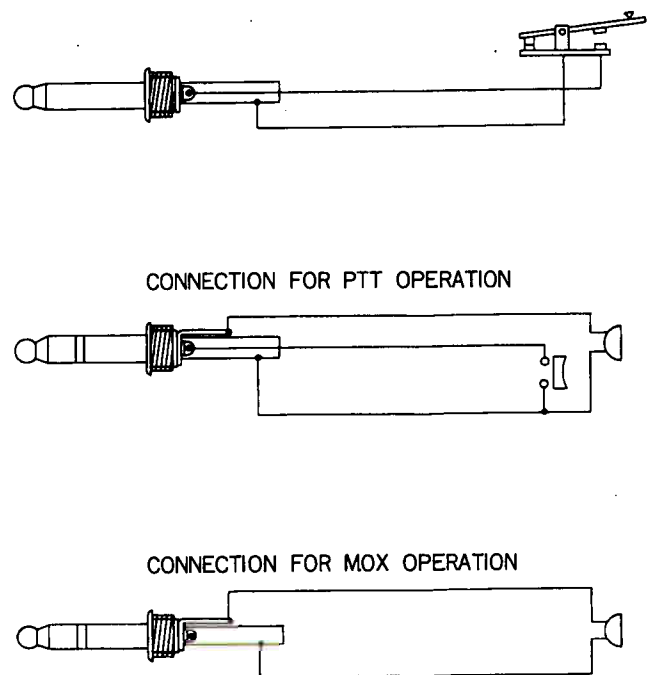
The PLATE control tunes plate circuit of the final amplifier.

(15) LOADING control

The LOADING control tunes the output circuit of the final amplifier pi-network to match the transmitter output impedance with feed line impedance.

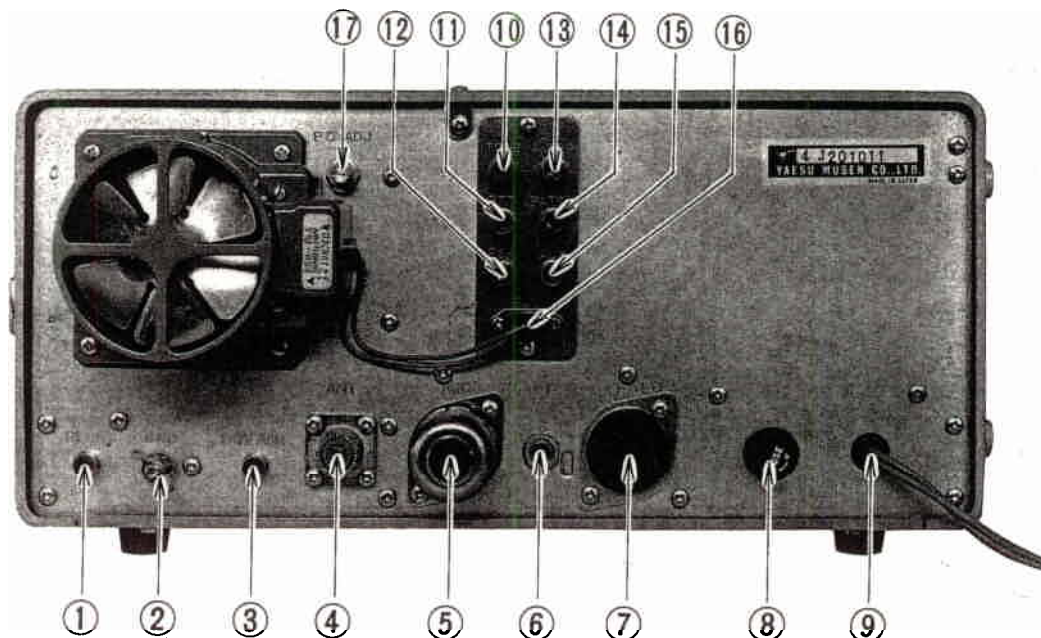
(16) MAIN TUNING control

The tuning dial determines the actual frequency of operation in combination with the BAND switch. Each revolution of the tuning knob results in a frequency change of 16 kHz as indicated on the dial located above the knob.



KEY AND MICROPHONE CONNECTIONS

Fig. 1



REAR PANEL

(1) RF OUT

Signal frequency output from the driver stage may be obtained through this jack for use with optional equipment, such as FTV-650B and FTV-250 VHF transverters.

(2) GND

Ground connection.

(3) RCV ANT

The station receiver is connected to the antenna through this jack.

(4) ANT

Coaxial connector for antenna.

(5) ACC

Accessory socket provides access to transceiver operating voltages and relay contacts.

(6) KEY

Key jack for CW operation.

(7) EXT VFO

Connection for an external VFO. Provision for voltage for an external VFO and receiver's EXT VFO output voltage are provided.

(8) FUSE

Fuse holder; requires 5 amps for 100 – 117 volts and 3 amps for 220 volt operation.

(9) AC

AC line cable.

(10) TONE

Sidetone output for CW operation.

(11) PTT

This jack may be used for external actuation of the transmitter. Example: a foot switch may be connected to this jack to provide remote control of the transmitter relay.

(12) FSK

Frequency shift keying voltage is supplied through this jack.

(13) A TRIP

Anti-trip voltage is applied to this jack from the station receiver.

(14) PATCH

Speech input terminal for phone patch connection. Impedance is 50 kilo ohms.

(15) AUX

Auxiliary jack.

(16) FAN

Power outlet for a cooling fan. 100 volts AC.

(17) PO ADJ

Meter sensitivity adjustment for relative power output indication.

OPERATION

DO NOT OPERATE THE EQUIPMENT BEFORE YOU ARE COMPLETELY FAMILIAR WITH THE INSTRUCTIONS IN THIS MANUAL.

The tuning procedure of the FL-101 is not complicated, however care should be taken when tuning to secure peak performance of the equipment. The following paragraphs describe the tuning procedure for the transmitter.

INITIAL CHECK

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

FREQUENCY SELECTION

The main tuning dial is color coded with the BAND switch for proper frequency readout. When the band selected is marked in green, the operator reads the green number of the main tuning dial. When the band selected is marked in white, the operator reads the white number on the main tuning dial.

The main tuning dial is marked in 50kHz increments. This provides a coarse frequency setting within the band. The round dial in the sub-dial window is marked in 1 kHz increments and provides fine setting of the transmitter operating frequency.

Following the example shown, familiarize yourself with the relationship of the main and sub dial readout.

For bands 40 – 20 – 15 – 10A – 10C, read the white scale on the main dial. The setting shown in the example would then be 132.5 kHz plus the starting bandedge frequency in Mega Hertz. For example, on 40 meters the frequency would be 7132.5 kHz, on 20 meters, 14,132.5 kHz, etc.

For bands 160 – 80 – 10B – 10D, read the green scale on the main dial. The setting shown in the example would then read 632.5 kHz. For example, on 80 meters the frequency would be 3632.5 kHz,

on 10B 28,632.5 kHz, etc.

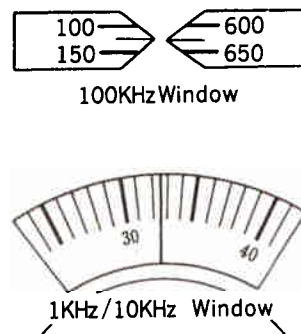


Fig. 2

PRE-TUNING

The following tune-up procedure must be performed prior to selection of desired operating mode, LSB, USB, CW, AM or FSK. Refer to paragraphs relating to the specific mode after basic transmitter tune-up.

Connect a dummy load or matched antenna to the coaxial fitting on rear panel, and preset controls and switches as follows:

POWER	OFF (released position)
VFO SELECT	INT
PTT-VOX-MOX	PTT depressed
METER	IC
MODE	TUNE
BAND	Desired band
MAIN TUNING	Desired frequency
DRIVE	Desired band segment
PLATE	Desired band segment

LOADING

BAND	LOADING
160	0 – 6
80	3 – 7
40	4 – 7
20	3
15	2
10	3 – 4

NOTE: Loading positions are nominal with 50 ohm resistive load connected. Slight variations from positions shown above are to be expected.

MIC GAIN Fully CCW (counter-clockwise position)
 CARRIER Fully CCW
 VOX GAIN Fully CCW
 ANTI TRIP Fully CCW
 DELAY Fully CCW
 CALIB 12 o'clock position

CAUTION

EXCEEDING THE TIME LIMIT OF 20 SECONDS OF CONTINUOUS POWER OUTPUT DURING TUNING PROCEDURES MAY RESULT IN DESTRUCTION OF FINAL OUTPUT TUBES.

- (1) With the POWER switch turn on (depressed position), allow at least 60 seconds for warm-up of the driver and final tubes. Be certain that an accessory plug is plugged in the accessory socket on the rear panel. The heater voltage to the final tubes is supplied through a jumper between pins 1 and 2 of the accessory plug.
- (2) Depress the MOX switch down. Meter will now indicate final amplifier idle current, which should be 50 – 60 mA.
- (3) Advance the CARRIER control arm carefully observing the Meter reading until it rises just above normal idle current (70 – 80 mA.).
- (4) Peak the DRIVE control for maximum meter reading.

CAUTION

WHEN THE METER READING EXCEEDS 350MA, REDUCE THE CARRIER CONTROL TO 300MA.

- (5) Tune the PLATE control quickly for minimum meter reading (plate dip).
- (6) Depress the PTT switch down.

The transmitter is now pretuned to the desired frequency. Final peak tuning is accomplished by carefully following the final tuning procedures.

FINAL TUNING

Final tunings utilize the meter relative to the power output position (PO). At full power output the meter will read approximately one-half full scale into a matched antenna load. If during the final tune-up it is noted that the meter indication exceeds full scale, discontinue the tune-up. Off scale meter indications are the results of reflected RF energy due to high VSWR and corrective action should be taken before attempting the final tune-up.

CAUTION

EXCEEDING THE TIME LIMIT NOTED DURING FINAL TUNING MAY RESULT IN DESTRUCTION OF THE FINAL TUBES.

- (1) Set the METER switch to IC position. Set the CARRIER control to fully CW (clockwise) position.
- (2) Momentarily depress the MOX switch (20 seconds maximum), and peak the DRIVER control for maximum meter reading and tune the PLATE control for the meter dip. If the dip current exceeds 350 mA, reduce the CARRIER control. Return the MOX to reduce by depressing the PTT switch.
- (3) Set the METER switch to PO position. Momentarily depress the MOX switch and increase or decrease the LOADING control for maximum meter reading. Return the MOX to PTT position.
- (4) Momentarily set the MOX position (20 seconds maximum) and tune the PLATE control for maximum meter reading. Return the MOX to PTT position.
- (5) Repeat above steps (3) and (4) until a maximum meter reading is obtained.
- (6) Set the METER switch to the IC position. Depress the MOX switch (20 seconds maximum). Check that the dip plate current is approximately 300 mA and this is 80 per cent of the detuned plate current, quickly rotating the PLATE control. If this exceeds 80 per cent, reduce the LOADING.

The transmitter is now tuned for maximum output. Return the CARRIER control arm fully CCW (counter-clockwise) to zero position.

NOTE: Depressing the MOX switch in the above procedures may be eliminated by simply operating the microphone PTT switch when the microphone is attached to the transmitter.

SSB OPERATION

After completion of the final tuning described above, set the MODE switch to a desired sideband, LSB or USB position. Set the METER switch to the ALC position. Be certain that the CARRIER control is fully CCW to the zero position. Depress the MOX switch to activate the transmitter and advance the MIC GAIN control until the meter kicks down to mid scale in the green colored portion marked ALC; when speaking normally into the microphone. The transmitter returns to receive condition by depressing the PTT switch down. For PTT (push-to-talk) operation, depress the PTT switch down, and depress the PTT switch on the microphone while speaking into the microphone.

Depress the VOX switch down. For VOX (voice operated relay) operation, adjust the VOX GAIN control until your voice actuates the transmitter. Set the ANTI TRIP control to a minimum point to prevent the speaker output from tripping the transmitter. Do not use the VOX GAIN and ANTI TRIP GAIN controls more than necessary. Adjust the DELAY control for suitable release time.

NOTE: When the METER is set to the IC position, voice modulation peaks will indicate 150 – 200 mA. Actual peak current, however, is approximately two times that of the indicated value.

CW OPERATION

Upon completion of the final tuning, insert a key plug in the jack marked KEY on the rear panel of the transmitter. Set the MODE switch to the CW position. Power output from the transmitter is determined by the CARRIER control arm position. The operator may select any power output desired by simply setting the CARRIER control within the limit of its range.

CAUTION

CARE MUST BE TAKEN TO AVOID AN EXCESSIVE DRIVE TO PREVENT SPURIOUS RADIATION AND DESTRUCTION OF FINAL TUBES. MAXIMUM KEY DOWN CURRENT SHOULD BE KEPT WITHIN 350MA FOR THE BANDS UNDER 15 METERS AND 280MA FOR 10 METERS BAND. KEEP THE KEY DOWN CURRENT WITHIN THE ABOVE LIMITS.

The transmitter may be operated manually or break-in by setting the MOX-PTT-VOX switch to either MOX (manual) or VOX (break-in) for the desired mode of operation. To release from manual transmission, depress the PTT switch down.

AM & FSK OPERATION

AM operation of the transmitter is accomplished by setting the MODE switch to AM position and inserting the proper amount of carrier with the CARRIER control.

After completion of the basic transmitter tune-up, set the CARRIER control to the point where the IC indication shows .15 (150mA). While speaking into the microphone normally, increase the MIC GAIN control until the meter indicates very slight movement with the voice peaks.

Care must be taken in adjusting the MIC GAIN control to assure that the CARRIER control arm is not rotated changing the carrier level.

For FSK (RTTY) operation, set the MIC GAIN control to zero position and RTTY signal is supplied with a jack marked FSK on the rear panel.

CAUTION

DO NOT EXCEED .15 (150MA) IC METER INDICATION DURING THE AM AND FSK OPERATION OR DESTRUCTION OF THE FINAL AMPLIFIER TUBES MAY RESULT.

TRANSCEIVER OPERATION

The FL-101 transmitter can be operated as a transceiver in conjunction with our FR-101 receivers. Connect the cables between two equipments as illustrated in Fig. 3. Set both BAND switches to the desired band and both MODE switches to the same mode.

- (1) Set both VFO SELECT switches to the INT position. This is a normal separate operation; both the transmitter and receiver are controlled with its own VFO.
- (2) Set the FL-101 to INT, and the FR-101 to the EXT position. The transmitter VFO now controls both transmitter and receiver frequencies.
- (3) Set both the VFO SELECT switches to the EXT position. This is called cross operation; the transmitter VFO controls the receiver frequency and the receiver VFO controls the transmitter frequency.
- (4) Set the FL-101 to TRX, and the FR-101 to

EXT position. This is a normal transceiver operation; the receiver VFO controls both transmitter and receiver frequencies.

When the external VFO unit, FV-101B/277B, is used to control the FL-101 transmitter, the VFO SELECT switch should be set to TRX position.

CALIBRATION

The FL-101 has adopted an electric calibration system for the dial calibration. To calibrate, use the calibrated station receiver. Set the transmitter dial to the same frequency in the calibrated receiver. Depress the spot switch of the FL-101 down and zero beat with the CALIBRATOR control.

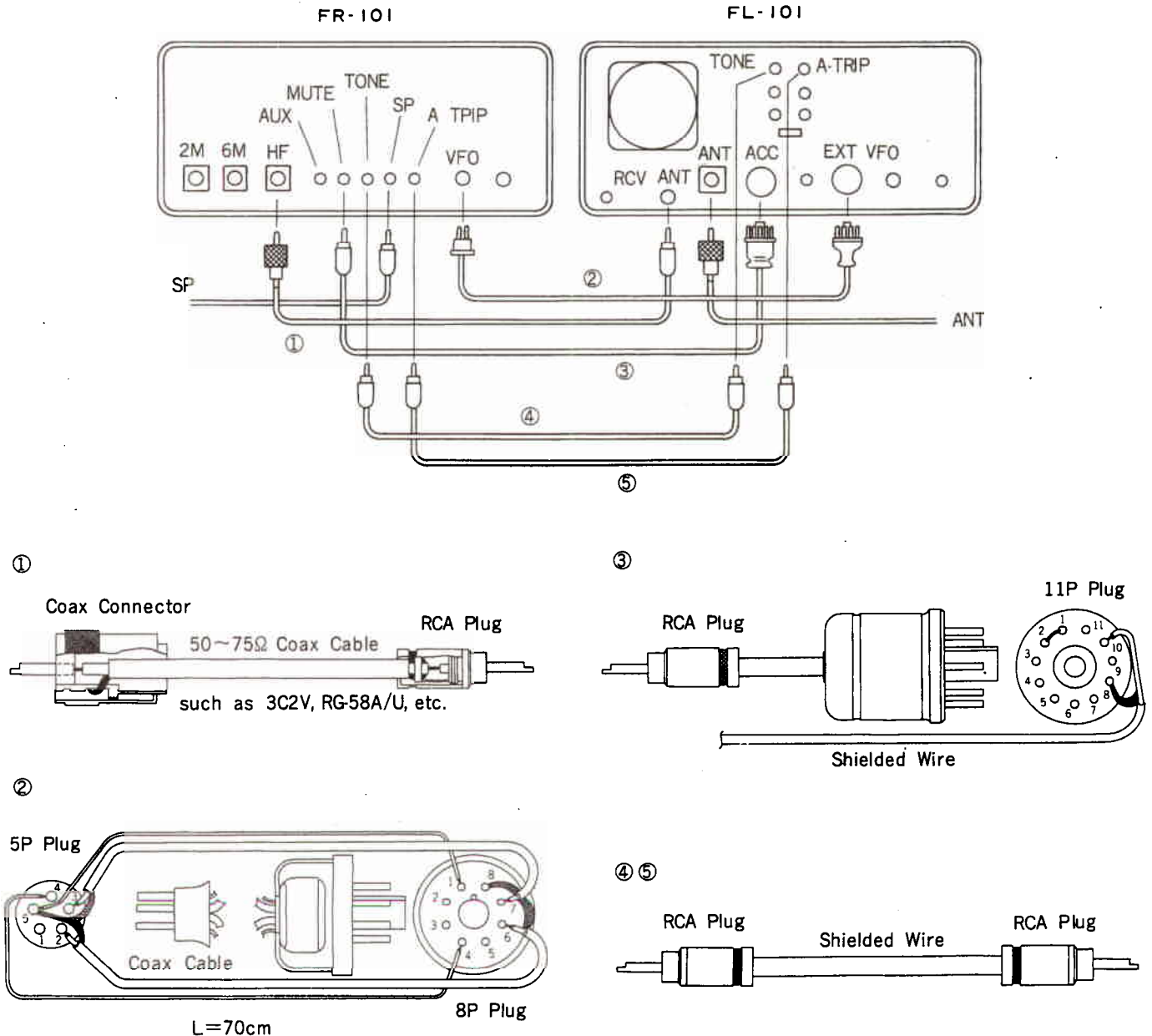
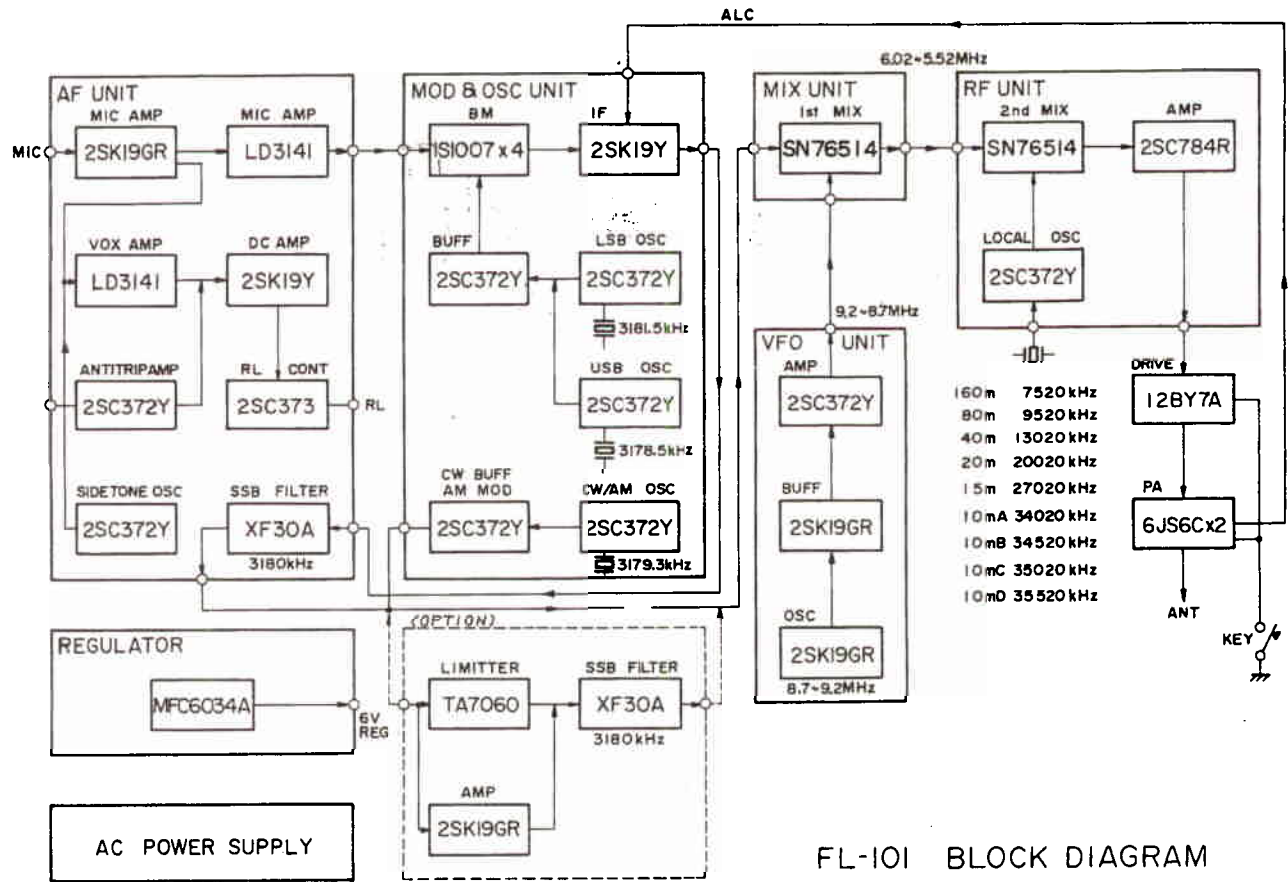
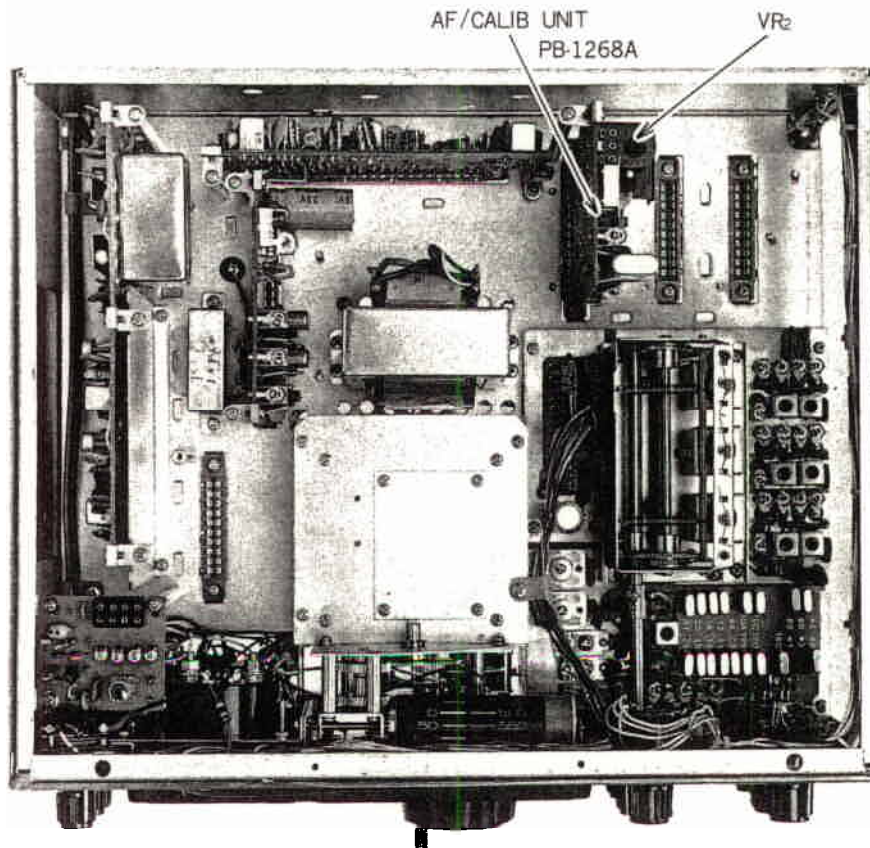


Fig. 3



FL-101 BLOCK DIAGRAM

Fig. 4



FR-101 TOP VIEW

CIRCUIT DESCRIPTION

The block diagram and the circuit description that follows will provide you with a better understanding of this transmitter. The FL-101 transmitter employs the use of computer type, plug-in modules.

AF UNIT (PB-1403)

This module contains the microphone speech amplifier, VOX circuit, CW sidetone oscillator and 3180 kHz crystal filter. A speech signal from the microphone is fed to the first microphone amplifier Q1, 2SK19GR FET, from pin 18. The input impedance of the microphone amplifier is 50 kilo ohms. The signal is controlled in amplitude by the MIC GAIN control, VR1a, connected between pin 19 and pin 17 is amplified by the second microphone amplifier Q2, LD3141 IC, and delivered to the balanced modulator from pin 14.

The signal from the first microphone amplifier is coupled through the VOX GAIN control, VR2b, to VOX amplifier Q3, LD3141 IC. The signal amplified by Q3 is fed to the VOX rectifier D1 and D2, 1S1555. The negative DC output voltage

from the rectifier is applied to the gate of the DC amplifier Q5, 2SK19Y FET. With cut off of Q5 by the control voltage, relay transistor Q6, 2SC373, conducts and actuates the VOX relay RL1 on the main chassis. The collector circuit of Q6 is connected to the VOX relay through pin 8.

The ANTITRIP circuit provides a threshold voltage to prevent the speaker output from tripping the transmitter into the transmit mode. The receiver audio fed from J6 is connected through the ANTI TRIP control VR2a to the antitrip amplifier Q4, 2SC372Y, and fed to rectifiers D3 and D4, 1S1555. The positive DC output voltage from the rectifier connected to the gate of Q5, reduces the gain of the VOX control transistor providing the necessary antitrip threshold. The ANTITRIP control VR2a adjusts the value of the antitrip voltage threshold so that the loud speaker output will not produce excessive negative DC output from the VOX rectifier to exceed the positive DC output from the antitrip rectifier and cause the control transistor to actuate the relay. When speaking into the microphone normally the negative voltage will exceed the positive antitrip voltage and actuate the relay. VR1 provides coarse adjust-

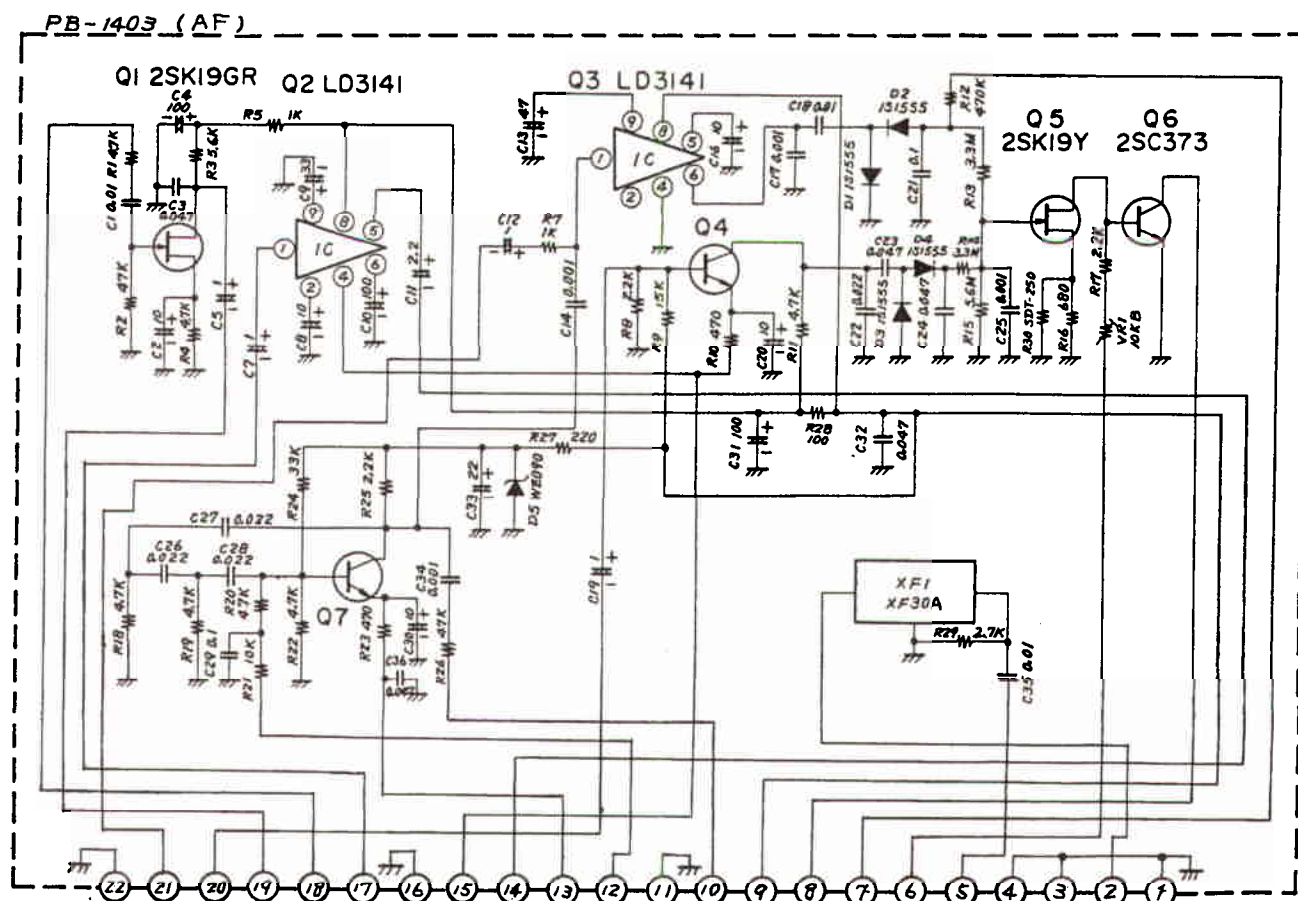


Fig. 5

ment for relay sensitivity. Relay hold time will be determined by the DELAY control VR3.

The sidetone oscillator Q7, 2SC372Y, operates when the MODE switch is in CW position. It is a phase-shift oscillator operating at approximately 800 Hz. The tone output is activated by the keying circuit and coupled to the receiver audio amplifier for sidetone monitoring in CW operation. The output from Q7 is also coupled to the VOX amplifier Q3 for break-in CW operation.

On this board a sideband filter is installed. A double sideband signal from the MOD & OSC unit is delivered through pin 5 and the unwanted sideband is rejected by the 3180 kHz filter. The resultant single sideband signal is fed to the first mixer unit from pin 2.

MODULATOR & CARRIER OSCILLATOR UNIT (PB-1404)

This unit contains the carrier oscillators, ring modulator circuit for SSB and AM modulator. The SSB carrier oscillator oscillates either 3178.5 kHz for USB or 3181.5 kHz for LSB, depending upon whether Q5, 2SC372Y, or Q3, 2SC372Y, are selected by the MODE switch.

The MODE switch disconnects the emitter circuit of either transistor when not in use. The output from the oscillator is fed to the buffer amplifier Q4, 2SC828P, and then balanced ring modulator D1 through D4, 1S1007. These crystal frequencies are matched to the band pass of the crystal filter to place the carrier frequency approximately 25 dB down on the skirt of the filter response. The speaker signal is fed to the ring modulator from pin 7.

Carrier balance is obtained by a potentiometer VR1 and a trimmer capacitor TC1. Double sideband suppressed carrier output from the balanced modulator is amplified by the IF amplifier Q1, 2SK19Y, and fed to the sideband filter in AF unit from pin 3.

For CW, AM and FSK operation, the 3179.3 kHz crystal-controlled oscillator Q6, 2SC372Y, operates to produce the carrier signal while Q3 and Q5 are disconnected.

Q2, 2SC372Y, operates as a modulator for AM operation and as a buffer stage for CW operation. The 3179.3 kHz crystal oscillator is shifted 170 Hz by the diode D5, 1S2689. The output signal from Q2 is fed through carrier control to the 1st mixer unit, PB-1406.

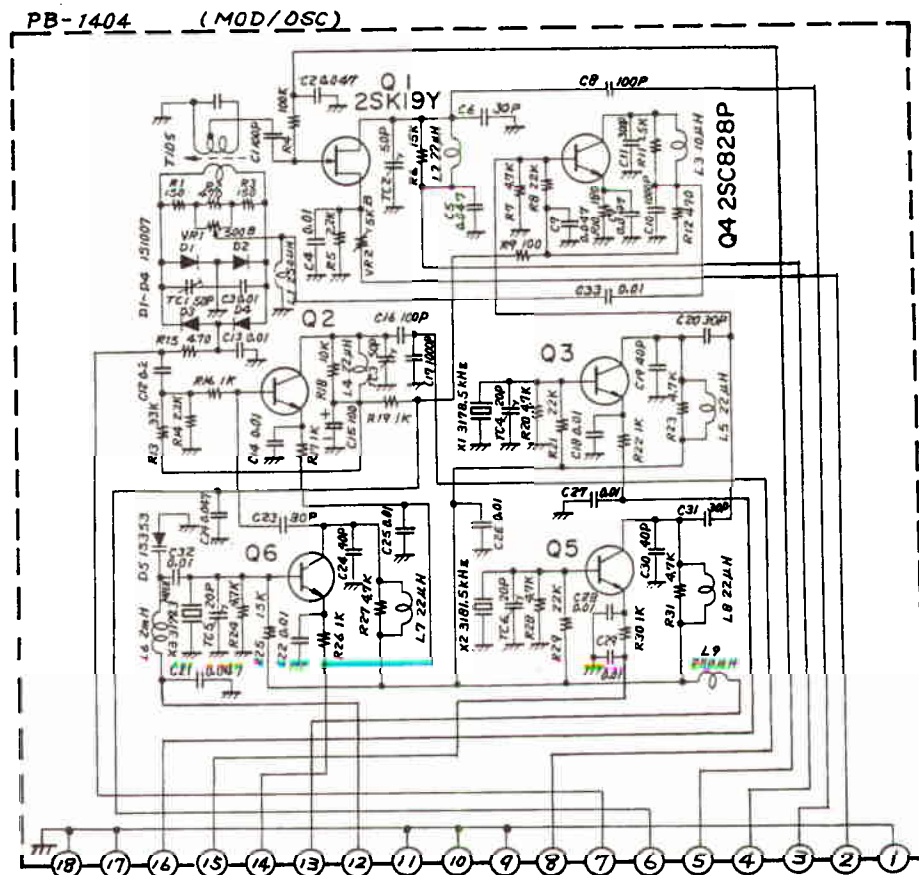


Fig. 6

VFO UNIT (PB-1412)

The VFO module unit is installed in the VFO chassis. The VFO uses FET transistors, Q1, 2SK19GR, as oscillator, Q2, 2SK19GR, as the first buffer, and Q3, 2SC372Y, as the second buffer.

The VFO oscillation frequency is 8700 kHz to 9200 kHz and covers 500 kHz IF range. The varactor diode D1, 1S2236, shifts the frequency for the calibration.

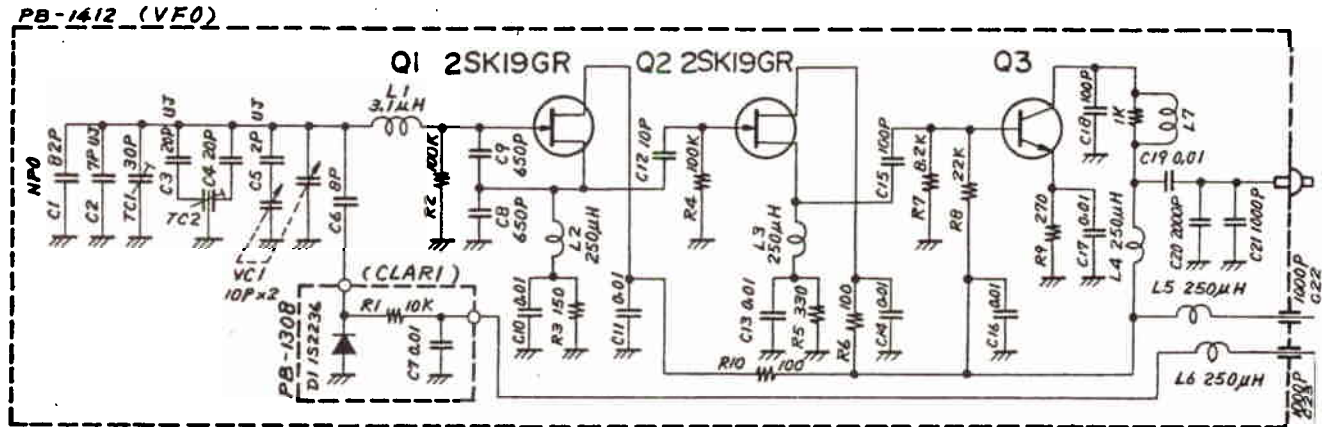


Fig. 7

MIXER UNIT (PB-1406)

This module contains the first mixer Q1, SN76514. The sideband signal is fed to the gate of Q1 from pin 3, and the CW, AM and FSK signal is fed to the gate from pin 2. The VFO signal is fed to the emitter of the Q1 which produces 5520 kHz to 6020 kHz high frequency IF signal. This signal is fed to the following stages from pin 13 through the band pass network which passes 5520 kHz to 6020 kHz signal. A 6360 kHz crystal filter is used in the output circuit of the mixer to eliminate the second harmonics of the 3180 kHz IF signal.

RF UNIT (PB-1407)

The 5520 kHz to 6020 kHz IF signal is fed from pin 7 to the second mixer Q1, SN76514, where the incoming signal is mixed with a signal from the heterodyne oscillator Q3, 2SC372Y. This arrangement converts the second IF signal to the desired transmitting frequency. The transmitting frequency signal is then amplified by Q2, 2SC784R, and fed to the following driver stage V1, 12BY7A.

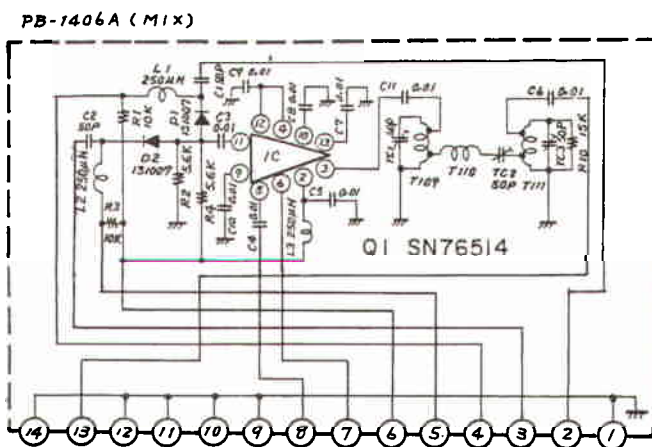


Fig. 8

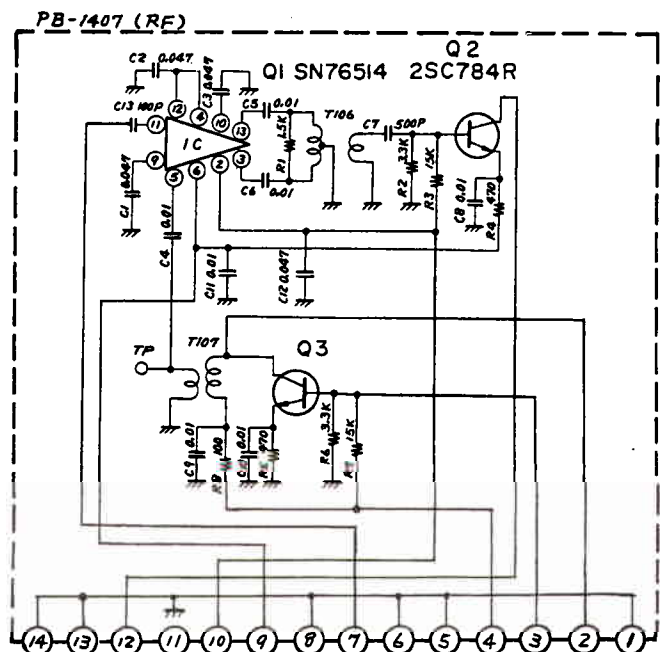


Fig. 9

MAIN CHASSIS

The main chassis contains the power supply, driver stage, final amplifier stage and other associated circuits. All sockets for the plug-in modules are mounted on the main chassis.

Driver & Final Amplifier

Signal from the RF unit PB-1407 is fed through the driver tuning circuit to the grid of transmitter driver V1, 12BY7A. The DRIVE control adjusts two gangtuned coils T101 and T102.

T101 tunes the driver grid circuit and T102 tunes the driver plate circuit. T103 and T104 are placed in the circuit when the BAND switch is in 160 through 40 meter bands to obtain impedance match for minimum distortion on these lower frequency bands.

The signal is amplified by the driver V1, 12BY7A, to a level sufficient to drive the final linear amplifier V2 and V3, 6JS6C. Neutralization of the power amplifier is accomplished by feeding back a small amount of the RF output through a neutralizing capacitor TC23 to the bottom of T102 and T104 combination. Final RF output power from V2 and V3 is fed to the antenna through pi-network. With the IC switch in the IC position, the meter is connected to the cathodes of final tubes in parallel with the shunt resistor R19, and measures total cathode current of the tubes.

The RF output voltage is divided by C74 and C76, and is rectified by D3, 1S1007, to indicate relative power output when the METER switch is in the PO position.

The ALC (automatic level control) voltage is obtained by D1 and D2, 1S1555, and controls the gain of the IF amplifier to prevent overdrive.

Power Supply

The power supply is designed to operate from either 100/110/117/200/220 or 234 volts, 50/60 Hz AC. A power transformer has two primary windings and these windings can be connected in parallel for 100/110/117 volts and in series for 200/220/234 volt operation.

The high voltage winding of the power transformer is connected to a bridge type solid state rectifier D5 through D12, 10D10, on PB-1387 to supply approximately +600 volts and +300 volts to the tubes. Output from the 120 volt winding is rectified by D4, 1S1942, to deliver +160 volts to the screen grids of the tubes, and by D3, 1S1942, to deliver -100 volts for the bias supply.

The 12.6 volt AC voltage is used for the tube heaters and pilot lamps. The output of high current winding of 10.5 volts is rectified by D1 and D2, V06B, on PB-1387, and is used to supply 13.5 volts DC for the transistorized stages.

The DC 13.6 volts from the rectifier unit PB-1387 is supplied to the voltage regulator Q1, MFC6034A, on PB-1405 to obtain an extremely stable +6 volts DC supply which is used for the various circuits, such as VFO or crystal oscillator circuit.

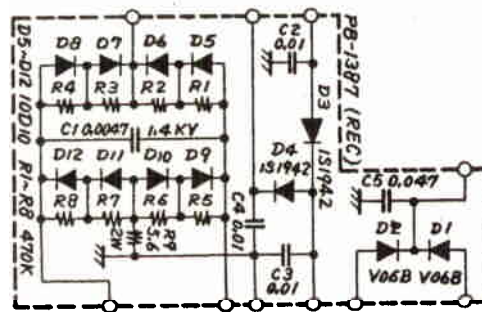


Fig. 10

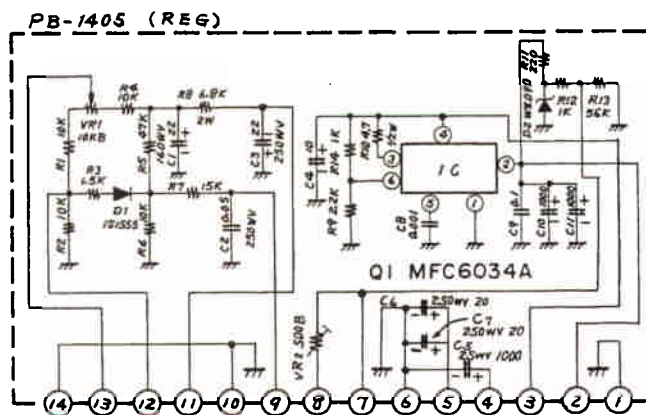
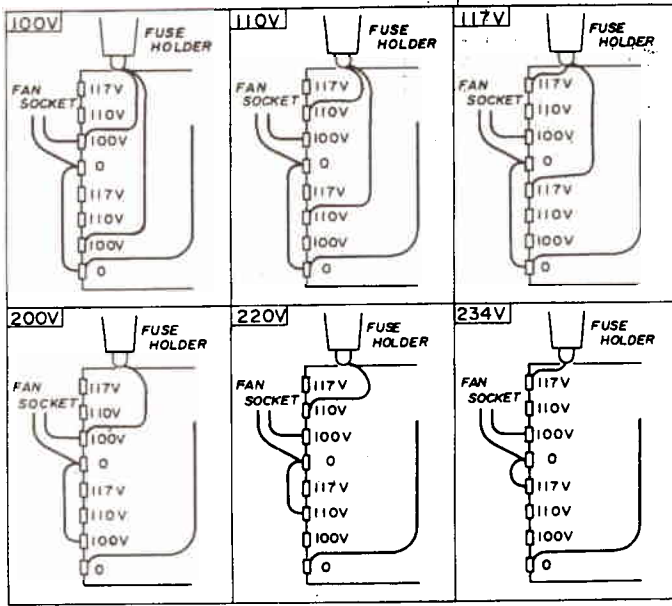
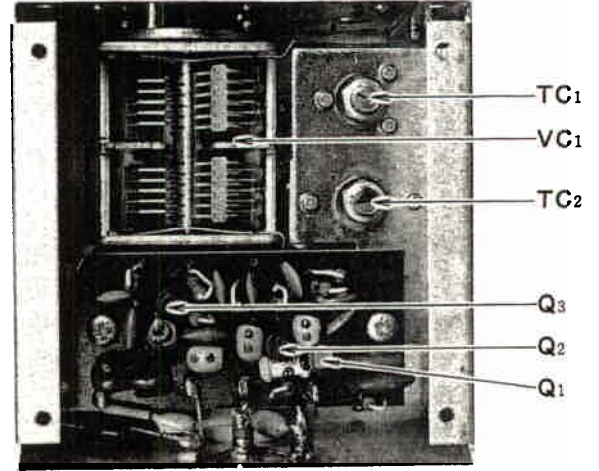


Fig. 11



POWER TRANSFORMER CONNECTIONS



VFO UNIT

Fig. 12

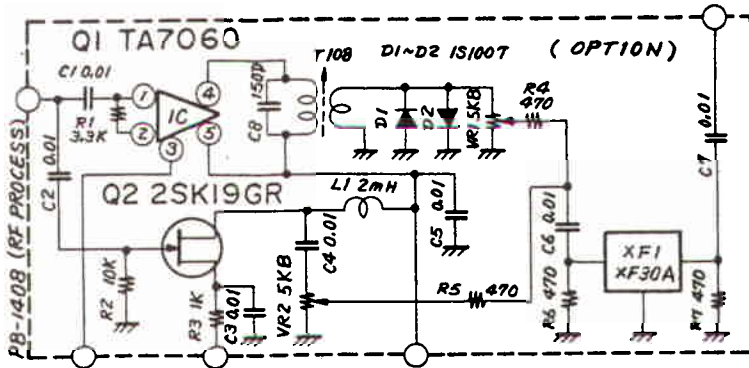


Fig. 13

ALIGNMENT AND MAINTENANCE

WARNING

DANGEROUS VOLTAGES ARE PRESENT INSIDE THE CABINET. USE EXTREME CAUTION WHEN WORKING ON THE TRANSMITTER WITH THE COVERS REMOVED. DISCHARGE ALL CAPACITORS BY SHORTING HOT TERMINAL TO GROUND WITH AN INSULATED SCREW DRIVER.

CAUTION

NEVER OPERATE THE TRANSMITTER WITHOUT A MATCHED ANTENNA OR ADEQUATE DUMMY LOAD. THE POWER AMPLIFIER TUBES AND PI NETWORK COMPONENTS CAN BE DAMAGED IF THE TRANSMITTER IS OPERATED WITHOUT THE PROPER LOAD TERMINATION.

The transmitter has been carefully aligned and tested at the factory and, with normal usage, should not require other than the usual attention given to electronic equipment. Service or replacement of a major component may require subsequent realignment, but under no circumstances should realignment be attempted unless the operation of the transmitter is fully understood, and the malfunction has been analyzed and definitely traced to misalignment. Service work should only be performed by experienced personnel using the proper test equipment.

The transmitter should be allowed to reach operating temperature before making any of the adjustments described below.

TEST EQUIPMENT REQUIRED

The followings are recommended test equipment for complete alignment of the transmitter.

- (1) RF Signal Generator; Hewlett-Packard model 606A or equivalent with one volt output at an impedance of 50 ohms and a frequency coverage to 30 MHz.
- (2) Vacuum Tube Volt Meter (VTVM); Hewlett-Packard model 410B or equivalent with an RF probe workable up to 40 MHz.
- (3) Dummy Load; Yaesu YP-150 or equivalent

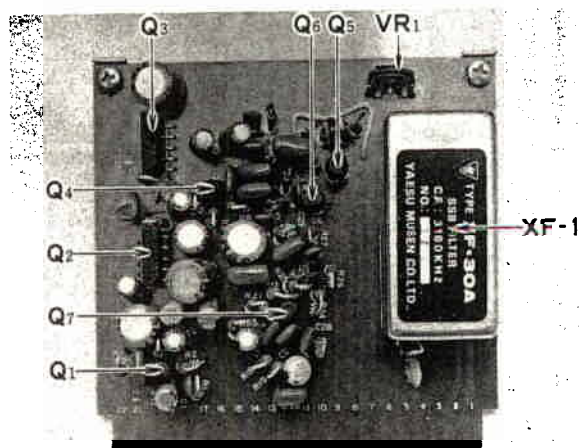
with 50 ohm non-reactive load rated at 150 watts average power.

- (4) AF Signal Generator; Hewlett-Packard model 200AB or equivalent.
- (5) General Coverage Receiver covering the frequency range of 3 to 30 MHz with a 100 kHz calibrator.

CABINET REMOVAL

It is not necessary to remove an entire cabinet from the chassis for the normal service of the transmitter. The top cover can be removed by turning 90 degrees the two top coin slot screws counterclockwise, and lift up the cover upward. For the bottom cover removal, remove 4 galvanized screws and two painted screws on the cover. The four plastic legs have nothing to do with the removal of the bottom cover.

AF UNIT (PB-1403)



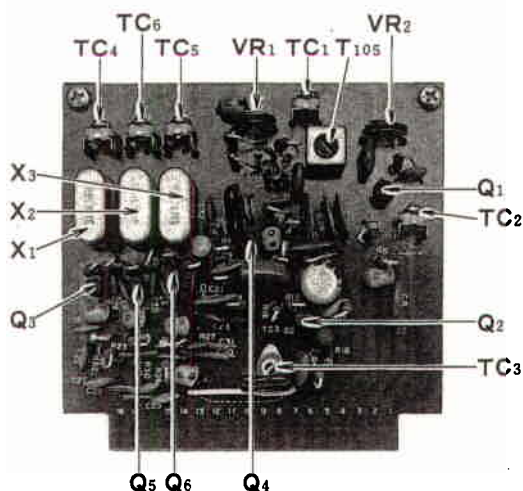
AF UNIT (PB-1403)

1. VOX

VOX controls are located on the printed board PB-1403 and on the front panel. These are relay threshold VR1, VOX gain control VR2b, ANTI-TRIP VR2a and DELAY VR3.

- (1) Set the MODE switch to LSB or USB position and depress the VOX switch down.
- (2) Set relay threshold VR1, on the printed board PB-1403, VOX GAIN VR2b, ANTI-TRIP VR2a, MIC GAIN VR1a and DELAY VR3 on the front panel, to their fully counter-clockwise positions.
- (3) Slowly advance the relay threshold control, VR1, clockwise until the relay activates, then return the control carefully counter-clockwise until the relay releases. This released point is the proper setting of VR1.
- (4) Set the MIC GAIN control to the 12 o'clock position. Speaking normally into the microphone, advance the VOX GAIN control VR2b on the front panel until your voice just activates the VOX relay into transmit.
- (5) Tune in a signal with the station receiver and adjust its speaker volume to a comfortable listening level. Adjust the ANTITRIP control VR2a on the front panel to the minimum point that will prevent the speaker output from tripping the VOX relay.
- (6) Adjust the DELAY control VR3 for a suitable relay hold time.

MODULATOR UNIT (PB-1404)



MOD/OSC UNIT

1. CARRIER BALANCE, TC1 & VR1

Tune up the transmitter for SSB operation using an antenna or dummy load. Turn the MIC GAIN control fully CCW to remove all audio from the modulator stage. With the MODE switch set to either the LSB or USB position, depress the MOX switch and adjust carrier balance controls VR1 and TC1 on PB-1404 for minimum PO meter reading. A more precise balance may be obtained by tuning a receiver having an S-meter, to the transmitted frequency. Adjust the balance controls for a minimum S-meter reading while switching the MODE switch back and forth between the two sideband positions to obtain good carrier suppression for both sidebands. It is not recommended to align T105.

2. CW OUTPUT, TC 3

This control peaks the output tuning circuit of the carrier buffer amplifier. Tune up the transmitter for CW operation on any band and set the CARRIER control on the front panel to a point that gives 150 mA IC current. Peak TC3 for maximum IC indication.

3. IF AMPLIFIER OUTPUT, TC2

This trimmer capacitor peaks the output tuning of the SSB IF amplifier. Tune up the transmitter in SSB mode and apply 1000 Hz audio signal generator output to the microphone input and set its output level at the point that gives 150 mA IC reading. Peak TC2 for maximum meter reading.

4. ALC METER ZERO ADJUSTMENT, VR2

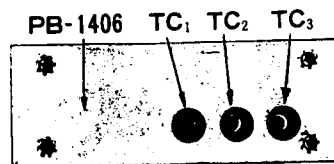
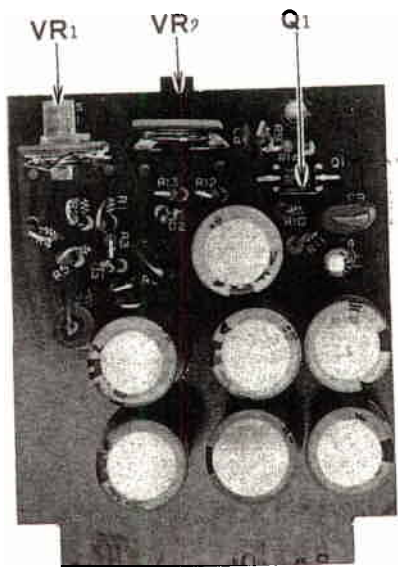
This is used to set the meter indication to full scale for ALC (automatic level control) metering. Tune up the transmitter in SSB mode and set the METER switch to ALC position. On transmit, adjust VR2 for the meter full scale reading (.5) with no modulation applied.

VOLTAGE REGULATOR UNIT (PB-1405)

1. BIAS

The operating bias for the final linear amplifier is adjusted with the BIAS control, VR1, on the voltage regulator unit, PB-1405. Set the transmitter to SSB transmitting mode. Set the MIC GAIN to the zero position. Adjust VR1 until the meter

MIXER UNIT (PB-1406)



REG UNIT

indicates idle point which is marked on the meter scale when the METER switch is set to the IC position.

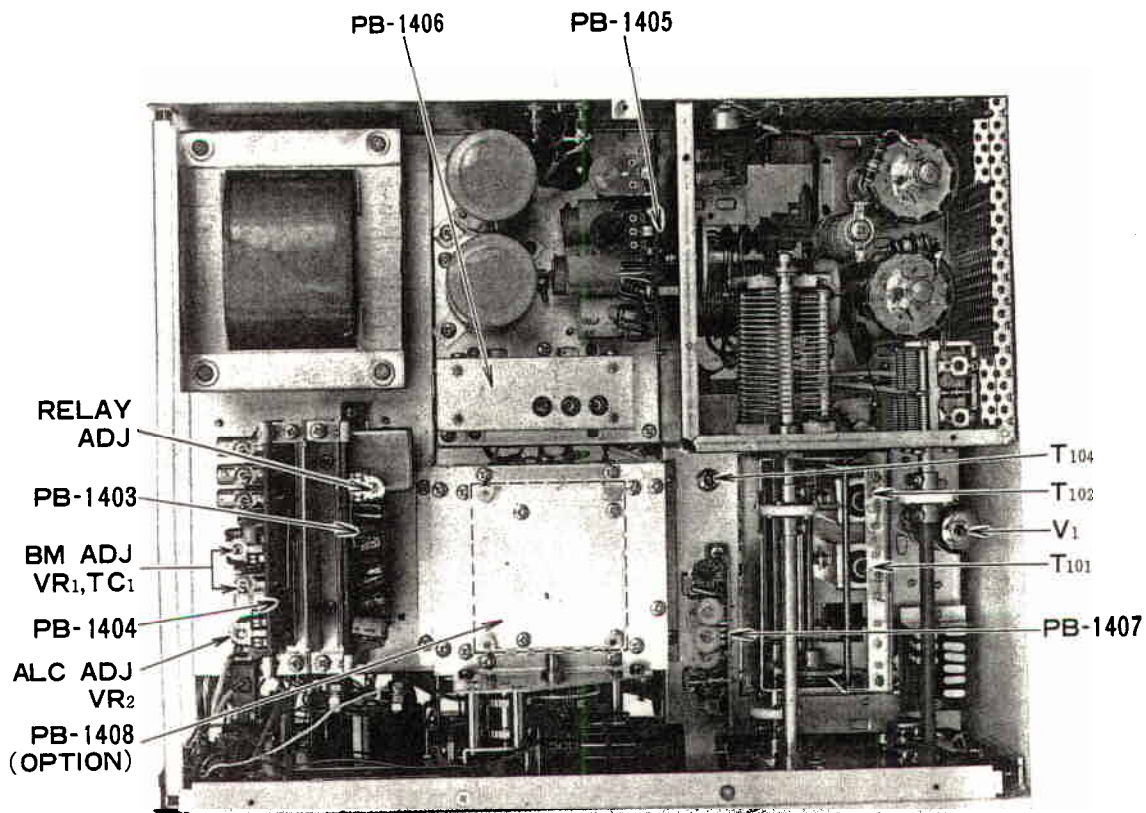
2. FSK

The frequency shift can be adjusted by FSK control VR2, when the MODE switch is in the FSK position.

This filter passes the 5.52 through 6.02 MHz IF signal. Tune up the transmitter in the TUNE mode at 14,200 kHz into a dummy load. After tune up, reduce the CARRIER control until the meter reads 100 mA in the IC position. Peak TC1 of T110 for maximum IC current.

Tune up the transmitter at 14.500 MHz and set the CARRIER control to give 100 mA IC current. Peak TC3 for maximum IC current. Then tune up at 14.000 MHz and set the CARRIER control to 100 mA. Peak TC2 for maximum IC.

Repeat the above procedures to give uniform output at any VFO setting.



MAIN CHASSIS

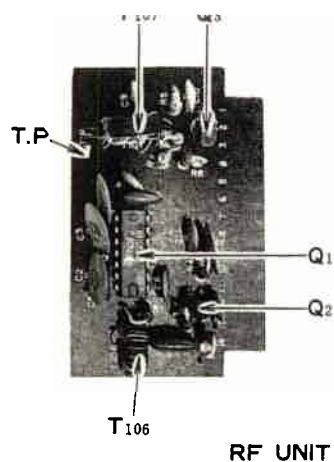
1. POWER METER SENSITIVITY ADJUSTMENT, VR5

This control is located on the rear panel and is used to adjust the PO meter sensitivity. The control has been factory set to indicate two-thirds of the meter scale with full power output into 50 ohm resistive load on 14 MHz.

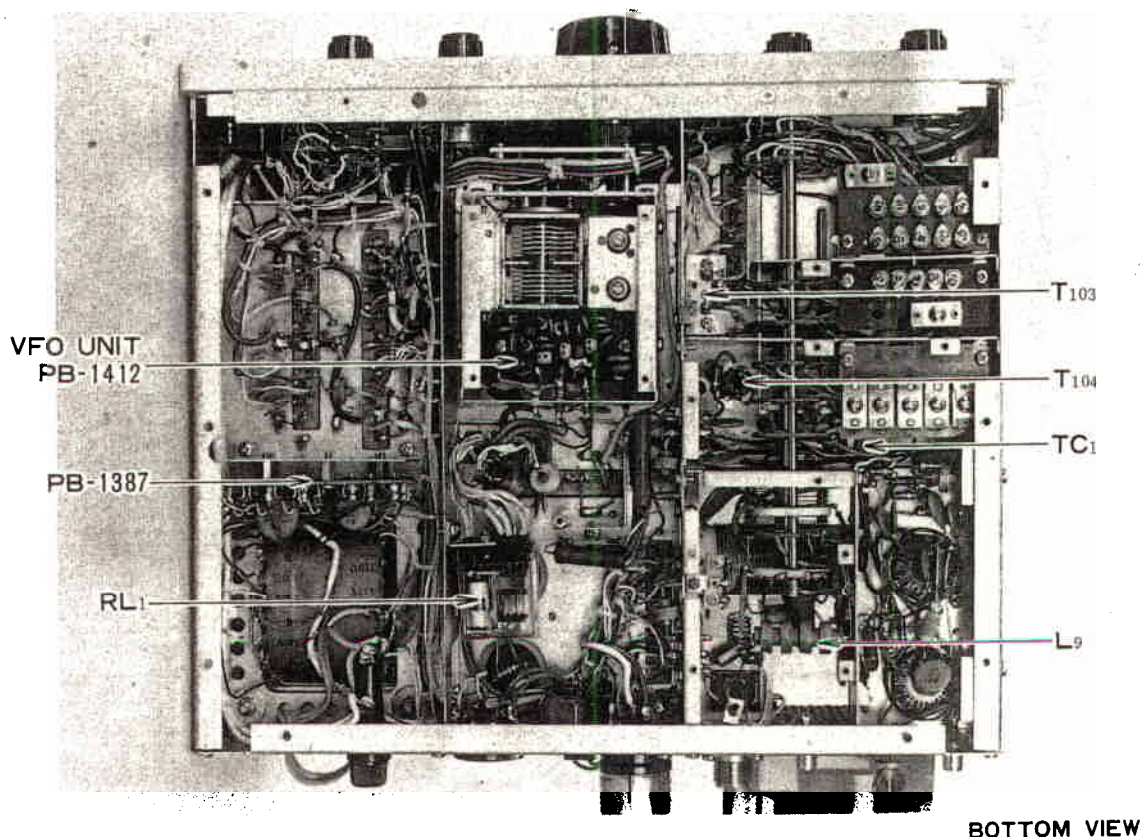
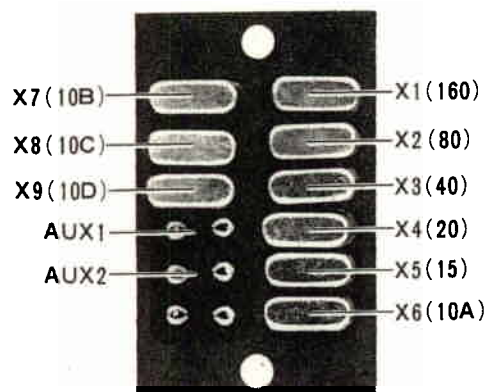
When the meter indication is not adequate for transmitter tune-up, adjust this control VR5 for a suitable setting whenever it is necessary.

2. HETERODYNE CRYSTAL OSCILLATOR, PB-1407

The heterodyne crystal oscillator output voltage may be checked by connecting a VTVM RF probe to the local oscillator test point TP on the RF unit, PB-1407. Adjust TC12 through TC22 for each of bands to read 250 milli volts (.25V).

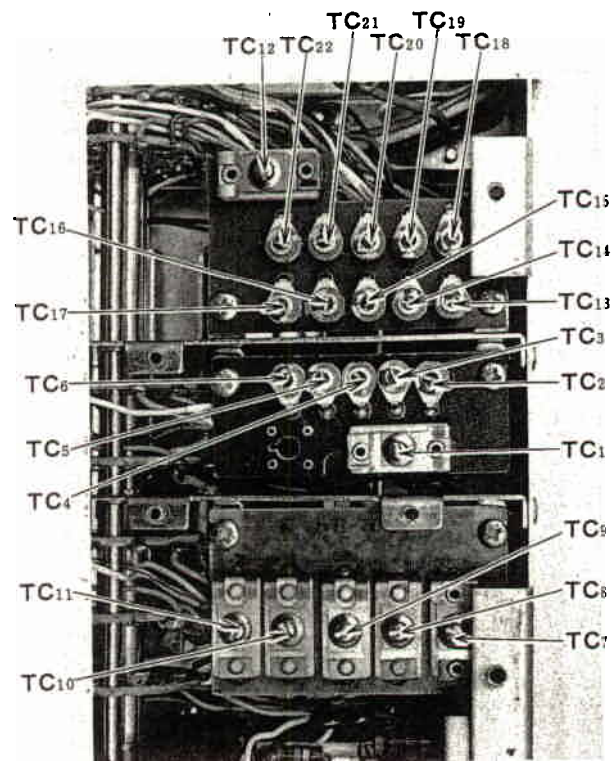


RF UNIT



BOTTOM VIEW

BAND	X-tal No.	Trimmer	X-tal Frequency
160	X1	TC12	7.52
80	X2	TC13	9.52
40	X3	TC14	13.02
20	X4	TC15	20.02
15	X5	TC16	27.02
10A	X6	TC17	34.02
10B	X7	TC18	34.52
10C	X8	TC19	35.02
10D	X9	TC20	35.52
AUX	X10	TC21	
AUX	X11	TC22	



3. RF TUNING CIRCUIT

The final amplifier bias adjustment must be set to 60 mA before extensive operation of the transmitter is attempted. It is assumed that the low level stages (signal generating stages) are functioning properly. Use the internally generated signal of the transmitter to align the mixer and driver stages. Use an insulated tuning driver to avoid a short circuit between the trimmer capacitors and the shields during alignment.

Connect a 50 ohm dummy load to the antenna connector on the rear panel. Tune up the transmitter in the TUNE mode at 30,000 kHz (BAND 10D, VFO Green 500) as follows:

- (1) Set the DRIVE control to the 10 position and depress the MOX switch down. Advance the CARRIER control and tune the final amplifier for maximum output. Reduce the CARRIER control and maintain the resonant plate current (IC) at 100 mA with the CARRIER control.
- (2) Set the trimmer TC6 to the mid capacitance position and adjust the slugs of T101 and T102 for maximum output to the dummy load. Depress the PTT switch.
- (3) Set the BAND switch to 10A, the DRIVE to position 9 and the VFO to white 000. Depress the MOX switch down. Peak TC6 for maximum power output.
- (4) Repeat steps (1) to (3) until the maximum power output is obtained equally on each band and then depress the PTT switch.
- (5) Set the BAND switch to 15, the DRIVE to 8.5 and the VFO to white 000 (21,000 kHz). Tune up the transmitter to 21,000

kHz as described above. Adjust TC5 and TC11 for maximum power output into the dummy load. Depress the PTT switch.

- (6) Set the BAND switch to 20, the DRIVE to 7.0 and the VFO to white 000 (14,000 kHz). Tune up the transmitter to 14,000 kHz as described above. Adjust TC4 and TC10 for maximum power output into the dummy load. Depress the PTT switch.
- (7) Set the BAND switch to 80, the DRIVE to 6.5, the VFO to green 500 (3500 kHz), and TC8 and TC12 to half capacitance point. Tune up the transmitter to 3,500 kHz as described above. Adjust TC104 and TC103 for maximum power output to the dummy load.
- (8) Then, set the VFO to green 1000 (4,000 kHz) and the DRIVE to 2.0. Tune up the transmitter and peak TC2 and TC3 for maximum power output.
- (9) Repeat above steps (7) and (8) until unity output is obtained at the high and low ends of the band. Depress the PTT switch.
- (10) Set the BAND switch to 40, the VFO to white 000 (7,000 kHz) and the DRIVE to 5.0. Tune up the transmitter as described above. Peak TC3 and TC9 for maximum power output to the dummy load. Then set the VFO to white 150 (7,150 kHz) and the DRIVE to 6. Tune up the transmitter as described above. Peak L33 for maximum power output to the dummy load. Depress the PTT switch.
- (11) Set the BAND switch to 160, the VFO to

green 900 (1,900 kHz) and the DRIVE to 2.0. Tune up the transmitter as described above. Peak TC1 and TC7 for maximum power output to the dummy load.

4. FINAL AMPLIFIER NEUTRALIZATION

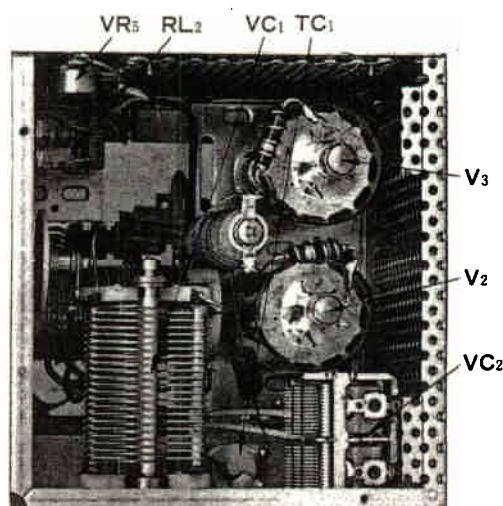
When replacing the final amplifier tubes, it may be necessary to reset the bias voltage to give a correct idle current. Also check the neutralization. Using the procedures described below will guarantee maximum output and long tube life.

CAUTION

HIGH VOLTAGES ARE PRESENT ON UNDERSIDE OF THE CHASSIS AND INSIDE OF FINAL COMPARTMENT. TAKE EXTREME CARE WHILE MAKING ADJUSTMENT WITH WIRING EXPOSED.

- (1) Connect a dummy load to antenna and set the METER switch to the IC position.
- (2) Locate TC1, neutralization variable capacitor shaft, on the underside of the chassis near the band switch driver wafer.
- (3) Check the final amplifier idle current in SSB position and adjust as described before.
- (4) Tune up the transmitter at 29,000 kHz, 10C band, with the MODE switch at TUNE position, and advance the CARRIER control until the IC meter reads 200 mA.
- (5) Rotate the PLATE tuning control and observe the resonant dip as indicated on the meter. If the dip is not prominent, reduce the loading control slightly for better indication. As the PLATE control is rotated, the meter should rise equally and smoothly on either side of the maximum dip indication.
- (6) Determine which side of the dip rises abruptly. Set the PLATE control slightly to this side of the dip keeping the meter reading below 100 mA.
- (7) Using a nonmetallic tuning wand, rotate the neutralization capacitor shaft very slightly in the direction which reduces the current shown on the meter. Repeat this procedure until the meter indicates a smooth and equal rise on either side of the maximum dip point.

NOTE: The final compartment shield cover must be in place to supply the RF shielding required during the neutralization procedure.



FINAL AMPLIFIER COMPARTMENT

TROUBLE SHOOTING

The following description may be helpful in trouble shooting.

TUBES AND TRANSISTORS

Most cases of weak power output can be traced to defective tubes. Substitution of new tubes will sometimes solve a difficulty of this kind.

The transistors may be damaged from shorting caused during a pattern check. Therefore extreme care should be paid during the pattern check. Do not remove or insert the printed board modules with the power switch on.

The tables in page 25 show typical voltage and resistance readings at each tube and module socket terminal. These are the best aid in trouble shooting. Make all measurements under the conditions noted on the charts. The values listed are nominal and very slightly due to the voltage fluctuation and normal tolerances in components.

TROUBLE SHOOTING GUIDE

AF UNIT (PB-1403)

1. RELAY NOT OPERATIVE WHEN VR1 ADJUSTED

If the VOX relay does not work when VR1 is adjusted, make sure that the transmitter works normally with PTT or MOX operation.

If it operates;

(1) Examine the wiring at pin 6 and pin 10 of the module socket of PB-1403.

(2) Check the voltage of the transistors Q5, 2SK19Y, and Q6, 2SC373. Normal voltages are as follows:

Q6, 2SK19Y : Drain 0.5V, Source 0.4V, Gate 0V

Q6, 2SC373 : Collector 13V, Emitter 0V, Base 0.5V

(3) If the VOX relay does not operate at PTT or MOX position, check the VOX relay.

2. RELAY NOT OPERATIVE WITH VOX GAIN ADJUSTMENT

When an SSB signal is transmitted in MOX operation, check the VOX amplifier LD3141.

The pin voltages are as follows:

1. 0.7V 2. 0.58V 3. 0.04V

4. 0V 5. 1.25V 6. 4.6V

7. 4.6V 8. 12V 9. 11.5V

When an SSB signal is not transmitted in MOX, though the relay is activated, check L2, microphone cord, microphone plug and the voltage for Q1, 2SK19GR, which are Drain 7.3V, Source 2.4V, and Gate 0V.

3. ANTITRIP NOT OPERATIVE

Check the voltages on Q4, 2SC372Y, which are; Collector 4V, Emitter 1V and Base 1.5V. Check D3 and D4.

4. DELAY NOT OPERATIVE

Check the following parts; VR3, R12 470 K ohms, R13 3.3M ohms, C21 0.1uF, D1 and D2 1S1555.

SIDETONE

CW transmission may be monitored with the station receiver when the interconnection is prop-

erly made as illustrated in this manual. The output level of sidetone signal can be adjusted with VR2 in the FR-101 receiver which is shown in page 12.

1. NO SIDETONE OUTPUT

(1) Check the setting of VR2 in the FR-101 receiver.

(2) Check the interconnection.

(3) When break-in (VOX) operation is working, the sidetone oscillator is working normally.

2. BREAK-IN NOT OPERATIVE

Set the MODE switch to CW position. Check the resistance between pin 13 of PB-1403 and ground. The resistance should be 0 ohms. If not, the MODE switch is defective.

VOLTAGE REGULATOR UNIT (PB-1405)

1. PA IDLING CURRENT UNSTABLE

Check the PA tubes with substitution of new tubes. Check the voltages at the tube sockets. Check the voltages at pin 5 and pin 10. The voltage of pin 10 should be zero volts during transmitting. The voltage at pin 11 should be -150 volt. If not, check D3 and C2 on the rectifier board.

2. 170 HZ SHIFT IS NOT OBTAINABLE.

With the MODE switch at FSK position, ground the internal connector of J8. The voltage at pin 12 of MOD/OSC unit should drop to 0.5 volt from 8 volts. If not, check D2, R11 through R13 and VR2. When the voltage change is normal with above procedure check L6 and D5 on the MOD/OSC unit.

MODULATOR UNIT (PB-1404)

1. INSUFFICIENT CARRIER ON SIDEBAND SUPPRESSION

Check D1 through D4, VR1, C13, TC1 and T105.

2. VR2 NOT OPERATIVE FOR ALC SET

Check Q1, C4 and R5 on the board and C51, D1, D2, C52 and R13 in the main chassis. Trouble in the ALC circuit may also cause distortion on the transmitted signal.

MJ	RESISTANCE (Ω)					DC VOLTAGE (V)					RF VOLTAGE (V)					
	UNIT PIN No.	AF/ VOX	MOD/ OSC	MIX	RF	REG	AF/ VOX	MOD/ OSC	MIX	RF	REG	AF/ VOX	MOD/ OSC	MIX	RF	REG
1	E	E	56	E	E	E	E	E	E	E	E	E	E	E	E	E
2	470	300	56	200	300	0	0.2	0	5.8	13	30mV	—	—	1.6	—	
3	E	∞	470	250	120	E	0	0	0.8	6	E	90mV	30mV	2.5	—	
4	E	300	0	100	300	E	13	8	6	13.5	E	—	—	—	—	
5	∞	300	0	E	50K	0	0	0	E	170	90mV	—	—	E	—	
6	100	300	300	E	E	6	13	13	E	E	—	—	—	E	E	
7	0~3M	500	400	∞	1 K	0	0	12	0	7.5	—	50mV	—	15mV	—	
8	∞	56~5K	E	E	1 K	0	0	0	E	7.5	—	—	95mV	E	—	
9	250	E	E	400	22K	13	E	E	12	-18	—	E	E	—	—	
10	∞	E	E	300	E	0	E	E	13	E	—	E	E	—	E	
11	E	E	E	NC	1.8K	E	E	E	NC	-160	E	E	E	NC	—	
12	22K	1.2K	∞	350	6 K	-15	7.5	E	13	-29	—	—	E	1.2	—	
13	∞	100 Ω	E	E	13K	0	6	0	E	-70	—	—	15mV	E	—	
14	500	10K	—	E	E	0	8	E	E	E	50mV	—	E	E	E	
15	0	∞	—	—	—	0	0.5	—	—	—	—	—	—	—	—	
16	E	400	—	—	—	E	13	—	—	—	E	—	—	—	—	
17	0~3.5K	E	—	—	—	0	E	—	—	—	2.2mV	E	—	—	—	
18	∞	E	—	—	—	0	E	—	—	—	2.2mV	E	—	—	—	
19	3.7K	—	—	—	—	0	—	—	—	—	4.5	—	—	—	—	
20	0~10K	—	—	—	—	0	—	—	—	—	—	—	—	—	—	
21	0~5K	—	—	—	—	0	—	—	—	—	—	—	—	—	—	
22	E	—	—	—	—	E	—	—	—	—	E	—	—	—	—	
	MODE USB. Resistance between pin and ground with printed boards installed.					MODE USB, STAND-BY. Measured with 20k Ω /V.					MODE USB, BAND 20m. Values without any unit are in VOLTS R. M. S. Values are signal levels to produce 100W output power modulated by 1 kHz mic input. Measured by VTVM.					

Order Instruction:

Parts number is independent for each unit, except T-transformers and T-inductors, therefore it is requested to specify parts number together with unit classification as following example.

No. 1 RF Unit R1 1.5K ohm $\frac{1}{4}$ w * VALUE IS NOMINAL

MAIN CHASSIS				1, 6	500 WV	820 PF
				41, 68, 90	500 WV	1000 PF
V	VACUUM TUBE			73	500 WV	2000 PF
1	12BY7A			51	1 KWV	2200 PF
2, 3	6JS6C			MOULDED MICA		
				54	1 KWV	80 PF
VS	VACUUM TUBE SOCKET			55, 75	1 KWV	100 PF
1	TS-103 9PIN			44	1 KWV	200 PF
2, 3	SB-0703 12 PIN			70	1.5 KWV	1000 PF
				CERAMIC DISC		
D	DIODE			34, 35, 36, 77, 81	50 WV	0.01 μ F
1, 2	Si	1S1555		22, 23, 24, 25, 26, 27	50 WV	0.047 μ F
3	Ge	1S1007		28, 29, 30, 31, 32, 33		
				60, 61, 62, 92		
X	CRYSTAL			40, 49, 50, 57, 59	500 WV	0.0047 μ F
1	HC-25/U	160m	7520 kHz	38, 43, 56, 58, 87, 88	500 WV	0.01 μ F
2	HC-25/U	80m	9520 kHz	89, 93, 94		
3	HC-25/U	40m	13020 kHz	69, 82, 83	1.4 KWV	0.0047 μ F
4	HC-25/U	20m	20020 kHz	66	1.4 KWV	0.01 μ F
5	HC-25/U	15m	27020 kHz	72	3 KWV	150 PF
6	HC-25/U	10m A	34020 kHz	71	3 KWV	300 PF
7	HC-25/U	10m B	34520 kHz	MYLAR		
8	HC-25/U	10m C	35020 kHz	21	50 WV	0.001 μ F
9	HC-25/U	10m D	35520 kHz	20	50 WV	0.47 μ F
				CERAMIC FILM		
R	RESISTOR			42, 46, 47, 48, 63, 64	500 WV	1000 PF
				65, 78, 79, 80		
				ELECTROLYTIC		
5, 8, 29	CARBON COMPOSITION			91	16 WV	1 μ F
3, 18	$\frac{1}{2}$ W	56	Ω	18	16 WV	10 μ F
28	$\frac{1}{2}$ W	470	Ω	45	450 WV	2.2 μ F
24	$\frac{1}{2}$ W	680	Ω	84, 85	500 WV	100 μ F
12, 27	$\frac{1}{2}$ W	1	K Ω			
1, 10	$\frac{1}{2}$ W	2.2	K Ω	VC VARIABLE CAPACITOR		
20	$\frac{1}{2}$ W	3.3	K Ω	1	AIR	RT18B300VC
26	$\frac{1}{2}$ W	4.7	K Ω	2	AIR	C123A129
11	$\frac{1}{2}$ W	10	K Ω	TC TRIMMER CAPACITOR		
2, 21	$\frac{1}{2}$ W	33	K Ω	2-6, 13-22	ECV-12W 50P32	50 PF
4	$\frac{1}{2}$ W	47	K Ω	9, 10, 11	MICA B-1PY	40 PF
30	$\frac{1}{2}$ W	56	K Ω	8	MICA B-2PY	100 PF
22, 23	$\frac{1}{2}$ W	470	K Ω	1, 7, 12	B-7PY	420 PF
13	$\frac{1}{2}$ W	1	M Ω	23	AIR TSN-150C 1.5KV	10 PF
15, 16	1 W	56	Ω			
17	1 W	47	K Ω	L INDUCTOR		
7	3 W	5.1	K Ω	17	RF CHOKE	250 μ H
25	5 W	5.6	Ω	1, 2, 12, 13, 14, 15	RF CHOKE (TV-245)	250 μ H
9	5 W	1.5	K Ω	16, 19, 20, 21, 22, 23, 24	RF CHOKE	300 μ H
19	WIRE WOUND METER SHUNT			9	RF CHOKE (PLATE)	500 μ H
VR	POTENTIOMETER			11	RF CHOKE	1mH
5	EVB-BOAS 15B13	1 K Ω B		3, 4, 5	P.S $\frac{1}{2}$ W 56 Ω 0.6 ϕ 4 TS	
1	EVK-A2A R10339	5K Ω A / 5K Ω B		6, 7	P.S 1 W 56 Ω 1 ϕ 4 TS	
4	EVK-A2A R10A14	10K Ω A / 10K Ω B		8	TUNK COIL	
4	VM-20A	50 K Ω B		10	L.P. FILTER COIL	
3	EVC-BOAS 15B36	3 M Ω B				
C	CAPACITOR			T	TRANSFORMER	
				101	GRID COIL A	
				102	DRIVER COIL A	
39	DIPPED MICA			103	GRID COIL B	
74	500 WV	2 PF		104	DRIVER COIL B	
5, 10, 53	500 WV	3 PF		PT POWER TRANSFORMER		
14	500 WV	10 PF		1	POWER TRANSFORMER	
3, 8, 9	500 WV	25 PF				
4	500 WV	30 PF		M METER		
13	500 WV	50 PF		1	PF-45	
15, 16, 17, 19, 95	500 WV	70 PF				
12	500 WV	100 PF		PL RELAY		
76	500 WV	150 PF		1	AE 3244	
2, 7	500 WV	200 PF				
37, 67	500 WV	250 PF				
		470 PF				

2	MX-2			1, 4, 6, 11, 18, 19, 22	1/4 W	4.7KΩ
				3	1/4 W	5.6KΩ
RLS RELAY SOCKET				21	1/4 W	10 KΩ
1	AE-3840			1	1/4 W	15 KΩ
2	PX-08			24	1/4 W	33 KΩ
				2, 20, 26	1/4 W	47 KΩ
S SWITCH				12	1/4 W	470 KΩ
1	PUSH SWITCH	(POWER, PTT, VOX)		CARBON COMPOSITION		
2, 4	ROTARY SWITCH	E123R20A		13, 14	1/4 W	3.3MΩ
3	ROTARY SWITCH	(BAND)		15	1/4 W	5.6MΩ
5	ROTARY SWITCH	E366R (MODE)		30	THERMISTOR SDT-250	
6	PUSH SWITCH	(RF PROCESS)		VR POTENTIOMETER		
J RECEPTACLE/JACK				1	TR-11	10KΩB
1, 3, 5, 6, 8, 10, 11, 13	CN-7017					
2	SG-7702	(MIC)		C CAPACITOR		
4	SG-7615-1	(KEY)		CERAMIC DISC		
7	SB-0611	(EXT VFO)		35	50 WV	0.01 μF
9	SA-602B	(ACC)		MYLAR		
12	JSO-239	(ANT)		14, 17, 25, 34	50 WV	0.001 μF
14	SI-7502	(FAN)		1, 18	50 WV	0.01 μF
				22, 26, 27, 28	50 WV	0.022 μF
MJ MULTI JACK				3, 23, 24, 32, 36	50 WV	0.047 μF
1	3305-022-011	22 P		21, 29	50 WV	0.1 μF
2	3305-018-011	18 P		ELECTROLYTIC		
3, 4, 5	3305-014-011	14 P		5, 6, 7, 12, 19	16 WV	1 μF
				11	16 WV	2.2 μF
F FUSE				2, 8, 16, 20, 30	16 WV	10 μF
	AC, 5A (100V)			33	16 WV	22 μF
				9	16 WV	33 μF
FH FUSH HOLDER				13	16 WV	47 μF
	S-N 1001			4, 10, 31	16 WV	100 μF
PL LAMP				MOD OSC UNIT		
1	16V0.15A			PB PRINTED CIRCUIT BOARD		
2	14V 0.2A (FUSE TYPE)			1404(A~Z)	MOD/OSC CIRCUIT	
3	TLR-104 (L.E.D.)					
PLH LAMP HOLDER				Q FET. TRANSISTOR		
1	001011			1	2SK19Y	
2	F-3265			2, 3, 5, 6	2SC372Y	
				4	2SC828Y	
AF UNIT				D DIODE		
PB PRINTED CIRCUIT BOARD				1, 2, 3, 4	Ge	1S1007
1403(A~Z)	MIC/VOX CIRCUIT			5	Varactor	1S2689
Q IC. FET. TRANSISTOR				X CRYSTAL		
2, 3	LD-3141			1	HC-6/U	3178.5 kHz USB
1	2SK19GR			2	HC-6/U	3181.5 kHz LSB
5	2SK19Y			3	HC-6/U	3179.3 kHz CW, AM, FSK
4, 7	2SC372Y			R RESISTOR		
6	2SC373			CARBON FILM		
D DIODE				9	1/4 W	100 Ω
1, 2, 3, 4	Si	1S1555		1, 3	1/4 W	150 Ω
5	Zener	WZ-090		10	1/4 W	180 Ω
				2, 12, 15	1/4 W	470 Ω
XF CRYSTAL FILTER				16, 17, 19, 22, 26, 30	1/4 W	1 KΩ
1	XF-30A			11	1/4 W	1.5KΩ
				5, 14	1/4 W	2.2KΩ
R RESISTOR				7, 20, 23, 24, 27, 28, 31	1/4 W	4.7KΩ
	CARBON FILM			18	1/4 W	10 KΩ
28	1/4 W	100 Ω		6, 25	1/4 W	15 KΩ
27	1/4 W	220 Ω		8, 21, 29	1/4 W	22 KΩ
10, 23	1/4 W	470 Ω		13	1/4 W	33 KΩ
29	1/4 W	560 Ω		4	1/4 W	100 KΩ
16	1/4 W	680 Ω		VR POTENTIOMETER		
5, 7	1/4 W	1 KΩ		1	TR11R	500 ΩB
8, 17, 25	1/4 W	2.2KΩ				

3	2SC372Y		D	DIODE	
			3, 4	Si	1S1942
R	RESISTOR		5-12	Si	10D10
	CARBON FILM		1, 2	Si	V06B
8	$\frac{1}{4}$ W	100 Ω			
4, 5	$\frac{1}{4}$ W	470 Ω	R	RESISTOR	
1	$\frac{1}{4}$ W	1.5K Ω		CARBON FILM	
2, 6	$\frac{1}{4}$ W	3.3K Ω	1-8	$\frac{1}{4}$ W	470K Ω
3, 7	$\frac{1}{4}$ W	15 K Ω		CARBON COMPOSITION	
			9	2W	5.6 Ω
C	CAPACITOR		C	CAPACITOR	
	DIPPED MICA			CERAMIC DISC	
13	50 WV	100 PF	5	500 WV	0.047 μ F
7	50 WV	500 PF	2, 3, 4	500 WV	0.01 μ F
	CERAMIC DICA		1	1.4KWV	0.0047 μ F
4, 5, 6, 8, 9, 10, 11	50 WV	0.01 μ F			
1, 2, 3, 12	50 WV	0.047 μ F			
T	TRANSFORMER				
106	MIX	OUT COIL			
107	LOCAL	OSC COIL			
	REG. UNIT				
PB	PRINTED CIRCUIT BOARD				
1405(A-Z)	REG. CIRCUIT				
Q	IC				
1	MFC 6030~6034 A				
D	DIODE				
1	Si	1S1555			
2	Zener	WZ-090			
R	RESISTOR				
	CARBON FILM				
12, 14	$\frac{1}{4}$ W	1 K Ω			
3	$\frac{1}{4}$ W	1.5K Ω			
9	$\frac{1}{4}$ W	2.2K Ω			
1, 2, 4, 6	$\frac{1}{4}$ W	10 K Ω			
7	$\frac{1}{4}$ W	15 K Ω			
5	$\frac{1}{4}$ W	47 K Ω			
13	$\frac{1}{4}$ W	56 K Ω			
	CARBON COMPOSITION				
10	$\frac{1}{2}$ W	4.7K Ω			
11	$\frac{1}{2}$ W	220 K Ω			
8	2	6.8K Ω			
VR	POTENTIOMETER				
1	V106KRZ-1	10K Ω B			
2	V18K	500 Ω B			
C	CAPACITOR				
	MYLAR				
8	50 WV	0.001 μ F			
2	50 WV	0.047 μ F			
9	50 WV	0.1 μ F			
	ELECTROLYIC				
4	16 WV	10 μ F			
10, 11	16 WV	1000 μ F			
5	25 WV	1000 μ F			
1	160 WV	22 μ F			
3, 6, 7	250 WV	22 μ F			
	RECT. UNIT				
PB	PRINTED CIRCUIT BOARD				
1387(A-Z)	RECTIFIER CIRCUIT				

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