

# MANUAL

FR50B

For Service Manuals Contact  
MAURITRON TECHNICAL SERVICES  
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**YAESU MUSEN CO., LTD.**

C.P.O. BOX 1500

TOKYO, JAPAN

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 FR-50B COMMUNICATION RECEIVER  
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The model FR-50B Communication Receiver, designed for the amateur bands, provides a high degree of sensitivity, selectivity and stability.

Basically, it is a double conversion super-heterodyne receiver employing a variable oscillator for the first mixer stage, and a crystal controlled oscillator for the second mixer stage.

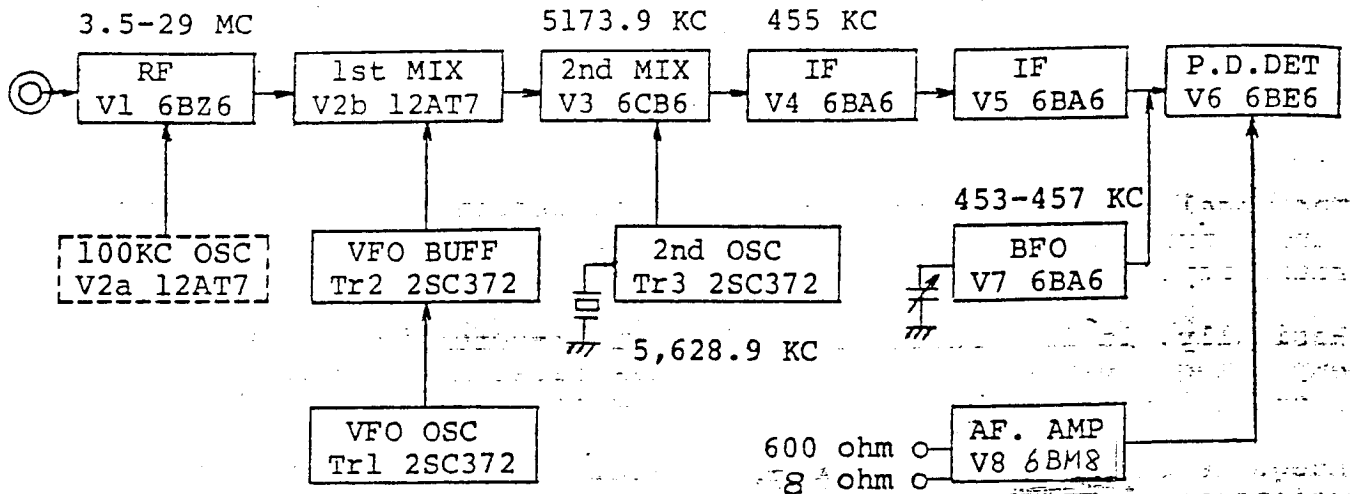
Adequate selectivity is provided for SSB, AM and CW with the utilization of two 4 Kc mechanical filters.

When used in conjunction with the FL-50B Transmitter, transceive operation - receiving and transmitting on the same frequency - is possible. This is a useful feature for SSB communication.

A built-in monitor circuit enables monitoring of the station transmitted signal at any time.

SPECIFICATIONS

Frequency range	80m	3.5 -- 3.8 Mc
	40m	7.0 -- 7.5 Mc
	20m	14.0 -- 14.5 Mc
	15m	21.0 -- 21.5 Mc
	10m	28.0 -- 29.2 Mc
	JJY & WWV	10.0 -- 10.5 Mc (can be installed)
Sensitivity	CW/SSB	Less than 0.5uV for 10db S/N ratio
	AM	Less than 1uV for 10db S/N ratio
Selectivity	At <u>+5 Kc</u> , -50 db. At <u>+1.8 Kc</u> , -6 db.	
Image ratio	More than 50 db	
Calibrator	100 Kc (crystal option)	
Audio output	1.5 W	4 ohm/600 ohm, speaker built-in
Power source	100 V AC 50/60 c/s 50 VA (220 or 240 V is available for export model)	
Dimensions	13" wide, 6" high, 10 $\frac{1}{4}$ " deep	
Weight	17 $\frac{1}{2}$ lbs. approx.	



### VFO Tuning Ranges

3.5 Mc band	8,672.4 -- 9,172.4 Kc	500 Kc coverage
7.0 " "	12,172.4 -- 12,672.4 Kc	" " "
14 " "	8,827.6 -- 9,327.6 Kc	" " "
21 " "	15,827.6 -- 16,277.6 Kc	" " "
28 " "	22,827.6 -- 24,027.6 Kc	1.2 Mc "

### CIRCUIT DESCRIPTION

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#### 1. RF Amplifier

The high Gm tube 6BZ6 provides a minimum of cross modulation. It is a semi-remote cutoff pentode and has an excellent AGC characteristic. A 5 Mc trap is inserted to reject a spurious signal which could enter directly into the first I.F. stage. To avoid complexity, two coils in each of the grid and plate tuning circuits, together with switched capacitors, cover the full range. A FM type variable condenser is used with electronic band spread for preselector tuning. The centre of each amateur band is approximately at the centre of the range of the pre-selector control. On the 3.5 Mc band, the preselector covers 3.5 - 3.8 Mc.

#### 2. 1st Mixer

The amplified signal and local oscillator output are mixed by introducing to the grid and cathode of triode mixer V2, 12AT7. The triode mixer is very effective because of its low conversion noise. The first I.F. is 5,173.9 Kc.

#### 3. VFO

Silicon transistor Tr1, type 2SC372, is employed on a colpitts oscillator circuit. Oscillator frequency range is selected by switching coil for each band. C61, C63, C65, C67, C69, C71 and C72 are temperature compensating capacitors which insure stability even in the 28 Mc band. Using the same dial mechanism as the FR-100B, with the 50 Kc variation per revolution of the knob, it is very effective for SSB and CW tuning.

Buffer amplifier Tr2, silicon transistor type 2SC372, is employed in an emitter follower circuit. Its output is injected to the first grid of mixer tube V2, and is also used as a VFO source for the transmitter when connected for transceiving. The output terminal is located on the rear panel of the receiver.

4. 1st I.F.

The signal converted into the 1st I.F., 5,173.9 Kc, by the 1st mixer, is applied to the 2nd mixer via transformer L6.

5. 2nd Mixer

1st I.F. and 2nd local oscillator signals are added at the control grid of V3, a 6CB6, and results in second I.F. at 455 Kc at the plate of the tube.

6. 2nd Local Oscillator

Tr3, silicon transistor type 2SC372, together with crystal and other parts, are installed in an I.F.T. case. Output of the 2nd local oscillator is applied to the control grid of V3 through transformer L16. Oscillator frequency is 5,628.9 Kc.

7. 2nd I.F. Amplifier

This is a two stage amplifier using two 6BA6 coupled by two 4 Kc mechanical filters. "S" meter is inserted in the cathode circuit of the first 6BA6 and must be adjusted to indicate zero with no input signal. "S" meter indicates cathode voltage variation V4, which is proportional to the AVC voltage. A diode in series with the "S" meter protects it from inverse deflection. Cathode return of V5 together with that of the RF tube is connected to the RF GAIN potentiometer.

8. AM Detector & Noise Limiter Circuit

Gold bonded diode, 1S1007, is used for AM detection. Series type automatic noise limiter (ANL), with silicon diode 1S1941 effectively suppresses pulse noise. The ANL may be switched off at the front panel.

9. SSB & CW Detector

Product detector V6, 6BE6, has a very efficient performance for SSB and CW detection. BFO voltage is derived from V7, 6BA6, in a self excited oscillator circuit. BFO pitch is controlled by trimmer condenser VC4.

10. AVC Circuit

AVC voltage from the AM detector is applied to control grids of V1, V4 and V5. AVC circuit keeps the output level of the

receiver almost constant regardless of input signal strength. In the case of reception of DX (CW & SSB signals), the AVC circuit may be switched off and RF GAIN control adjusted for good reception quality.

#### 11. Mute & Monitor Circuit

Adoption of a muting circuit enables smooth switching of transmit and receive. RF GAIN control VR1, and monitor control VR2 are in series to cathode return circuit of V1 and V4. For muting with a transmitter, relay contacts must open on "transmit" and close on "receive". Thus, on "receive", the mute terminal is grounded. On "transmit", the monitor potentiometer increases the bias.

#### 12. A.F. Amplifier

Output from the detector, through the mode switch, is applied to the triode section of V8, 6AW8, from which output is coupled to the power amplifier, the pentode section of V8.

Since the same circuit is used for the speaker connection and headphone jack, low impedance speaker or headphones, 4 - 8 ohms, should be used. The output transformer also has a 600 ohm winding to supply anti-trip signal for a VOX circuit.

#### 13. Power Supply

HT supply consists of four silicon diodes in a bridge circuit and with a filter choke performs with good regulation. Supply for the transistor oscillator is stabilized by a zener diode 1S225. Heater supply is 6.3 volts, same as that of the FL-50B.

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## OPERATION OF RECEIVER

The following operating conditions should be observed.

### 1. Antenna

The antenna input impedance of the FR-50B is 50 - 70 ohms. Use a matching antenna with coaxial lead-in. The receiving sensitivity is directly dependent on the quality of the antenna. However, a length of wire will suffice for casual listening.

### 2. Speaker

As the output impedance is 4 ohms, a speaker impedance close to this is recommended.

For headphone use, connect the leads to the plug supplied. Low impedance, 4 - 16 ohms, headphones should be used.

### AM RECEPTION

#### Position of Controls

Mode Switch:	AM	
Preselector:	Set to noise peak	
Band:	Desired band	Main dial may be accurately set for each band at the
RF GAIN:	Maximum	100 Kc points with the aid of a crystal
AF GAIN:	For suitable volume	calibrator and adjusting the Zero
ANL:	Off	set control to zero beat.
CALIB:	Off	
Monitor:	Minimum position	
AVC:	Fast	
CH-select:	VFO	

Turn the main tuning knob to receive the desired signal and adjust for maximum "S" meter reading, then peak with pre-selector. When impulse noise such as generated by auto-ignition systems is strong, switch on ANL. The tuning knob has 50 graduations, and one revolution of the knob covers about 50 Kc on each band, except 28 Mc where one revolution covers about 100 Kc.

### 3. SSB & CW Reception

Set knobs to the same position as above, except the mode switch is set to the SSB/CW position.

Tune for maximum "S" meter indication, then adjust BFO PITCH to resolve SSB signal, or, for CW, to obtain a comfortable listening tone. Most SSB stations use LSB on 80 and 40 meters

and USB on 20, 15 and 10 meters, so the BFO knob will point somewhere near 453.5 Kc or 456.5 Kc position.

To receive a weak signal, set RF GAIN to maximum and turn off AVC. For strong signals, decrease RF GAIN and increase AF GAIN.

#### 4. Operation in Conjunction with a Transmitter

It is possible to operate in the transceive condition if the transmitter is FL-50B. Refer to the diagram on page 4. Use as short a length of coaxial cable as possible to connect to the VFO. When using a transmitter other than the FL-50B, the mute terminal must be so connected as to be open circuited to ground during transmitting, and short circuited during receiving.

#### 5. Transceive Operation

Set the Xtal switch of the FL-50B in EXT OSC position. Switch to SPOT on the transmitter and set the carrier control to maximum, then adjust BFO PITCH for zero beat. Return carrier control to the SSB position. Then the transmitting and receiving frequencies are the same. In the case of adjusting while communicating, turn the BFO PITCH to give the same tone from the received signal and monitored signal. Note that the BFO PITCH control can be used to provide a degree of "off-set" tuning in the transceive mode.

### ALIGNMENT PROCEDURE

#### 1. Test Equipment Required

- A. Circuit tester
- B. VTVM & RF probe
- C. Standard signal generator

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#### 2. Voltage Measurement

Use the VTVM to measure voltages. Refer to the table for approximate values. A circuit tester used for measurement will indicate some lower voltages than those shown in the table.

#### 3. 455 Kc I.F. Alignment

Apply 455 Kc signal to grid 1 of V3. Adjust MF1, MF2 and L7 for maximum "S" meter reading. Use care if adjusting MF1, MF2. The adjusting screws have a fine thread and can be easily damaged, if too much pressure is applied. However, re-adjustment of these should not be necessary as there is little to get out of order.

4. 1st I.F. Alignment

Apply 5,173.9 Kc signal to grid 1 of V2. Adjust L6 (both cores) for maximum "S" meter reading.

5. Adjustment of 2nd Oscillator Output

Connect RF probe of VTVM to grid 1 of V3. Adjust the upper core of L16 for 70% of maximum reading, and the lower core for maximum reading.

6. Alignment of VFO Scale

For correct alignment a 100 Kc marker is necessary, and if this is built-in it should be used. Adjust coils at the low frequency end, and trimmer condensers at the high end of each band for zero beat. Repeat this adjustment for greatest accuracy. Note that turning of cores or trimmers too far may lead to incorrect frequency by an amount of  $\pm 100$  Kc.

7. RF Alignment

Set mode switch to AM, band to 10, and preselector to mid-scale. With the main dial, tune in a 28.5 Mc signal from the SSG. Adjust cores of L2 and L4 for maximum "S" meter reading. Set bandswitch to 15 and tune in a 21.25 Mc signal from the SSG, and adjust TC1C and TC2C for maximum "S" meter reading.

On 20 meters, with SSG output 14.25 Mc, adjust TC1B and TC2B for maximum "S" meter reading.

On 40 meters, with SSG output 7.25 Mc, adjust L3 and L5 for maximum "S" meter reading.

On 80 meters, with SSG output 3.5 Mc and preselector at "1", adjust TC1A and TC2A for maximum "S" meter reading. On this band, the upper limit of the preselector range is about 3.8 Mc so a slight sensitivity decrease results between 3.8 and 4 Mc.

During the alignment, keep the SSG output level down to the minimum of that required.

8. Adjustment of Trap

L1 is a trap to prevent a spurious signal from entering directly into 1st I.F. stage. Set the SSG output on 5,173.9 Kc and adjust L1 for minimum "S" meter reading. Adjust L19 so that no beat is heard from the speaker. This adjustment is unnecessary unless set up for transceive operation.

9. BFO Alignment

Set mode switch to SSB/CW. Tune receiver to a non-modulated signal from the SSG, adjusting for maximum "S" meter reading. Set BFO PITCH to "0" and adjust L18 for zero beat.



## 10. "S" Meter Zero Set

After removing antenna, adjust VR3 so that "S" meter indicates zero. Note that the "S" meter will not read inversely due to the installation of a diode.

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## MAINTENANCE

This receiver has been thoroughly adjusted with the aid of much measuring equipment by the manufacturer, so re-adjustment should not normally be necessary for a long time. If, due to component change or development of some fault, re-adjustment or repair should be found necessary, then this should be attempted only after full understanding of this booklet.

### 1. Removal of Chassis

After removing the four screws from the underside, push on the front panel and withdraw from the rear.

### 2. Location of Faults

Measure voltages and make resistance checks using the tables for reference. Any large departure from the values shown in the tables could be an indication of the faulty section. Use the VTVM for checking.

#### (1) Receiver not operating:-

Examine AC power cord and plug.

Check fuse.

If the fuse has gone, there may be a short circuit in the H.T. or heater circuits, or failure of silicon diode rectifiers.

#### (2) No sound from speaker:-

Examine speaker connections, making sure that the headphone plug is removed from the jack on the front panel.

Check audio amplifier section by touching grid of V8 with a screwdriver.

Check detector stages.

AM --- detector diode

SSB --- BFO and product detector

#### (3) Audio and detector stages OK but receive fails to operate:-

In checking IF and RF stages make use of the "S" meter.

Examine the 1st converter if the receiver fails only on one band.

If click is apparent when grid of V3 is touched with a screwdriver, fault is in the stages preceding V3. Local oscillator injection voltage must be measured with the VTVM.

NOTE:

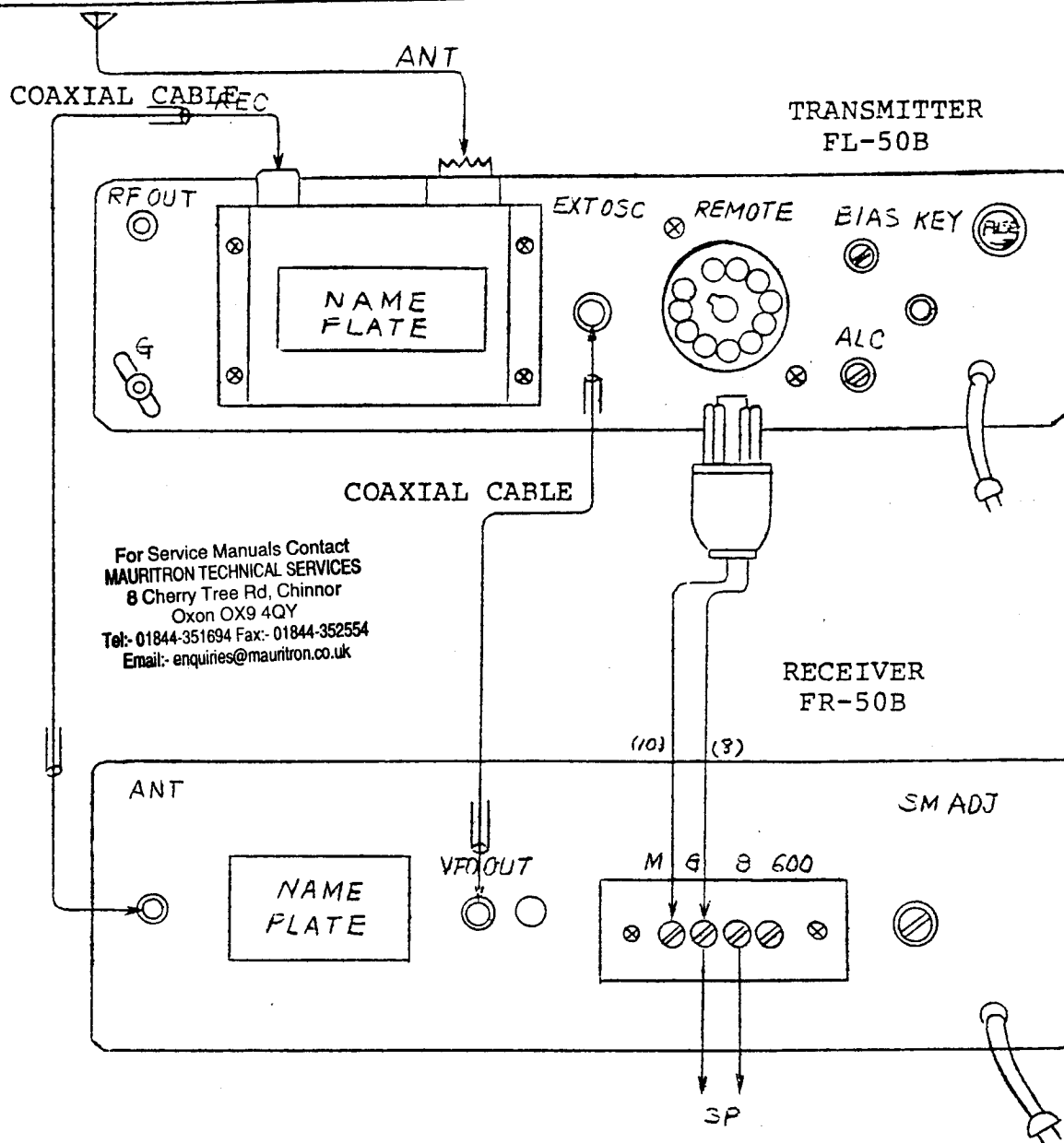
Dial Calibrations

On the main dial, the bottom scale is for 80 meters. "500" represents 3,500 Kc, "600" for 3,600 Kc, and so on. The centre scale serves for the 40, 20 and 15 meters bands where "0" represents 7,000, 14,000 or 21,000 Kc, "100" represents 7,100, 14,100 or 21,100 Kc, etc., depending on the band in use. The sub-divisions on the main dial are 10 Kc points. The graduations on the tuning knob skirt closely represent 1 Kc divisions. The upper scale on the main dial is used for 10 meters but in this case the knob skirt graduations represent 2 Kc divisions.

The knob skirt may be adjusted independently of the knob itself by firmly holding the knob while turning the skirt, and can be set at 0 for 100 Kc points with a crystal calibrator. Since, on all bands except 10, the knob rotates two full turns for each 100 Kc segment, a double numbering system is adopted on the skirt, thus, read 0 to 49 Kc with black figures and 50 to 100 with red figures. A plug-in 100 Kc crystal is available as an optional extra.

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CONNECTION OF FL-50B TRANSMITTER AND  
FR-50B RECEIVER FOR TRANSCEIVE OPERATION



If receiver is used while disconnected from transmitter, M & G terminals must be shorted together.

VOLTAGE MEASUREMENT

(VOLT)

TUBE	P I N N U M B E R								
	1	2	3	4	5	6	7	8	9
V1	0	1.3	0	AC6.3	145	70	0		
V2	75°	-1.6°	0	AC6.3	AC6.3	38	-0.4	0.25	0
V3	-0.1	0.4	0	AC6.3	100	17	0		
V4	-0.1	0	0	AC6.3	145	85	1.6		
V5	0	0	0	AC6.3	140	83	1.3		
V6	-2.6*	1.9*	0	AC6.3	75*	60*	0		
V7	-1.6*	0	0	AC6.3	38*	38*	0.6*		
V8	0	7.4	0	AC6.3	0	145	124	0.6	9.2

RESISTANCE MEASUREMENT

(OHM)

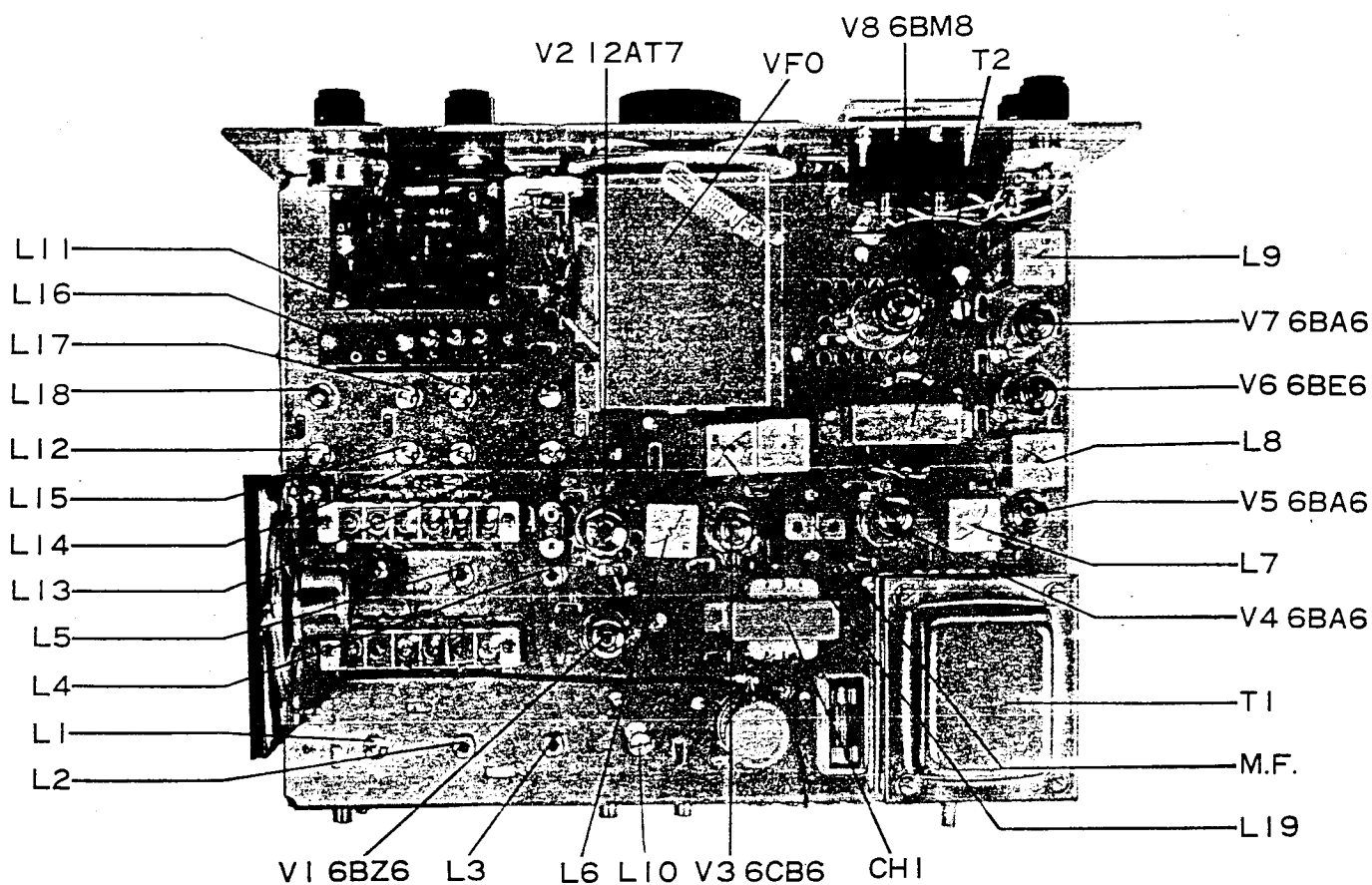
TUBE	P I N N U M B E R								
	1	2	3	4	5	6	7	8	9
V1		150	/	/	6K	18K	0		
V2	100K°	1M	0	/	/	120K	100K	270	0
V3	100K	330	/	/	52K	500K	0		
V4	∞	0	/	/	5.8K	30K	180		
V5	∞	0	/	/	5.6K	11.5K	130		
V6	22K	220	/	/	34K*	20K*	4.7K		
V7	47K	0	/	/	34K*	34K*	220		
V8	500K¢	220	470K	/	/	3.6K	9.5K	2K	300K

° CALIBRATER OPERATED

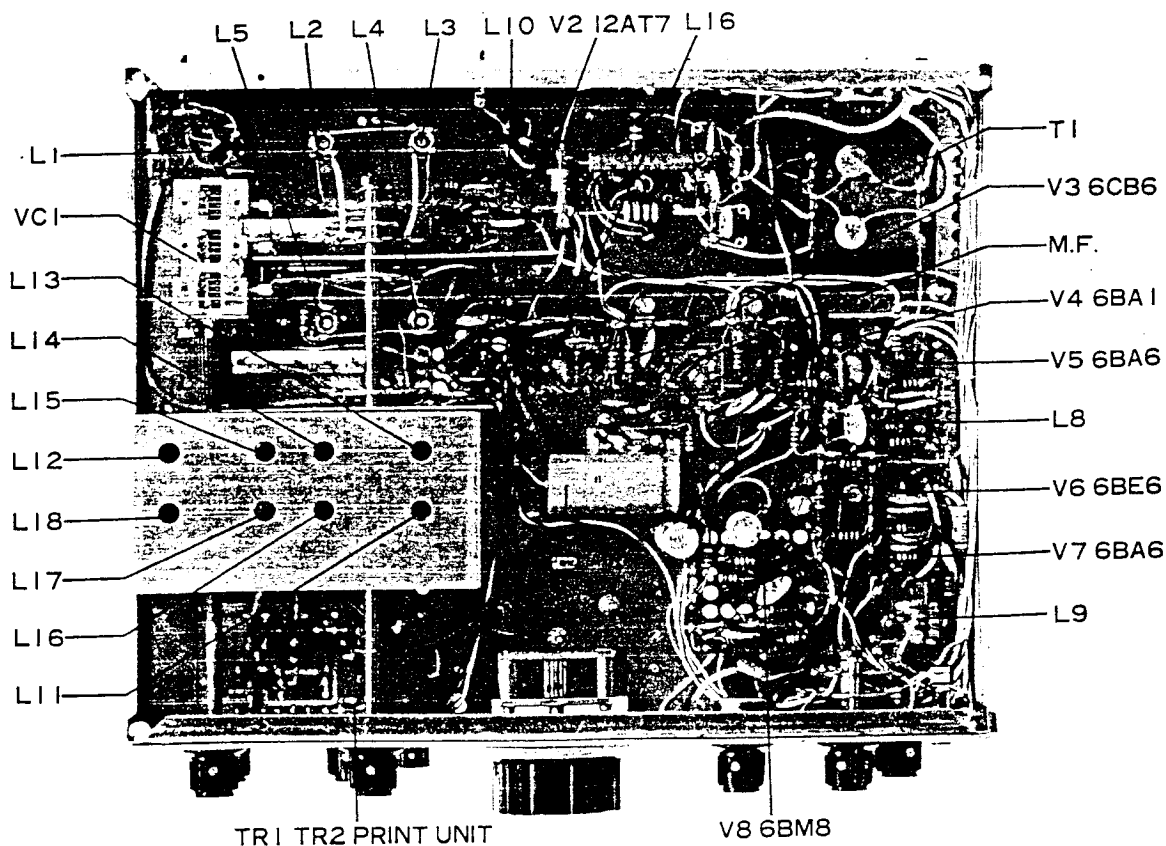
\* MODE SWITCH POSITION SSB/CW

¢ AUDIO GAIN MAX.

# PARTS LOCATION

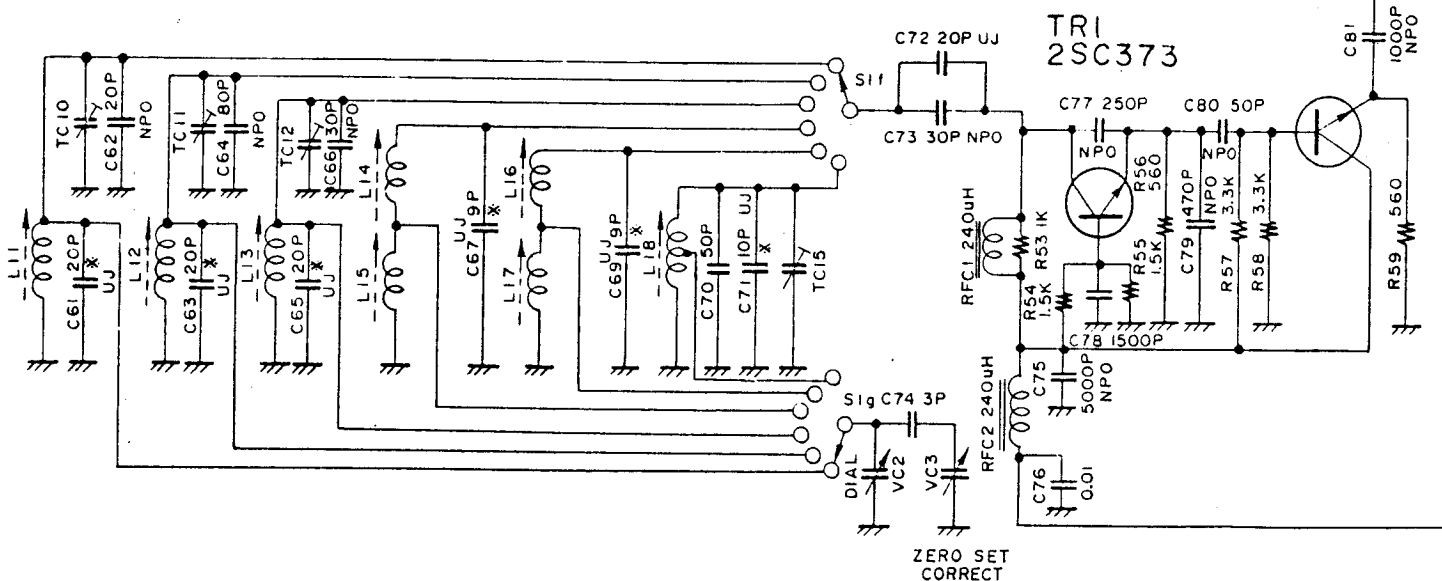
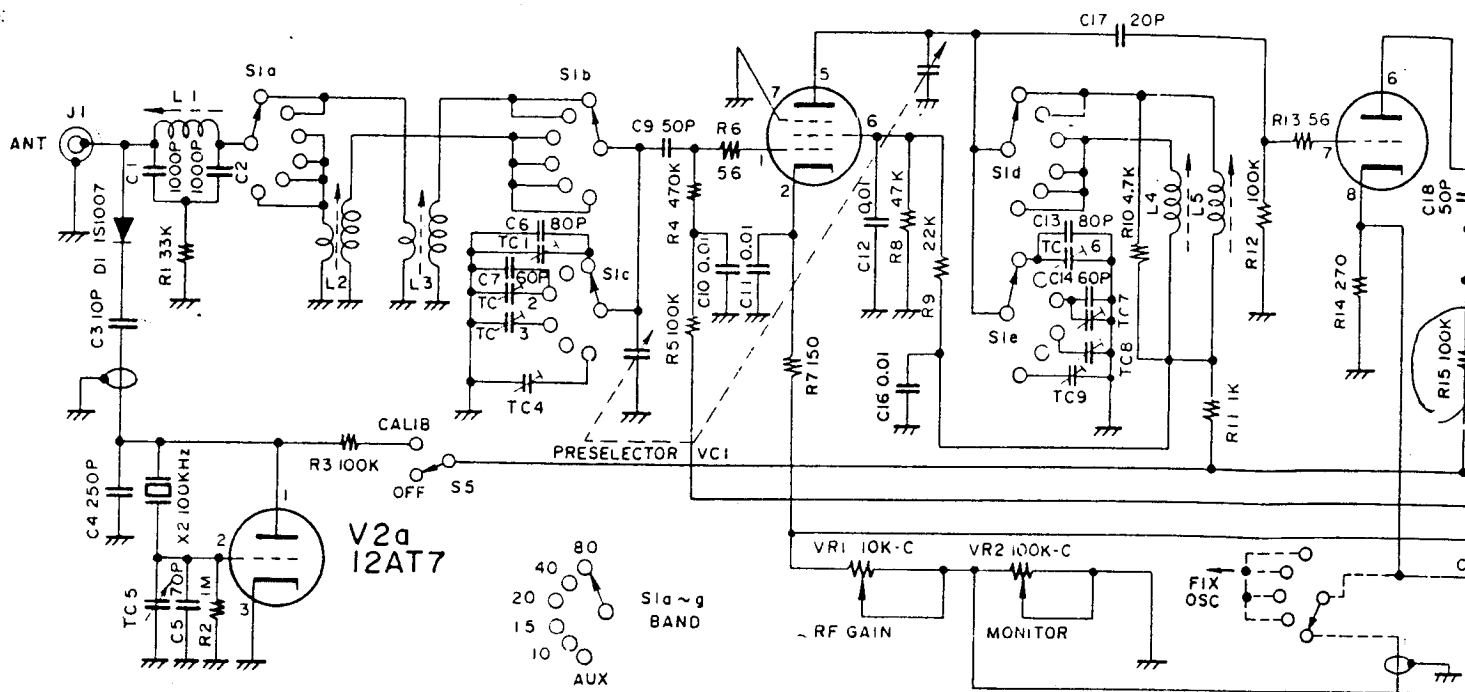


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VI 6BZ6

V2b 12AT7



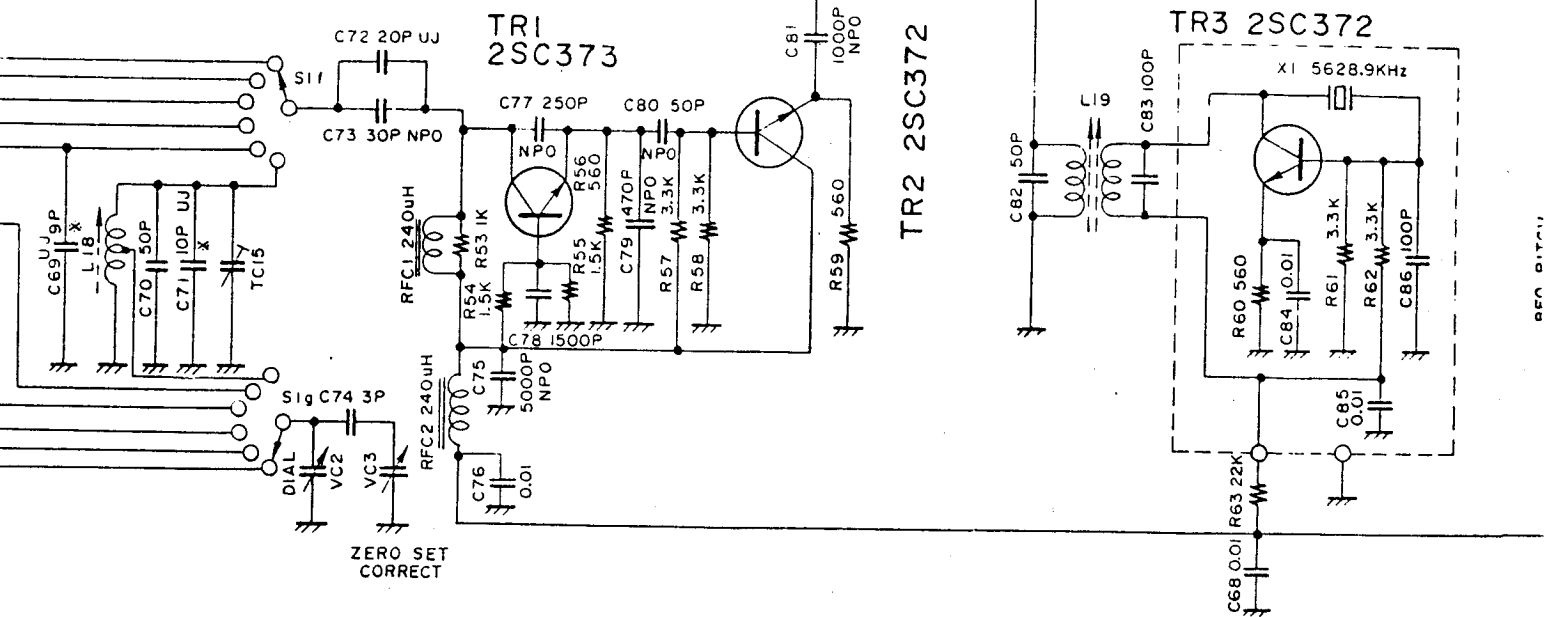
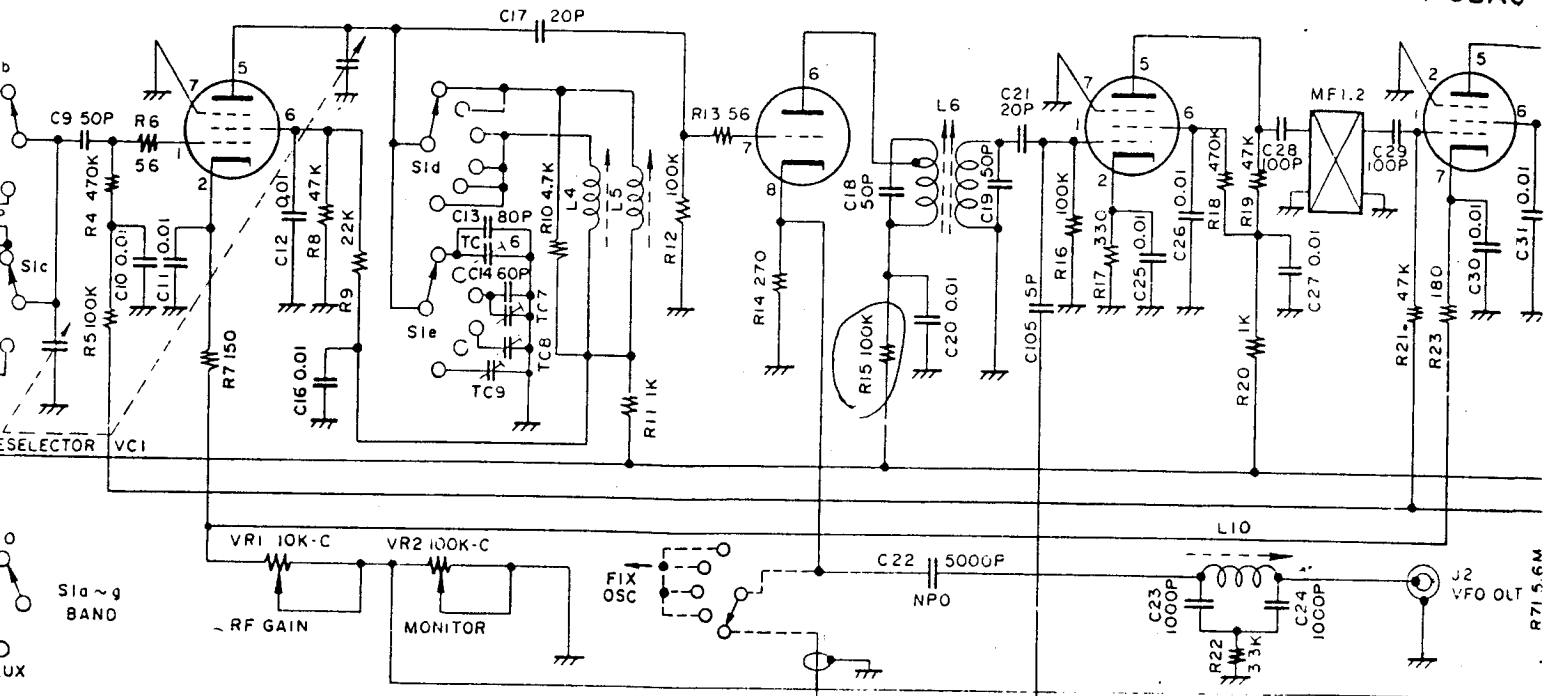
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VI 6BZ6

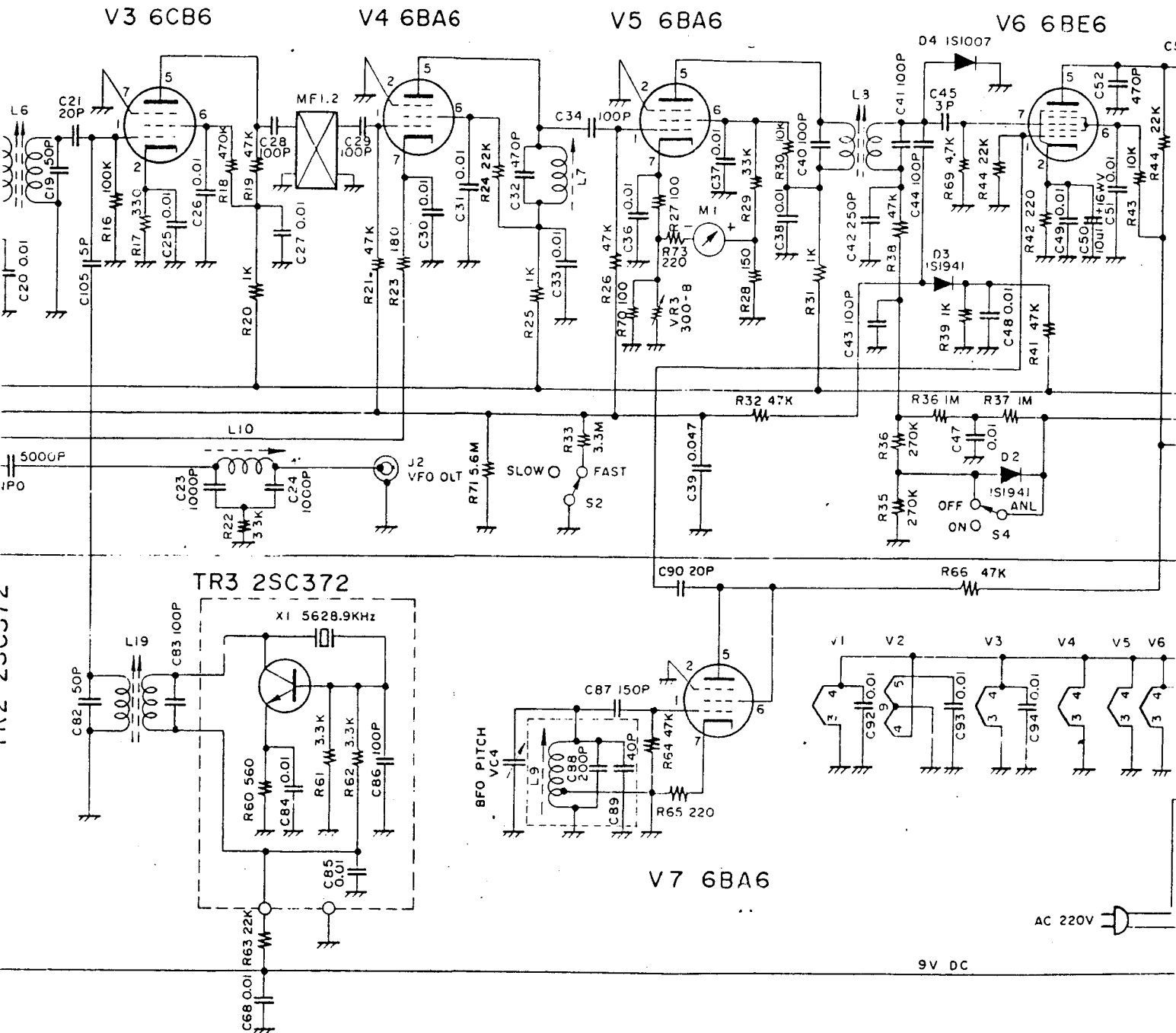
V2b 12AT7

V3 6CB6

V4 6BA6

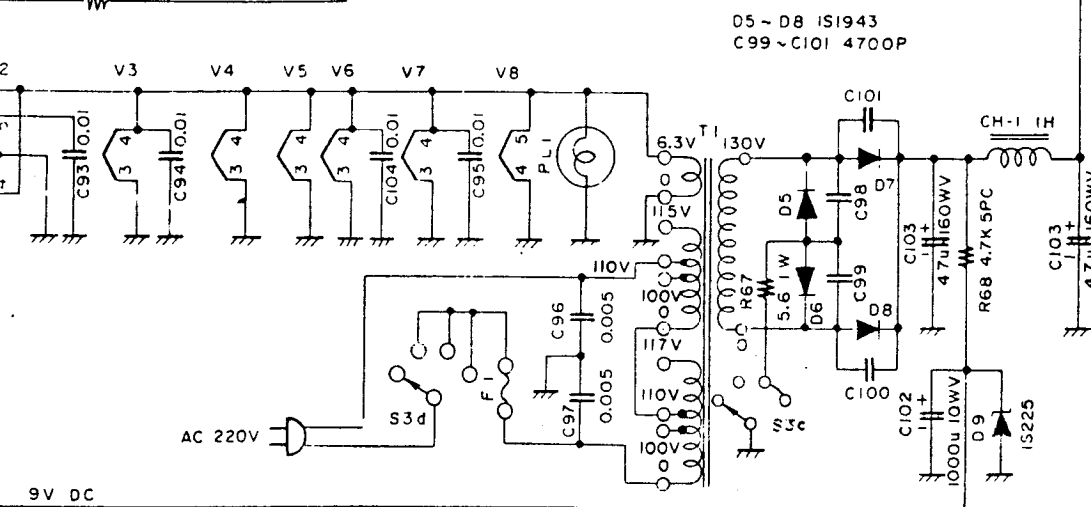
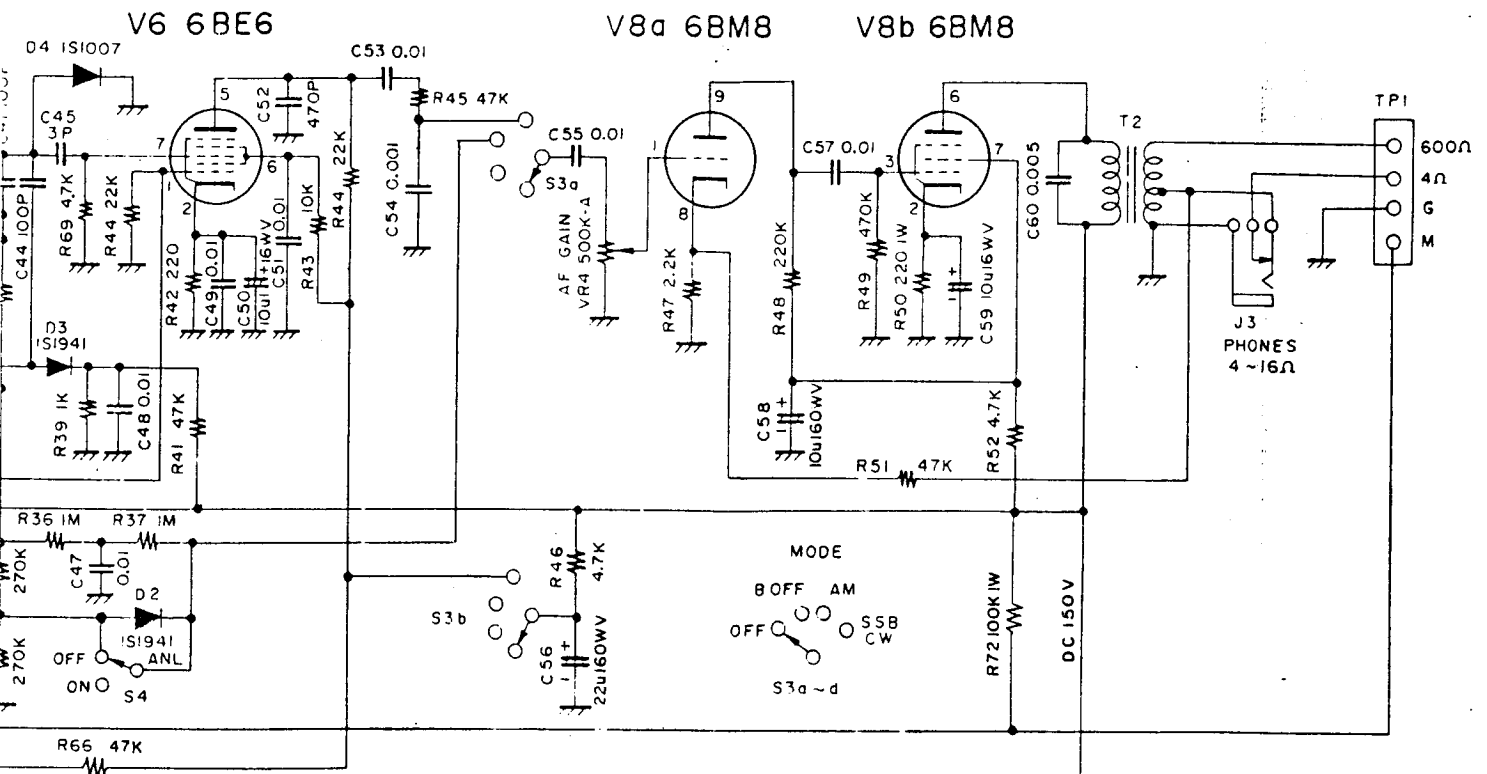


REC. DATA



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NOTES:

1. ALL RESISTOR IN OHM 1/2W±10% UNLESS OTHERWISE NOTED.
2. CAPACITOR IN uF UNLESS OTHERWISE NOTED.
3. \* VALUE IS NOMINAL.

**FR-50B**  
**CIRCUIT DIAGRAM**