SSB TRANSCEIVER
TS-500
OPERATING MANUAL

TRIO
RIO CORPORATION

Manufactured by TRIO CORPORATION, TOKYO, JAPAN
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SPECIAL FEATURES

1. The TS-500 is a handsome, well designed SSB Transceiver which performs even better than it looks. It is sure to add to the appearance and efficiency of any "ham shack."

2. It is a powerful, all-band transceiver which will assure greater enjoyment of quality SSB communication.

3. Precision, double-gear tuning mechanism, and linear tuning condenser provides 1 kHz direct reading divisions on all bands.

4. Besides SSB, it provides AM (A3H) and CW communication. It operates with a maximum input of 200 watts PEP on SSB and CW.

5. It completely covers all the amateur bands from 3.5 to 29.5 MHz with a 7-band tuning system, in both transmitting and receiving modes.

6. The receiver portion is a double-conversion type superheterodyne. A solid state VFO circuitry assures high stability performance.

7. Use of a new Trio developed crystal sideband filter provides superior shape factor and clear, crisp SSB quality.

8. Highly effective AGC circuit prevents fading; permits easy reading of signals.

9. It has a built-in crystal calibrator circuit, designed to work with 500 kHz, 1 or 3.5 MHz crystals.

10. Built-in RIT circuit permits fine tuning in receiving mode.

11. It's built-in circuits include VOX, PTT, ALC, RIT, CAL, RF - HV METER, and connectors for external VFO and ALC.

12. Used in combination with a remote VFO, a special switching circuit permits, in effect, the operation of two transmitters and two receivers.

13. This transceiver is operated together with a separate power supply and speaker unit, the PS-500AC.

CIRCUIT DESCRIPTION

RECEIVER

The receiver portion utilizes the transmitter's pi-matching network for its antenna circuit. It is switched in by a relay to G1 of the RF amplifier tube (V14) only when the transceiver is in the receiving mode. A variable resistor in the cathode circuit of this tube controls RF gain in this stage, as well as in the 2nd I.F. (V1). AGC voltage is also supplied here, and provides automatic gain control. The tuned plate coil, which is used at the output, is also used in common with the transmitter. It is switched in at the transmitter's 2nd Mixer output during transmitting mode.

A 6AU6 (V13) serves as the 1st Mixer. The 1st local oscillator output which is introduced here in a cathode injection circuit, is

Table1 Frequency chart

Receiver Xmitter Frequency Range Out Put Frequency	1st lowcal OSC	1st IF AMP	VFO Frequency	2nd IF	BFO Carrier	Side band
MHz	MHz	MHz	MHz	kHz	kHz	
3.5 ~ 4.0	12.85	9.35 ~ 8.85	12.74 ~ 12.24	3388.5	3390	LSB
7.0 ~ 7.5	16.35	〃	〃	〃	〃	〃
14.0 ~ 14.6	5.15	8.85 ~ 9.45	12.24 ~ 12.84	〃	〃	USB
21.0 ~ 21.6	12.15	〃	〃	〃	〃	〃
28.0 ~ 28.6	19.15	〃	〃	〃	〃	〃
28.5 ~ 29.1	19.65	〃	〃	〃	〃	〃
29.1 ~ 29.7	20.25	〃	〃	〃	〃	〃

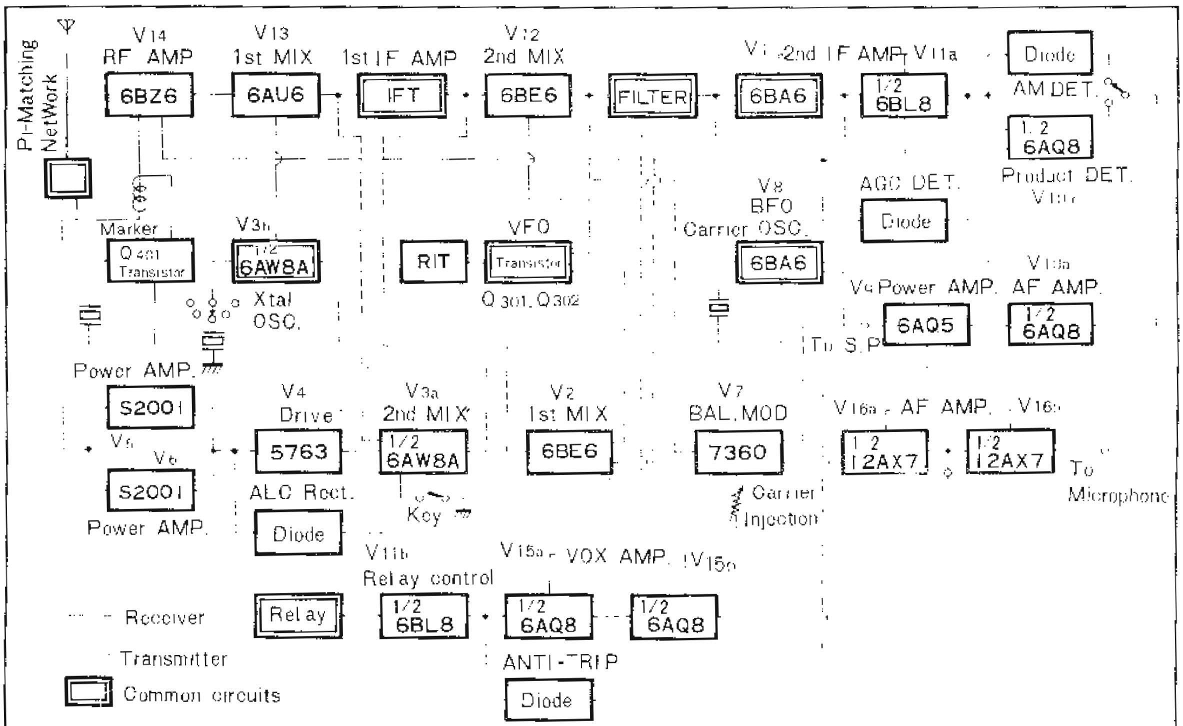


Fig1 Block Diagram

mixed with the input signal reaching G1. They are converted by this tube to a signal whose frequency is the difference in the frequencies of the mixed signals, and range from 8.85 to 9.45 MHz. These frequencies serve as the 1st I.F. for the various bands, as shown in Table 1. A 27 PF and 10 μH series-type resonant I.F. trap which is tuned to about 9.2 MHz is provided in the G1 circuit.

One half of a 6AW8A (V3b) serves as a 7-band, crystal controlled, 1st local oscillator, whose output frequencies are as shown in Table 1. This circuit is also used in common, both in the transmitter and receiver portions, with only the method of coupling the output differing. It is, coupled to the 1st mixer through a low impedance circuit during receiving mode.

As shown in Table 1, the 1st I.F. requires a bandpass width characteristic of 600 kHz. A variable condenser, which is ganged with the VFO, is used to resonate one side of the IFT to increase sensitivity. This section, too, is common to both the receiver and transmitter portions, as can be seen from the block diagram.

The 2nd Mixer uses a 6BE6 (V12) in a conventional mixer circuit. The 1st I.F. and VFO voltages are mixed here and converted to a voltage whose frequency is the difference of the mixed frequencies. This converted signal voltage, which appears at the tube's output, is then coupled into a half-lattice, crystal-filter network.

The VFO consists of a solid state, Vaccar oscillator circuit for compactness and good frequency stability. It is protected from any frequency drift that may arise from changing load conditions by an emitter-follower, buffer stage. It is also protected from any frequency

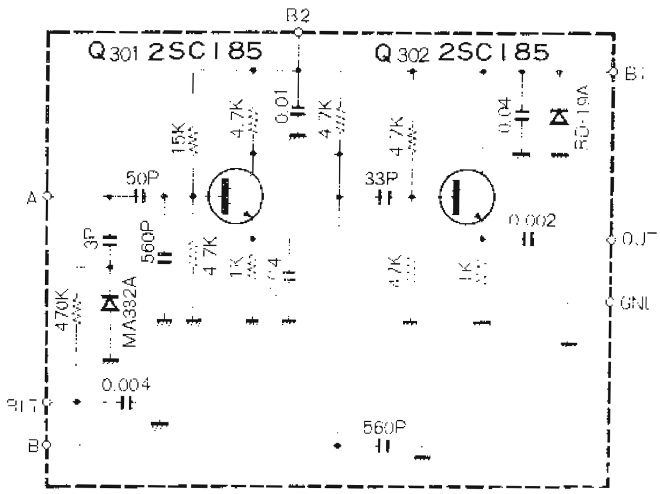


Fig2 VFO circuit

drift which may arise from fluctuating supply voltages, for it is supplied by an intricate voltage regulation system which employs zener diodes, and, in the 150 volt B line, a voltage divider network and a voltage regulator tube.

In the RIT (Receiver incremental tuning) circuit, a variable capacitor element is inserted in the VFO oscillator's base lead. A VR is used to vary the base potential, and thus shift frequency by ±3 kHz, enabling a 6 kHz spread of the incoming signal. The RIT circuit is used only in the receiving mode.

Five resonant crystals are used in a two-stage, half-lattice, crystal-filter circuit as shown in Figure 4. The output of the 2nd Mixer is introduced here. XF3 acts as a carrier shunt, sharply attenuating it, and improving sideband rejection. Since the carrier frequency is higher than that at the filter's center, the lower sideband (LSB) is utilized. With selectivity and passband width thus determined by the above filter network, gain becomes the only objective of the 2nd I.F. This is achieved through two stages of amplification which are coupled by a single resonant circuit.

For SSB reception a product detector is necessary, and the triode section of 6AQ8 (V10b) is used for this purpose. Audio output is obtained when the BFO frequency is synchronized with the carrier of the incoming signal. BFO injection is made in the low impedance cathode circuit, since the BFO and product

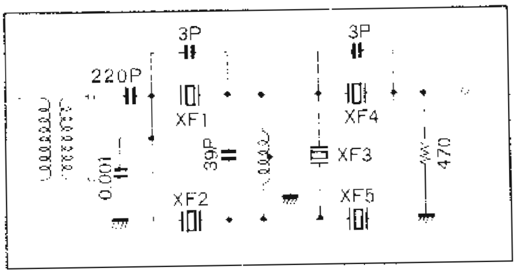


Fig3 Crystal Filter

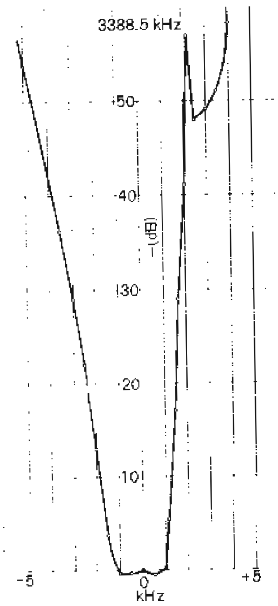


Fig4 Crystal Filter Characteristic Curve

detector circuits are quite separated.

For AM reception, a separate, 2 diode, detector circuit is used. Since BFO oscillation becomes unnecessary, the circuit is made inoperative for AM receiving mode.

AGC voltage is developed with a 2 diode, voltage-doubling rectifier circuit, and it is applied to the first RF amplifier (V14) and 2nd I.F. amplifier (V11a) for automatic gain control.

Audio power is obtained by employing one half of the 6AQ8 (V10a) as an audio amplifier to boost the audio developed at the detector's output, and a 6AQ5 (V9) as a power amplifier, which delivers more than one watt power output.

The S-meter circuit is as shown in Figure 5. It consists of a 500 microampere milliammeter which indicates current flow resulting

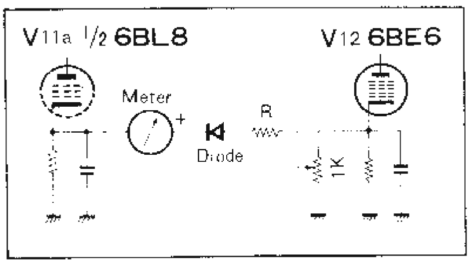


Fig5 S-Meter circuit

from cathode potential differences of the 2nd I.F. and the 1st Mixer. A series-connected diode prevents reverse current flow, and the potentiometer serves as a balance adjuster for "0" reading. An increase in incoming signal intensity causes an increase in AGC voltage. This upsets circuit balance which results in S-meter deflections.

A dial calibration purpose 500 kHz marker circuit is incorporated in this transceiver. Although 1 MHz and 3.5 MHz crystals can also be used here, a 500 kHz crystal makes calibration work easier. It is a miniature single, transistor oscillator circuit, the output of which is loosely coupled through a capacitance to G1 of the RF amplifier tube (V14).

TRANSMITTER SECTION

The microphone output is amplified by a two-stage, speech amplifier, 12AX7 (V16a, b). Its output is used to drive the deflection plate of the Balanced Modulator (BM). A filter circuit at the input of the 12AX7 is used for RF rejection.

Carrier frequency is obtained from the Xtal oscillator 6BA6 (V8), which is used in common with the receiver. For SSB, the frequency is lowered by 3,390 kHz, and for CW by about 3,389 kHz. During transmitting mode, the oscillator output is taken from the plate circuit, and it is inserted to the control grid of the 7360 (V7).

The crystal sideband filter, used during receiving mode, is also used in the transmitter. The DSB output, obtained from the 7360 balanced modulator, is coupled to this crystal filter which rejects the unwanted sideband and produces the desired SSB signal.

For AM and CW operation, Switch S2a in Figure 6 is flipped to upset balance, and the 7360 output is here

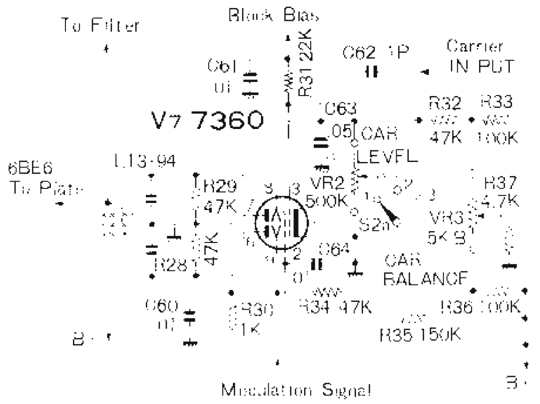


Fig6 7360 Balanced Modulator

again passed through the crystal filter, and introduced to the 1st transmitter Mixer. Thus, AM in actuality is A3H. The 7360 balanced modulator is quite unaffected by temperature changes. It posseses high carrier balance stability and delivers high power output. The audio characteristics curve is shown in Figure 7.

The crystal filter's output is amplified in the common 6BA6 I.F. Amplifier (V1), and enters the 1st transmitter Mixer for frequency conversion.

A 6BE6 (V2) serves this purpose, mixing the VFO and the lower sideband LSB voltage, and producing, at its output, an upper sideband USB voltage whose frequency is the difference in the frequencies of the mixed voltages.

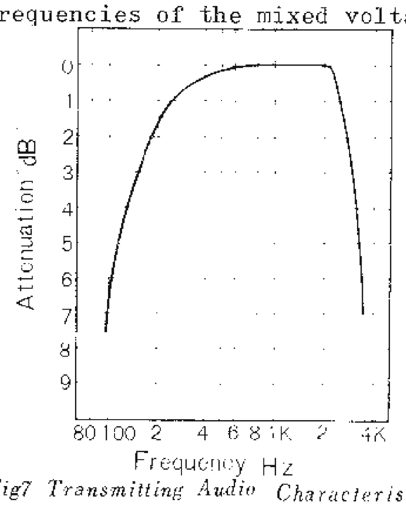


Fig7 Transmitting Audio Characteristics

This voltage is introduced to the transmitter's 2nd Mixer, for which a grid-fed 6AW8A (V3a) is employed. This tube receives its other mixing voltage from the 1st local oscillator, which is used in common with the receiver. The converted outputs of this stage are at frequencies covering the various bands of this transceiver. Those of the desired band are then bandpass-coupled through resonance circuits, which are also common with the receiver, to the transmitter driver.

A 5763 (V4) is employed as the amplifier-driver. This is a special VHF transmitting tube which is larger than a 12BY7A, and performs with less distortion. The 5763 output is used to drive the final RF amplifier.

The final RF power amplifier consists of two S2001 tubes, in parallel operation, with 900 volts supplied to the plates. Neutralization is achieved at the cold end of the drive coil from the plate. ALC voltage, obtained from the grid circuit, is applied to 6BA6 (V1). This ALC voltage is grounded out during CW operation.

The S-Meter, which is common with the receiver, performs a triple function during transmitting mode as Ip, HV and RF meters. Made to deflect when switched in series with a multiplier resistor tapped off the HV line, it serves as a HV meter. By measuring diode rectified current flow created by tapping the RF Antenna terminal, it serves as an RF meter. Switched to read cathode voltage of the final amplifier, it serves in reality as an RF + Ig2 meter, rather than a true Ip meter.

The RF output tank circuit is a conventional pi-network configuration. A fixed and variable condenser on the load side enables coarse and fine matching adjustments.

The voltage for the VOX circuit is taken from the plate of the AF amplifier (V16b). Ample gain is available since two stages of amplification are provided by V15 (6AQ8). The amplified output is diode rectified, and applied to the relay control tube 6BL8 (V11b).

For manual operation (MAN), the

relay control grid is grounded out, and this is achieved by an ON, OFF switch in the cathode circuit.

This circuit extends to the microphone connector jack and makes Push-to-talk (PTT) possible.

Anti-trip is achieved by obtaining the necessary voltage directly from the plate of the receiver portion's power output tube. This voltage is supplied to a diode voltage doubler and rectifier circuit, and its output is then, introduced to the grid of the relay control tube (V11b).

Keying is accomplished in the cathode circuit of the 2nd Transmitter Mixer 6AW8A (V3a), with semi-break-in at VOX. In this VOX position, keying pulse is fed to the the VOX amplifier, thus controlling the relay. The keying circuit is shown in Figure 8.

Standby switching is achieved by a very sensitive relay (RL1), and a DC 12V relay (RL2) in the plate circuit of the relay control tube 6BL8 (V11b). RL1 controls five switching functions, namely: bias of receiver prtion, grounding of RF gain potentiometer, EXT relay and RIT switching, and activation of RL2. RL2, in turn, controls the switching of the antenna circuit, bias of the transmitter portion, and meter function modes.

Mechanically, too, this transceiver has been most exactingly designed. The antibacklash, double-gear dial mechanism has a 28:1 ratio, and one complete revolution of the knob tunes across exactly 50 kHz.

It thus enables 1 kHz divisions of the frequency range which can be directly read.

The power supply socket connections, as seen from inside the chassis, are shown in Figure 9.

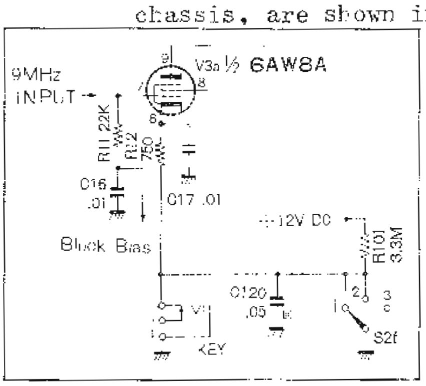


Fig8 Keying Circuit

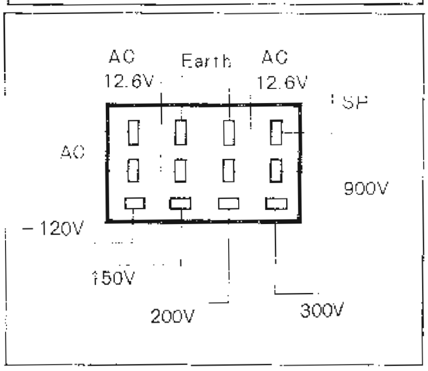


Fig9 Power Supply Connecting Socket

RF indicates RF output voltage at the antenna terminal of the transmitter. HV provides an indication of plate voltage in the final stage of the transmitter.

When the transceiver is in receiving mode, however, the S meter will be automatically switched to indicate incoming signal intensity, regardless of the position of this METER switch.

7. SEND-REC

This is the Standby Switch. It is switched up to SEND for transmission, and down to REC for receiving. It should be left in REC position when VOX is used.

8. VOX-MAN

This controls the switching to VOX (Voice Operate Control) or MAN (manual operation). When it is switched to MAN, transmit-receive switching should be accomplished manually by operating the SEND - REC switch at its left.

When switched to VOX, the above switching operations become automatic.

9 DIAL

This is the Tuning Knob, one revolution of which covers a range of 50 kHz. The flange indicator on the knob side can be moved to the left or right while holding the knob itself steadily. Thus, it can be adjusted to read 0 when the dial is set to 0. Flange indications will then enable 1 kHz direct readings. Red indications are provided for the 3.5 - 7 MHz range, and black for the 14 - 29.1 MHz range.

10. MIC GAIN

This control is adjusted to control microphone gain, depending on the microphone output voltage and room acoustics and noise. Keeping this control retarded to the minimum point that still provides sufficient modulation is the secret of good quality phone transmission.

By pulling off the knob of MIC GAIN, the RIT circuit shuts off, and the frequencies of both transmission and reception become identical regardless of the position of the RIT switch (same as the "0" position of RIT switch). When beating against a certain signal in reception with the RIT switch in "0" position, adjust the semi-fixed volume control

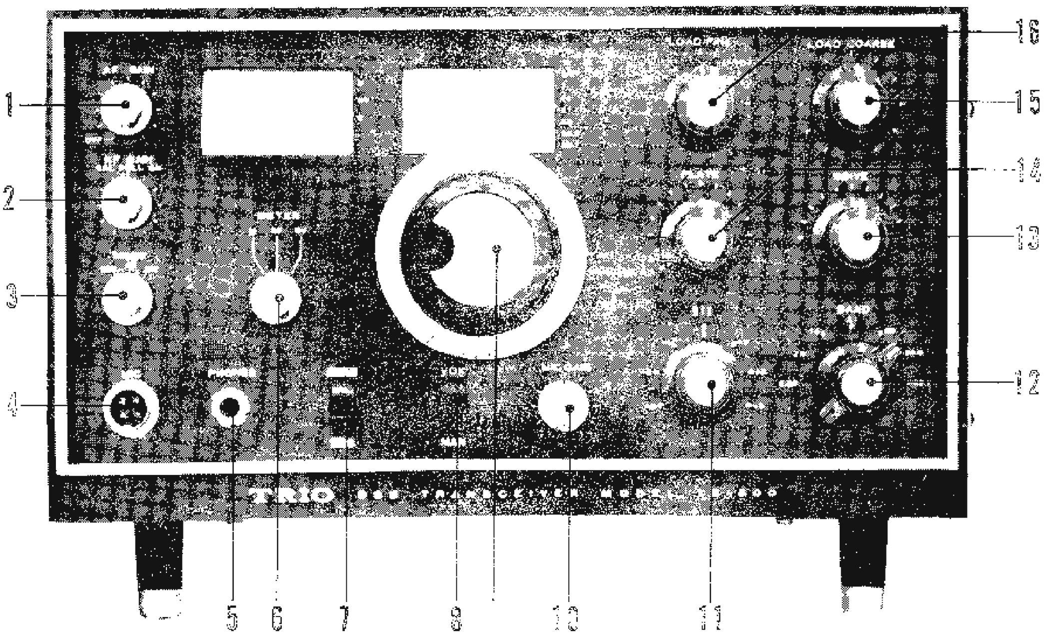


Photo1

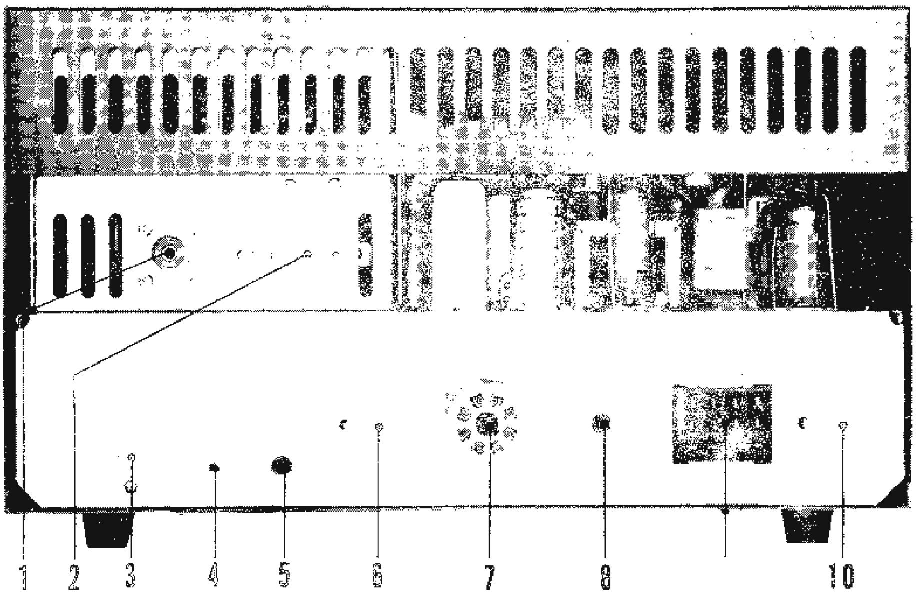


Photo2

(VR13 50kΩ) in the RIT circuit so that the beat tone does not change even with the RIT switch in either ON or OFF position.

When adjusted like this, you can get a perfect zero beat with the station in reception.

11. RIT (Receiver Incremental Tuning)

Turning this knob enables shifting the frequency of the incoming signal by approximately 3 kHz, up or down. This is only possible during receiving mode.

12. BAND

This is the Band-Change Switch. It divides all the amateur bands between 3.5-29.7 MHz into 7 ranges.

13. DRIVE

This control enables tuning of the transmitter's driver stage. The variable capacitor used here is common with the RF tuning condenser in the receiving mode.

14. PLATE

This controls the tuning of the transmitter's final stage, and it is common with ANT tuning in the receiving mode. Thus, when it is adjusted for transmitting, it will be automatically adjusted for receiving.

15. LODE COARSE

This provides coarse adjustment of the final tank circuit's load side. This is achieved by a fixed condenser and rotary switch circuit.

16. LODE FINE

This provides fine adjustment of the load side to match the transmission line.

PEAR TERMINALS AND CONTROLS (See photo 2)

1. ANTENNA

Antenna connections should be made here. Be sure to connect an antenna or a dummy load before the transceiver is used. Impedance here is 50 to 75 ohms.

2. RF METER ADJ

This controls adjustment of the RF meter swing level. Adjust it so that the meter will not swing off-scale even at peak RF power adjustments.

3. BIAS

This controls the bias of the transmitter's final power amplifier. Adjust it for a plate current reading of 60 milliamperes, under no signal conditions, in the transmitting mode.

4. GND

This is the grounding terminal. It is recommended that a good ground be connected here for safety's sake.

5. KEY

This jack accepts the keying plug for CW operation. It must be remembered that when a key is plugged in here, no current flows in the plate circuit of the final amplifier unless the key is pressed down. Thus, the key must be down when it is desired to make final tank adjustments.

6. RELAY ADJ

This adjusts the operating potential point for the Standby Relay circuit.

7. REMOTE

This terminal is provided for connection of auxiliary equipment such as a linear amplifier.

8. VFO OUT

This connector is provided for the connection of a remote VFO which may be used in conjunction with this transceiver.

9. POWER SUPPLY

This is the Power Supply Connecting Jack.

10. S METER ZERO ADJ

This enables zero adjustment of the S Meter. It should be adjusted to "0", under no incoming signal conditions.

UPPER CHASSIS CONTROLS AND THEIR FUNCTIONS

(See photo 3)

1. VOX GAIN

This adjusts Vox sensitivity. In noisy surroundings, it should be kept retarded.

2. ANTI-TRIP

This is the anti-trip adjustment. It should be set so that the speaker response during VOX operation in the receiving mode will not accidentally trip the relays to transmitting mode.

3. CAR LEVEL

This adjusts the carrier level during AM transmission. It should be set so that the transmitter's final amplifier plate current is about one half of that during CW operation.

OPERATING INSTRUCTIONS

ACCESSORIES

The following accessories are supplied with this transceiver.

Please check to see that all are there.

M-type receptacle (For antenna connection) 1

4 prong metal microphone plug 1

Receiver Plugs ..... (For connecting headphones and transmitting key).. 1

Miniature 6 prong Plug (already plugged in place) 1

CS plug (already plugged in place) 1

Hyzex legs 2

Bolts (4 mm) 2

Operating Manual 1

REGARDING INSTALLATION LOCATION

Avoid high humidity locations when selecting installation locations, as excessive moisture is the cause of most troubles in electronic apparatus. Thus, it is wise to choose a dry location which is free from direct sunlight. Keep ample space at the back and sides of the transceiver for proper air circulation. Also avoid placing objects on top of the transceiver.

POWER SUPPLY

This transceiver is not equipped with a built-in power supply, and it must be separately procured. The PS-500AC model speaker and power supply is available for use with this transceiver. It is a handsome matching unit which has a built-in 16cm speaker, and it enables operation from AC 115 or 230V line sources. The PS-500 AC is supplied with a single connecting cord, 2 meters in length, with which all necessary connections can be made to the transceiver, as shown in Figure 10.

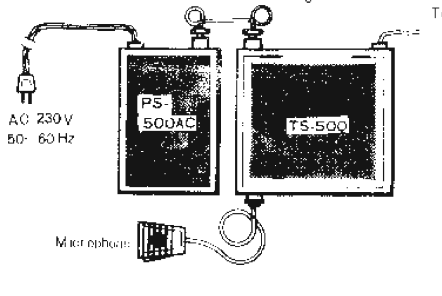


Fig10 How to connect the PS 500AC

Figure 11 shows a schematic diagram for those who may wish to build their own power supply unit. Voltages should be closely adhered to since any change will affect the performance of the transceiver. Table 2 shows the proper terminal voltages. They are actual load condition values, that is, voltages measured under required current flow conditions. The power transformer is not sold on the open market, and it must be specially procured.

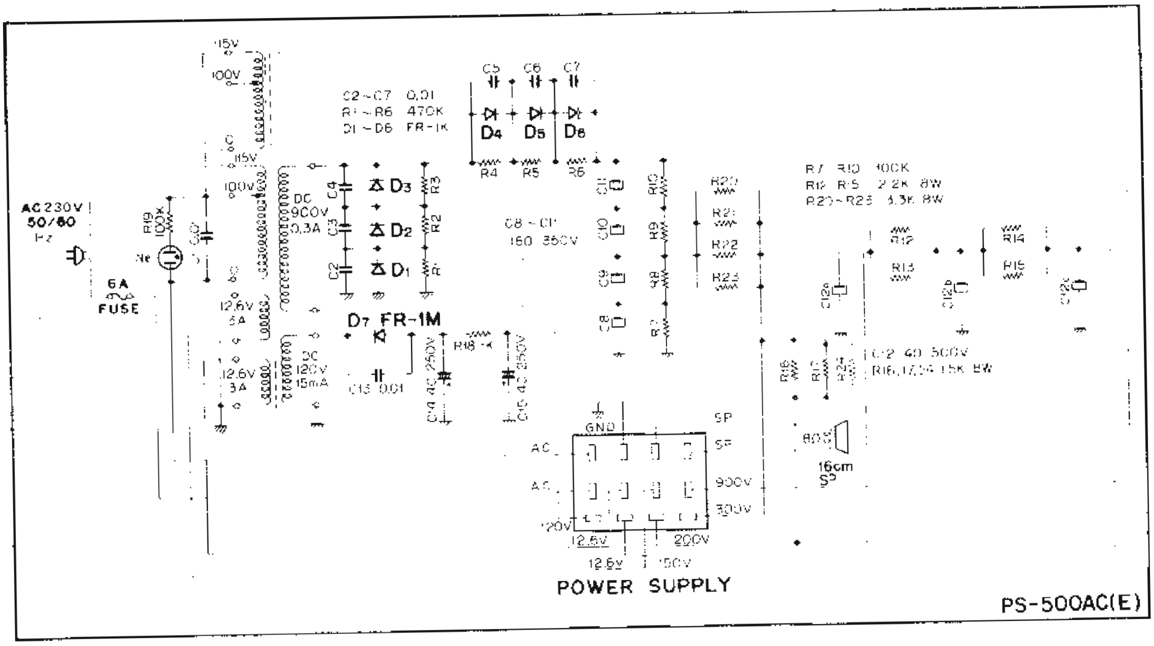
Table2 Power Supply Voltage and current values (During transmitter)

Terminal	Voltage	Current	Allowable Voltage Values
900V	890V	206mA	±6%
300V	287V	53.5mA	±8%
200V	225V	74.0mA	±8%
150V	142V	44.5mA	±8%
120V	116V	5.5mA	±8%
12.6V	12.6V	3A	±6%
12.6V	12.6V	1A	±6%

ANTENNA

A good antenna is very important for proper RF power radiation, so it will be wise to use a good one.

It must also be remembered that perfect matching to the antenna must be made, as, mismatching at high power will cause TV and broadcast interference.



12 prong Power Supply Connecter terminals are shown as viewed from within the chassis

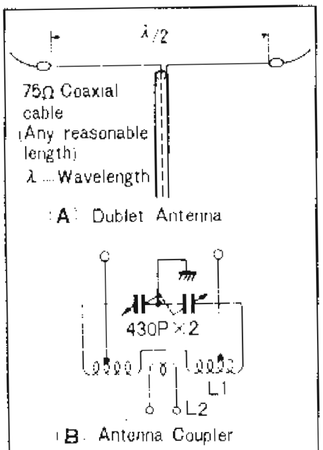
Fig11 Power Supply Schematic Diagram

The impedance at the antenna terminals of the TS-500 is 50 to 75 ohms. Thus, a 75 ohm coaxial line from a doublet antenna can be connected directly. However, an antenna coupler must be used for proper matching of all other types of antennas.

MICROPHONE

Since speech quality is considerably affected by microphone characteristics, a high quality microphone should be used.

A 50,000 ohm dynamic microphone or a crystal microphone, equipped with a switch, is recommended.



Band	L1	L2
3.5MHz	16×2	6
7MHz	14×2	4
14MHz	5×2	3
21MHz	3×2	2
28MHz	2×2	2

Coil diameter 40φ

Fig12 Antenna and Antenna Coupler

Figure 13 shows two types of switching arrangements ordinarily offered in microphones which are switch-equipped. In choosing your microphone, B type switching should be obtained as it will enable Push-to-talk operation of this transceiver.

The microphone cable should be connected, as shown in Figure 14, to the 4-prong Metal Connector, which is supplied as an accessory.

PRELIMINARY ADJUSTMENTS

1. POSITIONING THE CONTROLS

Connect the power supply, antenna (or dummy load) and the microphone, and set the controls as follows:

AF GAIN ....OFF

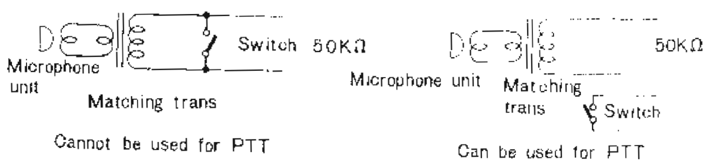


Fig13 Microphone with Switch

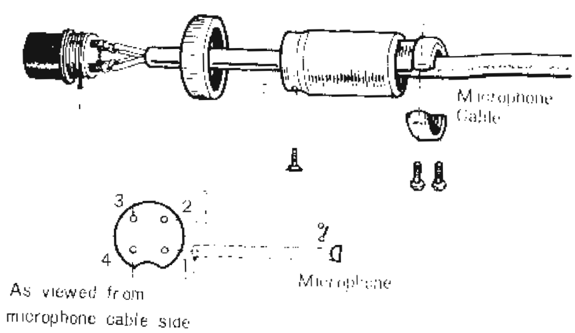


Fig14 Microphone Connections

RF GAIN ....maximum clockwise position

MODE ....SSB

METER ....Ip

SEND - REC ....REC

VOX - MAN ....MAN

MIC GAIN ....center

RIT ....to 0

BAND ....Desired band

DRIVE ....center

PLATE ....approximately as shown in Figure 15 depending on band.

LOAD COARSE .... "

LOAD FINE .... center

DIAL .... Within the desired amateur band (3.5 to 7 MHz range indicated by red. 14 to 29.7 MHz range indicated by black.)

Finally, check to see if the 6-prong miniature plug is firmly plugged in

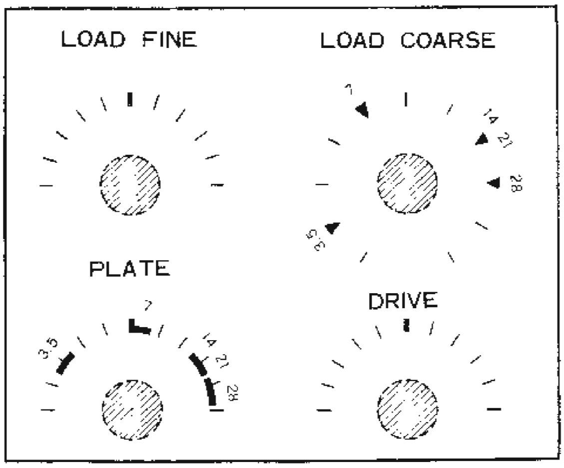


Fig15 PLATE and LOAD COARSE setting positions (with Load Impedance of 75 ohms)

to its connecting socket at the rear of the chassis. VFO will not operate if this plug is not in.

2. RECEIVING

Switch the AC power on by turning AF GAIN to the right. After the neon lamp of the power supply (PS-500 AC) and the pilot lamp of the TS-500 are lit, and the tubes have had a chance to warm up, a weak set noise will be heard from the speaker. If an antenna is connected, incoming signals will be received if the dial is slowly tuned for them. Now adjust DRIVE and PLATE for maximum sensitivity. With a screw driver, set S-METER ZERO ADJ, at the chassis rear to "0" position, under no incoming signal conditions.

3. TRANSMITTER

Remove the antenna and connect a dummy load. After allowing over 3 minutes warm-up from the time the power switch is turned ON, switch SEND-REC to SEND. This will cause a deflection of the meter. Now adjust BIAS at the chassis rear so that a 60 milliampere reading is obtained.

Switch MODE to CW. This will cause an increase in Ip, so quickly adjust PLATE for maximum dip in meter swing. Remember that when the key is plugged in, there will be no Ip flow, and no meter deflection unless the key is closed. Therefore, either keep the key pressed down, or remove the key connecting plug from the transceiver altogether.

Now set METER TO RF, and tune DRIVE for maximum meter deflection. Adjust LOAD COARSE and LOAD FINE for further meter deflection. Adjustment of the LOAD side will cause the PLATE adjustment to shift slightly, so LOAD and PLATE should be adjusted back and forth, alternately. In case the RF meter swings off scale, RF METER ADJ at the chassis rear should be adjusted for a smaller meter swing.

Finally, switch SEND-REC to REC. This completes all preliminary adjustments. It should be remembered that these adjustments should be made quickly. No more than a continuous 10 second interval should be taken, or there is danger of damaging the S2001 final amplifier tubes. In case the above adjustments cannot be completed within a 10 second period, switch the transceiver to the receiving mode and allow at least a 10 second rest interval before continuing the transmitter adjustment.

HOW TO OPERATE THE TRANSCEIVER

1. INPUT LEVEL

Maximum plate current (Ip) for CW operation should be kept at 200 milliamperes. Further increase of Ip will not result in any increase in RF power. For SSB transmission, MIC GAIN should be retarded so that Ip is about 100 mA, and at its peak, 150 mA.

For AM transmission, CAR LEVEL at the chassis rear should be adjusted so that Ip will be about one half of that for CW operation. Furthermore, MIC GAIN should be retarded to about one half of that for SSB transmission.

2. RIT

When RIT is set at "0" position on this transceiver, the transmitting and receiving frequencies will be identical. Therefore, transmissions can be made on the same frequency as the received signal, and there is no need of calibration.

RIT is used when it is desired to have a slight separation between the receiving and sending frequencies. The RIT, circuit makes it possible to shift the incoming signal frequency within a range of 3 kHz, up or down. It shifts the received signal only, without affecting the transmitter frequency. For example, a drift of an incoming signal can be followed by adjusting RIT, which will mean that only the receiving frequency has been shifted, and the transmitting frequency remains stationary.

If the transmitting and receiving frequencies happen to become separated with RIT set at "O", it can be realigned easily by following the instructions outlined under the section "Alignment and Maintenance."

3. VOX

Voice-controlled automatic switching of transmitting and receiving modes is possible with this transceiver when SEND - REC is switched to REC, and VOX - MAN is switched to VOX. VOX GAIN control on the chassis topside should be retarded in case the surrounding noise level near the microphone is high.

Changes in supply voltages may sometimes cause, sluggish relay action. In such a case, circuit readjustment can be made as outlined under "Alignment and Maintenance."

A built-in Anti-trip circuit is incorporated to prevent speaker response from tripping the relay, and switching the transceiver from receiving to transmitting mode. The ANTI-TRIP control located on the chassis topside should be adjusted so that this will not occur. It is not desirable, however, to advance it too far, for this will result in insufficient VOX sensitivity. Therefore, the microphone and speaker should be located away from each other, and the speaker volume level should be kept low.

Use of a uni-directional microphone will make VOX operation even more effective.

4. DIAL CALIBRATION

Set the dial indicator to "O".

Now press the dial knob flange lightly and slip the flange indicator also around to "0", while the knob itself is held stationary. Since one revolution of the knob covers a range of 50 kHz, each division on the flange provides a reading of 1 kHz.

When dial calibration is made with a 500 kHz crystal, a beat response will be obtained at 0 kHz and 500 kHz. Set the flange indication to zero when these beats are obtained.

5. CALIBRATOR CRYSTALS

A calibrating crystal is not supplied with this transceiver. It must be separately purchased and the following type is recommended.

Type HC-6 u

Frequency- 500 kHz or 1 MHz.

Frequency Tolerance accuracy within ± 0.003%.

The calibrator circuit used in this transceiver is shown in Figure 16.

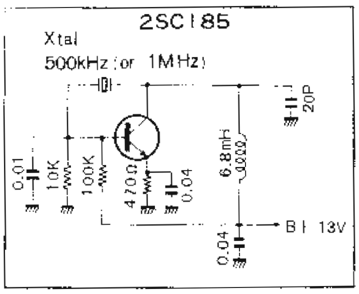


Fig16 Xtal controlled Calibrator Circuit

6. REGARDING A REMOTE VFO

A remote VFO unit, Model VFO-5, is available for those who wish to send and receive on different frequencies. Besides enabling crystal controlled operation, the VFO-5 will enhance the versatility of the TS-500 transceiver.

The VFO-5 can be connected easily to this transceiver. All that is necessary is to remove the 6-prong connector at VFO OUT, located on the rear chassis, and/plug in the connecting cord supplied with the VFO-5.

7. CONCERNING RIT DURING CW OPERATION

Because of transceiver characteristics, the CW carrier frequency will be identical with the BFO frequency. Therefore, no beat will be heard when

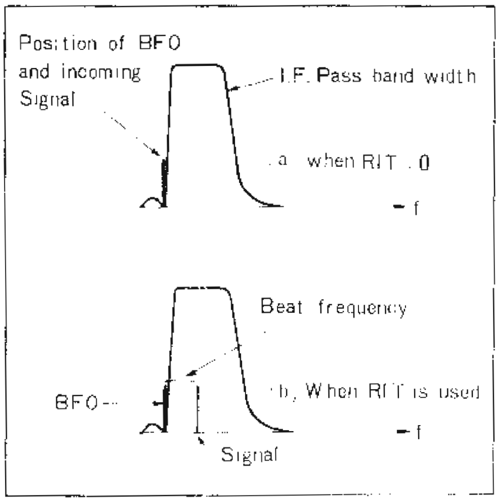


Fig17

its top performance capabilities.

Normal operating voltages of this transceiver are shown in Table 3.

A large number of expensive test equipment is required to do a perfect alignment job. However since there is a limit to test equipment available to individuals, only the alignment methods which can be done with ordinary testing equipment will be explained here. (a), (b), (c), in the following text refers to their respective locations shown in Figure 18.)

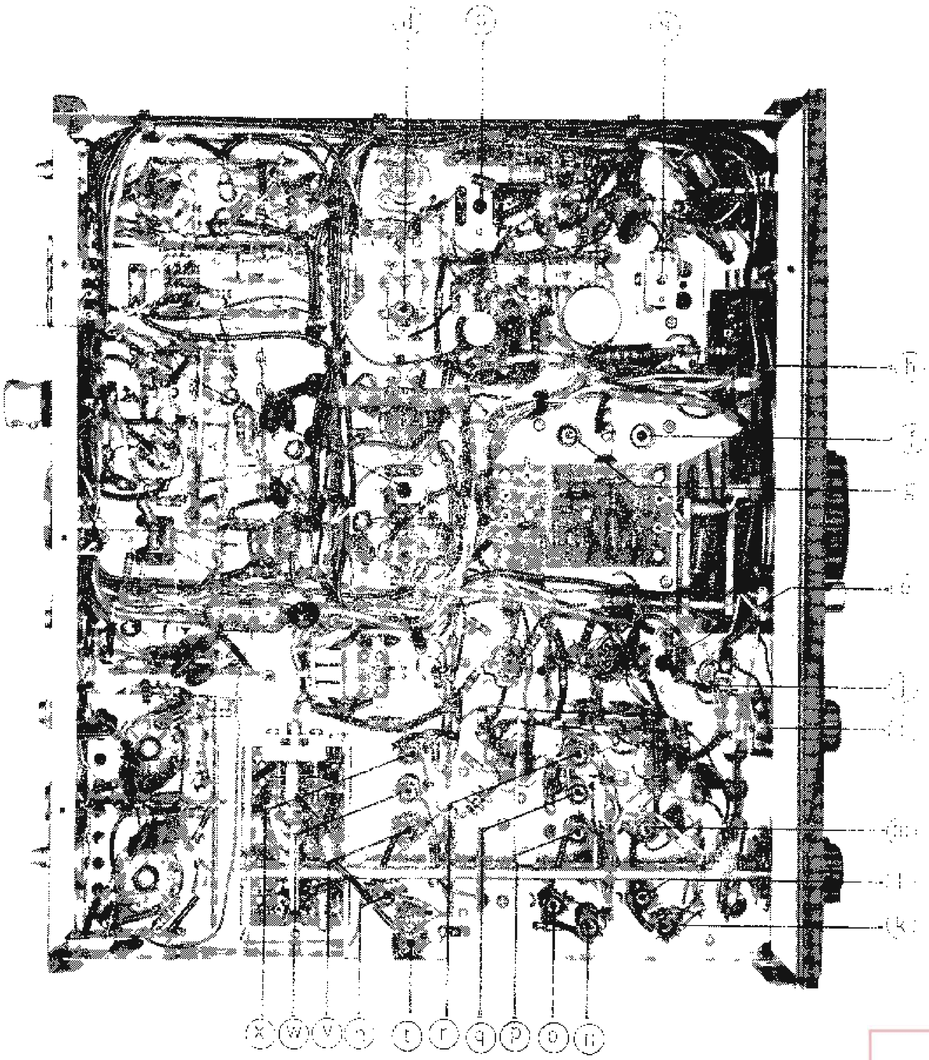


Fig18 Alignment points

RECEIVER PORTION

1. IF CIRCUIT

With the transceiver in receiving mode, tune in a stable signal. (Marker, Signal Generator or Dip Meter outputs.) Adjust IFT (a) and (b) slightly for maximum deflection of the S meter. (c) and (d) should be left untouched, as adjustment will affect the special characteristics of the filter. They can be adjusted, however, with an accurate Sweep Generator and Oscilloscope.

Now receive a stable signal at the dial reading of 400 (black). IFT (e) is double tuned, so it requires two alignments, from the topside and bottomside of the chassis.

2. VFO

A Frequency Counter is required to ascertain accurately the frequency of the VFO. However, since one is expensive, a marker may be used.

Place a 500 kHz crystal in the calibrator circuit, and switch the circuit to ON. Adjust (f) and (g) of the VFO Oscillator coil so that the crystal calibrator output can be heard at 0 and 500 kHz dial readings.

3. RIT

A Frequency Meter is required to align RIT accurately. However, a fairly accurate alignment can be made with a tester as follows, as the RIT circuit utilizes a change in voltage to vary the capacitance of a variable capacitance element.

Set the RIT knob on the front panel accurately to "0". Now with a Voltmeter set at its smallest range, place its (-) probe at junction (h) of the 2.2 kohm resistor and zenner diode, and the (+) probe to terminal (i) of the RIT VR.

If the voltmeter should swing either up or down, adjust the Voltage Controlling VR (j) so that the voltmeter needle moves accurately back to 0. This adjustment will ensure that when the RIT is set at 0, the receiving and transmitting frequencies will be identical.

4. CRYSTAL OSCILLATOR CIRCUIT

Normally this circuit requires no alignment, but a slight adjustment of the Oscillator Coil core will become necessary when the crystal is changed. Crystal oscillation is activated by coil (k) for the 3.5, 7, and 21 MHz bands, by (l) for the 14 MHz band, and by (m) for the 28, 28.5, and 29.1 MHz bands. To adjust these cores, turn them downwards toward the chassis side. This should result in increasing oscillation strength, until a point is reached where oscillation ceases. Back up the core by one-half turn from this point.

5. RF CIRCUIT

The 3.5 MHz coil (n), 7 MHz coil (o), 14 MHz coil (p), 21 MHz coil (q), and the 28, 28.5, 29.1 MHz coil (r) are aligned in the RF circuit. Alignment is made by adjusting their respective cores for maximum deflection of the S meter, while tuned to a stable signal within these respective bands. The correct position of the DRIVE knob when making these adjustments, is shown in Figure 19.

6. S METER

With RF GAIN set at maximum, MODE at AM position, and the antenna removed, the S METER is adjusted to "0" indication. Since a diode used in the S meter circuit prevents reverse current flow, a forward deflection should be made prior to making the "0" setting adjustments.

7. CARRIER FREQUENCY

Carrier frequency alignment is important in order to obtain crisp, quality SSB reception. To make an accurate alignment, a carrier frequency should be chosen that will enable demodulation of audio signals between 300 and 3,000 Hz within a -6 dB range. When testing equipment is unavailable, actually tune in a SSB signal, and adjust the dial for maximum deflection of the S Meter. Now insert a beat at this point, and adjust the Variable Frequency Trimmer (s) so that a perfect response is obtained.

TRANSMITTER PORTION

1. DRIVER COIL

With the DRIVE knob positioned as shown in Figure 19, adjust the respective driver coils (t) for 3.5 MHz, (u) for 7 MHz, (v) for 14 MHz, (w) for 21 MHz and (x) for 28.0, 28.5, 29.1 MHz for maximum Ip indication.

2. 28.0 MHz TRAP

This trap is designed to eliminate the spurious interference arising from the 28.0 MHz band local oscillator's (19.5 MHz) second harmonic and the 2nd I.F. frequency. If the transmitter frequency is set at 28.5 MHz the spurious interference will appear at 29.950 MHz,

(oscillator) (2nd I.F.)
19.150 x 2 - 9.350

(Spurious Interference)
= 28.950 MHz

Therefore a Field Strength Meter (Receiver with S Meter also usable) that has a range of 28.950 MHz becomes necessary. If a CW 28.5 MHz signal is radiated on the 28.5 MHz band with the TS-500, the Field Strength Meter will show the spurious interference signal at 28.950 MHz. Now adjust the core of the trap (coil winding of (m) closes to the chassis) from the topside of the Chassis with an alignment screwdriver for minimum meter reading. Next, adjust the oscillator core of (m) (viewable from chassis bottomside) for further minimum deflection.

Spurious interference suppression of over 50 dB can be obtained if the above trap adjustment procedure is repeated.

The trap should now be tuned to 38.3 MHz. The trap core resonance frequency furthest from the oscillator coil should be chosen.

3. BIAS

The bias voltage for the transmitter's final power amplifier tubes S2001 is about -55V, and total plate current for the two tubes under this condition should be 60 mA. Therefore adjust the bias so that with no signal in the SSB mode, a total plate current of 60 mA is obtained.

ACCESSORY CIRCUIT

1. RELAY ADJ

With the transceiver in receiving mode, turn RELAY ADJ VR in a

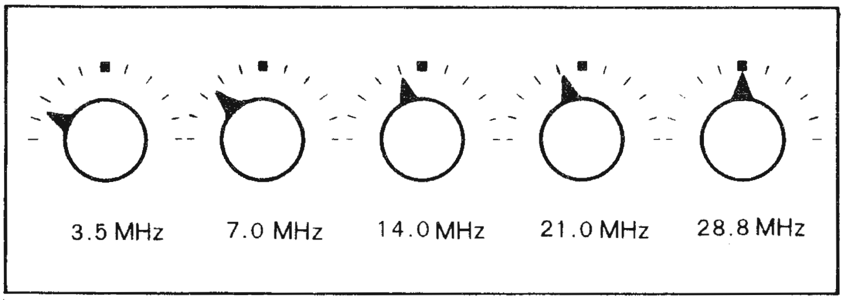


Fig19 Drive Stage Controls

counterclockwise direction until the relay is activated. From this point, back up the adjustment by 1/4 turn and restore the relay action so that the transceiver is again in receiving mode. This will complete the relay adjustment.

MAINTENANCE

1. REMOVING THE CHASSIS ENCLOSURE

Remove the two flat-head bolts from the top of the enclosure, the four decorative bolts from its sides, and the five locking bolts from the bottom. The chassis can now be pulled out toward the front.

The Hyzex legs need not be removed, as they are not connected to the chassis.

2. VACUUM TUBES

Be sure that the final power amplifier of the transmitter is always kept well tuned during operation. If the power amplifier S2001 tubes are operated under untuned conditions, they may be subject to damage.

Always remember to switch off the AC power and pull the AC power cord out before attempting to remove the transceiver case. This precaution should be taken because of the high plate voltage used in the transmitter's final stage.

3. GEAR

Make it a point to lubricate the dial gear about about once a year with fine machine oil. This will ensure smooth friction-free operation.

4. PILOT LAMP

Two pilot lamps are used in this transceiver. Should it become necessary to replace them, use 16V swan-base type lamps.

5. RESISTORS

If and when it becomes necessary to replace a defective resistor, replacements can be made with one which has a value within ± 10% of the original. For example, a 300 ohm resistor may be used to replace one of 330 ohms.

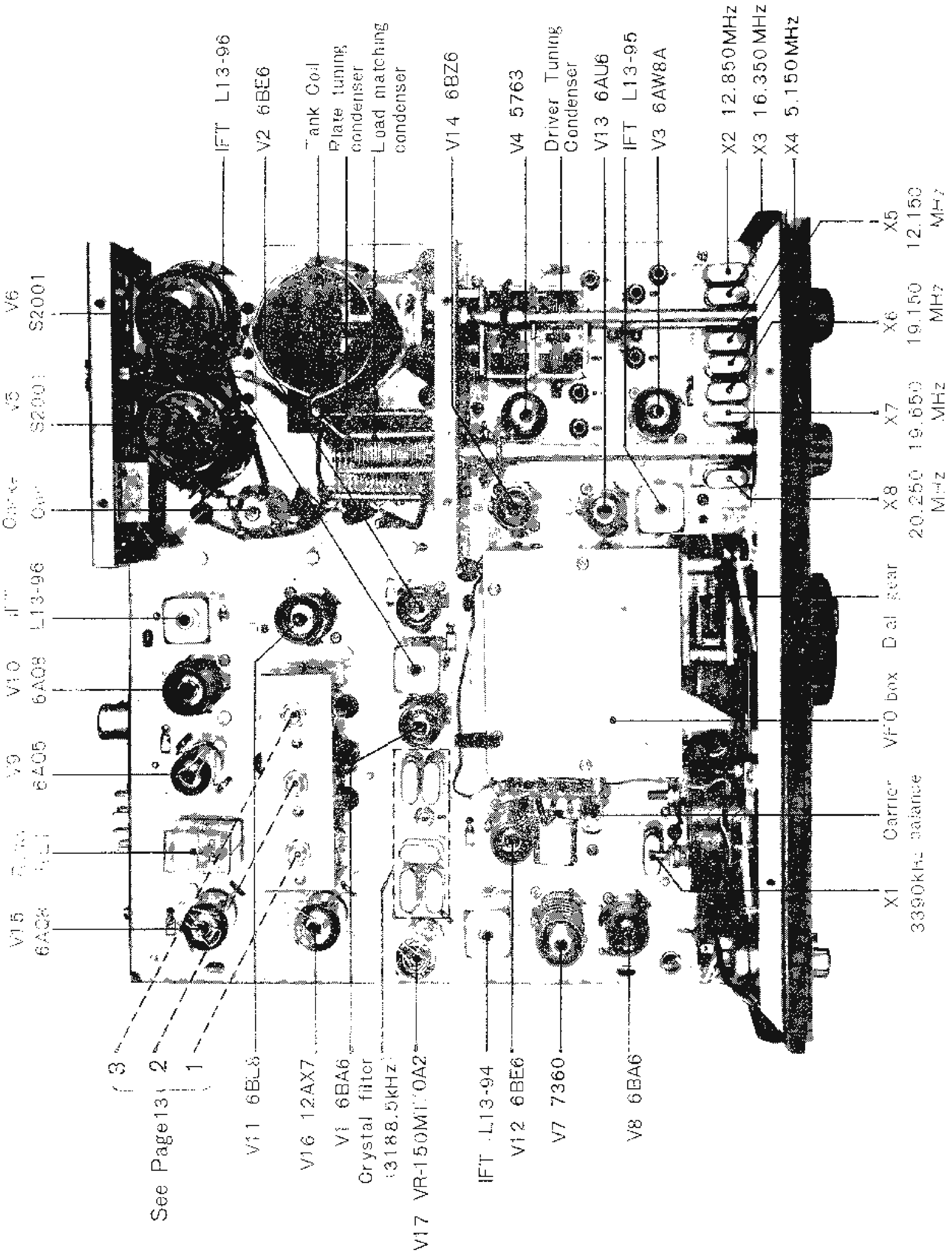


Photo3 Chassis Top view

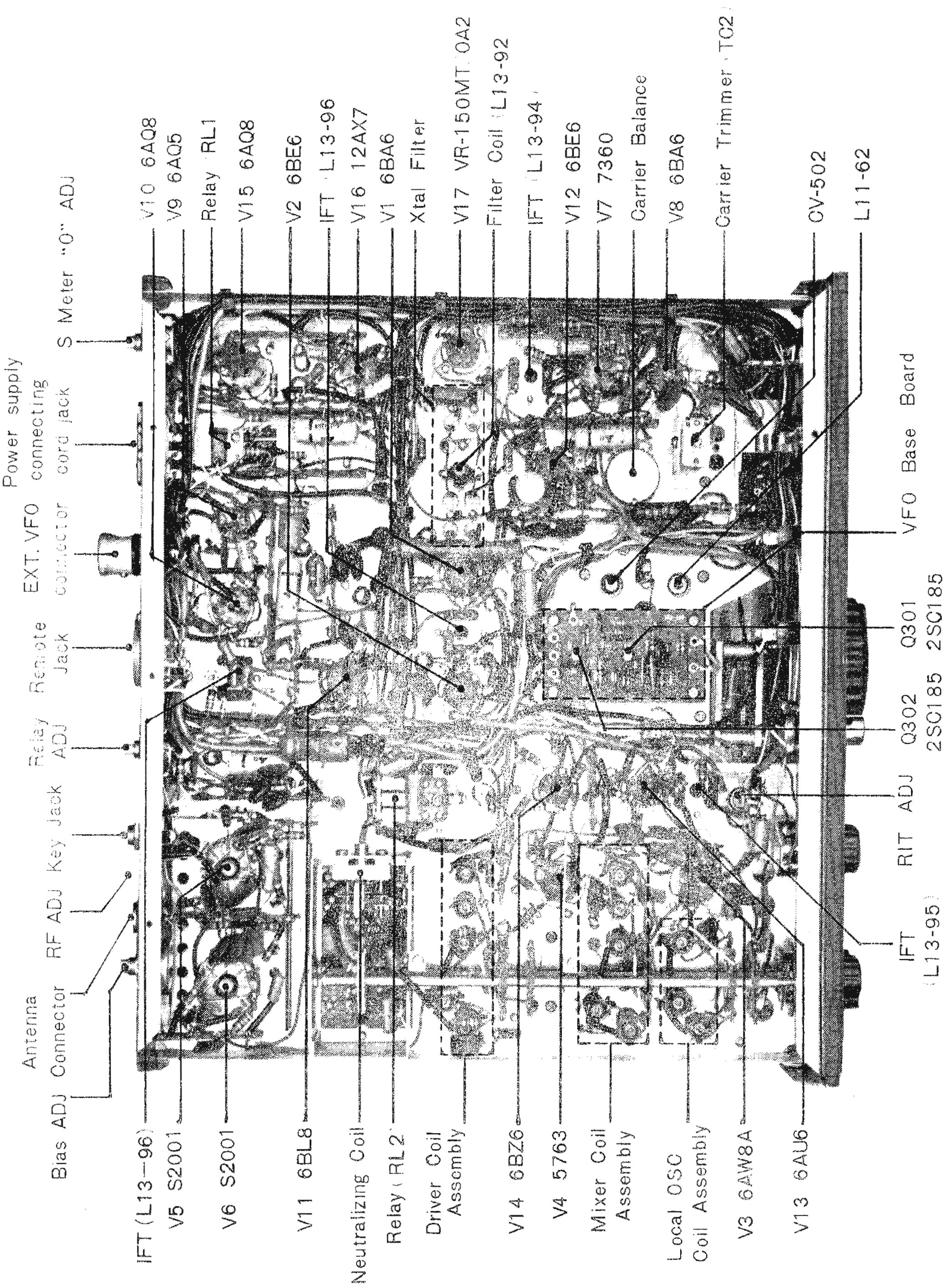
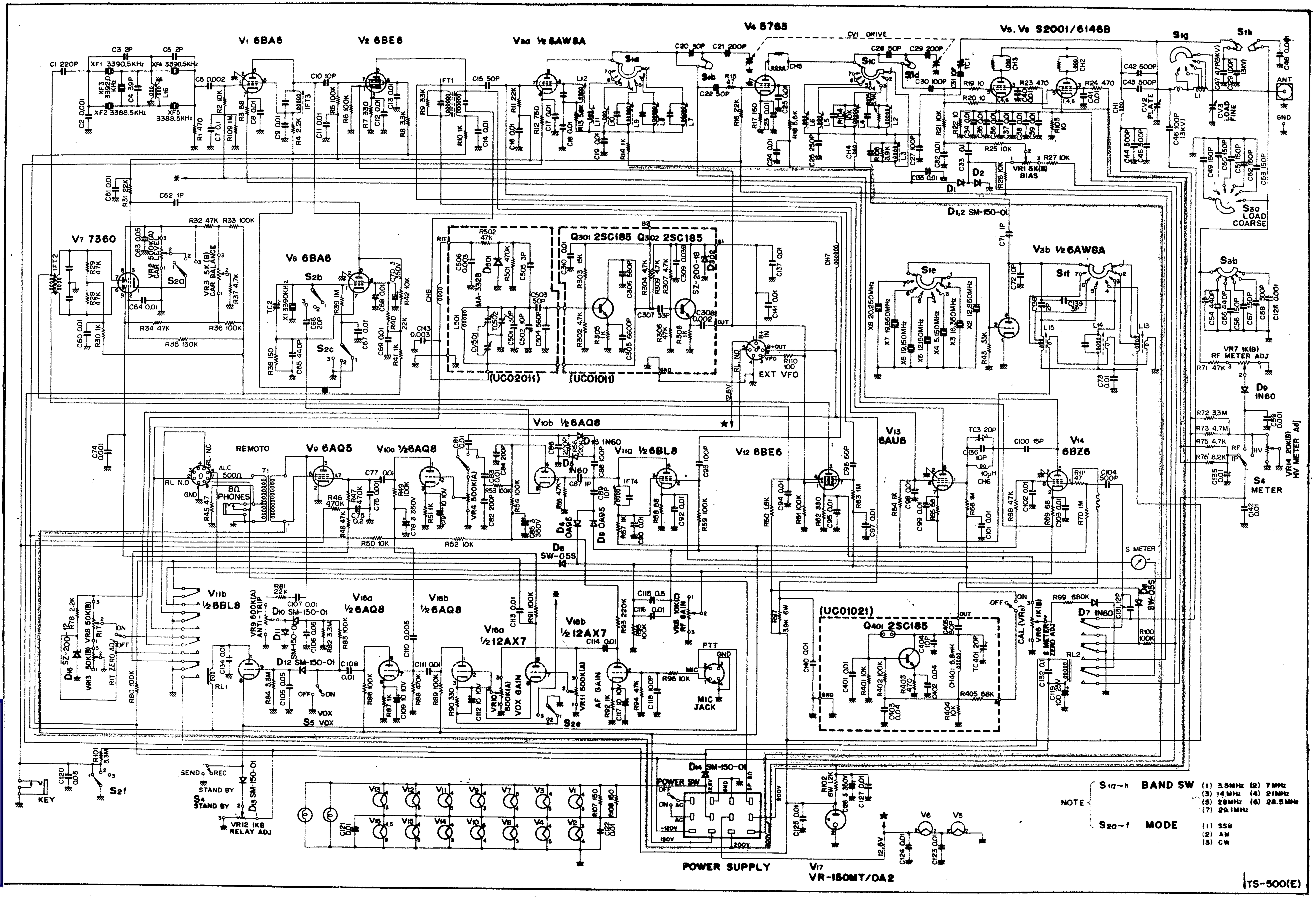


Photo 4 Chassis Bottom view

TS-500 SPECIFICATIONS

FREQUENCY	80m Band 3.5-3.575 MHz 40m Band 7.0-7.1 MHz 20m Band 14.0-14.35 MHz 15m Band 21.0-21.45 MHz 10mA Band 28.0-28.5 MHz 10mB Band 28.5-29.1 MHz 10mC Band 29.1-29.7 MHz
COMMUNICATION METHOD	SSB (A3j) AM (A 3H) CW (A1)
MAXIMUM INPUT POWER (Xmitter final stage)	200W (PEP)
STANDARD INPUT POWER(Xmitter final stage)	180W (PEP) 120W on 28 MHz band only
ANT INPUT IMPEDANCE	50-75 ohm
CARRIER SUPPRESSION RATIO	More than 40 dB
SINGLE SIDE BAND RATIO	More than 40 dB
MIC. INPUT IMPEDANCE	High impedance (dynamic or crystal microphones recommended)
XMITTER AUDIO FREQUENCY CHARACTERISTICS	300-3,000 Hz (-6 dB)
RECEIVER SENSITIVITY	1μV S/N 10 dB (14 MHz)
RECEIVER SELECTIVITY	2.7 kHz (-6 dB) 5.0 kHz (-55 dB)
SPURIOUS REJECTION RATIO	More than 45 dB
IMAGE RATIO	More than 60 dB
UNDISTORTED POWER OUTPUT	More than 1W
RECEIVER OUTPUT IMPEDANCE	SP 8500 ohm PHONE 8 ohm
POWER CONSUMPTION (using PS-500AC)	450W (At maximum power output) 250W (Receiving mode)
TUBES AND TRANSISTORS USED	17 TUBES 3 TRANSISTORS 15 DIODES
DIMENSIONS	W: 330 H:220 D:300 (mm)
WEIGHT	17.6 Lbs

SCHEMATIC DIAGRAM



SCHEMATIC DIAGRAM

POWER SUPPLY

PS-500AC(E)