KENWOOD

ALL BAND

SSB TRANSCEIVER

Model TS-515

OPERATING MANUAL

CONTENTS

SPECIFICATIONS

FREQUENCY RANGE	80 meter band	3.5 ~ 4.0 MHz
	40 meter band	7.0 ~ 7.3 MHz
	20 meter band	14.0 ~ 14.35 MHz
	15 meter band	21.0 ~ 21.45 MHz
	10 meter band	A 28.0 ~ 28.5 MHz
		B 28.5 ~ 29.1 MHz
		C 29.1 ~ 29.7 MHz
MODE	SSB (A3j)	
	CW (A1)	
INPUT POWER TO FINAL STAGE	3.5 ~ 21 MHz	180 W
	28 MHz	120 W
	(When used with the PS-515 power supply)	
ANTENNA IMPEDANCE	50 ~ 75Ω	
CARRIER SUPPRESSION	Better than 40 dB	
SIDEBAND SUPPRESSION	Better than 40 dB	
MICROPHONE IMPEDANCE	High impedance type (50 kΩ)	
TRANSMIT AUDIO FREQUENCY BANDWIDTH	400 ~ 2600 Hz (–6 dB)	
HARMONIC RADIATION	Better than 40 dB	
SENSITIVITY	3.5 ~ 21 MHz band:	0.5μV S/N 10 dB
	28 MHz band:	1.5μV S/N 10 dB
IMAGE RATIO	More than 50 dB	
IF INTERFERENCE	More than 50 dB	

FREQUENCY STABILITY	Within ±2 kHz from one minute after switching on the set to 60 minutes and later with 100 Hz per 30 minutes.	
SELECTIVITY	SSB and CW: More than ±1.2 kHz at –6dB and less than ±2.4 kHz at –60dB.	
AF OUTPUT	More than 1W (10% distortion)	
RECEIVER OUTPUT IMPEDANCE	8Ω for both speaker and headphone	
POWER CONSUMPTION	At maximum transmission	350 W
	At maximum reception	120 W
	(When used with the PS-515 power supply)	
VACUUM TUBES AND TRANSISTORS	Vacuum tubes	10
	FET	4
	Transistors	33
	Diodes	51
DIMENSIONS	13" wide, 7-9/32" high, 13-5/8" deep	
WEIGHT	22 lbs.	

FEATURES

All band coverage

The TS-515 transceiver operates in SSB (USB and LSB) and CW on any amateur band of from 3.5 to 29.7 MHz.

Two representative transmitting tubes (S2001) are employed in the final stage for a maximum DC input of 180 W.

High stability VFO

The extreme stable VFO built around 2 FET's, 2 transistors and 3 diodes is employed. The combined precision double-gear and frequency-linear tuning capacitor permit direct reading of 1 kHz over a revolution range of 25 kHz.

Abundant accessory circuits

Abundant accessory circuits include VOX, PTT, amplifier type AGC, ALC, RIT, AVR, switchable CAL circuit, ALC-Ip-RF-HV meter switching, AGC time constant switching, and external VFO terminals.

Hybrid type

Since the TS-515 is a hybrid type using 10 vacuum tubes and 88 semiconductors, reliability has been increased on full magnitude and service life extended considerably.

Selectivity switching

The SSB and CW crystal filters are switched by a diode switch. The optional CW filter can readily be added with simple modification, whereas the SSB filter is supplied with the transceiver.

Amplifier type AGC, ALC

Higher performance amplifier type AGC circuit quickly responds to even the strongest input signal. SLOW and FAST selector switch permits selection of the optimum time constant in accordance with the mode of input signals.

Amplifier type ALC provides excellent rise characteristics and compression effect.

High sensitivity S meter

The built-in S meter provides proper indication of even the weakest signal without regard to the setting of the RF GAIN knob.

Built-in marker

Dial can be accurately calibrated for each revolution of the main tuning dial by means of a 25 kHz marker derived from a 100 kHz crystal. The marker can also be used as a frequency measuring device when making QRO.

Sinde tone

Built-in CW use side tone oscillator permits accurate operation while monitoring your own keying.

RIT

RIT circuit permits small changes in the receive frequency independent of the transmit frequency and is extremely useful for fine tuning during reception.

Cooling fan

Forced air cooling system employing a 6-vane fan extends the life of the final stage tubes and increases operating stability.

Newest wiring system

Wire wrapping wiring system increases reliability on full order of magnitude.

High level operation

"Cross" operation possible through the use of the remote VFO (VFO-5S).

The cross operation is an extremely high level operation in which the single transceiver offers a dual effect that would be obtained from two sets.

Special power supply

The PS-515 power supply with built-in speaker is available for use with the TS-515.

SECTION 1. CONTROLS

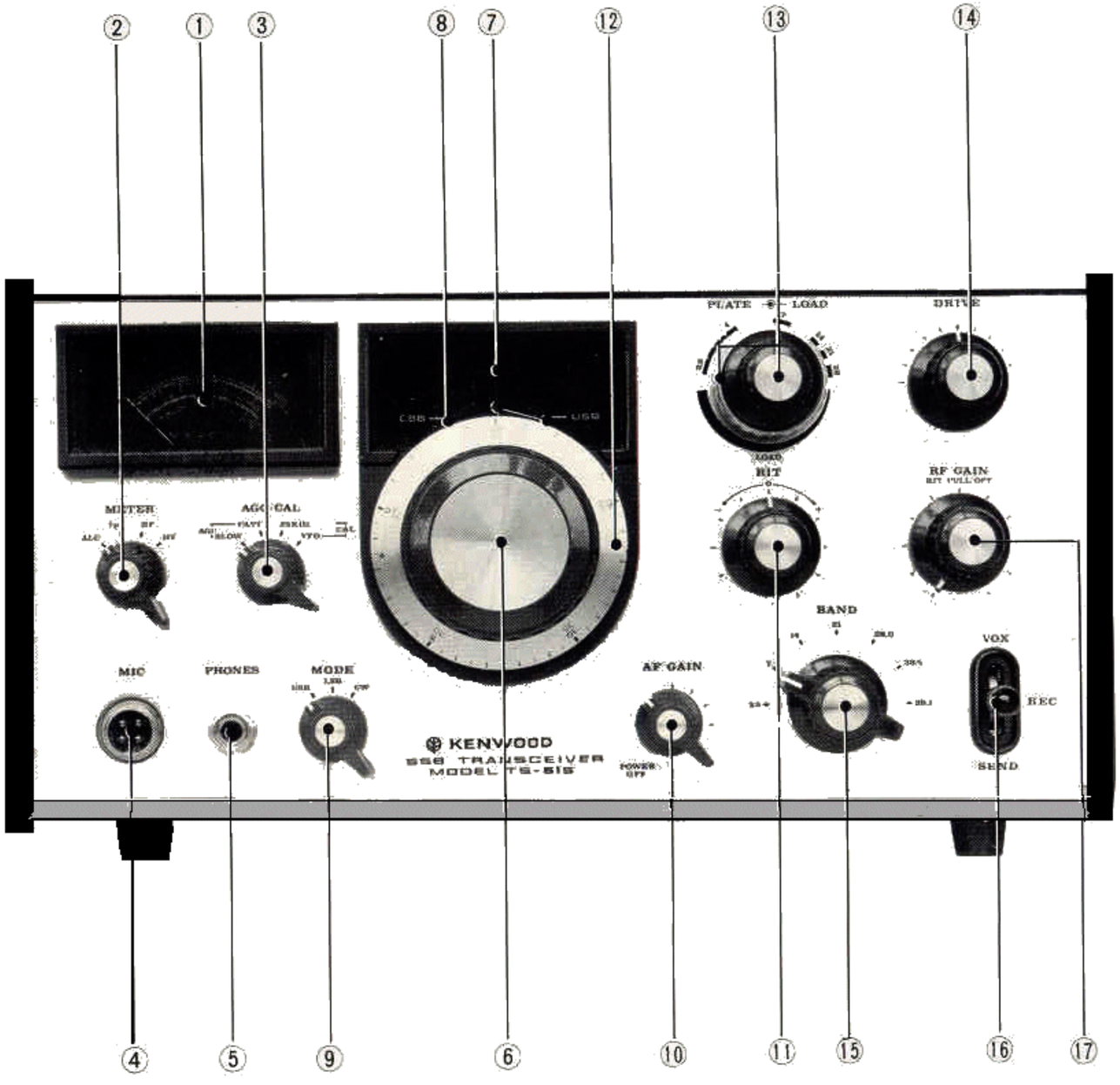


Fig. 1 Front Panel Controls

1-1 FRONT PANEL

① Meter

Operates as an S meter during reception and indicates ALC, Ip, RF or HV during transmission.

② METER Switch

Switches meter reading between ALC, Ip, RF and HV during transmission.

③ AGC/CAL Switch (AGC time constant and calibrator switch)

AGC: SLOW (long time constant) or FAST (short time constant) AGC can be selected in accordance with QSO condition.

CAL: The 25 kHz position is used for frequency calibration of the tuning dial with the 25 kHz marker, and VFO position to calibrate the remote VFO with the transceiver.

④ MIC Connector (Microphone connector)

4 pin connector for a high impedance microphone. PTT operation is possible when a microphone equipped with a switch is used.

⑤ PHONES Jack

The speaker is disabled when low impedance (8Ω) headphones are connected to this jack.

⑥ Main Tuning Dial Knob

Operates the main tuning dial.

⑦ Auxiliary Dial Plate

Used together with the main dial for fine frequency reading over 0 to 600 kHz range.

⑧ Dial Gauge

Reference lines for reading USB, LSB and CW frequency.

⑨ MODE Switch

Used to change the mode of emission. USB, LSB or CW can be selected.

⑩ POWER/AF GAIN (Combined power switch and AF gain control)

At the POWER OFF position, all power to the transceiver is turned off. Power is turned on by turning the knob clockwise. It also controls sound volume.

⑪ RIT Control (Receiver Incremental Tuning Control)

Permits changing the receive frequency ±2 kHz during reception independent of transmit frequency.

⑫ Main Tuning Dial

Each graduation of the main tuning dial represents 500 Hz. One complete revolution of the dial covers 25 kHz.

⑬ PLATE/LOAD Control (Plate tuning and load adjustment control)

This is a dual knob. The center knob is for tuning the plate of the final power tubes and the outer knob for adjusting the load. These knobs together adjust the output circuit variable tuning capacitors.

⑭ DRIVE control (Drive stage/RF stage tuning)

RF tuning during reception and driver stage tuning during transmission.

⑮ BAND switch

3.5 through 29.7 MHz frequency selector switch.

⑯ REC/SEND/VOX Switch (Stand-by switch)

When set to REC, the transceiver is set to the receive state and when set to SEND, the transceiver is set to the transmit state. At VOX, transmission is effected in accordance with the voice entering the microphone.

⑰ RF GAIN/RIT PULL OFF (Combined RF gain adjustment and RIT on-off switch)

When turned clockwise, RF gain increases. RIT is disabled when the knob is pulled out (receive and transmit frequencies are then identical).

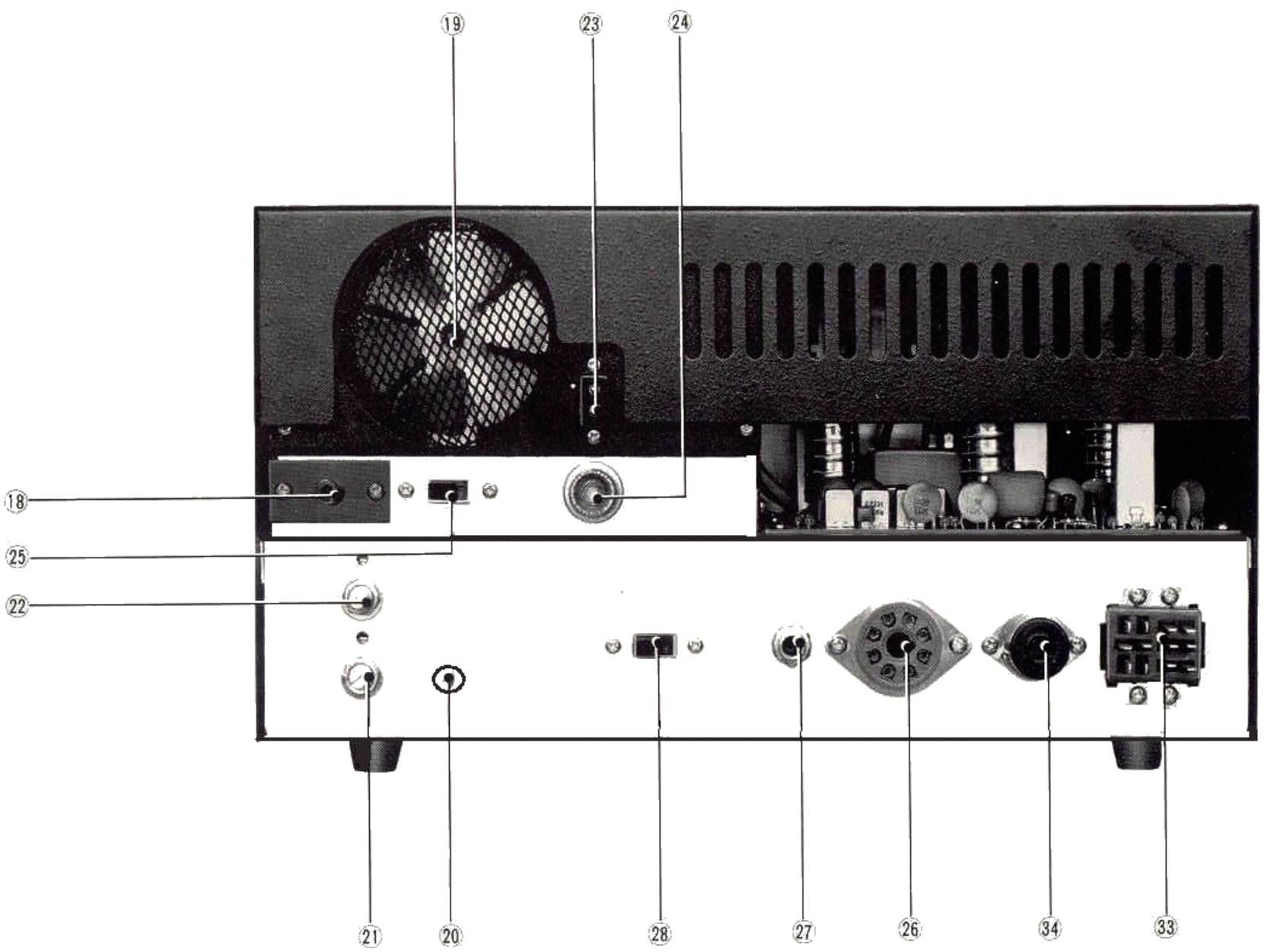


Fig. 2 Rear Panel Controls

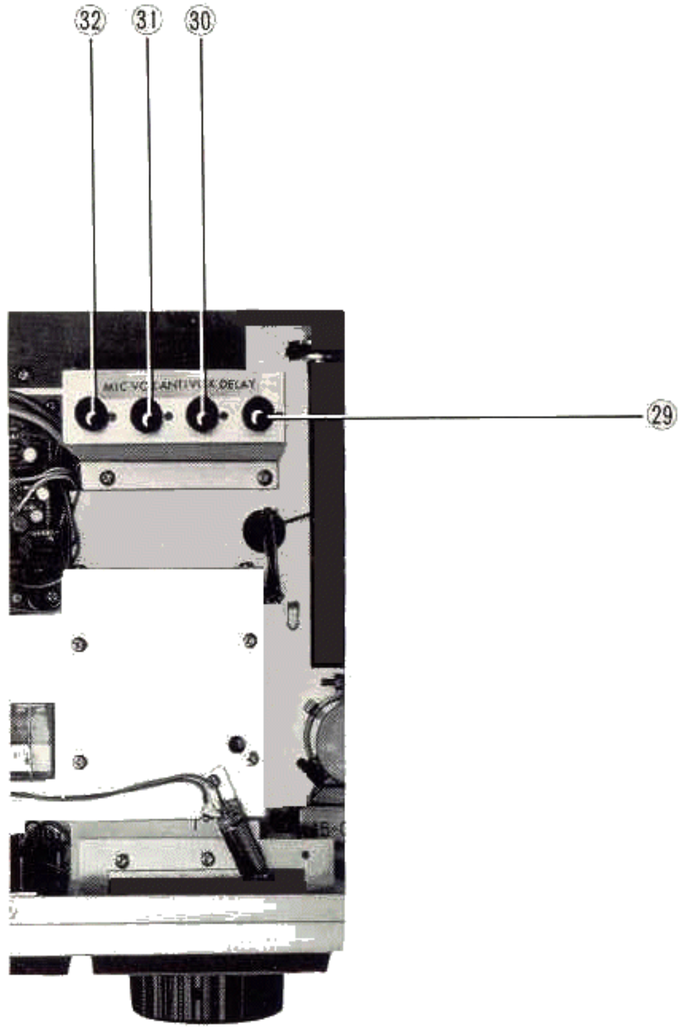


Fig. 3 Internal Control

(29) **DELAY Control**

(30) **ANTI VOX Control**

(31) **VOX Sensitivity Control**

(32) **MIC Gain Control**

(33) **POWER Supply Connector**

Connect to the PS-515 power supply with the special cable.

(34) **VFO OUT outlet**

Used when the VFO-5S is used. Normally insert the accessory shorting plug.

1-2 REAR PANEL

⑱ REC ANT Terminal

This terminal is used when the receive and transmit antennas are separate

⑲ Cooling Fan

6-vane forced air cooling system.

⑳ GND Terminal (Ground terminal)

Always connect this terminal to a good ground to prevent TVI and BCI. This should also be used when an external VFO is connected to the transceiver.

㉑ RF VOLT Control

Adjust the sensitivity of the RF output meter.

㉒ BIAS Control

Controls the bias voltage of the final stage S2001 tubes. Plate current increases when this control is turned clockwise.

㉓ Fan Motor Connector

Connect the PS-515 with the accessory cable.

㉔ Antenna Connector

Connect to a 50 to 75 Ω unbalanced type antenna.

㉕ REC/COM ANT Switch

Set this switch to COM when a common antenna is used for both transmission and reception and to REC when separate antennas are used for transmission and reception.

㉖ REMOTE Connector

Audio frequency output and relay circuit. Permits remotely controlling other devices.

㉗ KEY jack

Telegraph key jack for CW transmission.

㉘ SG SW Switch (Screen grid on-off switch)

S2001 screen grid switch. Set to OFF to remove the screen grid voltage from the final stage tubes when tuning and neutralizing the other stages.

SECTION 2. PREPARATIONS

2-1 ACCESSORIES

The following accessories are supplied with this transceiver. Please check to see that all are provided.

Test rod	1
Microphone plug	1 set
US plug	1
Supplementary legs	2
Fan cable	1

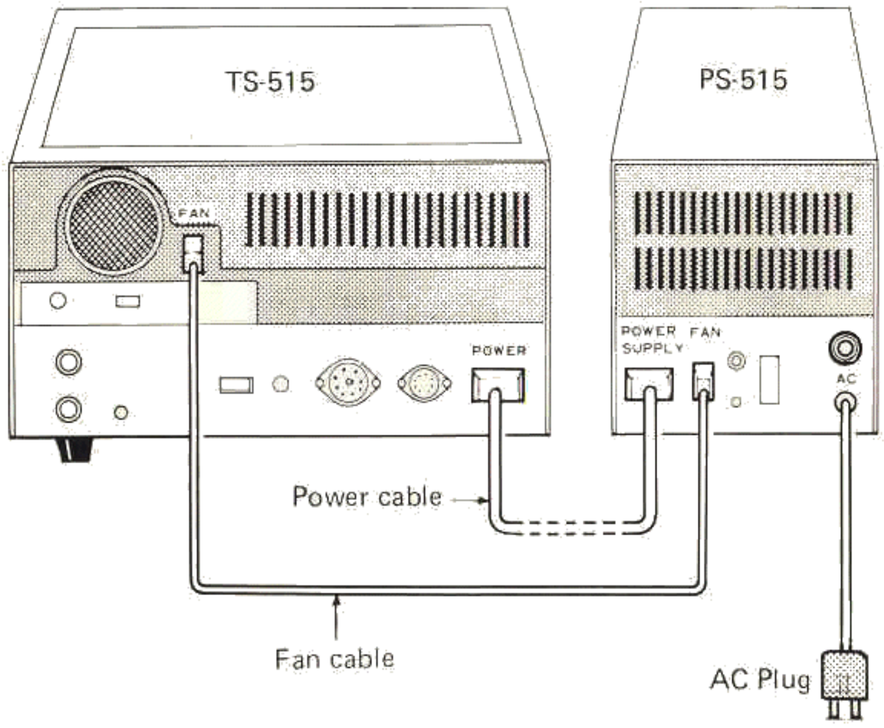


Fig. 4 Power Supply Connections

2-2 CONNECTION TO PS-515 POWER SUPPLY

The Model TS-515 is not equipped with a built-in power supply and must therefore be used with the Model PS-515 power supply specially designed for use with the TS-515 transceiver.

Connect the PS-515 with the power cable and fan cable as shown in Fig. 4. The power cable is supplied with the PS-515.

CAUTIONS: Prior to starting operation, check the fan cable connection and settings of the AF knob and stand-by switch against Fig. 5, and then insert the AC plug into the receptacle. If this is not done, the transceiver may be damaged when power is applied. The fan motor is rated 117 V operation.

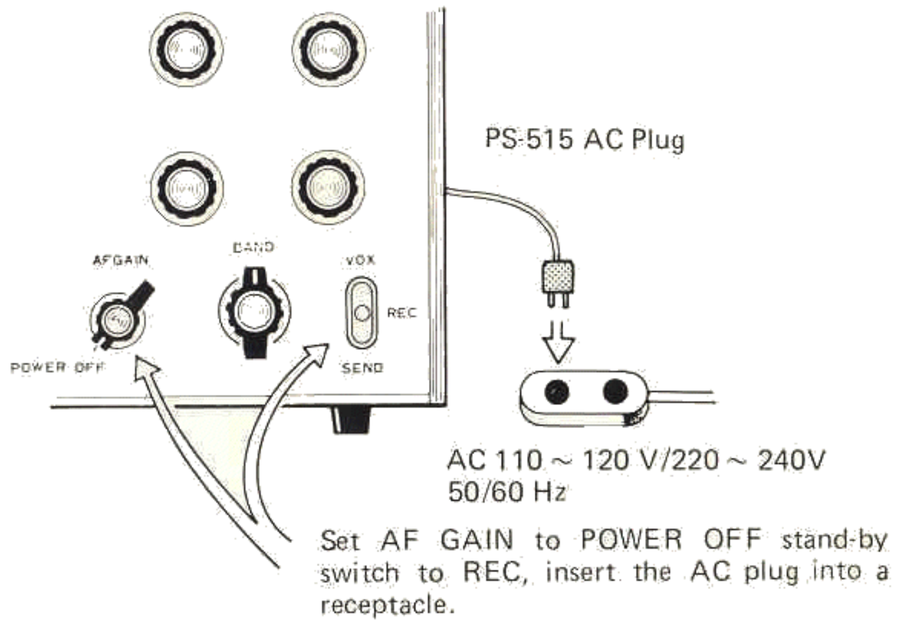


Fig. 5 Initial Switch Settings

2-3 ANTENNA CONNECTIONS

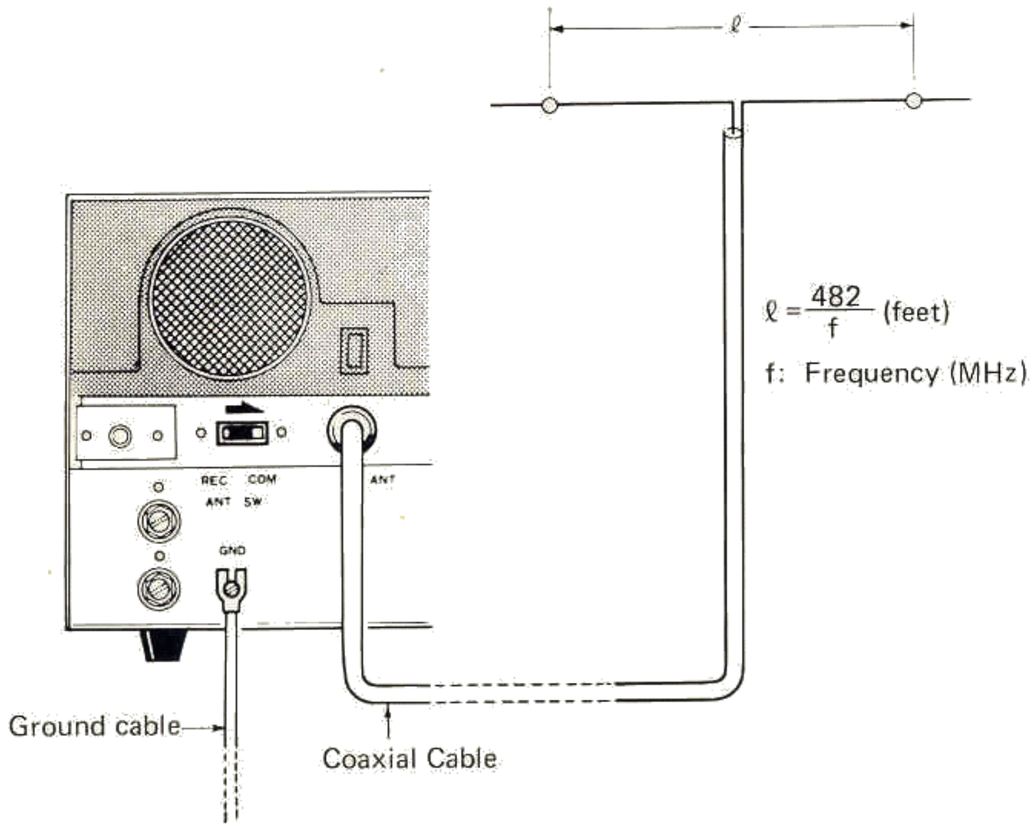
The use of a high performance antenna is essential for efficient QSO. Select a half-wave dipole antenna, vertical antenna, Yagi antenna, cubicle quad antenna, or other type of antenna depending on the surrounding conditions and connect it to the ANT connector as shown in Fig. 6.

2-4 MICROPHONE

Since sound quality is governed by the type and characteristics of the microphone, a high-quality microphone should be used.

A 50 kΩ dynamic microphone or crystal microphone equipped with a switch is recommended. Fig. 7 illustrates the two types of switching arrangements ordinarily offered in microphones. Type B switching is suitable for PTT operation since in this configuration the switching circuit is independent of the microphone circuit while in Type A the microphone circuit is merely shorted.

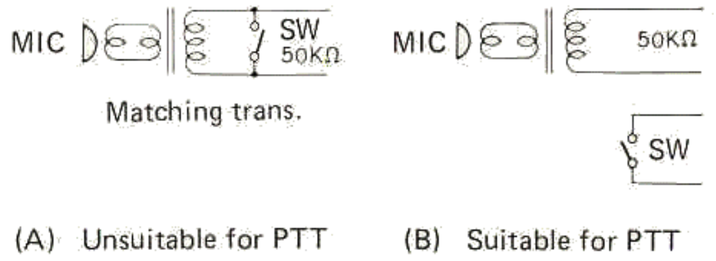
The microphone should be connected as shown in Fig. 8 using the accessory plug.



$$\ell = \frac{482}{f} \text{ (feet)}$$

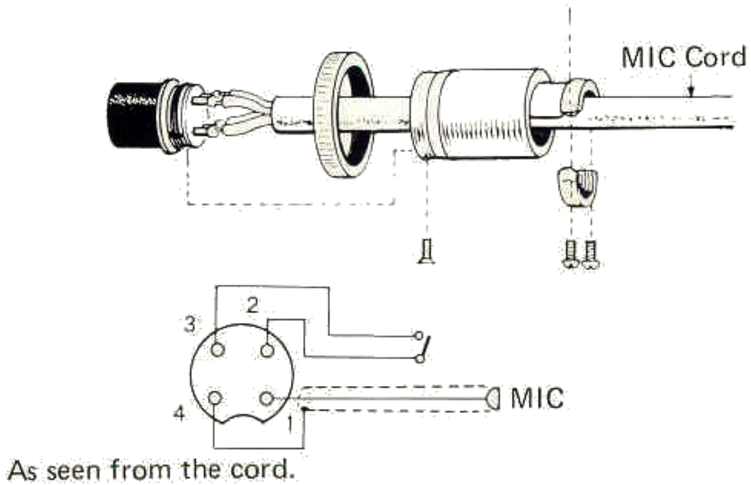
f: Frequency (MHz)

Fig. 6 Antenna Connections



(A) Unsuitable for PTT (B) Suitable for PTT

Fig. 7 Microphone with Switch



As seen from the cord.

Fig. 8 Microphone Cord Connections

SECTION 3. OPERATION

3-1 RECEPTION

After the antenna, power supply, and other connections have been made, perform the reception operation in the following manner. In SSB, 3.5 MHz and 7 MHz transmissions are customarily performed on LSB, and 14 MHz and above on USB.

Knob Settings

Perform the following preliminary settings. (7 MHz is used here as an example.)

AF GAIN	POWER OFF
Stand-by switch	REC
BAND	7 MHz
PLATE	7
LOAD	Fully counterclockwise
DRIVE	Centered
RIT	Centered
RF GAIN	Fully clockwise
RIT switch	PULL OFF
METER	Ip
AGC/CAL	SLOW
MODE	LSB
ANT SW	COM
SG SW (rear panel)	ON

Checking the VFO Plug

After the above settings are complete, check to see if the VFO plug in Fig. 9 is inserted. If this plug is not inserted when an external VFO is not used, the internal VFO will not operate neither during transmission nor reception.

POWER on

Turn the power on by turning the AF GAIN knob clockwise. The operating state will be indicated by lighting of the TS-515 meter and dial, and the PS-515 pilot lamp.

AF GAIN

Allow the transceiver to warm-up for about 40 seconds. When the AF GAIN knob is turned further clockwise, noise or signals will be heard from the speaker. Adjust the AF GAIN knob for suitable volume of sound.

Main Tuning Knob

Slowly turn the main tuning knob and amateur stations will be recieved. Adjust the dial for the best reception.

DRIVE Knob/RF GAIN Knob

Turn the DRIVE knob and adjust for maximum sensitivity while observing the S meter.

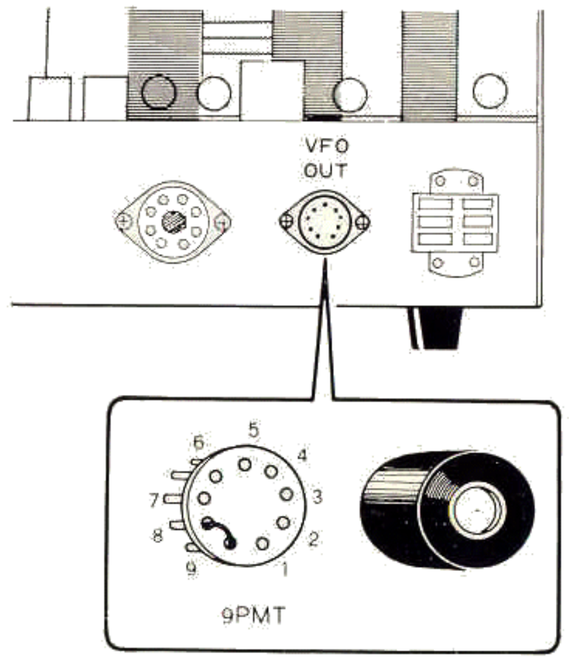


Fig. 9 VFO Plug Connections

When the signal is too strong, adjust sensitivity by turning RF GAIN counterclockwise. However, this is normally unnecessary. The S meter will hold its correct indication regardless of the RF GAIN setting.

Reception of CW

To receive CW, set the MODE switch to CW. When the MODE switch is set to the CW position with using CW optional filter the SSB filter is automatically switched to the CW crystal filter through the switching diodes.

AGC Switching

Set AGC switch to SLOW position or FAST position depending upon the state of reception. SLOW position is generally used for SSB and FAST for CW. The AGC time constant at SLOW is approximately 10 times that of FAST.

RIT Adjustment

In this type of transceiver, the transmit and receive frequencies are the same. However, the receive frequency can be varied without varying the transmit frequency by using RIT. If you change the receive frequency using the main tuning knob when the associated station changes its frequency when making a QSO, your transmit frequency will also change. In cases such as this, turn RIT on by pushing the RF GAIN knob and tune with the RIT knob. The receive frequency can then be changed approximately ±2 kHz without effecting your transmit frequency.

PLATE, LOAD, and METER knobs have nothing to do with reception.

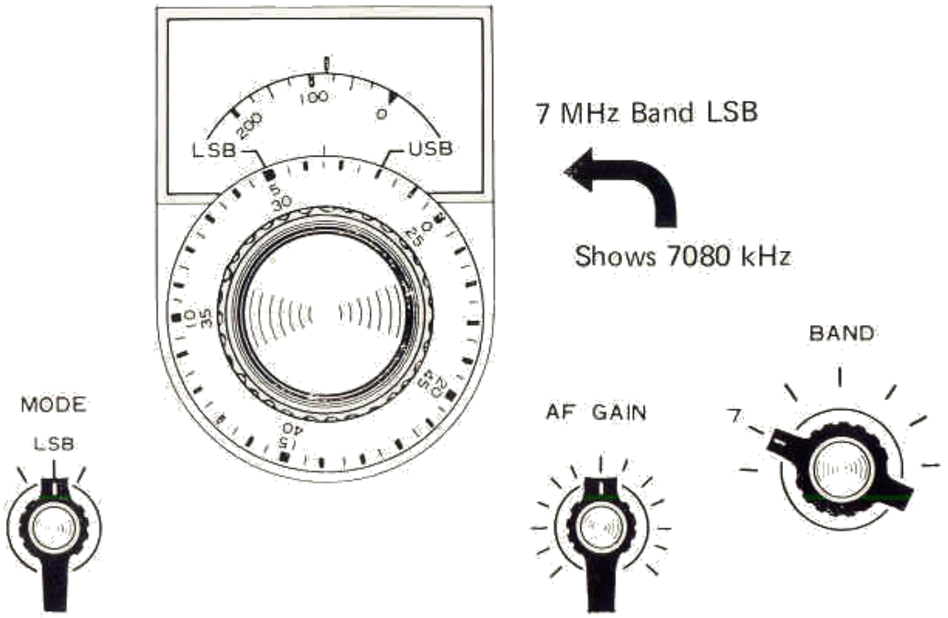


Fig. 10 Frequency Readout

3-2 READING THE FREQUENCY

The frequency at which the transceiver is operating can be read from the dial mechanism of the TS-515. The method is illustrated in Fig. 10. The dial mechanism consists of the main dial, auxiliary dial, dial gauges and main tuning knob. The frequency of the VFO is changed 25 kHz per revolution of the main dial, and 24 revolutions of the dial cause the auxiliary dial to move from 0 to 600 kHz. Rough reading of the frequency may be taken from the auxiliary dial; however, to read with an accuracy of 1 kHz, the main dial must be utilized. Fig 10 shows a case in which LSB operation is performed on the 7 MHz band. The central gauge shows that the auxiliary dial is slightly past the 50th graduation, which represents a transceive frequency of a little higher than 50 kHz (or 7050 kHz) on the 7 MHz band. To know how higher than 50 kHz, the main dial is used: Since the LSB gauge indicates the 30th graduation, add 30 kHz to 7050 kHz and therefore, 7080 kHz is obtained.

When the BAND and MODE switches (to USB) are altered, the USB gauge must be used.

When the CW filter is not used, the receive frequency is correctly indicated by the central gauge when the beat from a receive signal becomes approximately 800 Hz. When the CW filter is inserted, the beat frequency to give a correct receive frequency becomes approximately 700 Hz, (in this case, the S meter will deflect a maximum). The transmitting frequency will be directly indicated by the central gauge in both cases.

CAUTIONS: The dial will come to a stop at a certain point beyond the 0 to 600 dial scale. Never attempt to turn it beyond this point since this may damage the precision double gears.

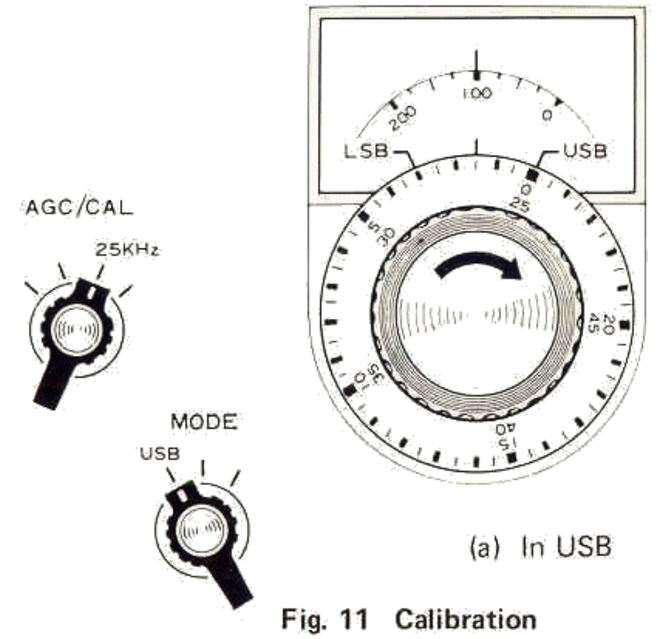


Fig. 11 Calibration

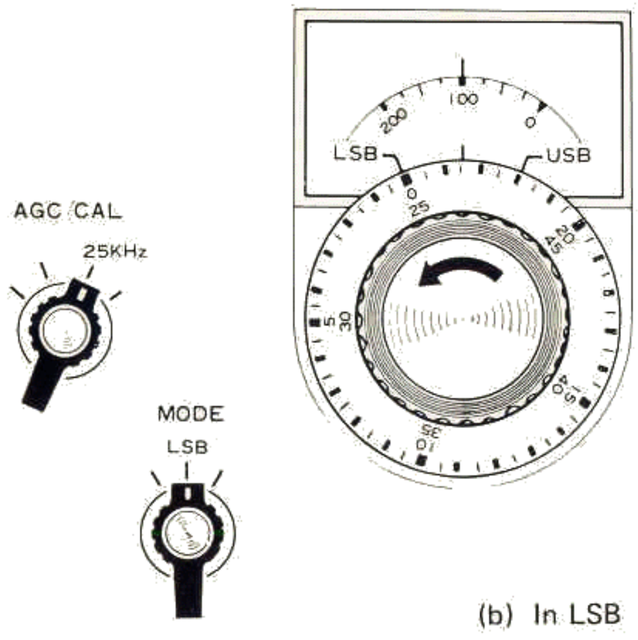
3-3 CALIBRATION

The dial must be calibrated in advance if reading of the frequency is to be accurate. This is done by using the internal 25 kHz marker. Calibration is described below using Fig. 11 ~ 12 as an example (RIT switch set to OFF).

In the case of USB: Since markers will appear at 25 kHz intervals, accurate calibration over the complete range of the dial is possible. First select the desired band and set the transceiver to the receive state. Then set the AGC/CAL switch to 25 kHz. Beat tones will be heard every one complete revolution of the main tuning knob. A beat is produced at exact 25 kHz intervals. The beat tone will be high at first but will then gradually become lower as the knob is turned clockwise until a zero beat is finally obtained. Stop the knob at the zero beat point and set the zero position of the main dial scale to the USB line. Since the main dial is held by spring, force it slips easily.

In the case of LSB: In this mode, the beat tone will change from a high tone to a low tone as the knob is turned counterclockwise until a zero beat is obtained. At this time, set the zero position of the main dial scale to the LSB line.

In the case of CW: When the CW filter is not inserted, first set the zero position of the main dial scale to the LSB line at the point at which a zero beat is obtained, in the same manner as for LSB explained above. And then, turn the main tuning dial clockwise by 700 Hz while holding the main tuning dial knob. When the CW filter is inserted, set the zero position of the main dial scale to the center line of the dial gauge at the point at which the marker signal deflects the S meter maximum.



(b) In LSB

Fig. 12 Calibration

3-4 TRANSMIT OPERATION

Use of a 50 to 75Ω dummy antenna is recommended when performing transmit adjustments. This will eliminate any danger of interferring with other stations operating in the ham band due to unnecessary radiations. The dummy antenna of more than 100W are suitable for TS-515 adjustment. A light bulb of 100W to 200W can also be used when a dummy antenna is unavailable.

Connect the dummy antenna to the ANT terminal with a coaxial connector.

Knob Settings

Perform the following settings.

AF GAIN	POWER ON
Stand-by switch	REC
BAND	7 MHz
PLATE	7
LOAD	Fully counterclockwise
DRIVE	Centered
RIT	Centered
RF GAIN	Fully clockwise
RIT switch	PULL OFF
METER	Ip
AGC/CAL	SLOW
MODE	LSB
ANT SW	COM
SG SW	ON

Check the Base Current

Set the stand-by switch from REC to SEND and confirm that the plate current is 60 mA as shown in Fig. 13. When the plate current is not 60 mA, adjust the BIAS control to get the correct reading.

Tuning the Plate

Since the plate current will suddenly increase when MODE is switched to CW, quickly adjust the PLATE knob for minimum plate current as shown in Fig. 14. When Ip doesn't increase even when MODE switch is switched to CW, adjust the DRIVE knob. If minimum plate current flows at point other than around 7 MHz, the plate is improperly tuned.

The above operations should be performed within 10 seconds. When a longer period of time is required, return the transceiver to the receive state (REC) and wait more than 10 seconds before continuing.

Tuning DRIVE

Set METER switch from Ip to ALC and adjust DRIVE knob for maximum drive as shown in Fig. 14.

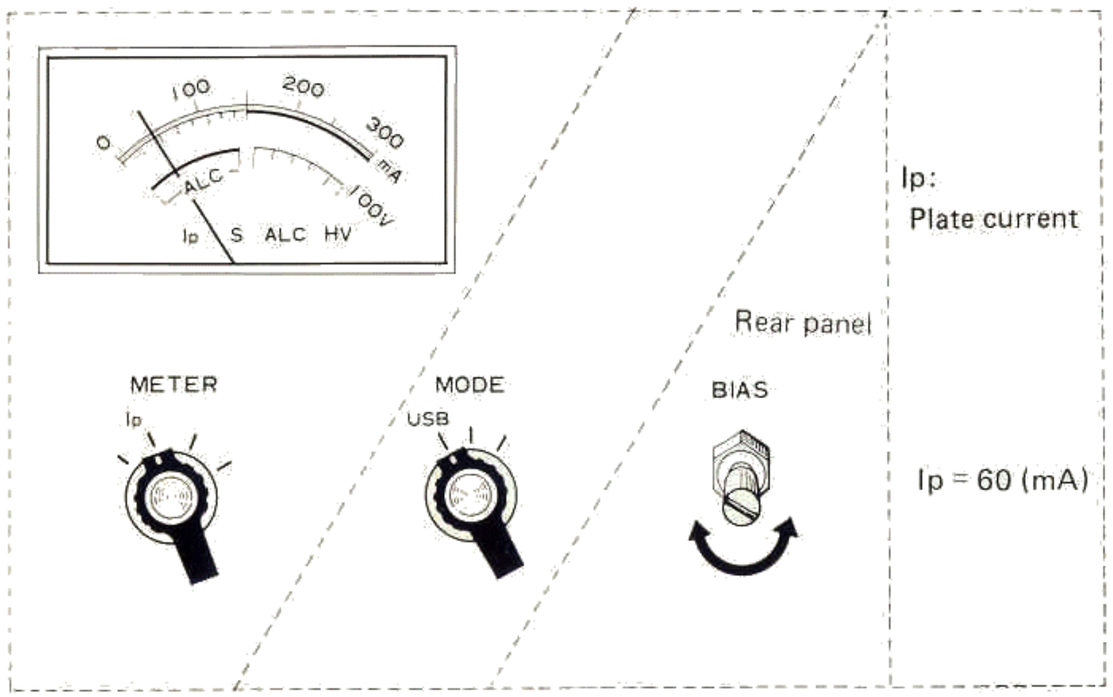


Fig. 13 Bias Voltage Adjustment

Tuning the Output Circuit

Set METER switch to RF and fine adjust PLATE and LOAD knobs alternately for maximum meter deflection. When RF meter deflection is insufficient or when the meter deflects full scale, adjust meter sensitivity with the RF VOLT control (Fig. 15). This also applies when a replacement of antenna is made.

CW Transmission and Break-In

Keying can be performed by connecting a telegraph key to the KEY jack and can be monitored from the speaker of the PS-515. Semi-break-in permitting switching to reception without touching the stand-by switch is possible by setting the stand-by switch to VOX.

SSB Transmission

Return the MODE switch to LSB. When a microphone is connected to the MIC connector, the RF meter will deflect in accordance with the voice entering the microphone. The METER indicates the plate current, ALC level, plate voltage, when the meter switch set to Ip, ALC, and HV respectively. Adjust the microphone gain so that the pointer of the ALC meter falls within the ALC range indicated.

VOX Adjustment

Return the stand-by switch to REC. When set from REC to VOX, stand-by is automatically performed in accordance with the voice. VOX sensitivity can be adjusted with the VOX control.

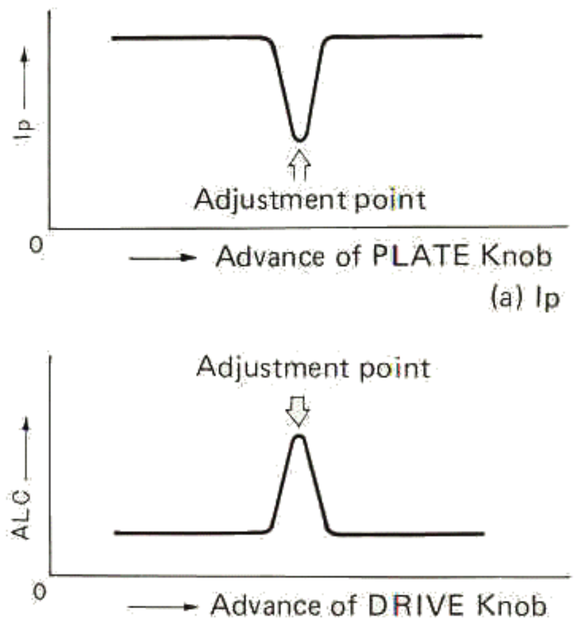


Fig. 14 Adjustment of DRIVE and PLATE Knobs

section also contains a 1 transistor S meter amplifier and a 2 transistor AGC amplifier.

The crystal filter, bandpass filter and 1st stage of the IF Unit are used in common for both transmission and reception. An optional CW filter may be added in addition to the SSB filter. These filters are automatically switched by a diode switch.

Drive Unit (X47-0005-00)

The drive unit contains a transmit section heterodyne mixer and driver, the receive section RF amplifier and heterodyne mixer, and the local oscillator which is common for both transmission and reception. The unit body is independent of the coil pack. During transmission, the signal from the IF unit is converted by the heterodyne mixer into an appropriate frequency of each band. The converted signal is then amplified by a single stage amplifier and supplied to the final unit. The 2nd local oscillator is a stable crystal oscillator circuit and operates as the 1st local oscillator during reception.

During reception, the signal from the antenna is first amplified by an RF amplifier, converted to the 1st IF by the heterodyne mixer, and fed to the IF Unit.

OSC Coil Unit (X44-0026-00)

MIX Coil Unit (X44-0027-00)

DRV Coil Unit (X44-0028-00)

These three coil units operate together with the drive unit. The coils, heterodyne crystal, and rotary switch are functionally arranged on a printed circuit board. The DRV coil operates as the antenna coil during reception.

Final Unit (X56-0004-03)

This is a power amplifier having an 80 W output. All the circuits and mechanisms are compactly arranged on a sub-chassis and contains a built-in cooling fan. The final stage rotary switch is ganged with the band switch by bevel gears.

Control Unit (X53-0002-00)

This unit is composed of a ALC circuit which produces the ALC voltage by rectifying the final stage grid current and an Ip meter circuit. The meter circuit indicates peak values.

Marker Unit (X52-0005-01 or UC1505J)

This unit generates the 25 kHz markers required in calibration and contains a 100 kHz crystal oscillator circuit and a 25 kHz multivibrator.

AF Unit (X49-0008-00)

This unit amplifies the detected output to the level required to drive the speaker and consists of a 3 stage AF amplifier and 2 transistor complementary power amplifier. It also contains a CW monitoring use sidetone generator. Monitoring sound volume adjustment is performed by semi-fixed resistor VR2 of this unit.

VOX Unit (X54-0001-01 or UC3101J)

This unit performs stand-by in accordance with the voice entering the microphone and includes a VOX amplifier which operates the transmit-receive switching relay and an ANTI VOX circuit which prevents VOX operation by sound from the speaker during reception.

The VOX circuit employs 6 transistors and the ANTI VOX circuit uses 2 transistors to assure sharp rise characteristic.

VFO Unit (X40-0016-02 or UC0116J-2)

This perfectly shielded unit is an high-stable VFO built around 2 FET's, 2 transistors and 3 diodes. During transmission, it operates as the 1st local oscillator and during reception it operates as the 2nd local oscillator. Since adjustment of this unit calls for a high degree of skill, it should never be touched.

Also note that its performance cannot be guaranteed if it is modified in any way.

AVR Unit (X43-0010-01 or UC1010J)

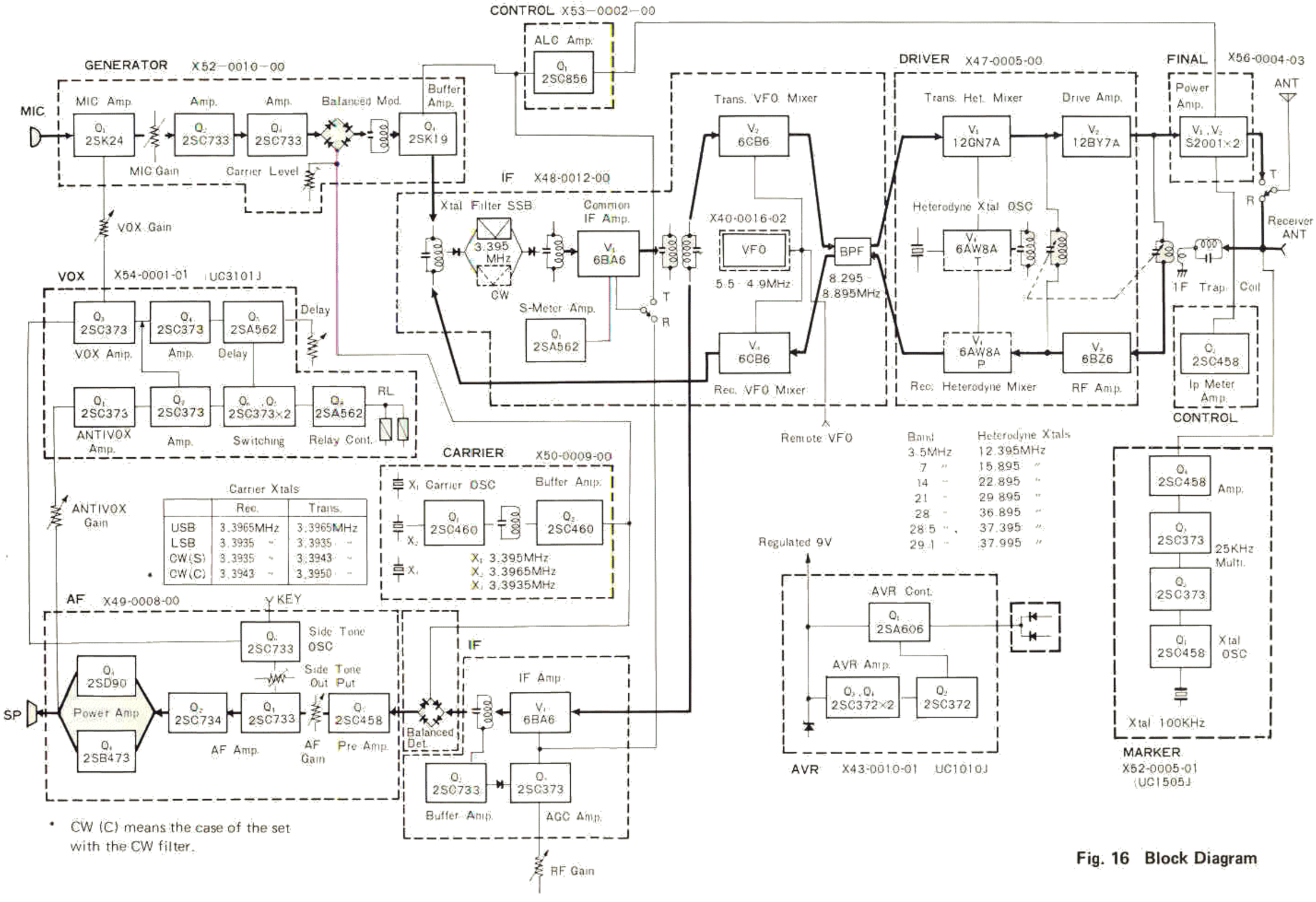
This unit supplies the stable voltage to the VFO and carrier units and consists of 4 transistors and 1 zener diode.

Power Supply

Since the TS-515 is a hybrid type, low DC voltages are required for the transistors. This unit rectifies the heater voltage obtained from the PS-515.

The terminals of all units are marked with the following symbols to facilitate discrimination when making interconnections. Moreover, since terminals having the same nomenclature are generally interconnected, these markings can also serve together with the schematic diagram in alignment and adjustment.

Ground	E, GND, G	Receive system	R
Heater	H	VFO system	VF
High voltage 900 V	900	Potentiometer terminal	XV1, XV2, etc.
150V DC	150	Input	IN
16V DC	16 or 14	Output	OUT
Transmit system	T		



Carrier Xtals	Rec.	Trans.
USB	3.3965MHz	3.3965MHz
LSB	3.3935 "	3.3935 "
CW(S)	3.3935 "	3.3943 "
CW(C)	3.3943 "	3.3950 "

* CW (C) means the case of the set with the CW filter.

Fig. 16 Block Diagram