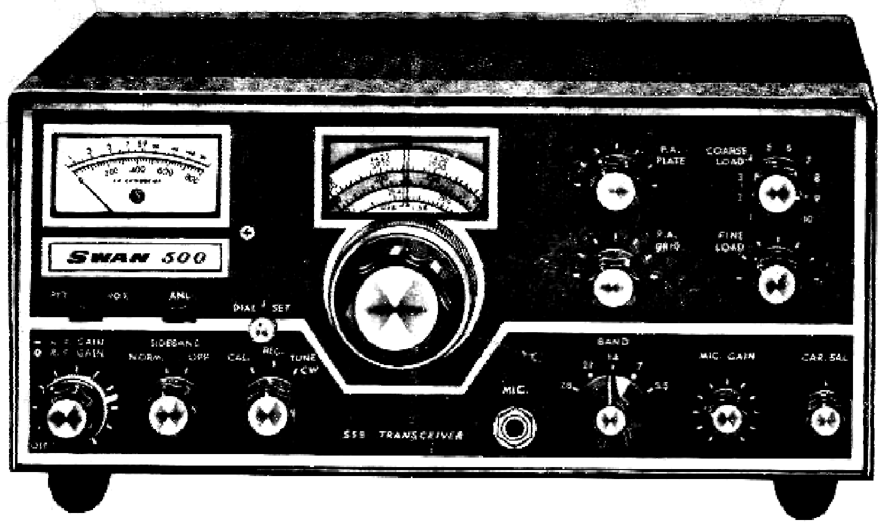
SWAN ELECTRONICS

OPERATION and MAINTENANCE
MODEL 500 SERIES
Single Sideband Transceiver



INTRODUCTION

The Swan Model 500 Single Sideband Transceiver together with its accessories and optional equipment, is designed to be used in either CW or SSB modes on all portions of the 80-, 40-, 20-, 15-, and 10 meter amateur radio bands. MARS frequencies may also be covered by using the Model 405X oscillator accessory.

The model 500 generates a single sideband signal by means of crystal lattice filter, and the transceive operation automatically tunes the transmitter to the received frequency. Provisions are included in the transceiver for operation on either upper or lower sideband.

Basic circuitry of the single conversion design has been proven in several thousand of the popular Swan transceivers. Mecahnical, electrical, and thermal stability is exceptionally high. All oscillators are temperature compensated and voltage regulated. Push-to-talk operation is standard, with provision for plugging in the Model VX-1 accessory Vox unit for automatic voice control.

The basic transceiver provides coverage of all portions of the 80 through 10- meter amateur bands. In addition to this, the amplifier circuits will tune to most MARS frequencies near the 80-, 40-, and 20-meter bands. By using the Model 405X crystal oscillator accessory, MARS operation is thus possible.

With a suitable power supply, operation may be fixed, portable, or mobile. Power input on all bands exceeds 480 watts, PEP, on single sideband, 360 watts on CW, and 125 watts on AM. The model 500 includes automatic gain control, (AGC), automatic level control, (ALC), automatic noise limiter, (ANL), and grid block keying.

Part I of the instruction manual covers the basic transceiver. Part II covers the recommended power supplies, Model 117-XC for ac operation and Model 14-117 for 12-volt dc operation. Part III provides information on various accessories.

SWAN
ELECTRONICS CORP.
Oceanside, California

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CONTENTS:

SPECIFICATIONS:

FREQUENCY RANGES

80 Meters	3.5 to 4.0 mc.
40 Meters	7.0 to 7.5 mc.
20 Meters	13.85 to 14.350 mc.
15 Meters	21.0 to 21.5 mc.
10 Meters	28.0 to 29.7 mc.

POWER INPUT

Single Sideband, Suppressed Carrier:
480 watts, PEP, minimum on all bands.
CW:
360 watts, dc input on all bands.
AM (Single Sideband with Carrier):
125 watts dc input on all bands.

DISTORTION

Distortion products down approx. 30 db.

UNWANTED SIDEBAND SUPPRESSION

Unwanted sideband down more than 50 db.

CARRIER SUPPRESSION

Carrier suppression greater than 60 db.

RECEIVER SENSITIVITY

Less than 0.5 microvolt at 50 ohms impedance for signal-plus-noise ratio of 10 db.

AUDIO OUTPUT AND RESPONSE

Audio output, 4 watts to 3.2 ohm load. Response essentially flat from 300 to 3000 cps in both receive and transmit.

TRANSMITTER OUTPUT

Wide-range Pi-network output matches antennas essentially resistive from 15 to 500 ohms impedance, with coarse and fine load adjustment.

METERING

Power amplifier cathode current 0-800 ma on transmit, S-Meter 0-70 db over S9 on receive.

FRONT PANEL CONTROLS

CAL-Rec-Tune/CW, AF-RF Gain, Mic. Gain, Bandswitch, Carrier Balance, PA Plate Tune, PA Grid Tune, PA Load Course, PA Load Fine, VOX-PTT Switch, AND Switch, Dial set.

REAR PANEL CONTROLS AND CONNECTIONS

Bias potentiometer, CW key jack, Jones plug power connector, Vox connector, Antenna Jack, S-Meter zero, Auxilliary relay switching, Outboard VFO connector.

VACUUM TUBE COMPLEMENT

V1	6EW6 VFO Amplifier
V2	12BE6 Transmitter Mixer
V3	6GK6 Driver
V4	6HF5 Power Amplifier
V5	6HF5 Power Amplifier
V6	12BZ6 Receiver RF Amplifier
V7	12BE6 Receiver Mixer
V8	6EW6 First IF Amplifier
V9	12BA6 Second IF Amplifier
V10	12AX7 Product Detector/Receive Audio
V11	6BN8 AGC Amplifier/Rectifier
V12	6GK6 Audio Amplifier
V13	7360 Balanced Modulator
V14	12BA6 Carrier Oscillator
V15	12AX7 Mic. Amplifier/Transmit Audio
V16	OA2 Voltage Regulator
V17	12BA6 100KC Calibrator

DIODE AND TRANSISTOR COMPLEMENT

Q1	2N706 Oscillator
Q2	2N706 Emitter Follower
D401	TS-2 ALC Diode
D402	TS-2 ALC Diode
D1601	1N2974A Zener voltage regulator
D1602	TS-2 Relay Silencing Diode
D1603	TS-2 AGC Charging bypass

POWER REQUIREMENTS

Filaments	12.6 volts, 5.5 amps, ac or dc
Relay	12 volts dc, 250 ma.
Bias	-110 volts dc, 100 ma.
Med. voltage	275 volts dc, 150 ma.
High voltage	800 volts dc, 500 ma. Peak Trans.

DIMENSIONS AND WEIGHT

Height	5-1/2 in.	Depth	11 in.
Width	13 in.	Weight	17-1/4 lb.

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A. CIRCUIT THEORY

GENERAL DISCUSSION

The Swan 500 transceiver provides single sideband, suppressed carrier transceive operation, and generates the single sideband signal by means of a crystal lattice filter. To permit a logical discussion of this mode of operation, certain definitions are necessary. In a normal AM signal, (double sideband with carrier), a radio frequency signal is modulated with an audio frequency signal. This is considered by many to be merely a case of varying the amplitude of the carrier at an audio rate. In fact, however, there are actually sideband frequencies generated, which are the results of mixing the RF and the AF signals. These sidebands are the sum of, and the difference between the two heterodyned signals. In the detection of this conventional AM signal, the two sidebands are mixed with the carrier to recover and reproduce the audio intelligence. This is an inefficient means of transmission, because only 25 percent of the transmitted power is used to transmit intelligence. There are other attendant drawbacks, also. The bandwidth of AM voice transmission is approximately 6 kc, while the actual demodulated audio is only approximately 3 kc. The result is inefficient use of the frequency band, and over half of the alloted band is unusable due to heterodynes, interference, and congestion.

In the single sideband, suppressed carrier mode of transmission, only one of the sideband signals is transmitted. The other sideband and the carrier are suppressed to negligible level. In addition to increasing the transmission efficiency by a factor of four, single sideband effectively doubles the number of stations or channels which can be used in a given band of frequencies.

It should be remembered that in the single sideband, suppressed carrier mode of transmitting, the unwanted sideband and carrier are only suppressed, not entirely eliminated. Thus, with a transmitted signal from a transmitter with 50 db sideband suppression, the other or unwanted sideband will be present, and will be transmitted, but its level will be 50 db below the wanted sideband. When this signal is received at a level of 20 db over S9, the unwanted sideband will be pesent at a level of approximately S5. The same is true of carrier suppression. With carrier suppression of 60 db, and a signal level of 20 db over S9, carrier will be present at a level of approximately S3 to S4.

In the Model 500 transceiver, the single sideband suppressed carrier signal is generated by the crystal lattice filter method. For details, refer to the schematic diagram, and to Figures 1, 2, and 3.

SIGNAL GENERATION

When the push-to-talk switch on the microphone is pressed, the transmitter portion of the transceiver is activated, and it generates a single sideband, suppressed carrier signal in the following manner. Carrier is generated by V14 Carrier Oscillator, which is a Pierce oscillator with the crystal operating in parallel resonance. This stage operates in both the transmit and receive modes. When transmitting, the RFoutput of the oscillator is injected into the control grid of the Balanced Modulator, V13. This balanced modulator is a beam deflection tube, and operates similar to a cathode ray tube in that the electron beam from the cathode is deflected to one output plate or the other by the charge appearing on the deflection plates. The carrier signal fed to the control grid of the balanced modulator appears on both plates of the output. The two plates are connected to Transformer Z1301 in push-pull, so the carrier signal cancels itself out in Z1301. The deflection plate DC voltages are adjusted by means of the carrier balance control so that the RF being fed to the output plates will cancel out, and the output from Z1301 will be zero. Audio signals from the Microphone Amplifier, V15, are applied as a modulating voltage to one deflection plate, and the two sidebands resulting from the sum and difference frequencies of the audio and carrier signals appear in the output of transformer Z1301. Carrier suppression is approximately 60 db.

The double sideband, suppressed carrier signal is then coupled from the secondary winding of Z1301 to the crystal filter, which suppresses the lower sideband, and permits only the upper sideband to be fed to the First IF Amplifier, V8. The carrier frequency is generated at approximately 5172.8 kc, normal sideband. With the opposite sideband crystal, the carrier crystal frequency will be 5176.3 kc, and this positions the double sideband signal on the other side of the filter response curve, attenuating the upper sideband by at least 50 db. In the single conversion mixing process, these sidebands become inverted on 80 and 40 meters. Thus the Swan-500 normally operates on lower sideband on 80 and 40, while on 20, 15, and 10 meters normal operation is on upper sideband.

Q1, the VFO 2N706 Oscillator, operates in the common base configuration as a Colpitts oscillator. Q2, the Emitter Follower is used for isolation and impedance matching purposes. The extremely good regulation achieved through using the Zener diode regulator D1601 across the bias supply voltage, also contributes to the stability. Bandswitching is accomplished by changing the tank circuit coil. The VFO in the Model 500 exhibits extremely good stability after the initial warm-up period. Drift from a cold start will be less than 1 kc for the first hour on 80-, 40-, and 20-meter bands, and less than 2 kc on 10 and 15 meters. After the initial warm-up period, drift will be negligible.

The single sideband, suppressed carrier signal from the First IF Amplifier is fed to the Transmitter.

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I MODEL 500 TRANSCEIVER

A. Circuit Theory (Cont)

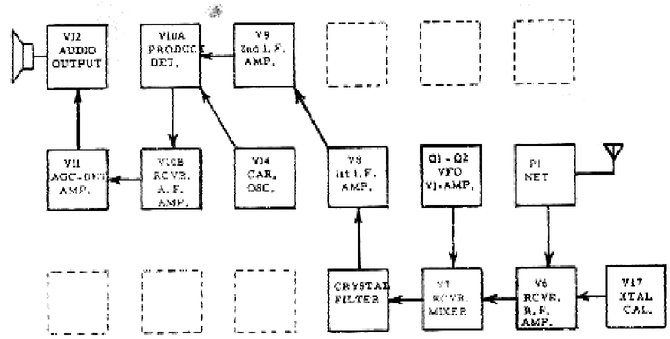

FIGURE 1 BLOCK DIAGRAM, RECEIVE MODE

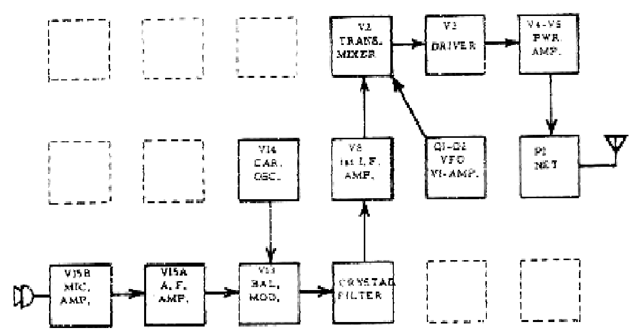

FIGURE 2 BLOCK DIAGRAM, TRANSMIT MODE

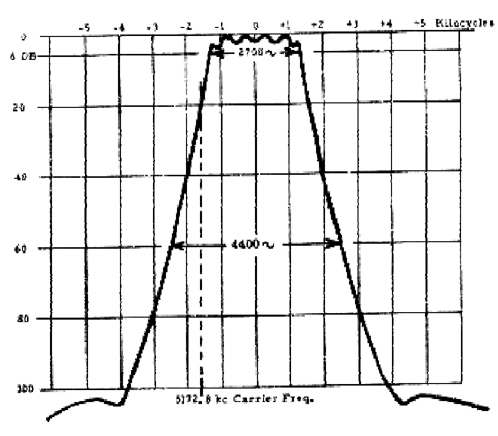

FIGURE 3 CRYSTAL FILTER, TYPICAL CHARACTERISTIC

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A. Circuit Theory (Cont)

SIGNAL GENERATION (cont)

Mixer, V2, where it is heterodyned with the VFO signal. The resultant signal at the desired transmit frequency is amplified by the Driver, V3, and the Power Amplifiers, V4 and V5. The signal from the VFO Amplifier is initiated in the transistorized VFO-Emitter Follower circuit Q1, Q2. The signal from the VFO is routed to the VFO Amplifier, and on 40 and 80 meters, is subtractively mixed with the single sideband signal from the IF Amplifier to result in LSB operation. On 20, 15, and 10 meters, the frequencies are additively mixed, resulting in output on the upper sideband.

When in TRANSMIT, the gain of the First IF Amplifier is controlled through the Automatic Level Control network D401-D402, etc., to control the gain of the stage in response to the average input power to the Power Amplifiers. This ALC system will compensate for any extremely strong input signals, but does not completely eliminate the necessity of proper adjustment of the Mic. Gain Control. This feature will help prevent the transmitter from flat topping and spurious emissions, but considerable distortion may occur if the Mic. Gain Control is not properly adjusted. Refer to Operating Instructions.

TUNE AND CW OPERATION

(See page 9 for Tuning Instructions)

Normally, the frequency of the carrier oscillator is approximately 300 cps outside the 6 db passband of the crystal lattice filter. In TUNE position, the frequency of the carrier oscillator is moved approximately 500 cps to place it well within the passband of the crystal lattice filter. A similar procedure is followed for CW to allow full carrier output during CW operation. During CW operation, the cathode of V15A is disconnected from ground. This allows CW operation with no accidental audio modulation from the microphone.

RECEIVE

In RECEIVE position, or at any time when the transmitter is not in TRANSMIT, all circuits used in transmitting are disabled through the relay controlled circuits, K1, K2. The relays are energized for transmitting and de-energized for receiving. Relay K2, when de-energized, allows signals from the transmitting tank circuit and antenna to be fed to the Receiver RF Amplifier, V6, where they are amplified and then fed to the control grid of the Receiver Mixer, V7. The local oscillator signal from the VFO Amplifier is now used to heterodyne the received signal to the IF frequency. All IF amplification is accomplished at this frequency, nominally 5174.5 kc, through V8 and V9 IF amplifiers. In the Product Detector V10A, the IF signal is heterodyned with the carrier frequency generated by Carrier Oscillator, V14. The resultant audio signal is then put thru a noise clipper network which is in or out of circuit by selection of ANL switch. The signal is then amplified by V10B, which then couples to V11, the AGC amplifier, and V12, the output audio stage.

FREQUENCY CALIBRATION

Frequency calibration of the Model 500 is in 5 kc increments on 80-, 40-, 20-, and 15-meters, and in 20 kc increments on 10M. 80- and 20-meters are calibrated directly on the upper dial scale. 40- and 15-meters are calibrated from zero to 500 on the green tinted center scale, and 10-meters is calibrated directly on the lower dial scale.

The two red indicator lines on the dial window represent the passband of the transceiver, and the actual carrier frequency depends on which sideband is in use. For upper sideband, carrier frequency is read with the left hand indicator line. For lower sideband, use the right hand line.

Dial accuracy and tracking are very good on the 500, but caution must always be observed when operating near band edges. Measuring the frequency with the 100 kc calibrator when working near band edges is recommended.

DIAL SET

A dial-set has been provided so that dial adjustment can be made at any 100 kc point of the dial. With calibrator on, set the dial to any 100 kc point closest to the frequency you wish to work. Now adjust dial-set control to zero-beat the VFO with the 100 kc Calibrator. This provides greater accuracy of dial readout.

CAUTION: Care must be exercised when tuning for the 100 kc harmonics of the calibrator. Several spurious image signals may be heard, although they will be somewhat weaker than the actual harmonics.

TRANSMIT AND RECEIVE SWITCHING

Transmit and receive switching is performed by relays K1 and K2. In TRANSMIT position, only those tubes that operate in the transmit mode are operative, all others being biased to cutoff through the relay contacts. In the RECEIVE position, with the relays de-energized, the tubes that are used only in transmit are cut off in the same manner. Relay K2 when de-energized, feeds signals from the output pi-network to the receiver, and is used also to control external switching circuits. In transmit position the meter indicates the combined cathode current of the two power amplifiers. In receive position, it indicates the voltage across R903 in the screen grid of the Second IF Amplifier, V9, which is inversely proportional to the AGC voltage used to control the gain of the tube. Thus, the meter indicates the relative strength of received signals.

POWER RATING

The Swan 500 is capable of 480 watts, PEP input under steady state two-tone test conditions, when operated with any of the recommended power supplies. The peak envelope power, when voice modulated, is considerably greater, typically 500 watts, or more.

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A. Circuit Theory (Cont)

Recommended power supplies produce a no-load plate voltage of approximately 925 volts. Under TUNE conditions, or CW operation, this voltage will drop to approximately 720 volts. Under steady state two-tone modulation, the voltage will drop to approximately 750 volts. If the power amplifier idling current is 50 ma, and the two-tone current, just before flat-topping, is 375 ma, the peak two-tone current will be 560 ma. Under these conditions the PEP input will be 750 volts times 560 ma, = 420 watts. Under voice modulation, because average power is considerably less, the power amplifier plate and screen voltages will be maintained higher, even during voice peaks, by the power supply filter capacitors. Peak plate current will therefore also be higher than with two-tone test conditions. Under typical operating conditions, peak plate current before flat-topping will be 625 ma at 800 volts, to result in an input of 500 watts, PEP. Readings of cathode current will not reflect this 500 watt power input, however, because of the damping in the cathode current meter. Cathode current readings under normal voice input should not exceed approximately 150 to 175 ma.

POWER AMPLIFIER PLATE DISSIPATION

There is often a misunderstanding about the plate dissipation of tubes operated as AB1 amplifiers under voice modulation. In the Swan 500, while in the transmit position, and with no modulation, the plate voltage will be 890 volts, the plate current 50 ma, and the power input will be 45 watts.

Authorities agree that the average voice power is 10 to 20 db below peak voice power. Normally some peak clipping in the power amplifier can be tolerated, and a peak-to-average ratio of only 6 db may sometimes occur. Under such conitions, the average power input will be 125 watts, and average plate current will be 156 ma. With power amplifier efficiency of 65 percent, plate dissipation will be 44 watts, or 22 watts per tube. The 6HF5 is rated at 28 watts, continuous duty cycle, in normal TV service. Thus it can be seen that under normal operating conitions, the power amplifier tubes in the Swan 500 are not being driven very hard. Note, however, that proper modulation level must be maintained by correct setting of Mic. Gain, and that the length of time in TUNE position must be limited to not more than 30 sec. at a time.

B. INSTALLATION

GENERAL

The Swan 500 transceiver has been designed to provide the utmost in ease of operation, stability, versatility, and enjoyment. Maximum enjoyment from your Swan will depend to a great extent on the installation. For fixed station or portable use, operation with the Model 117-XC power supply provides a compact arrangement with maximum ease of operation. All switching is performed in the transceiver. For mobile installations, the Model 14-117 supply provides similar switching arrangements, and speaker output may be fed to an optional 3 x 5 speaker with mounting provisions on the inside of 500 cabinet. Alternately, the speaker output may be fed through the car broadcast radio speaker.

POWER SUPPLY

The Swan Models 117-XC or 230-XC Power Supplies provide all necessary voltages required by the transceiver for AC operation. The supplies come equipped with a pre-wired plug and cable, all ready for plugging into the transceiver. The Model 14-117 supply for mobile operation includes all necessary cables, connector plug, fuses, and installation hardware. The Jones plug for connection to the transceiver is furnished with the unit.

Power requirements for the Swan 500 are listed in the following table. Pin connections to the Jones type power connector are listed as an aid in connecting other brands or home-brew supplies.

EXTERNAL SPEAKER CONNECTIONS

Audio output from the transceiver is provided at pin 12 of the Jones plug, and to a terminal lug located near V12 audio output tube on top of chassis for optional "3 x 5" internal speaker. The other speaker lead goes to the common chassis ground at pin 6 of Jones plug or to ground terminal at the terminal strip. For mobile installations, mounting a "3 x 5" internal speaker makes the installation simple. In case you wish to use the car broadcast radio speaker a DPDT selector switch should be installed to select either the broadcast radio or transceiver output. (See Figure 8).

Provisions for headphones will be found on front of AC Power Supply. (See Page 17) It is recommended that high impedance phones be used for best results.

JONES PLUG CONNECTIONS

	Pin	Nominal	Minimum	Maximum
High Voltage	8	800 VDC 500 MA	600 VDC Low Pwr.	1200 VDC Hi. Power
Medium Voltage	10	275 VDC 150 MA	225 VDC	325 VDC
Bias Voltage	3	-110 VDC 100 MA	-100 VDC	-130 VDC
Filament Voltage	4	12.6 V* 5.5 amp	11.5 V	14.5 V
Relay Voltage	5	12 VDC 250 MA	10 VDC	14.5 VDC
*AC or DC				

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B. Installation (Cont)

MICROPHONE

The microphone input is designed for high impedance microphones only. The choice of microphone is important for good speech quality, and should be given serious consideration. The crystal lattice filter in the transceiver provides all the restriction necessary on audio response, and further restriction in the microphone is not required. It is more important to have a microphone with a smooth, flat response throughout the speech range. The microphone plug must be a standard 1/4 in. diameter three-contact type. The tip connection is for push-to-talk relay control, the ring connector is the microphone terminal, and the sleeve is the common chassis ground. The microphone manufacturer's instructions should be followed in connecting the microphone cable to the plug. With many microphones, the push-to-talk button must be pressed to make the microphone operative. For VOX operation, this feature may be disabled, if desired, by opening the microphone case and permanently connecting the contacts which control the microphone.

ANTENNA

Any of the common antenna systems designed for use on the high frequency amateur bands may be used with the Swan transceiver, provided the input impedance of the transmission line is not outside the capability of the pi-output matching network. The transmission line should be of the coaxial cable type. An antenna system which shows a standing wave ratio of less than 4:1 when using 50 or 75 ohm coaxial transmission line, or a system that results in a transmission line input impedance that is essentially resistive, and between 15 and 500 ohms will take power from the transceiver with little difficulty. If open-wire or balanced type transmission line is used with the antenna, a suitable antenna tuner is recommended between the transreceiver and the feedline. Methods of constructing and operating such tuners are described in detail in the ARRL Antenna Handbook, and similar publications. For operation on the 75- and 40- meter bands, a simple dipole antenna, cut to resonate in the most used portion of the band, will perform satisfactorily. For operation on the 10, 15, and 20 meter bands, the efficiency of the station will be greatly increased if a good directional rotary antenna is used. Remember that even the most powerful transmitter is useless without a proper and efficient antenna system.

MOBILE ANTENNA

Mobile antenna installations are critical, since any mobile antenna for use on the high frequency bands represents a number of compromises. Many amateurs lose the efficiency of their antenna through improper tuning. Points to remember about the mobile antenna used with the Swan 500 are:

1. The "Q" of the antenna loading coil should be as high as possible. There are several commercial models available which use high "Q" coils, including the Swan Model 45 and Model 55 5 band "Swantennas".
2. The loading coil must be capable of handling the power of the Model 500 without over heating. In TUNE position, the power output of the transceiver may exceed 250 watts. Wide spaced, heavy wire loading coils are essential.
3. The SWR bridge is a useful instrument, but unfortunately it is quite often misunderstood, and over rated in importance. Basically, the SWR bridge will indicate how closely the antenna load impedance matches the transmission line. With long transmission lines, such as will be used in many fixed station installations, it is desirable to keep the impedance match fairly close in order to limit power loss. This is particularly true at the higher frequencies. The longer the line, and the higher the frequency, the more important SWR becomes. However, in mobile installations the transmission line seldom exceeds 20 feet in length, and an SWR of even 4 to 1 adds very little to power loss. The only time SWR will indicate a low figure is when the antenna presents a load close to 50 ohms, but many mobile antennas will have a base impedance as low as 15 or 20 ohms at their resonant frequency. In such a case, SWR will indicate 3 or 4 to 1, and yet the system will be radiating efficiently.
4. The really important factor in your mobile antenna is that it should be carefully tuned to resonance at the desired frequency. The fallacy in using an SWR bridge lies in the fact that it is sometimes possible to reduce the SWR reading by detuning the antenna. Field strength may actually be reduced in an effort to bring SWR down. Since field strength is the primary goal, we recommend a Field Strength Meter for antenna tuning.
5. For antenna adjustments, the Swan-500 may be loaded lightly to about 100 ma. cathode current instead of the usual 500 ma. This will limit tube dissipation during adjustments, and will also help reduce interference on the frequency. In any case, do not leave the transmitter on for very long at one time. Turn it on just long enough to tune and load, and get a field strength reading.

Start out with the antenna whip at about the center of its adjustment range. Set the VFO to the desired operating frequency and then adjust P. A. TUNE for dip, and P. A. LOAD for 100 ma. Then observe the field strength reading. The Field Strength Meter may be set on top of the dash, on the hood, or at an elevated location some distance from the car.

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Change the whip length a half inch, or so, at a time, retune the P.A. for 100 ma. loading each time, and check field strength. Continue this procedure until the point of maximum field strength is found. This adjustment will be most critical on 75 meters, somewhat less critical on 40, etc., until on 10 meters the adjustment will be quite broad. After tuning the antenna to resonance, load the P. A. to full power.

CONTROL FUNCTIONS

ON-OFF SWITCH (On AF & RF Gain Knob)	Turns power supply on and off
CAL-REC-TUNE-CW	
Calibrate	All voltages are applied to transceiver. Grounds cathode of V17. Removes ground from cathode of V15A.
Receive	All voltages are applied to transceiver.
Transmit (Push-to-Talk)	12 volt dc circuit through relay K1 and K2 is completed, and tubes used only in receive are biased to cutoff.
Tune-CW	All circuits for transmit are energized, as above. Capacitator C1401 in the carrier oscillator is removed from gound.
MIC. GAIN	Contols potentiometer R1503 in the grid of V15A and controls amount of audio to the balanced modulator.
CAR. BALANCE	Controls potentiometer R1305 in the balanced modulator deflection plate circuit, and permits nulling out the carrier.
RF GAIN	Controls variable resistor R609, common in the grids of receiver mixer V7, RF Amplifier, V8 and V9 IF Amplifiers.
AF GAIN	Controls potentiometer R1201 in grid circuit of V12 AF Output, and controls audio volume.
MAIN TUNING	Controls C1706 in frequency determining tank circuit of VFO.
PA GRID	Controls CIA and CIB in plate tanks of transmitter mixer and driver.
PA TUNE	Controls C417 on pi-network to tune final power amplifier plate to resonance.
PA LOAD, Fine	Controls C420 in pi-network to match impedance of output load. Tunes input to Receiver RF Amplifier.
PA LOAD, Coarse	Switches in progressively more capacitance in parallel with PA Load, Fine.
MAIN BANDSWITCH	Switches, plate coils, and associated capacitors of VFO, VFO Amplifier, V1, Transmitter Mixer, V2, and Driver, V3. Also switches tank coil of pi-coupling system and associated capacitors in PA output tank.

C. OPERATION

Before connecting any cables to the Swan 500 perform the following steps:

1. Rotate the PA BIAS control on the rear chassis apron, fully counter clockwise.
2. Rotate the CAL-REC-TUNE-CW on the lower left of the front panel counter clockwise to REC.
3. Rotate the AF GAIN Control counter clockwise to operate the power switch to OFF.

POWER SUPPLY, ANTENNA AND GROUND CONNECTIONS

1. Connect wire from earth ground to ground stud provided on rear of chassis.
2. Connect a 50 to 75 ohm antenna feed-line to the coaxial connector on the rear chassis panel.
3. Connect the power supply cable to the Jones connector on the rear chassis apron.
4. Connect the power supply to the proper voltage source.

The Swan Model 500 may be operated from 117 volts, ac, 50 - 60 cycle power with the Model 117-XC power supply, or from 230 volts, 50 - 60 cycles with the Model 230-XC. The Model 500 may be operated from a 12 volt dc source with the Swan Model 14-117 power supply.

WARNING

DANGEROUS HIGH VOLTAGE IS PRESENT ON THE PLATE OF THE POWER AMPLIFIER WHENEVER THE POWER SUPPLY IS ENERGIZED. NEVER TURN POWER ON WHEN THE POWER AMPLIFIER COVER IS REMOVED. HIGH VOLTAGE IS ALSO PRESENT AT PIN EIGHT OF THE POWER PLUG.

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RECEIVE OPERATION

1. Rotate the AF GAIN Control clockwise to about the 3 o'clock position. The power switch will operate applying filament, relay, bias, medium, and 800 volt high voltage to the transceiver.
2. Wait approximately one minute to allow the tube filaments to reach operating temperature. During this period, perform the following steps:

   (a) Rotate the BANDSWITCH to desired band.
   (b) Rotate MIC. GAIN fully counter-clockwise.
   (c) Rotate CAR. BAL. control to the mid-scale position, with white dot on knob aligned with the long index mark on the panel.
   (d) Preset PA PLATE control to mid-position.
   (e) Preset PA GRID control to mid-position.
   (f) Preset PA LOAD FINE to mid-position.
   (g) Preset PA LOAD COARSE to position 1.
   (h) Set tuning dial to desired operating frequency.
   (i) Set RF GAIN control to approximately 3 o'clock position.

3. Carefully adjust the PA GRID and the PA PLATE controls for maximum receiver noise. Note: The PA GRID control resonates the transmitter driver stages and the receiver RF amplifier plate circuit. The PA PLATE and PA LOAD controls adjust the input and output capacitors in the transmitter power amplifier final plate circuit, as well as the receiver RF amplifier grid circuit. Proper adjustment of these controls in the receiver position will result in approximately resonant conditions in the transmitter stages.

RECEIVER TUNING—IMPORTANT, READ CAREFULLY.

Precise tuning of a single sideband signal is very important. Do not be satisfied to merely tune until the voice can be understood, but take the extra care of setting the dial to the exact spot where the voice sounds natural. Above all, avoid the habit of tuning so that the voice is pitched higher than normal. This is an unfortunate habit practiced by quite a number of operators. The following points help to explain the effects of mistuning:

1. If you tune so the received voice is higher than normal pitch, you will then transmit off frequency, and your voice will sound lower than normal pitch to the other station. He will probably retune his dial to make you sound right. If you keep this up, you'll gradually waltz one another across the band. If both of you are mistuning to an unnatural higher pitch, you'll waltz across the band twice as fast. (And someone will no doubt be accused of frequency drift).
2. Mistuning results in serious harmonic distortion on the voice, and should be quite noticeable to the average ear. Some will claim that if they don't know how the other person's voice actually sounds, they can't tune him in properly, but this is not true. With a little practice, it will be fairly easy to tell. Some voices are relatively rich in harmonics, and are easier to tune in than a person with a "flat" voice. Also, a transmitter which is being operated properly with low distortion will be easier to tune in than one which is being over-driven and is generating excessive distortion. There is no mistaking when you have a station tuned right on the nose. It will sound just like "AM", so to speak. Mainly, avoid the habit of tuning so everyone sounds higher than normal pitch, or like Donald Duck. This is incorrect, unnecessary, and sounds terrible.
3. A vernier control for receive frequency, sometimes referred to as "incremental tuning", is not available on the Swan-500. Such a device is not necessary if proper tuning habits are exercised.
4. Your Swan-500 will automatically transmit on exactly the same frequency as the one to which you are listening. There is no adjustment for making them the same, since by using the same oscillator for both send and receive, it happens automatically. If separation of receive and transmit frequency control is desired, the model 406B or 410 VFO unit may be used. In this case the model 22 dual VFO adaptor must be installed in the 500.

TRANSMITTER TUNING

CAUTION

The Model 500 covers several frequency ranges outside the amateur bands. Care must be exercised not to transmit on these frequencies.

Tuning of the transmitter is not complicated, provided the few simple steps are followed in the correct order. Do not attempt initial tuneup without first performing the procedures for Receive operation described above. The following procedures assume that the unit has been checked out in Receive position, and a high impedance push-to-talk microphone is inserted in the MIC. JACK.

1. Press Push-to-Talk to place unit in TRANSMIT, read the cathode current on the meter.
2. Quickly rotate the CAR. BAL. control on the front panel until the meter reads minimum cathode current.
3. Next, adjust the PA BIAS control on the rear of the chassis until the meter reads 50 ma.

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4. If this is the first time the transceiver is being tuned on this band, set the PA LOAD switch to position 5. After experience in tuning up, the control may be set to whatever position has been found to be optimum on each respective band. Now, in rapid succession:
   (a) Turn the CAR. BAL. control clockwise until a slight increase in meter reading is obtained.
   (b) Rotate the PA GRID control for maximum meter reading.
   (c) Rotate the PA PLATE control for minimum meter reading.
   (d) Adjust car. bal. for a reading of 150 ma.

   IMPORTANT—Tuning the PA PLATE for minimum, or "dip", is known as "resonating" the power amplifier plate circuit, and is very important to preserving tube life. If the transceiver is held in Transmit or TUNE position for more than a few seconds while out of resonance and with some grid drive, the 6HF5 tubes may be severely damaged. For this reason we repeat: CAUTION—Do not hold the transceiver in Transmit or TUNE position for any length of time without "dipping" the PA PLATE control. The PA GRID must first be "peaked" as in (b), above, and this requires some carrier supplied as described in (a), so it can be seen that these steps must be performed quickly. If the PA LOAD control is too far clockwise, it may not be possible to find a "dip" with the PA PLATE control. For this reason, be sure to observe the first sentence in this section, Step 4.

5. Rotate the CAL-REC. TUNE switch to TUNE position. Quickly check the PA PLATE control for "dip" or minimum reading. If the meter dips to less than 500 ma., increase loading by rotating the PA LOAD controls clockwise. After each increase in PA LOAD resonate the PA PLATE again; that is, adjust it for dip. Continue increasing PA LOAD until the PA PLATE dips to 450-500 ma. Then switch back to RECEIVE. NOTE: For 10 meter operation it will be necessary first to repeak the PA grid control for maximum output in the tune position.

   CAUTION: Do not hold the transceiver in TUNE position for more than 30 seconds at a time, even though PA PLATE is resonated. With full grid drive to the 6HF5 PA tubes, which you have in TUNE position, they are dissipating considerably more power than they do during normal voice transmission, so a short tuning period must be observed.

6. Under some conditions, it may not be possible to load up to 500 ma. This may occur with lower than normal line voltage or tubes not quite up to par, particularly on 10 and 15 meters. The current increase when tuning the plate circuit off resonance will provide a clue as to how far the power amplifier can be loaded. If the meter swings up to 600 or 700 ma. on either side of resonance, it will be easy to load up to 500 or even more. But, if the tubes draw just 500 ma. off resonance, you can only load to 400 or 450 ma. This is not necessarily a sign that you have a problem. Peak input power with voice modulation will still be 400 watts when you load to 400 ma. in TUNE position. A new pair of PA tubes may allow you to load higher, or possibly a new driver tube will help. Primarily, the level to which you can load will serve as an indication of when tubes are deteriorating. If you can load to 500 ma. when the set is new, and after a few months of operating you cannot get above 400 ma., or so, it is probably time to replace the 6HF5 tubes, and possibly the 6GK6 driver. The other tubes should also be checked at that time.

7. AVERAGE PA LOAD SWITCH POSITIONS. The following positions are for a 50 ohm non-inductive load, and indicate approximately where the PA LOAD switch will end if the antenna and coaxial cable are well matched.

BAND	PA LOAD SWITCH
80	POS. 7
40	8
20	9
15	9
10	10

   A large deviation from these positions indicates a possible matching problem, although operation may still be quite satisfactory. PA LOAD switch positions below 5 will generally be needed only with very low impedance loads, such as a 75 meter mobile antenna with center loading coil.

8. VOICE TRANSMISSION. After tuning up as outlined above, press the Push-to-Talk button on the mike and carefully set the CAR. BAL. control for minimum meter reading. While speaking into the mike, slowly rotate the MIC. GAIN control until occasional peak reading of 175 to 200 ma. are obtained. With most microphones, the MIC. GAIN control will be set between 9 and 12 o'clock, but it may vary considerably. The ALC circuit will help limit cathode current to about 200 ma., but turning the MIC. GAIN up too high will still produce flat-topping and spurious signals, so it is important to hold it down. The meter is quite heavily damped, and its reading with average voice modulation may not look very impressive, but the voice peaks are going well over the 480 watt power rating of your Swan transceiver, and signal reports will verify this fact. NOTE: Transceiver will not modulate with Function Switch in CAL. position.

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8. **TRANSMITTER TUNING WITH SWR BRIDGE OR FIELD STRENGTH METER.** If either of these instruments is available, they are highly recommended as a better method of tuning the PA Amplifier, since they provide a direct indication of relative output. With the SWR Bridge in Forward position, or with the Field Strength Meter set to pick up a portion of the radiated power, simply adjust the PA TUNE and PA LOAD controls for maximum output. This must be done quickly, limited to about 30 seconds, to limit tube dissipation as previously mentioned. This method will result in maximum possible output and efficiency, as well as maximum linearity. You will probably find that cathode current readings end up somewhat less than 500 ma. on 10 meters because grid drive is the least on this band. On 80 meters where grid drive is the greatest, maximum output will be reached at more than 500 ma. These are a normal condition.

NOTE—The cathode current level to which the PA is loaded will have no bearing on tube life. When transmitting with normal voice modulation, average power input will be the same regardless of how high or low the PA was loaded while tuning. Peak output, linearity, and lowest distortion will go along with maximum loading. In other words, you will not extend tube life by loading to a lesser degree. The secret to long tube life is simply to keep TUNE-up periods short and not too frequent.

AM OPERATION (Single Sideband With Carrier)

1. Tune transmitter to full output on single sideband as described above.
2. Rotate MIC GAIN control to minimum full CCW.
3. With Push-to-Talk pressed, rotate CAR. BAL. control until cathode current is approximately 150 ma.
4. While talking in a normal tone of voice into the microphone, increase MIC GAIN setting until the meter kicks upward slightly. This setting will result in excellent AM transmission.

CW OPERATION—SPECIAL NOTE

1. Tune transmitter to full output same as for SSB operation. Then adjust carrier balance for a meter reading of approximately 2/3 the maximum tune-up reading. For example: If tune-up results in 400 ma. cathode current, adjust carrier balance for approximately 275 ma., or if tune-up reading is 500 ma., then reduce to approximately 350 ma. for CW, etc. Note: This reduction in drive is essential on 15 meters in order to eliminate a possible spurious radiation.
2. Insert CW Key in the Key Jack provided on the back of the 500 Use a standard 1/4 inch diameter 2 circuit phone plug.
3. Switch to TUNE-CW position to transmit. Back to RECEIVE for receiving.

D. ALIGNMENT AND TROUBLESHOOTING

GENERAL

The following procedures are given in the order performed during the factory alignment for the transceiver. For home servicing, only partial alignment may be necessary. Read all procedures carefully before commencing either partial or complete alignment. See Figures 4 and 5 for component placement.

Equipment Required

1. Calibrated audio frequency signal generator, range 200 to 5000 cps.
2. 500 watt dummy load with output meter
3. Vacuum tube voltmeter
4. Walsco 2543 coil adjustment tool
5. Field strength meter
6. Calibrated RF Signal Generator

Pre-Alignment Conditions

1. Neutralizing capacitors C413 set to mid-point and C315 set to approximately 3/4 turn from full compression.
2. Peak IF transformers for maximum background noise with AF and RF gain full clockwise (either bottom or top core adjustment).
3. Loosely couple field strength meter to C318 (off pin 9 of V4) with alligator clip on ceramic capacitor body.
4. Transmit bias potentiometer full counter-clockwise (maximum bias).

VFO AMPLIFIER PLATE CIRCUIT ALIGNMENT

With VTVM from pin 1 of V7, Receiver Mixer, to ground, on -15 volt scale, adjust VFO Amplifier Plate coils for peak VTVM heading as follows:

Band	VFO Frequency (kc)	Dial Frequency (kc)	Coil
80	8,975	3,800	L104
40	12,300	7,125	L103
15	16,050	21,225	L102
10	23,325	28,500	L101

TRANSMITTER MIXER AND DRIVER PLATE CIRCUIT ALIGNMENT

1. Remove screen voltage from V4 and V5 by disconnecting the wire from terminal strip immediately adjacent to V5 base. (A, Fig. 5).

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Operation (Cont.)

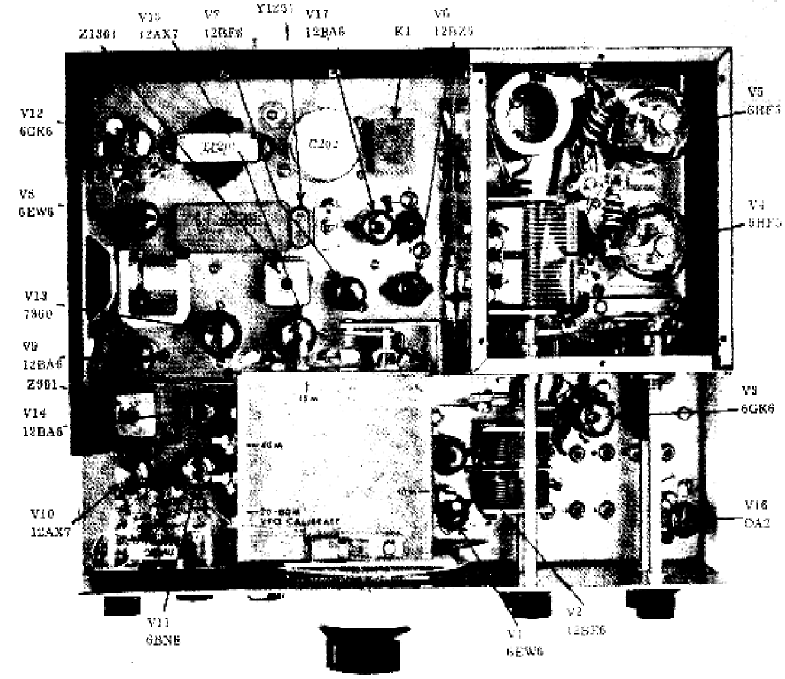
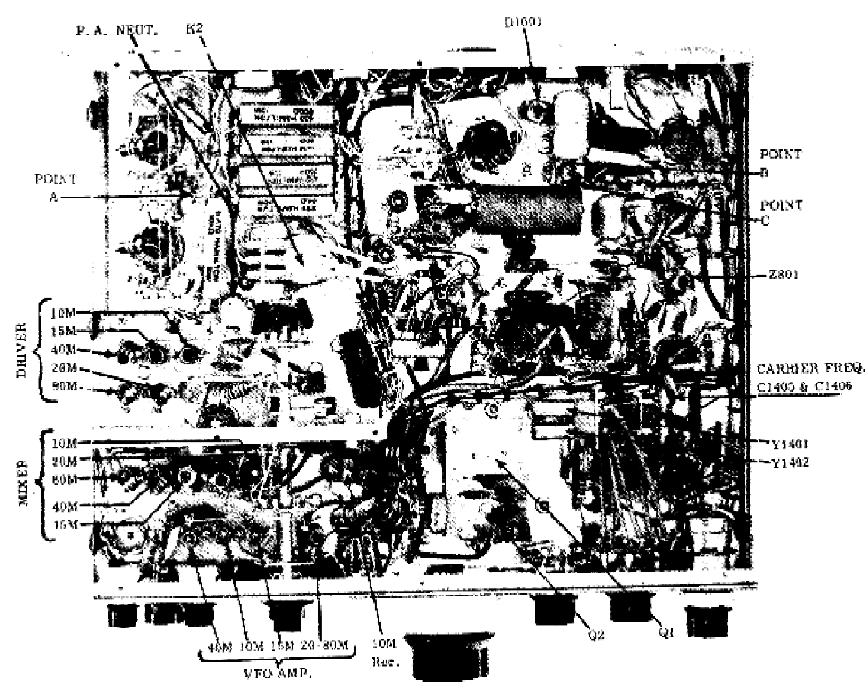


FIGURE 4
TOP VIEW, MODEL 500 TRANSCEIVER

FIGURE 5
BOTTOM VIEW, MODEL 500 TRANSCEIVER



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2. Connect VTVM across R412, 4.7K resistor between pins 1 and 2 of terminal strip, using 15 volt scale. (Points B and C, Fig. 5).

Procedure:

Adjust band switch and P.A. Grid as shown, and adjust coils for peak VTVM reading as follows, with function switch in Tune position:

Band	P.A. Grid	Dial Freq. (kc)	Adjust
80	12 o'clock	3,800	L205, Z1301 C1402, L1305
40	11 o'clock	7,150	L204, L304
20	11 o'clock	14,150	L203, L303
15	2 o'clock	21,450	L202, L302
10	2:30 o'clock	29.7	L201, L301

*Note: If VTVM and field strength meter exceed full scale reading, switch to REC. position, actuate push-to-talk circuit, and insert carrier with carrier balance control to keep reading on scale. Field strength meter and VTVM must both peak at same time since it is possible to tune the coils to the VFO frequency on 10 meters. Care must be taken that the coils be tuned properly.

Following the above procedures, replace screen wire to pin 1 of terminal strip adjacent to V5.

ALIGNMENT OF 5175 KC FILTER TRAP

With RF and AF gain at midscale, feed 5175 kc signal to antenna connector and adjust L602 until the heterodyne signal is nulled to minimum.

ALIGNMENT OF 13 MC FILTER TRAP

Tune VFO to 14,325 kc, insert RF signal to antenna at 13,000 kc and tune RF generator for heterodyne signal in speaker. Adjust L603 and L604 for minimum heterodyne signal.

ADJUSTMENT OF CARRIER FREQUENCY

A. With dummy load and output meter attached, tune transceiver for maximum output.

B. Null out carrier with PTT pressed and set resting plate current to 50 ma with bias pot.

C. Connect AF generator to MIC JACK, adjust MIC. GAIN full CCW.

Procedure:

1. With AF generator at 1500 cps. increase MIC. GAIN to produce a 100 ma. reading on the meter.
2. Adjust Z801 for maximum meter reading.
3. Adjust both top and bottom cores of Z1301 for maximum meter reading.
4. Adjust MIC. GAIN for meter reading of 300 ma.
5. Set AF generator to 300 cps. Adjust C1402 for meter reading of 75 ma.

P.A. NEUTRALIZATION

With P.A. coarse load in position 1, set freq. to 14.150, PA Plate control at 9 o'clock, insert carrier and peak P.A. Grid control, adjusting Car. Bal. control for 200 MA. Turn PA control slowly through resonance. Cathode current should dip smoothly and rise to 200 MA on the low capacity side of resonance. If, instead, there is a peak above 200 MA either side of the dip, stop rotation of the PA plate control at the peak and adjust C413 to reduce Ip to 200 MA. Repeat above check and readjust as necessary to obtain the desired smooth dip. For 10 meters, use above procedure but adjust #C 315.

ADJUSTMENT OF L601

With transceiver tuned to 28.8 mc, and RF and AF gain at maximum, adjust L601 for maximum background noise.

S-METER ADJUSTMENT

With antenna disconnected and with RF Gain fully clockwise, set R605, located on rear panel, for zero meter reading. Make sure no local signals are being received. It will be noticed that a slight change in S-meter zero setting will change when switching from band to band. Also, when using the ANL circuit there will be a decrease in the S-Meter reading. This is normal.

VFO ALIGNMENT

A locking type trimmer condenser is provided for each VFO range, of which there are four. The same range is used on both 20 and 80 meters. Dial tracking has been factory set by pruning the coil, and will not ordinarily require further adjustment.

When dial calibration changes beyond the adjusting range of the front panel dial set control, calibration may be restored by carefully adjusting the trimmer for that range. It may be necessary to loosen the locknut. Be sure to tighten it again.

The following chart lists the actual oscillating frequency of the VFO at band edges:

Dial Frequency	Oscillator Frequency
3500 (13.85)	8673 KC
3800 (14.15)	8973
4000 (14.35)	9173
7000	12,173
7200	12,373
7300	12,473
21,000	15,827
21,250	16,077
21,450	16,277
28,000	22,827
28,500	23,327
29,000	23,827
29,700	24,527

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TROUBLESHOOTING GUIDE

DEFECT	POSSIBLE CAUSE
PA IDLING CURRENT UNSTABLE	1. Defective 6HF6 — See NOTE. 2. Defective Bias Potentiometer 3. Defective Bias Supply
INABILITY TO LOAD TO 400-500 MA. (SEE PAGE 10)	1. PA Grid Improperly Tuned 2. Bandswitch Improperly Set 3. Antenna Not Resonant at Frequency 4. Defective Transmission Line 5. Defective Mobile Antenna Coil 6. V2, V3, V4, V5 Defective 7. R407 or R408 Defective
INSUFFICIENT CARRIER SUPPRESSION	1. Carrier Balance Control Improperly Adjusted 2. Defective 7360 Balanced Modulator 3. Carrier Oscillator Frequency Incorrect
INSUFFICIENT SIDEBAND SUPPRESSION	1. Excessive MIC. Gain 2. Incorrect PA Load Adjustment 3. Carrier Oscillator Frequency Incorrect
MICROPHONICS IN RECEIVER	1. Z901 Improperly Tuned 2. V14, V10, V8, V7, or V6 Defective
LOW RECEIVER SENSITIVITY	1. PA Grid, Plate, or Load Improperly Set 2. Bandswitch Improperly Set 3. K2 Back Contacts Defective 4. V6, V7, V8, V9, V10, V11, V12 Defective

NOTE: It is recommended that the final tubes be replaced with General Electric tubes for neutralization purposes.

VOLTAGE CHART

TUBE TYPE		PIN NO.											
		1	2	3	4	5	6	7	8	9	10	11	12
V1 6EW6	R	0	.75	6.3	0	130	130	0					
	T	0	.75	6.3	0	125	125	0					
V2 12BD6	R	-90	0	12.6	0	245	240	-90					
	T	-2.0	0	12.6	0	245	100	0					
V3 6GK6	R	0	-30	0	6.3	0	0	255	255	0			
	T	0	-6.0	0	6.3	0	0	250	260	0			
V4 6HF6	R	6.3	—	—	0	-75	0	—	0	-75	0	—	0
	T	6.3	—	—	.12	-75	215	—	215	-75	.12	—	0
V5 6HF5	R	12.6	—	—	0	-75	0	—	0	-75	0	—	6.3
	T	12.6	—	—	.12	-75	215	—	215	-75	.12	—	6.3
V6 12BZ6	R	-.05	.8	0	6.3	230	140	0					
	T	-.5	0	0	6.3	230	-20	0					
V7 12BE6	R	-3.0	0	12.6	0	235	75	.1					
	T	-3.0	0	12.6	0	210	-20	.3					
V8 6EW6	R	-.1	.5	12.6	6.3	230	130	0					
	T	-.1	0.5	12.6	6.3	205	120	0					
V9 12BA6	R	-.05	0	12.6	0	230	105	3.2					
	T	-.5	0	12.6	0	220	-15	0					
V10 12AX7	R	110	-.05	1	12.6	0	160	0	1.5	6.3			
	T	40	-.25	-.5	12.6	0	155	-100	.5	6.3			
V11 6BN8	R	0.2	2.5	0.2	12.6	6.3	0	200	.4	70			
	T	0	2.3	0	12.6	6.3	.3	100	.2	40			
V12 6GK6	R	0	-6	—	12.6	6.3	—	240	230	0			
	T	0	-21	—	12.6	6.3	—	260	230	0			
V13 7360	R	0	0	90	6.3	0	225	225	25	25			
	T	0	70	0	6.3	0	135	135	23	23			
V14 12BA6	R	-7	0	0	12.6	60	100	1					
	T	-7	0	0	12.6	60	100	1					
V15 12AX7	R	95	0	0.8			70	0.2	0	0			
	T	50	0	0.3	6.3	-6.3	50	0.2	0	0			
V16 OA2	R	150	—	—	—	150		0					
	T	150	—	—	—	150		0					
V17 12BA6	R	0	0	12.6	0	240	240	70					
	T	0	0	12.6	0	240	240	70					

All Voltage Measurements Made With Simpson 260, 20 K Ohms per Volt, Or Equivalent

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E. PARTS LIST

CAPACITORS

C101	.002, 20% 1 KV Disc
C102	.01, +80-20%, 500V Disc
C103	.002, 20% 1 KV Disc
C104	.01, +80-20%, 500V Disc
C105	.01, +80-20%, 500V Disc
C106	50, 5% 500V Mica
C201	.01, +80-20%, 500V Disc
C202	40-30-10-20 Mfd. 450-450-450-25 WV Elect.
C203	.002, 20% 1 KV Disc
C204	.001, 5% 500V Mica
C205	82,5% 500V Mica
C206	24, 5% 500V Mica
C207	120, 5% 500V Mica
C208	27, 5% 500V Mica
C209	20, 5% 500V Mica
C210	27,5% 500V Mica
C211	50, 5% 500V Mica
C212	1.5-20pf Mica Trimmer
C213	3.3 pf 10% 500V Ceramic
C214	.1 mf 10% 200V Mylar
C215	100, 5% 500V Mica
C216	-5, 10% NPO Disc
C217	10, 5% 500V Mica
C218	100, 5% 500VMica
C219	1.5-20 pf Mica Trimmer
C301	.01 +80-20%, 500V Disc
C302	.01 +80-20%, 500V Disc
C303	100 5% 500V Mica
C305	100, 5% 500V Mica
C306	27,5% 500V Mica
C307	50, 5% 500V Mica
C308	.002, 20% 1 KV Disc
C309	510, 5% 500V Mica
C310	540, 5% 500V Mica
C311	100, 5% 500V Mica
C312	680, 5% 500V Mica
C313	50, 5% 500V Mica
C314	91, 5% 500V Mica
C315	1.5-20 pf Mica Trimmer
C316	15, 20% 3KV Disc
C317	330, 5% 500V Mica
C318	.002, 20% 1 KV Disc
C319	68pf DM15
C320	1.5-20pf Mica Trimmer
C401	.002, 20% 1 KV Disc
C402	.002, 20% 1 KV Disc
C403	.01, +80-20%, 500V Disc
C404	.01, +80-20%, 500V Disc
C405	.01, +80-20%, 500V Disc
C406	10 mf 150 WV Electrolytic
C407	.01, +80-20%, 500V Disc
C408	.01, +80-20%, 500V Disc
C409	.01, +80-20%, 500V Disc
C410	.002, 1 KV Disc
C411	.002, 20% 2 KV Disc
C412	.002, 20% 2 KV Disc
C413	20 pf P.A. Neut. Trimmer
C414	15, 20% 3 KV Disc
C415	270, 5% 2500V Mica
C416	270, 5% 2500V Mica
C417	320 pf P.A. Tune
C418	50 10% 6 KV Disc
C419	100 10% 6 KV Disc
C420	410 pf P.A. Fine Load
C421	Two 150 ± 5% 1000 WV Mica
C422	Two 150 ± 5% 1000 WV Mica
C423	330, 10% 500V Mica
C424	330, 10% 500V Mica
C425	330, 10% 500V Mica
C426	330, 10% 500V Mica
C427	330, 10% 500V Mica
C428	330, 10% 500V Mica
C429	330, 10% 500V Mica
C430	.002, 20% 1 KV Disc
C431	.47 10% 100V Mylar
C432	.01 Disc SM
C601	.01 +80-20%, 500V Disc
C602	.01 +80-20%, 500V Disc
C603	.01 +80-20%, 500V Disc
C604	10, 5% 500V Mica
C605	5, 10% NPO
C606	100, 5% Mica
C607	1.5-20 pf Mica Trimmer
C701	30, 10% 1 KV Disc
C702	30, 10% 1 KV Disc
C703	.01 +80-20% 500V Disc
C704	220 5% 500V Mica
C705	430 5% 500V Mica
C709	.01, +80-20% 500V Disc
C802	.01, +80-20% 500V Disc
C803	.01, +80-20% 500V Disc
C804	10, 10% 1 KV Disc
C805	.01, +80-20% 500V Disc
C806	50 5% N750 Disc
C807	50 5% N750 Disc
C901	.01 +80-20% 500V Disc
C902	.01 +80-20% 500V Disc
C903	.01 +80-20% 500V Disc
C904	.01 +80-20% 500V Disc
C1001	100, 5% 500V Mica
C1002	220, 20% 1 KV Disc
C1003	.002, 20% 1 KV Disc
C1004	.001, 20% 1 KV Disc
C1005	.001, 20% 1 KV Disc
C1006	.22 mf 200VDC
C1007	500, 20% 1 KV Disc
C1008	.002 20% 1 KV Disc
C1009	.002 20% 1 KV Disc
C1101	.001 20% 1 KV Disc
C1102	.01 +80-20% 500V Disc
C1104	.001 500V Disc
C1201	.01 +80-20% 500V Disc
C1202	220 20% 1 KV Disc
C1203	.0047 10% 1000V Mylar
C1204	.1 200VDC
C1301	.01 +80-20% 500V Disc
C1302	220 20% 1 KV Disc
C1303	.01 +80-20% 500V Disc
C1304	.002 20% 1 KV Disc
C1305	.01 +80-20% 500V Disc
C1306	.01 +80-20% 500V Disc
C1401	27, 5% 500V Mica
C1402	50, 5% 500V Mica
C1403	50, 5% 500V Mica
C1404	15, 5% 500V Mica
C1405	6-30 pf Ceramic Trimmer
C1406	6-30 pf Ceramic Trimmer
C1407	.01 +80-20% 500V Disc
C1501	.01, 400V Mylar
C1502	.01 +80-20% 500V Disc
C1503	.01 +80-20% 500V Disc
C1504	100, 20% 1 KV Disc
C1505	.01 +80-20% 500V Disc
C1506	20 mf 25VDC
C1507	.47 200V
C1601	80 mf, 150 WV Electrolytic
C1602	.01 +80-20% 500V Disc
C1603	1 MF 50V
C1604	2 MF 50V
C1701	270, 2% SM
C1702	470, 5% SM
C1703	430, 2% SM
C1704	27, 5% SM
C1705	430, 2% SM
C1706	5-12 Main Tuning
C1707	.01, 500V Disc
C1708	5 pf Trimmer
C1709	22, N 220 Disc
C1710	10, N 150 Disc
C1711	5, N 150 Disc
C1712	5 pf Trimmer
C1713	10, N 150 Disc
C1714	25 NPO Disc
C1715	5 pf Trimmer
C1716	.01 500V Disc
C1717	2 pf Dial Set
C1718	22, N 75 Disc
C1719	39 NPO Disc
C1720	5 pf Trimmer
C1721	5, N 75 Disc
C1751	5-80 Ceramic Trimmer
C1752	150, 5% 500V Mica
C1A-B	85 pf per section

RESISTORS

R101	82 ohms
R102	56 ohms
R103	47K - 1 watt
R104	12K - 2 watt
R201	27K
R202	18K - 2 watt
R203	4.7K - 1 watt
R204	6.8K
R205	6.8K
R206	4.7K
R207	27K
R301	100K
R302	270K
R303	100 ohms
R304	10K

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R305	8.2K
R306	10K
R401	2.2 Meg
R402	1K
R403	100 ohms
R404	100 ohms
R405	Selected
R406	470 - 5% - 1/2 W
R407	10K - 10 watt
R408	1 ohm - 5% - 1 watt
R409	1 ohm - 5% - 1 watt
R410	10K Bias Pot.
R411	10K - 1 watt
R412	4.7K
R413	4.7K
R601	1K
R602	56 ohms
R603	47K - 1 watt
R604	1K
R701	27K
R702	22K - 1 watt
R801	470 ohms
R802	56 ohms
R803	47K
R804	1K
R902	100 ohms
R903	27K - 1 watt
R904	47 ohms
R905	100K
R906	100K - 5%
R907	1K SMeter Zero
R1001	10K
R1002	1K
R1003	100K
R1004	270K
R1005	2.2 Meg.
R1006	2.2 Meg.
R1007	270K
R1008	1 Meg.
R1009	2.7K
R1010	100K
R1101	470K
R1102	1K
R1103	47K
R1104	2.7K
R1105	270K
R1106	120, 1 watt
R1201	1 Meg. A.F. Gain Po
R1202	470K
R1203	270K
R1204	470K
R1301	47K
R1302	47K
R1303	150K
R1304	4.7K
R1305	5K CAR. BAL. Pot.
R1306	47K
R1307	47K
R1308	100K
R1309	100K
R1310	27K
R1401	1 Meg.
R1402	270 ohm
R1403	27K
R1404	27K
R1405	1K
R1501	150K
R1502	1K
R1503	1 Meg. MIC GAIN Pot.
R1504	270K
R1505	2.2 Meg.
R1506	47K
R1601	800 - 10 watt
R1602	900 - 10 watt
R1603	27K
R1604	27K
R1605	750 - 10 watt
R1606	6K - 10 watt
R1608	100K
R1609	470K
R1610	270K
R1611	270K
R1612	10K RF Gain Pot.
R1613	270K
R1614	27K
R1701	1K, 5%
R1702	1K, 5%
R1703	1K, 5%
R1704	470 ohms 5%
R1705	2.7K
R1706	2.7K
R1707	470 ohms 5%
R1751	1 Meg.
R1752	27K
R1753	100K

COILS

L101	23 mc - 2 uh
L102	16 mc - 4 uh
L103	12 mc - 7 uh
L104	9 mc - 4 uh
L201	28 mc - 2 uh
L202	21 mc - 2 uh
L203	14 mc - 3.2 uh
L204	7 mc - 3.6 uh
L205	4 mc - 11 uh
L206	RFC - 200 uh
L207	5173 kc Trap - Toroid
L301	28 mc - 2 uh
L302	21 mc - 2 uh
L303	14 mc - 3.2 uh
L304	7 mc - 3.6 uh
L305	4 mc - 11 uh
L306	RFC - 200 uh
L401	14 mc - 0.8 uh
L402	4 mc - 6 uh
L403	RFC - 38 uh
L404	RFC - 200 uh
L405	RFC - 55 uh
L406	RFC - 17 uh
L601	28 mc - 1.2 uh
L602	5175 kc - 90 uh
L603	13 mc, 30 uh
L604	13 mc, 1.5 uh
L605	18 mc, 17 uh
L701	RFC - 200 uh
L1001	RFC - 200 uh
L1701	80/20M - VFO Coil
L1702	40M - VFO Coil
L1703	15M - VFO Coil
L1704	10M - VFO Coil
L1705	RFC - 200 uh
L1706	RFC - 200 uh

TRANSFORMERS

Z301	Parasitic Suppressor
Z401	Parasitic Suppressor
Z501	Parasitic Suppressor
Z801	5175 kc I.F. Trans.
Z901	5175 kc I.F. Trans.
Z1301	5175 kc BAL. MOD. Trans.
T1201	A.F. Output Trans.

SWITCHES

S-1	Power On-Off (part of AF & RF Gain Control)
S-2	CAL-REC-TUNE-CW
S-3	VOX PTT
S-4	A-B-C-D-E-F Bandswitch
S-5	PA Coarse Load
S-6	Sideband Selector
S-7	ANL ON-OFF Switch
S-46	OSC. Selector

DIODES

D401	TS-2 ALC Diode
D402	TS-2ALC Diode
D1001	IN 34A ANL
D1002	IN 34A ANL
D1601	1N 2974A Zener
D1602	TS-2 Relay Quieting
D1603	TS-2 AGC Charging bypass

RELAYS

K1	4PDT Relay, 12 VDC Coil
K2	PDT Relay, 12 VDC Coil

CRYSTALS

Y1401	5176.8 KC Car. Osc.
Y1402	5172.8 KC Car. Osc.
Y1751	100 KC Crystals Calibrator

TUBES

V1	6EW6 VFO Amplifier
V2	12BE6 Trans. Mixer
V3	6GK6 P.A. Drive
V4	6HF5 Power Amplifier
V5	6HF5 Power Amplifier
V6	12BZ6 Rec. R.F. Amp.
V7	12BE6 Rec. Mixer
V8	6EW6 1st I.F. Amp.
V9	12BA6 2nd I.F. Amp.
V10	12AX7 Prod. Det./Rec. A. F.
V11	6BN8 AGC Amp./Rect.
V12	6GK6 A.F. Output Amp.
V13	7360 Bal. Mod.
V14	12BA6 Carrier Oscillator
V15	12AX7 Mic. Amplifier
V16	OA12 Voltage Regulator
V17	12VA6 100 kc Oscillator

TRANSISTORS

Q1	2N706
Q2	2N706

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