INSTALLATION, OPERATION AND MAINTENANCE

SWAN MODELS 350B AND 350D SINGLE SIDEBAND TRANSCEIVERS

scan by IW2HEU

SWAN ELECTRONICS
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INTRODUCTION

The Swan Model 350B and 350D Single Sideband Transceivers are 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. The model 350B incorporates a translucent, calibrated, moveable dial while the Model 350D incorporates a digital frequency display utilizing six seven-segment display units.

Power output on all band exceeds 125 watts P.E.P. on all single sideband frequencies and 90 watts on CW. These transceivers include automatic gain control (AGC), automatic level control (ALC), and grid block keying.

The basic transceiver provides coverage of all portions of the 80 through 10 meter amateur bands. The internal AC power supply permits fixed station or portable operation wherever 117 volts 50-60 cycles is available. Export models for 208-220-240 volts are available on special order.

For 12-14 volt DC operation in mobile, marine or portable applications, a DC converter unit, Model 14A is available. It attaches to the rear of the transceiver in place of the AC power cord connector. Its dimensions are 1-1/2 x 3 x 4 inches.

The Model 350B and 350D generate single sideband signals by means of a crystal lattice filter which removes the carrier and one of the sidebands. Provisions are included in the transceiver for operation on either the upper or the lower sideband. Transmitter and receiver circuits are tuned by a common front panel control so that the transmitter frequency is always tuned to the indicated receiver frequency.

The basic circuits of the 350B and 350D transceivers, which are of the single conversion design, have been proven in several thousand of the popular Swan transceivers. Mechanical, electrical, and thermal stability are exceptionally high. All oscillators are temperature compensated and voltage regulated. Push-to-talk operation is standard, with provision for plug in connection of the Model VX-2 accessory VOX unit for automatic voice control of the transmitter.

SPECIFICATIONS

Table 1. Specifications, Model 350A and 350D.

Frequency Ranges	80 Meters 3.5 to 4.0 MHz. 40 Meters 7.0 to 7.300 MHz. 20 Meters 14.0 to 14. 350 MHz. 15 Meters 21.0 to 21.450 MHz. 10 Meters 28.0 to 29.7 MHz.
Power Output	Single Sideband: 125 Watts (Approx. 10% less on 15 and 10 Meters). CW: 90 Watts (Approx. 10% less on 15 and 10 Meters).
Distortion	Meets FCC Type Acceptance requirements for spurious and harmonic suppression.
Unwanted Sideband Supression	Unwanted sideband suppressed by more than 50 db.
Carrier Suppression	Carrier supressed by more than 50 db.
Selectivity	Provided by 5500 KHz crystal lattice filter, 2700 Hz wide at 6 db down, 4600 Hz wide at 50 db down. Shape factor of 1.7 with ultimate rejection greater than 100 db.
Receiver Sensitivity	Less than 0.5 microvolt at 50 ohms impedance for signal-plus noise ratio of 10 db.
Audio Output and Response	3 watts to 3.2 ohm load. Response essentially flat from 300 to 3000 Hz in both receive and transmit.
Transmitter Output Impedance	Wide range pi-L network output matches resistive loads from 50 to 75 ohms.
Metering	Power amplifier cathode current 0-400 ma. on transmit, S-Meter 0-40 db over S9 on receive.

(Continued)

Table 1. (Continued)

Front Panel Controls and Indicators	A.F. Gain, R.F. Gain, Sideband Selector, Cal-Rec-Tune/CW, Mic Gain, Carrier Balance, P.A. Plate Tune, Driver Tune, P.A. Load, Dial Set (350B Only), Meter Switch, CW Selectivity Switch, Digital Frequency Display, Display Dimmer. (Frequency Display and Dimmer - 350D Only).
Rear Panel Controls	Bias Potentiometer, CW key jack, Jones power connector, Antenna jack, S-Meter Switch, Auxiliary relay switching, Headphone jack, Sidetone On/Off Switch. The VOX connector is located on the side of the chassis.
Frequency Counter (Model 350D Only)	Displays Receiving/Transmitting frequency on 6-digit display. Display consists of 0.3 inch high, seven-segment LED's.
Vacuum Tube Complement	V1 12BA6 VFO Amplifier. V2 12BE6 Transmit Mixer. V3 6GK6 Driver. V4 6MJ6 Power Amplifier. V5 6MJ6 Power Amplifier. V6 12BE6 Receive Mixer. V7 12BA6 First I.F. Amplifier. V8 12BA6 Second I.F. Amplifier. V9 12AX7 Product Detector/Receive Audio Amplifier. V10 6GW8 Audio Amplifier. V11 12AX7 Microphone Amplifier. V12 6AV6 AGC Amplifier.
Transistor Complement	**350D Counter Only** Q1 40822 Buffer. Q2 40822 Buffer. Q3 2N5670 Reference Oscillator. Q4 MPS-H81 Buffer. Q5 MPS-H81 Buffer. Q6 MPS-5172 Oscillator Buffer. Q7 - Q13 MPS-5172 Segment Drivers. Q14 MPS-5172 Level Translator Q15 MPS-H81 Pulse Shaper. **350B and 350D Main Chassis** Q1 40673 Oscillator. Q2 1N5670 Buffer. Q3 MPS-H-10 Carrier Oscillator.
Integrated Circuits	**350D Counter Only** A1 78L05UC Voltage Regulator. A2 7812 Voltage Regulator. A3 74LS02 Quad NOR Gate. A4 CD4011B Quad NAND Gate. A5 CD4013B Flip Flop (Frequency Divider). A6 74LS00 Quad NAND Gate A7 CD4011B Quad NAND Gate. A8 74LS190 Counter (Frequency Divider). A9 CD4020 Counter (Frequency Divider). A10 74C90 Counter (Frequency Divider). A11 CD4013B Flip Flop (Frequency Divider). A12 CD4023B Quad NAND Gate. A13 MC1416P Digit Driver A14 50938 6-Decade Counter/Display Decoder. A15 555 Timer (Scan Pulse Generator). **350B Calibrator Only** A1 7400 Quad NAND gate. (Calibrator Oscillator/Buffer). A2 7490 Counter (Frequency Divider). A3 7490 Counter (Frequency Divider). A4 7474 Flip Flop (Frequency Divider).
Power Requirements	117V AC, 50 Hz at 4 Amps. (208-220-240V AC at 25 Amps. Max., Export Model). 12-14V DC with Model 14A Converter plugged into back of transceiver. Current Drain: 8 Amps. in receive mode, 12 Amps. average with voice modulation. 25 Amps max., in Tune mode.
Dimensions	5-1/2 inches high by 13 inches wide by 11 inches deep. (14 cm. by 33 cm by 28 cm.).
Weight.	24 lbs. (10.9 Kgs).

INSTALLATION

GENERAL

Installation of the Swan Models 350B and 350D transceivers is not at all difficult and it involves only the placement of the transceiver in its operational area (fixed or mobile), connection of power (117VAC, 208/220/240VAC or 12 volts DC, as appropriate), and the connection to an antenna. The following paragraphs are, therefore, devoted to the installation requirements involving microphones, fixed and mobile operation, and recommended antenna types.

PRE-INSTALLATION INSPECTION

Prior to installation of the Model 350B or 350D, verify that the power cord is removed from the rear panel connector. Then remove the cover of the unit (three screws on either side of the cabinet).

WARNING

HIGH VOLTAGE, dangerous to life, is present at the plate connection of the power amplifier tube whenever the power supply is energized.

Locate the P.A. compartment and remove the packing material around the P.A. tube. Inspect the transceiver for any damage that may have been incurred during shipment. If in-shipment damage is in evidence, contact the Swan dealer from whom you purchased the transceiver or the carrier's agent, if the unit was shipped to you by a common carrier. Do not return the unit to the factory for repair of damage incurred in shipment before the carrier's agent has authorized repairs. Also, do not return the unit to the factory without obtaining authorization by telephone or letter. Prior authorization of return insures that your unit will be handled expeditiously on its receipt and will be returned to you with the least delay.

Since the installation and tune up of the transceiver, as described in the following paragraphs, requires a knowledge of the operating procedures, it would be well to review the operation section of this manual prior to proceeding with the installation instructions.

FIXED INSTALLATION

Locate the transceiver in an area which is well ventilated and which will provide complete operational freedom of the front panel controls. Connect a heavy wire from earth ground to the ground stud provided on the rear of the chassis. Though not essential, this is recommended. Connect the AC power cord to the 12-pin Jones connector on the rear panel. If the transceiver is a 117 volt model, plug the power cord into a standard 117 volt, 50-60 cycle outlet having a capacity of at least 10 amperes. If the transceiver is an Export Model, it should first be set to the proper voltage tap: 208, 220 or 240 volts, 50-60 cycles. Remove the cabinet, and locate the terminal strip near the top of the power transformer. There are 3 terminal lugs, and a decal indicates the voltage tap for each. Connection has been made to the 220 volt tap at the factory. If your supply voltage is 208 or 240, unsolder the red wire and move it accordingly.

Connect an antenna to the transceiver which is suitable for the band on which it is to be used.

FIXED ANTENNAS

A standard PL259 coax connector plug will fit the transceiver's antenna jack. A 50 or 75 ohm coaxial cable is recommended for the connection between transceiver and antenna. RG-58 or RG-59 is satisfactory for runs up to 50 feet. For longer runs, the larger RG-8 or RG-11 produces less line loss, particularly on 10 meters.

Any of the common antenna systems designed for use on the amateur high frequency bands will work well with the Model 350B or Model 350D. However, the amateur should consider an antenna system which best fits his operational requirements. For example, a rotatable beam antenna is usually best suited on the 20, 15 and 10 meter bands for DX operation, and an inverted "V" or similar antenna is usually best suited for 80 and 40 meters. Methods for constructing antennas and antenna tuners are described in detail in the ARRL Antenna Handbook and similar publications. It is recommended that these publications be consulted during the design of any antenna system.

MOBILE INSTALLATION

Many different methods of mobile installation are possible, and it is expected that hams will find methods which are best suited for their installation requirements. Swan Electronics has available a Mobile Mounting Kit which is suitable for under-the-dash installations. Figure 1 shows the recommended mounting methods using this kit.

DC CONVERTER, MODEL 14A

For 12-14 volt DC operation in mobile installations, it will be necessary to use the 14A converter, which plugs directly onto the rear of the transceiver in place of the AC power connector. This accessory is available from your Swan dealer. Refer to installation instructions supplied with the 14A converter.

MICROPHONE

The microphone input circuit of the 350B and 350D transceivers will operate properly only with high impedance microphones. The operator should give serious consideration to his choice of microphone since it's important for good speech quality. 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 important that the selected microphone have a smooth, flat response throughout the speech range. The microphone jack on the front panel of the 350B and 350D transceivers accepts a standard 1/4-inch diameter, three contact microphone plug. The tip terminal will be connected to the push-to-talk switch of the microphone to provide relay control of the transmitter. The ring terminal will be connected to the microphone element and the sleeve is the common chassis ground. The microphone manufacturer's instructions should be followed when connecting the microphone cable to the plug. Either a hand-held or desk type microphone with push-to-talk control will provide a suitable installation.

VOX operation requires that the microphone element be connected to the microphone input circuit at all times. The Swan Model 444C microphone may be used, without modification, for either push-to-talk or VOX operation. If other types of microphones are used, it is suggested that the microphone manufacturer be contacted on directions for modification of the microphone for VOX operation.

MOBILE ANTENNAS

Mobile antenna installations are quite critical since the antenna represents a number of compromises when used on the high frequency bands. Many amateurs lose the efficiency of their mobile antennas through improper tuning. Points to remember about the mobile antenna are:

1. The "Q" of the antenna loading coil should be as high as possible. There are several commerical models available which are high "Q" coils, including the Swan Models 35, 45 and 55 mobile antennas. (Contact your Swan distributor or Swan Electronics for details).

2. The loading coil must be capable of handling the power of the Model 350B or 350D without overheating. In the TUNE position, the power output of the transceiver may exceed 120 watts. Wide spaced, heavy wire loading coils are essential.

3. The VSWR bridge is a useful instrument. Unfortunately it is quite often misunderstood and, perhaps, overrated in importance. Basically, the VSWR bridge will indicate how close the antenna load impedance is matched to the transmission line. With long transmission lines, such as will be used in many fixed station installations, it is desirable to maintain the impedance match fairly close so as to limit power loss. This is particularly true at the higher frequencies. The longer the line, and the higher the frequency, the more important VSWR becomes. However, in mobile installations the transmission line seldom exceeds 20 feet in length, and a VSWR of even 4 to 1 adds very little to power loss. The only time VSWR 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 cases, VSWR 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 of relying entirely on the VSWR bridge lies in the fact that it is sometimes possible to reduce the VSWR reading by detuning the antenna. Field strength may actually be reduced in an effort to bring VSWR down. Since field strength is a primary goal, we recommend a Field Strength Meter for antenna tuning.

5. For antenna adjustment, the Swan 350B or 350D may be loaded lightly to about 100 milliamperes cathode current instead of the usual 200-300 milliamps. This will limit tube dissipation during adjustments, and will also help reduce interference on the frequency. In any case, do not turn the transmitter on for long periods at one time. Turn it on just for the time required to tune and load and obtain a field strength reading.

Begin the tuning adjustment with the antenna whip tuned to the center of its adjustment range. Set the VFO to the desired operating frequency and then adjust P.A. TUNE for a dip in the front panel meter reading. Then adjust P.A. LOAD for one hundred milliamperes. Observe the field strength reading. The Field Strength Meter may be set on top of the dash, or the hood, or at an elevated location some distance from the vehicle.

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

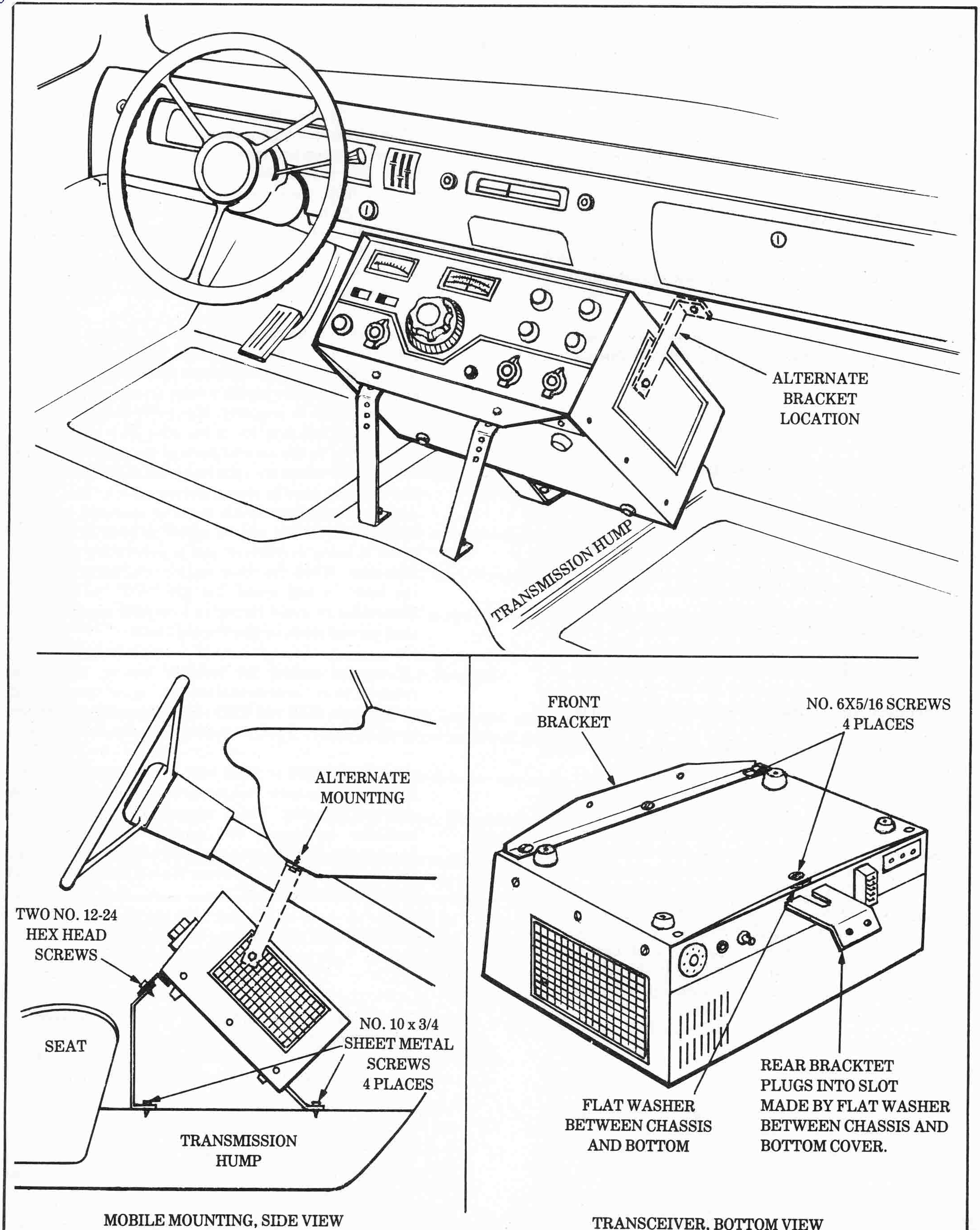


Figure 1. Mobile Mounting on Transmission Hump.

OPERATION

CONTROL FUNCTIONS

The names and functions of the front panel controls of the Model 350B and 350D transceivers are listed in Table 2.

RECEIVE OPERATION

1. Rotate the AF GAIN Control clockwise to about the 3 o'clock position. The power switch will operate applying 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 BANDSWITCH to desired band.

   b. Rotate MIC. GAIN fully counter-clockwise.

   c. Rotate CAR. BAL. control to the midscale position.

   d. Set P.A. TUNE control fully counter-clockwise.

   e. Set DRIVER control to mid-position.

   f. Set P.A. LOAD fully counter-clockwise.

   g. Set tuning dial to desired operating frequency.

   h. Set RF GAIN control to its full clockwise position.

3. Carefully adjust the DRIVER and the P.A. TUNE controls for maximum receiver noise.

NOTE

The DRIVER control resonates the transmitter driver stages and the receiver RF amplifier plate circuit. The P.A. TUNE and P.A. 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 receive position will result in approximately resonant conditions in the transmitter stages.

RECEIVER TUNING

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 your receiver such that the voice of the other operator is higher than normal pitch, you'll be off frequency when you transmit and your voice will sound lower than normal pitch to the other operator. He will then probably retune his dial to make you sound natural. If this is continued, you will both 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 of the receiver results in serious harmonic distortion of the voice, and should be quite noticeable to the average ear. Some operators claim that if they don't know how the other person's voice actually sounds, they can't tune him in properly. However, this is not true. With just a little practice, it becomes fairly easy to tune the receiver to the natural pitch of the other operator's voice. 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 overdriven and is generating excessive distortion. When the other station is tuned in "right on the nose", it will sound just like "AM", so to speak. Remember to avoid tuning so everyone sounds higher than normal pitch, or like Donald Duck.

3. A vernier control for receiver tuning, sometimes referred to as "incremental tuning," is not incorporated in the Swan 350B and 350D transceivers. Such a device is not necessary if proper tuning habits are excerised.

4. Your Swan 350B or 350D will, automatically, transmit on exactly the same frequency as the station to which you are listening. These transceivers use the same oscillator to control the receiver and transmitter frequencies. If separate control of receive and transmit frequency is desired, the Swan Models 508 or 510X VFO units may be used.

TRANSMITTER TUNING

NOTE

The following five paragraphs contain important information that, when followed, will prevent damage to the power amplifier tube. These should be read carefully and should be kept in mind whenever you are tuning the transmitter.

1. The most important detail to keep in mind when tuning the transmitter portion of your Swan 350B or 350D is that ***the P.A. TUNE control must be resonated as quickly as possible!***

2. This is accomplished by adjusting the P.A. TUNE for minimum meter reading with the Function switch in

Table 2. Front Panel Control Functions.

CONTROL	FUNCTION
ON-OFF Switch	Turns power supply on and off.
CAL-REC-TUNE/CW	**Calibrate:** All voltages applied to receiver. Receive: All voltages applied to receiver. **Tune/CW:** Transmitting circuits are energized. C141 is ungrounded shifting frequency into filter passband. Carrier is fully inserted. P.A. Cathode resistor is switched in, reducing power.
MIC GAIN	Controls potentiometer R87 in the grid of V11-A and controls amount of audio to the balanced modulator.
CAR. BAL.	Controls potentiometer R98 in the balanced modulator and permits nulling out of carrier.
R.F. GAIN	Controls variable resistor R114, common in the grids of Receiver Mixer, R.F. Amplifier and V8 I.F. Amplifier.
A.F. GAIN	Controls potentiometer R69 in grid circuit of V10, A.F. Output, and controls audio volume.
MAIN TUNING	Controls C21 in frequency determining tank circuit of VFO.
DRIVER	Controls C40 and C50 in plate tanks of transmitter mixer and driver.
P.A. TUNE	Controls C62 in pi-network to tune final power amplifier plate to resonance.
P.A. LOAD	Controls C68 in pi-network to match impedance of output load. Tunes input to Receiver R.F. Amplifier.
BANDSWITCH	Switches tank coils and associated capacitors in VFO, VFO Amplifier, Driver, Transmit Mixer and Final Amplifier.
NORM-OPP	Selects upper or lower sideband.
METER SWITCH	Selects S-Meter/Relative Output or P.A. Cathode current reading.
CW FILTER SWITCH	Selects audio pass band for CW Receive.

TUNE position. P.A. cathode current, as indicated by the meter, will show a "dip" as P.A. TUNE is rotated through resonance. Stop at the "dip," or minimum reading.

3. The P.A. tube is dissipating all the input power when it is not in resonance, and can be permanently damaged in just a few seconds.

4. When resonance has been established, the P.A. may operate at full power for quite awhile, although we recommend 30 seconds as a safe maximum. But, it is most important to realize that the 30 second limit (which is accumulative) assumes that the P.A. TUNE control has been immediately resonated. This rule applies generally to all transmitters.

5. Do not tune more often than necessary. You should not have to retune except when changing bands or antennas. The P.A. tube will last for many months, or even years, of normal operation, but excessive tuning will shorten tube life.

TRANSMITTER TUNING STEPS

1. Set the front panel controls as follows:

P.A LOAD —	(3.5 MHz Band)	11 O'clock.
	(7.0 MHz Band)	11 O'clock.
	(14.0 MHz Band)	1 O'clock.
	(21.0 MHz Band)	2 O'clock.
	(28.0 MHz Band)	2 O'clock.

P.A. TUNE — 9 O'clock.

DRIVER — 12 O'clock.

CAR BAL — 12 O'clock.

MIC GAIN — Full Counterclockwise.

CAUTION

If the foregoing adjustments are not made as directed, spurious signals will be produced at the output of the transceiver.

NOTE

Initial settings for P.A. TUNE, P.A LOAD and DRIVER can also be determined in the receive mode by adjusting all three for maximum noise from the speaker output.

2. Set the Meter switch to P.A. CATH and the Mode switch to REC.

3. Key the transmitter with the microphone switch. Adjust CAR BAL for minimum P.A. cathode current.

4. Adjust P.A. Bias control on rear panel for Δ Indication on meter.

5. Key the transmitter and adjust CAR BAL control for 100 ma (1) indication on meter.

6. ***Quickly peak DRIVER*** for maximum meter indication, then unkey transmitter.

7. Place meter switch in S-Meter position. S-Meter reads relative transmitter power output in S-Meter position.

8. Turn Mode switch to TUNE and ***quickly adjust P.A. TUNE and P.A. LOAD*** for maximum meter indication. First one, then the other. Unkey transmitter by returning Mode switch to RECEIVE.

CAUTION

P.A. TUNE and P.A. LOAD will interact. Repeat adjustments until further peaking is not possible. Minimize time that transmitter is keyed. If tuning takes more than 30 seconds, unkey transmitter for a few seconds, then rekey and make adjustments quickly.

9. Place meter switch in P.A. CATH position. Key transmitter with microphone switch and minimize meter reading with CAR BAL control. Unkey transmitter.

10. The preceding step completes the Transmitter Tuning procedure.

Note that the 350B and 350D operate at reduced power in the TUNE-CW mode. The P.A. cathode bias resistor, R36 is in the circuit during TUNE and CW operation. In voice mode, the bias resistor is shorted out and the transceiver operates at full rating.

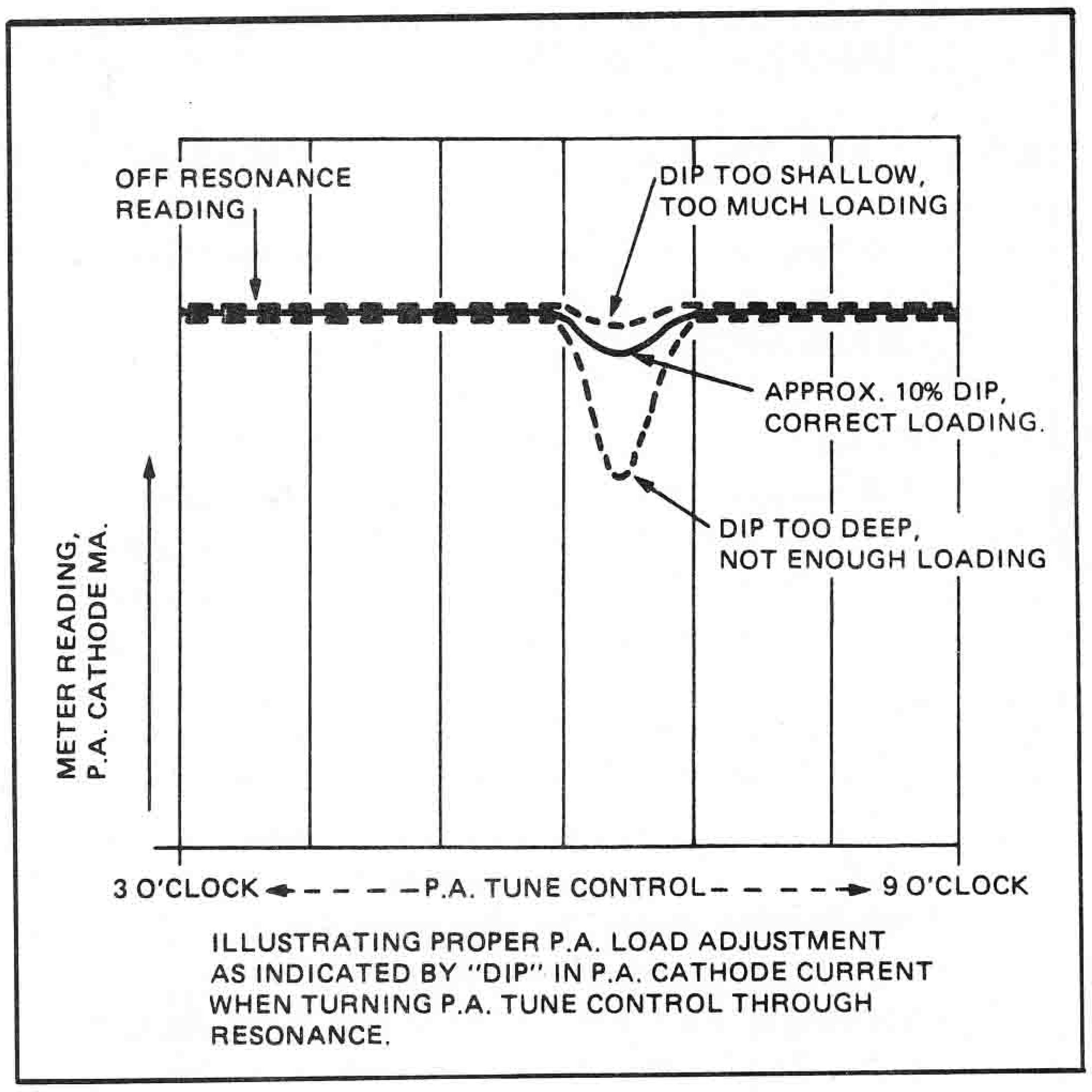


Figure 2. Interrelation of P.A. Tuning and P.A. Cathode Current.

VOICE TRANSMISSION

After tuning up as outlined above, switch to REC position. Press the microphone switch and then carefully set the CAR. BAL. control for minimum meter reading. While speaking into the mike, slowly rotate the MIC. GAIN control until occasional peak readings of 110 to 130 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, 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 125 watt rating of your Swan transceiver.

NOTE

Transceiver will not modulate properly with Function Switch in CAL. position.

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 button pressed, rotate CAR. BAL. control until cathode current is approximately 75 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

1. Insert a CW Key in the Key Jack on back of the Transceiver.

2. Close the key and tune the transmitter as outlined in Step 5. Power output will be approximately 110 watts.

3. In CW operation it will be necessary to switch the Function control back to REC. for receiving and then to CW for transmitting.

4. When communicating on voice, the transmit and receive frequency are identical. However, this would be disadvantageous on CW. The Swan Models 350B and 350D use an "Off-Set CW Transmit Frequency" scheme. During reception, the carrier oscillator is located 300 Hz outside the passband of the crystal lattice filter. During transmission, it is moved higher by approximately 800 Hz placing it well within the filter passband. This automatic frequency shift makes it unnecessary to retune the receiver after every transmission.

VOX OPERATION

To operate the Model 350B or 350D in the VOX mode, it is only necessary to follow the instructions furnished with the VX-2 VOX accessory.

DIAL CALIBRATION (MODEL 350B ONLY)

The Model 350B is equipped with an internal crystal controlled calibrator that enables accurate calibration of the tuning dial. The calibrator generates markers spaced throughout the tuning range of the 350B. The odd 100 KHz markers (3500 KHz, 3700 KHz, etc.) are the strongest and the others are considerably weaker. To calibrate the dial, first set the dial to a frequency that is an odd 100 KHz harmonic of the calibrator and which is nearest to the frequency on which you wish to operate. (For example, if you wish to operate on 3827.5 KHz, set dial to 3900 KHz). Turn the Mode switch to CAL and, with the DIAL SET control, zero beat the calibrator signal. The dial is now calibrated at 3900 KHz. Next set the dial to the 25 KHz mark on the dial that is nearest to your selected operating frequency (3825 KHz). Zero beat the calibrator signal heard there. (It should require only a very small amount of rotation of the DIAL SET control to obtain zero beat at this point). The dial is now calibrated accurately in the area in which you wish to operate and will be accurate within 100 KHz of the point of calibration.

350D FREQUENCY COUNTER DISPLAY

The frequency counter/display of the Model 350D uses a 5.242880 MHz crystal controlled oscillator as a reference. The oscillator frequency is divided to 160 Hz and 80 Hz to operate a system of gates that pass the VFO signal and then the Carrier Oscillator signal for precise periods of time. The gate time periods are such that the number of VFO and Carrier Oscillator cycles counted is equal to the VFO plus the Carrier on the 20, 15 and 10 meter bands and the VFO minus the Carrier on the 80 and 40 meter bands. A large scale integrated (LSI) circuit counts the oscillator cycles and stores the number internally. It then performs the BCD to seven-segment conversion required to drive the digital display. The display digits are multiplexed which enables all six display digits to be serviced by a single set of outputs on the LSI chip. The scan rate is constant but the time each digit display is driven may be varied from the front panel to control display brightness.

350D FREQUENCY DISPLAY CALIBRATION

The calibration of the Model 350D Frequency Counter/Display is accomplished at the factory and field adjustment will normally consist of checking the frequency of the clock oscillator in the Frequency Counter/Display.

CIRCUIT THEORY

GENERAL DISCUSSION

The Swan Models 350B and 350D transceivers provide single sideband, suppressed carrier operation in both the receive and transmit modes. In an amplitude modulated (AM) system (double sideband with carrier), a radio frequency is modulated with an audio frequency signal. When viewing the modulated envelope on an oscilloscope, it appears that the carrier level is merely varied at the audio rate. However, a transmitter amplitude modulation system is a type of mixer. Its output contains the two input frequencies (RF and audio) and their products which are equal to their sums and differences. (The RF circuits at the output of the modulated stage present a very low impedance to the modulating audio signal and it is lost from the output). The carrier and the mixer products, which are the upper and lower sidebands, are present at the output of the modulated stage.

The detector stage of the AM receiver is yet another type of mixer. One product of mixing the sidebands and carrier is a reproduction of the audio signal that modulated the transmitter. The detector load presents a low impedance to the rectified carrier and sidebands but a relatively high impedance to the recovered audio signal. Therefore, the sidebands and carrier are lost and only the audio remains.

The AM system is inefficient since all of the intelligence is contained in the sidebands which represent one-third of the total transmitted power. The carrier contains no intelligence whatever. Moreover, one sideband contains as much intelligence as both sidebands. Therefore, if the carrier and one sideband are suppressed, and all the available transmitter energy used to transmit a single sideband, the transmitter range will be measurably increased. Since less band width is required to transmit and receive a single sideband, more efficient use of the available spectrum is achieved as well as improved signal to noise ratio.

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 levels. 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 present 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.

For the following discussion refer to the schematic diagram, and Figures 3, 4 and 8.

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 Q4 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 RF output of the oscillator is injected into Balanced Modulator, A8. A8 is a type 1496 integrated circuit Balanced Modulator. The amplified microphone audio and the carrier are mixed in A8, generating frequencies that are equal to the sum and difference of the two input signals. The sum and difference frequencies appear across the primary winding of T2. The carrier has been suppressed by 50 db or more.

The double sideband, suppressed carrier signal is then coupled from the secondary winding of T2 to the crystal filter, which suppresses the unwanted sideband, and permits only the selected sideband to be fed to the First IF Amplifier, V7. The carrier frequency is generated at approximately 5500.0 KHz, normal sideband. With opposite sideband, the carrier crystal frequency will be 5503.3 KHz, and this positions the double sideband signal on the other side of the filter response curve, attenuating the unwanted sideband by at least 50 db. In the single conversion mixing process, these sidebands become inverted on 80 and 40 meters. Thus, the Swan 350B and 350D normally operate on lower sideband on 80 and 40 meters, while on 20, 15 and 10 meters, normal operation is on upper sideband.

Q1, the 40673 VFO Oscillator, is connected as a Colpitts oscillator with Q2, Q3 and V1 operating as buffers to isolate the oscillator from the load. A7 provides excellent regulation of the +8V supply which contributes to the stability of the VFO frequency.

Bandswitching of the VFO is accomplished by changing the VFO tank circuit coil. The VFO exhibits extremely good stability after the initial warm-up period. Drift from a cold start will be less than 1 KHz for the first hour on 80, 40 and 20 meters and less than 2 KHz on 10 and 15 meters. After initial warm-up, drift will be negligible

The single sideband, supressed carrier signal from the first IF amplifier is fed to the Transmitter Mixer, V2, where it is subtractively mixed with the output of the VFO Amplifier, V1, on 40 and 80 meters. On 20, 15 and 10 meters, the frequencies are additively mixed. Therefore, the output of the Transmitter Mixer is LSB on 80 and 40 meters and USB on 20, 15 and 10 meters. The output of the Transmitting Mixer is amplified by the Driver, V3, and the Power Amplifier, V4.

When in TRANSMIT, the gain of the First IF Amplifier is controlled through the Automatic Level Control network (using the AGC Amplifier V12) to control the gain of the stage in response to the average input power to the Power Amplifier. 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. The ALC feature will help prevent flat topping and generation of spurious emissions, but considerable distortion may occur if the Mic. Gain Control is not properly adjusted. Refer to Operating Instructions.

TUNE AND CW OPERATION

Normally, the frequency of the carrier oscillator is approximately 300 Hz outside the 6 db passband of the crystal lattice filter. In TUNE position, the frequency of the carrier oscillator is moved approximately 800 Hz 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.

CW FILTER

The CW Filter consists of A6-A, A6-B and associated components connected as active filters. In the 100 Hz position of the CW FILTER Switch, the output of V9-A is passed through the circuit of A6-A which narrows the audio passband to 700-900 Hz. The output of A6-A is then applied to the input of the audio amplifier. When the switch is in the 80 Hz position the output of A6-A is passed through the circuit of A6-B before being applied to the audio amplifier. A6-B further narrows the passband to 720-880 Hz.

RECEIVE

In RECEIVE position, or at any time when the transmitter is not in TRANSMIT, all circuits used in transmit only are disabled through relay RY1. The relay is energized for transmitting and de-energized for receiving. One contact, when de-energized, allows signals from the transmitting tank circuit and antenna to be fed to the Receiver RF Amplifier, V5, where they are amplified and then fed to the control grid of the Receiver Mixer, V6. 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 5500.0 KHz, through V7 and V8 IF amplifiers. In the Product Detector, V9A, the IF signal is heterodyned with the carrier frequency generated by Carrier Oscillator, Q4. The resultant audio is then amplified by V9B, which then couples to V12, the AGC amplifier, and V10, the output audio stage.

FREQUENCY CALIBRATION

Frequency calibration of the Model 350B is in 5 KHz increments on 80, 40, 20 and 15 meters, and in 20 KHz increments on 10 meters. Dial accuracy and tracking are very good on the 350B, but caution must always be observed when operating near band edges. Measuring the frequency with the crystal calibrator when working near band edges is recommended.

DIAL SET (MODEL 350B ONLY)

A dial-set has been provided so that dial adjustment can be made on any point of the dial. With the calibrator on, set the dial to the 25 KHz point closest to the frequency you wish to work. Now adjust the dial-set control to zero-beat the VFO with the crystal calibrator. This provides greater accuracy of dial readout.

CAUTION

Care must be exercised when tuning for the calibrator signals. The odd 100 KHz harmonics will be strongest. The even 100 KHz, and all 75 KHz, 50 KHz and 25 KHz harmonics will be considerably weaker.

The internal crystal calibrator has a 10 MHz crystal oscillator that is applied to a frequency divider. The divider has 100 KHz, 50 KHz and 25 KHz outputs that are all summed and applied, through a small coupling capacitor, to the input of the receive RF amplifier. Since these signals are, essentially, square waves, they are rich in harmonics and provide calibration signals throughout the tuning range of the receiver.

TRANSMIT AND RECEIVE SWITCHING

Transmit and receive switching is performed by relay RY1. In the TRANSMIT position, only those tubes that operate in the transmit mode are operative. In the RECEIVE position, the tubes that are used only in transmit are cut off. Relay RY1, when de-energized, feeds signals from the output pi-network to the receiver, and is used also to control external switching circuits. In transmit, the meter indicates the cathode current of the P.A. when the meter switch is in the P.A. CATH position or relative output from the P.A. when in the S-METER position. In receive, with the switch in the S-METER position, the meter indicates the voltage across R126 in the screen circuit of the first IF amplifier, V7, which is inversely proportional to the AGC voltage used to control the gain of the tube. Thus, the meter indicates the relative strength of the received signals.

POWER RATING

The Swan 350B and 350D are capable of over 200 watts, PEP input under steady-state, two-tone conditions. The peak envelope power, when voice modulated, is considerably greater, typically 300 watts or more.

The built-in power supply produces no-load plate voltage of approximately 800 volts. Under TUNE conditions, or CW operation, this will drop to approximately 680 volts, and the maximum input power will be reduced accordingly. 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. Under typical operating conditions, peak plate current, before flat topping, will be 375 ma at 800 volts, to result in an input of 300 watts, P.E.P. Readings of

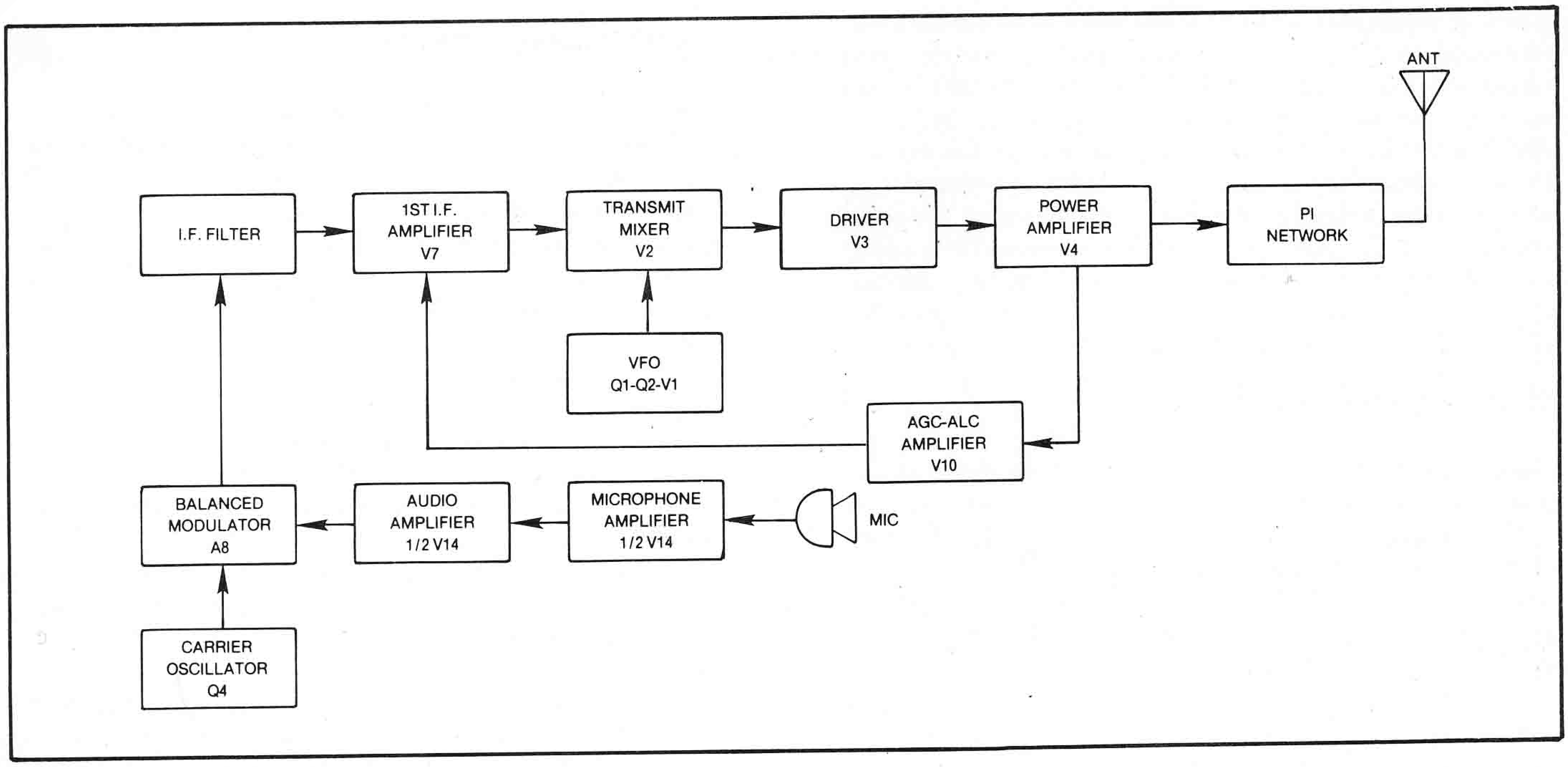


Figure 3. Block Diagram, Model 350B/350D in Transmit Mode.

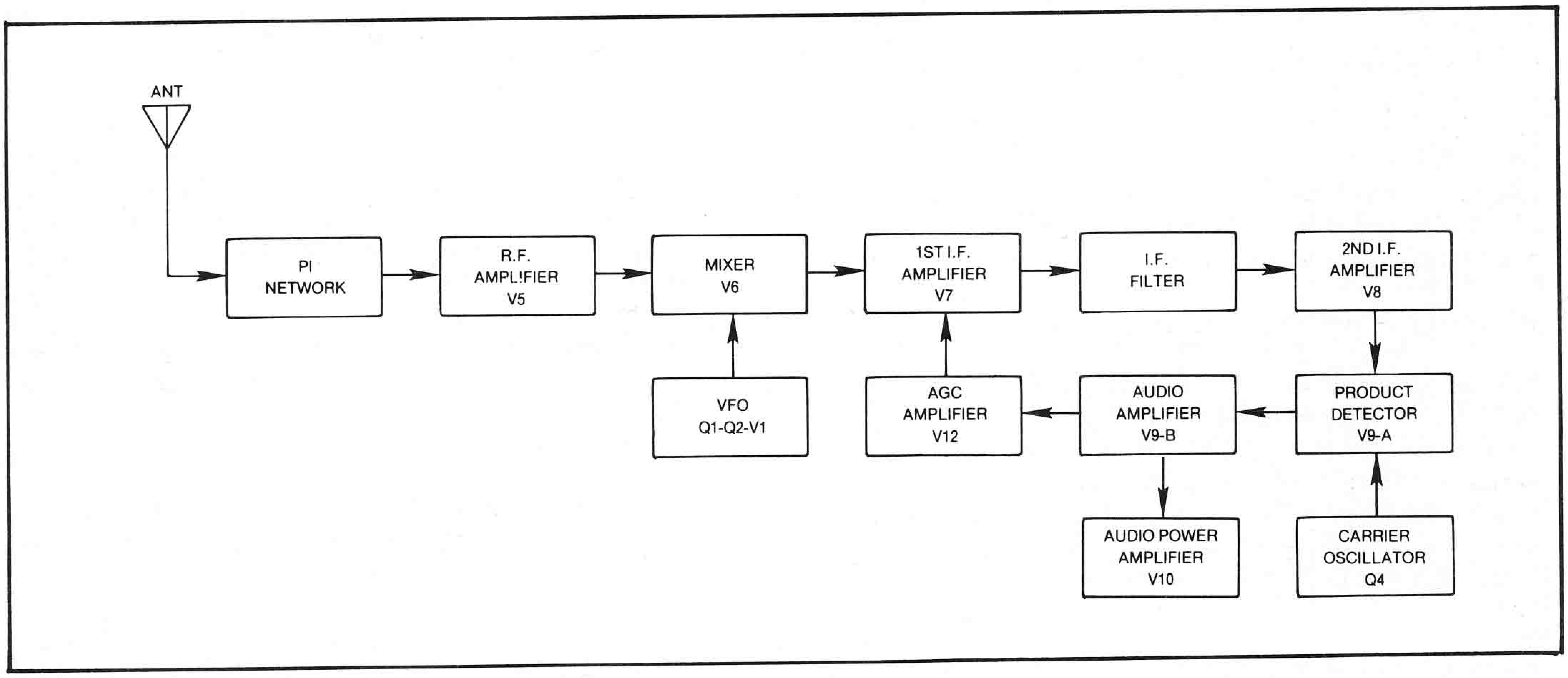


Figure 4. Block Diagram, Model 350B/350D in Receive Mode.

cathode current will not reflect this power input, however. Because of the damping in the cathode current meter, cathode current readings under normal voice input should not average more than 110 to 130 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 350B and 350D, while in transmit and with no modulation, the plate voltage will be approximately 750 volts, the plate current 40 ma, and the power input will be 30 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 conditions, the average dissipation will be approximately 35 watts. The 6MJ6 is rated at 40 watts, continuous duty cycle. Thus, it can be seen that under normal operating conditions, the power amplifier tube in the Swan 350B and 350D is not

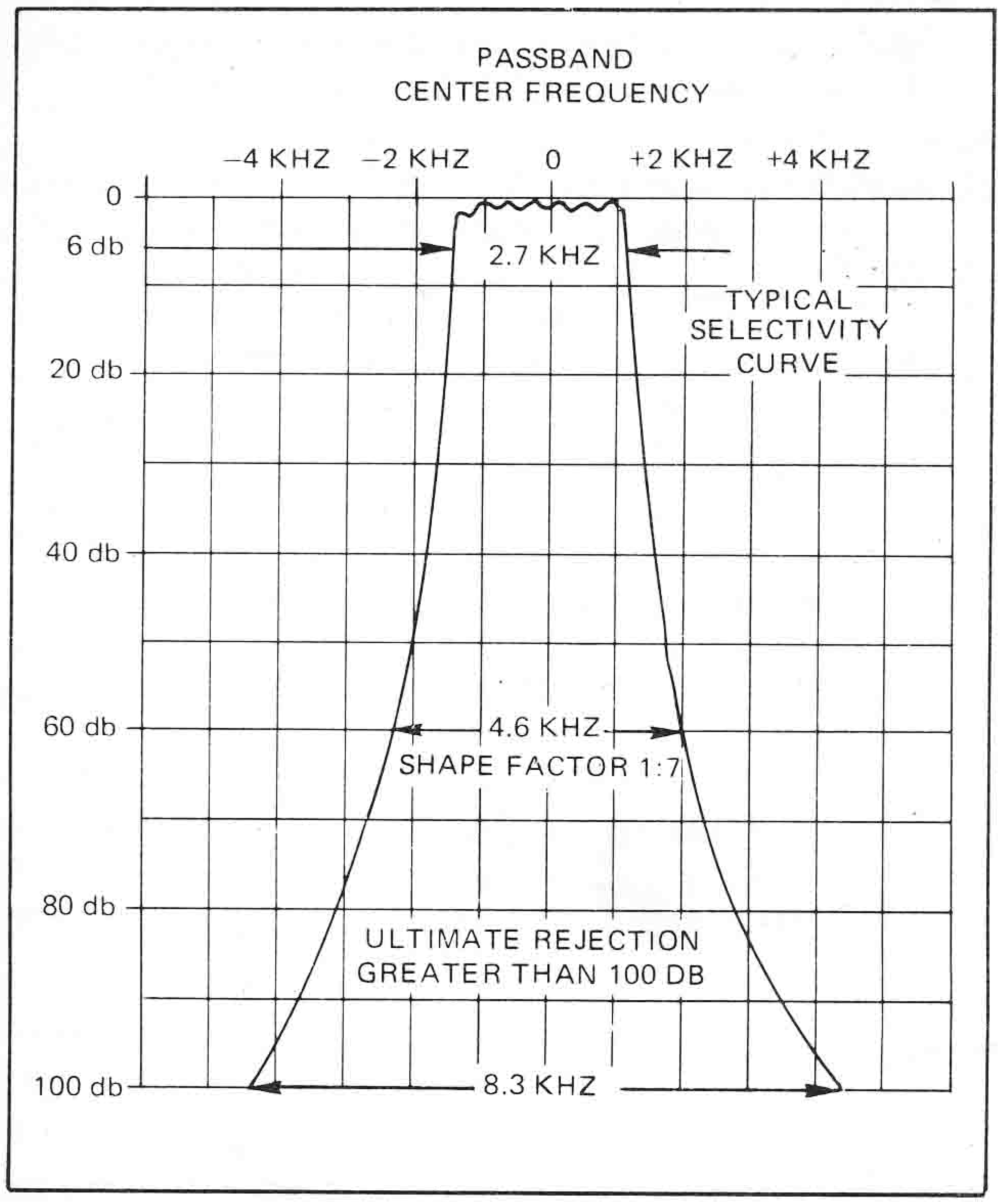


Figure 5. IF Filter Response Characteristics.

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 seconds at a time.

ALIGNMENT AND TROUBLESHOOTING

The alignment procedures presented in this section are routine touch-up procedures for all tuned circuits and other adjustments. It is recommended that the procedures be performed in the order presented. However, if complete realignment is not required (as may be the case when just one tube is replaced), perform just those procedures required. Refer to Figures 6 and 7 for component placement.

RECEIVER ALIGNMENT

Receiver alignment involves only the adjustment of the Second IF coil. The RF coils which effect receiver performance are also used in the transmit mode. Their adjustment is covered under Transmitter Alignment.

1. After allowing approximately five minutes for warm-up, tune the receiver to the middle of any band and at a "clear" frequency.

2. Adjust the P.A. TUNE, P.A. LOAD, and DRIVER front panel controls for maximum background noise.

3. Adjust IF coil L23 for maximum background noise.

S-METER ADJUSTMENT

With antenna disconnected, RF Gain fully clockwise and the Meter switch in the S-METER position, set R123, located on rear panel, for zero meter reading. Make sure no local signals are being received.

TRANSMITTER ALIGNMENT

1. **Power Amplifier Bias.**

a. Switch meter to P.A. CATHODE.

b. After allowing approximately five minutes for warm-up, key the transmitter with the microphone switch. Without speaking into the microphone, adjust the CAR. BAL. control, R98, for a minimum power amplifier cathode current.

c. Again key the transmitter with the microphone switch, and without speaking into the microphone, adjust the P.A. BIAS control, R31, on the rear panel for the delta symbol on the meter, corresponding to 40 ma idling current.

2. **Transmitter Circuits**

The alignment of transmitter circuits involves the adjustment of tuned circuits in the VFO Amplifier, V1, the Transmit Mixer, V2, and Driver stage, V3. It is recommended that a dummy load be connected to the antenna jack during this series of adjustments.

a. Start first by adjusting the 40 meter band. Set tuning dial and driver control as indicated by Table 3, Page 16.

b. Set P.A. LOAD control to 9 o'clock.

c. Press Mic. Button. Check idling current. It should be on the delta symbol with CAR. BAL. control nulled. Adjust P.A. BIAS control, if required.

d. With Mic. Button pressed, adjust CAR. BAL. control for slight increase in meter reading, 50 to 60 ma. Adjust P.A. TUNE to resonance, (dip).

e. Adjust coils as indicated by alignment chart for maximum meter reading. When reading goes higher than 80 ma, adjust CAR. BAL. for 60 ma. again.

f. Adjust coils carefully for maximum peak. Exercise caution with CAR. BAL. control. Do not exceed 100 ma reading for more than a few seconds. Be sure P.A. TUNE control is resonated (adjusted for "dip" in meter reading).

g. Switch to 80 meter band, and repeat steps (a) through (f), following the tuning chart carefully. Follow this procedure through for each band.

3. **Power Amplifier Neutralization**

Perform the power amplifier neutralization adjustment on 20 meters and in the following manner.

a. After allowing approximately five minutes for warm-up, tune the transmitter to approximately 14.250 MHz.

b. Position the P.A. LOAD control to the 9 o'clock position (full counter clockwise).

c. Set meter switch to P.A. CATHODE.

d. Key the transmitter with the microphone switch, and without speaking into the microphone, adjust the CAR. BAL. control for a power amplifier current of approximately 100 ma. Adjust the DRIVER control for peak. Quickly adjust CAR. BAL. to 100 ma. again if it increased to a higher reading.

e. With the Mic. Button still pressed, rotate the P.A. TUNE control through its range from 9 o'clock to 3 o'clock. You will note a pronounced "dip" in meter reading at resonance. Observe any tendency for the meter to "peak" above the 100 ma. plateau on either side of resonance. If there is a such a peak, adjust C55, the P.A. Neutralizing trimmer, to suppress the peak. When properly neutralized, the meter reading will hold steadily at 100 ma. except for the sharp dip at resonance, but there should be very little, if any, rise above the 100 ma. level.

f. Key the transmitter with the microphone switch and readjust the CAR. BAL. control for minimum power amplifier current. Power amplifier idling current should be on the delta symbol. If not, repeat the power amplifier bias adjustment described on Page 13.

4. **Carrier Frequency Adjustment**

A dummy load, wattmeter and audio generator are required for this adjustment.

a. After allowing a five-minute warm-up period, tune the transmitter to approximately 14.250 MHz.

b. Key the transmitter with the microphone switch and adjust the CAR. BAL. control for minimum power amplifier current.

c. Insert 1500 Hz of audio from an audio generator into the Mic. Jack located on the front panel. Adjust the gain of the audio generator and the Mic. Gain control (R87) until the wattmeter reads between 10 and 15 watts.

d. Adjust the first IF coil (L22) for maximum output. Adjust both slugs of the balanced modulator transformer (T2) for maximum output.

e. Increase output of audio oscillator until wattmeter reads 40 watts. Sweep generator down to 300 Hz and adjust the Normal Sideband carrier oscillator trimmer (C140) for a wattmeter reading of 10 watts.

f. Switch to Opposite Sideband. Adjust the Opposiite Sideband carrier oscillator trimmer (C142) for a reading of 10 watts.

g. Recheck with audio generator set at 1500 Hz and output at 40 watts. Sweep down to 300 Hz and readjust, if required, for 10 watts.

h. Reduce the audio generator output to zero. Insert an in-line "T" voltage divider in the antenna lead and connect a frequency counter to its low level output. Adjust the carrier balance control for an output that produces a stable reading on the counter.

i. Tune the transceiver to 14.000000 MHz as indicated on the counter. Set the Mode switch to CW and adjust the CW offset control for a counter reading of 14.000800 MHz.

5. **Carrier Balance Adjustment**

Several times, during the preceding adjustments, the CAR BAL control has been adjusted for varying reasons. Be sure that this control is always re-set for exact null before operating.

6. **Balanced Modulator Gain Adjustment**

The balanced modulator circuit board in the Model 350B and 350D is used in other Swan transceivers where a balanced modulator gain adjustment is required. In the 350B and 350D, however, the balanced modulator gain control is always set at its maximum clockwise position.

VFO CALIBRATION

1. After allowing approximately five minutes for warm-up, put the DIAL SET control at the "12 o'clock" position and tune the receiver near 3800 KHz. Using a frequency standard, or the 100 KHz crystal calibrator as an accurate signal source, tune the signal for zero beat and note the corresponding dial reading. If the 3800 KHz signal does not zero beat at 3800 on the dial, adjust the 80 Meter trimmer until it does.

2. In a similar manner, check each of the other bands in the normally used portion of the band. For example: 7200, 14.200 or 14,300, 21,300 or 21,400, 28.700 or whichever portion of 10 meters is normally used. Accuracy in other parts of the bands will be quite good, but remember that the 350B is not to be considered a frequency standard. Be cautious when operating near band edges. FCC regulations require that every amateur radio station have a means available for measuring its transmitting frequency.

If a frequency meter or frequency counter is available, the information contained in Table 5 can be used to perform direct VFO and Carrier Oscillator frequency measurements.

SIDETONE ADJUSTMENTS

1. Place the Mode switch in the CW position. Turn Sidetone switch to ON. Adjust the Sidetone Level control for the desired level from the speaker.

2. Adjust the Sidetone Pitch control (R128) for an 800 Hz tone from the speaker.

CARRIER OSCILLATOR PEAKING

1. Connect an RF voltmeter to the junction of C137 and R103 on the balanced modulator board and adjust the carrier oscillator coil for a maximum reading on the voltmeter.

Table 3. Transmitter Alignment Chart.

BAND	DRIVER SETTING	TUNING DIAL	ADJUST COILS
40 Meters	12 O'Clock	7180 KHz	L9, L11-A, L14-A
80 Meters	12 O'clock	3790 KHz	L10, L13
20 Meters	12 O'clock	14205 KHz	L11-B, L14-B
15 Meters	12:30 O'Clock	21270 KHz	L7, L12-A, L15-A
10 Meters	12:30 O'clock	28920 KHz	L8, L12-B, L15-B

Note: Adjust 40 Meter Band First.

Table 4. Toubleshooting Chart.

SYMPTOM	POSSIBLE CAUSE
PA Idling Current Unstable	1. Defective Power Amplifier Tube, V4. 2. Defective Bias control and/or associated components. 3. Defective bias supply
Inability to Load Per Operating Instructions	1. Antenna not resonant at operating frequency. 2. Defective transmission line. 3. Defective antenna loading coil(s). 4. Tube V1, V2, V3 or V4 defective.
Insufficient Sideband Suppression	1. Carrier Oscillator (Q3) operating on incorrect frequency. 2. Crystal filter defective or mistuned.
Insufficient Carrier Suppression	1. Balanced Modulator, A3, defective. 2. Transformer T2 defective or mistuned. 3. Carrier Oscillator (Q3) operating on incorrect frequency.
Microphonics in Transmitter	1. Tube V11 defective. 2. IF coil L22 defective or incorrectly adjusted. 3. Microphone defective.
Low Receiver Sensitivity	1. Tube V5, V6, V7, V8, V9 or V10 defective. 2. Incorrect adjustment of the transmitter Pi-Network. 3. IF coil L23 incorrectly adjusted or defective. 4. RY1 contacts defective.

Table 5. VFO and Carrier Oscillator Frequencies.

TUNING DIAL	V1 INJECTION FREQ.	Q1 VFO FREQ.	Q3 CARRIER OSC. FREQ.
3,500 KHz	9,000 KHz	9,000 KHz	5,500 KHz
4,400 KHz	9,500 KHz	9,500 KHz	5,500 KHz
7,000 KHz	12,500 KHz	(1/2) 6,250 KHz	5,500 KHz
7,300 KHz	12,800 KHz	(1/2) 6,400 KHz	5,500 KHz
14,000 KHz	8,500 KHz	8,500 KHz	5,500 KHz
14,350 KHz	8,850 KHz	8,850 KHz	5,500 KHz
21,000 KHz	15,500 KHz	(1/2) 7,750 KHz	5,500 KHz
21,450 KHz	15,590 KHz	(1/2) 7,975 KHz	5,500 KHz
28,000 KHz	22,500 KHz	(1/2) 11,250 KHz	5,500 KHz
29,700 KHz	24,200 KHz	(1/2) 12,100 KHz	5,500 KHz

14650.
18050
3000 ÷ 3350
10000 ÷ 10450
17000 ÷ 18700

3660 + 5500 = 9160

Table 6. Voltage Chart.

		1	2	3	4	5	6	7	8	9
V1 12BA6 VFO Amp	R T	0 0	0 0	0 0	12VAC 12VAC	+170 +152	+59 +53	0 0	N/A N/A	N/A N/A
V2 12BE6 Xmit Mix.	R T	−2 −2	0 0	0 0	12VAC 12VAC	+228 +216	−2 +123	0 0	N/A N/A	N/A N/A
V3 6GK6 Driver	R T	0 0	−6 −6	0 0	0 0	6VAC 6VAC	N/C N/C	+260 +230		0 0
V4 6MJ6 Pwr. Amp.	R T	0 +188	−55 −55	0 0	6VAC 6VAC	12VAC 12VAC	−55 −55	N/C N/C	0 0	N/C N/C
V5 6CB6 R.F. Amp.	R T	−1 −1	0 0	6VAC 6VAC	0 0	+228 +217	+99 −4	0 0	N/A N/A	N/A N/A
V6 12BE6 Rec. Mix.	R T	−2 −2	0 0	0 0	12VAC 12VAC	+254 +226	+99 −4	−1 −1	N/A N/A	N/A N/A
V7 12BA6 1st IF	R T	−2 −1	0 0	0 0	12VAC 12VAC	+200 +179	+118 +106	0 0	N/A N/A	N/A N/A
V8 12BA6 2nd IF	R T	−1 −2	0 0	0 0	12VAC 12VAC	+201 0	+99 −4	0 0	N/A N/A	N/A N/A
V9 12AX7 Rec. Aud.	R T	+48 −1	0 0	0 0	12VAC 12VAC	0 0	+137 0	−1 −1	0 0	N/C N/C
V10 6GW8 Aud. Pwr.	R T	0 0	+2 +6	+209 +186	0 0	6VAC 6VAC	+250 +224	+7 +6	0 0	+142 +185
V11 12AX7 Mic. Amp.	R T	+6.5 +63	0 0	0 0	0 0	12VAC 12VAC	0 +88	0 0	0 +1	N/C N/C

METER: VTVM or DVM with 10 megohm input impedance.

RECEIVE TEST CONDITIONS: A.F. GAIN—12 O'clock, R.F. GAIN—Full CW, SIDEBAND—NORM, MODE Switch—REC, CW FILTER—OFF, TUNING DIAL—14.300 MHz. No Input Signal, S-METER at zero.

TRANSMIT TEST CONDITIONS: SIDEBAND—NORM, MODE Switch—REC, CW FILTER—OFF, CAR. BAL.—12 O'Clock, MIC GAIN—Full CCW, P.A. BIAS—Δ, Set Keyed with PTT switch on mike, no modulation.

(Continued)

Table 6. Voltage Chart (Continued).

		E	B	C			G1	G2	S	D
Q4 MPS-H10 Car. Osc.	R T	+4.5 +4.5	+4.5 +4.5	+7.8 +7.8	Q2 2N5670 VFO Buff.	R T	+1.8 +1.8	N/A N/A	+3.7 +3.7	+7.5 +7.5
Q3 MPS-H10 VFO Out.	R T	+3 +3	+1.1 +1.1	+7.3 +7.3	Q1 40673 VFO	R T	0 0	+3.9 +3.9	+0.4 +0.4	+7.8 +7.8
Q5 2N5355 Sidetone	R T Tune	−1.4 −1.4 −.14	−2.0 −2.0 −1.7	−7.6 −7.6 −7.2						

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
A6 MC1458 CW Filter	R T	+3.9 +3.9	+3.5 +3.5	+3.5 +3.5	0 0	+3.5 +3.5	+3.5 +3.5	+3.7 +3.7	+6.8 +6.8						
A8 MC1496 Bal. Mod.	R T	−6.2 −6.2	−6.9 −6.9	−6.9 −6.9	−6.2 −6.2	−10.8 −10.8	0 +6.8	0 0	0 0	0 0	0 0	0 0	−0.8 +6.8	0 0	−12 −12
A1 7400 Cal. Gate (350D only)	OFF ON	0 +4.1	+4.0 +1.1	+4.0 +1.1	+1.3 +1.5	+1.3 +1.5	+1.1 +1.1	0 0	+3.0 +1.7	+1.1 +1.1	+1.1 +1.1	0 +4.5	+4.9 0	+4.9 0	+5.0 +5.0
A2 7490 Cal. Div. (350D only)	OFF ON	+3.0 +1.7	0 0	0 0	0 0	+5.0 +5.0	0 0	0 0	0 +1.7	0 +1.6	0 0	+0.1 +0.8	+0.1 +2.1	0 0	+0.1 +0.8
A3 7490 Cal. Div. (350D only)	OFF ON	+0.1 +2.1	0 0	0 0	0 0	+5 +5	0 0	0 0	+4.1 +1.8	+0.1 +1.7	0 0	+4.0 +1.0	+0.1 +2.1	0 0	+4.0 +4.0
A4 7474 Cal. F/F (350D only)	OFF ON	+1 +1.5	+4.0 +2.1	0 +2.1	+1.4 +1.4	+4.0 +2.0	+2.1 +2.1	0 0	+2.0 +2.0	0 +2.0	+1.4 +1.4	0 +2.1	+4.0 +2.0	+1.4 +1.4	+5.0 +5.0

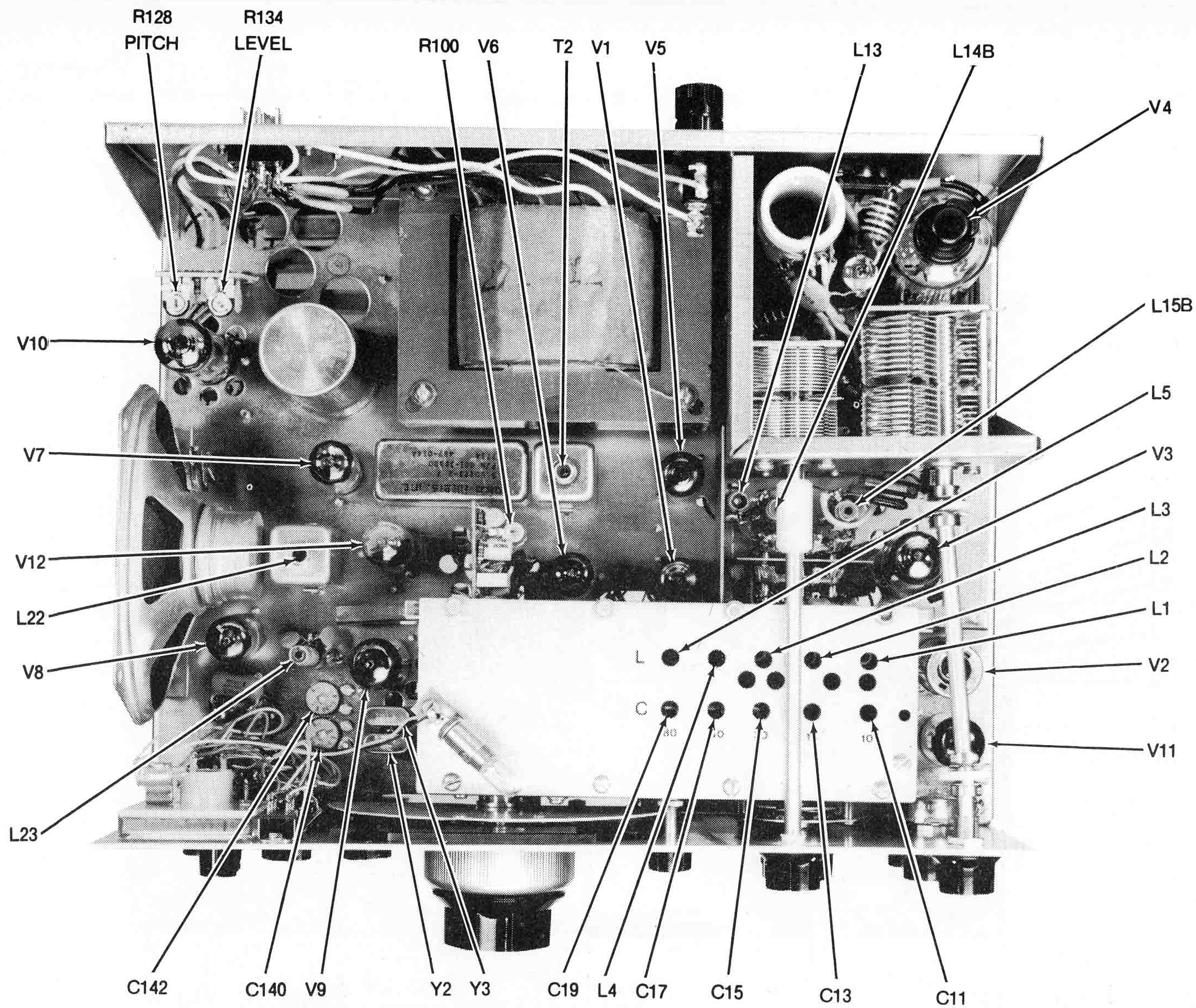


Figure 6. Top View of 350B With Cover Removed Showing Adjustments.

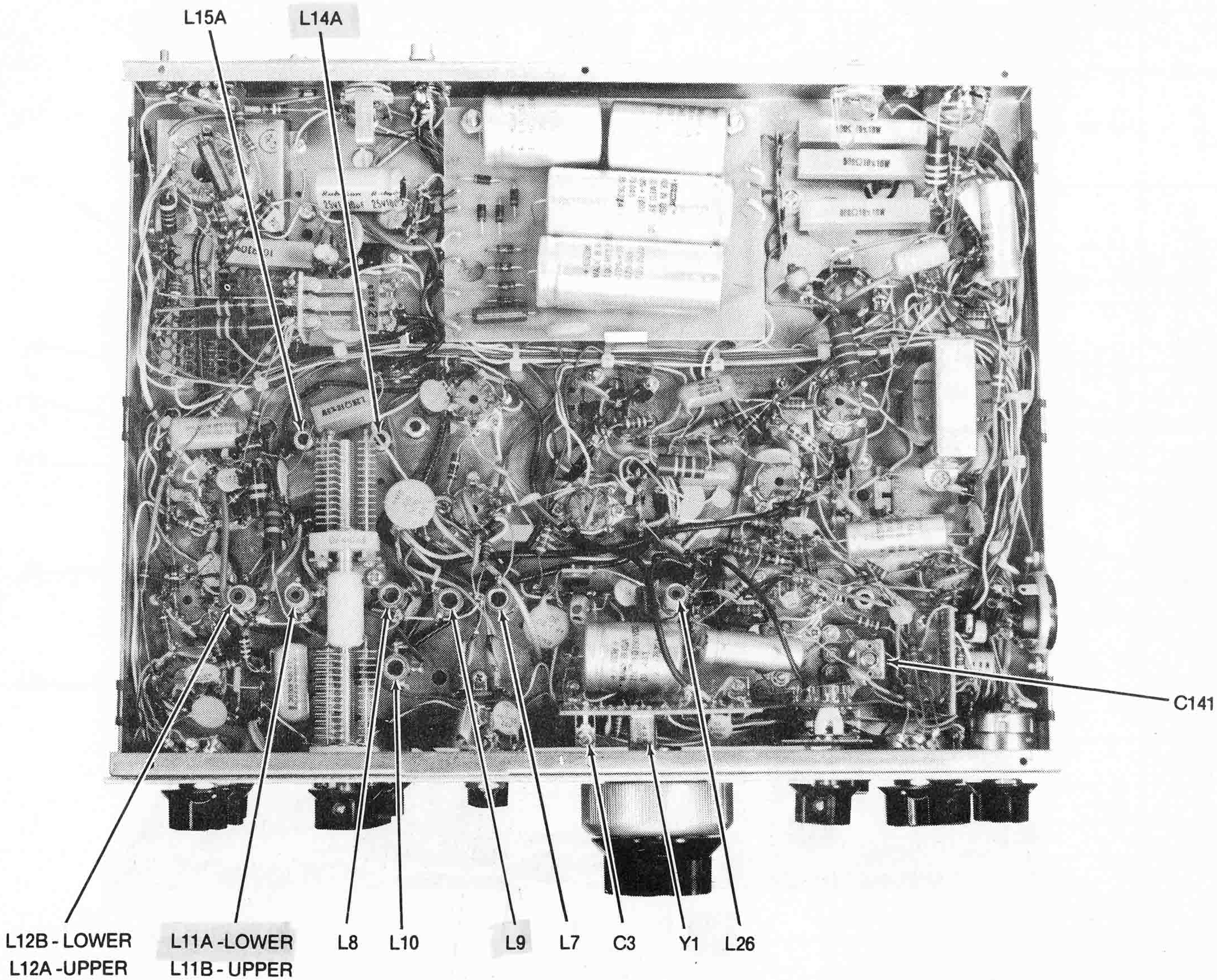


Figure 7. Bottom View of 350B With Cover Removed Showing Adjustments.

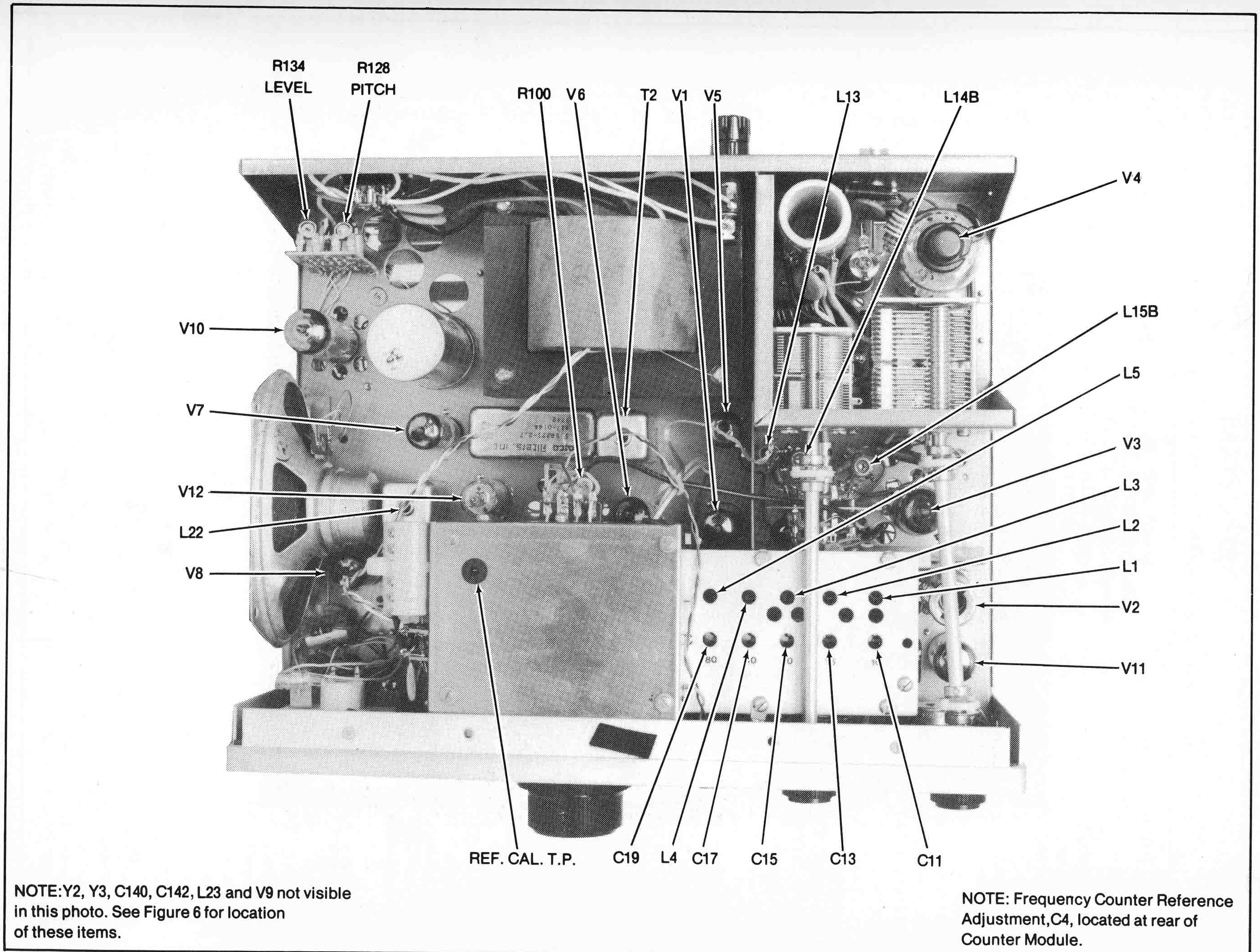


Figure 8. Top View of 350D Showing Adjustments.

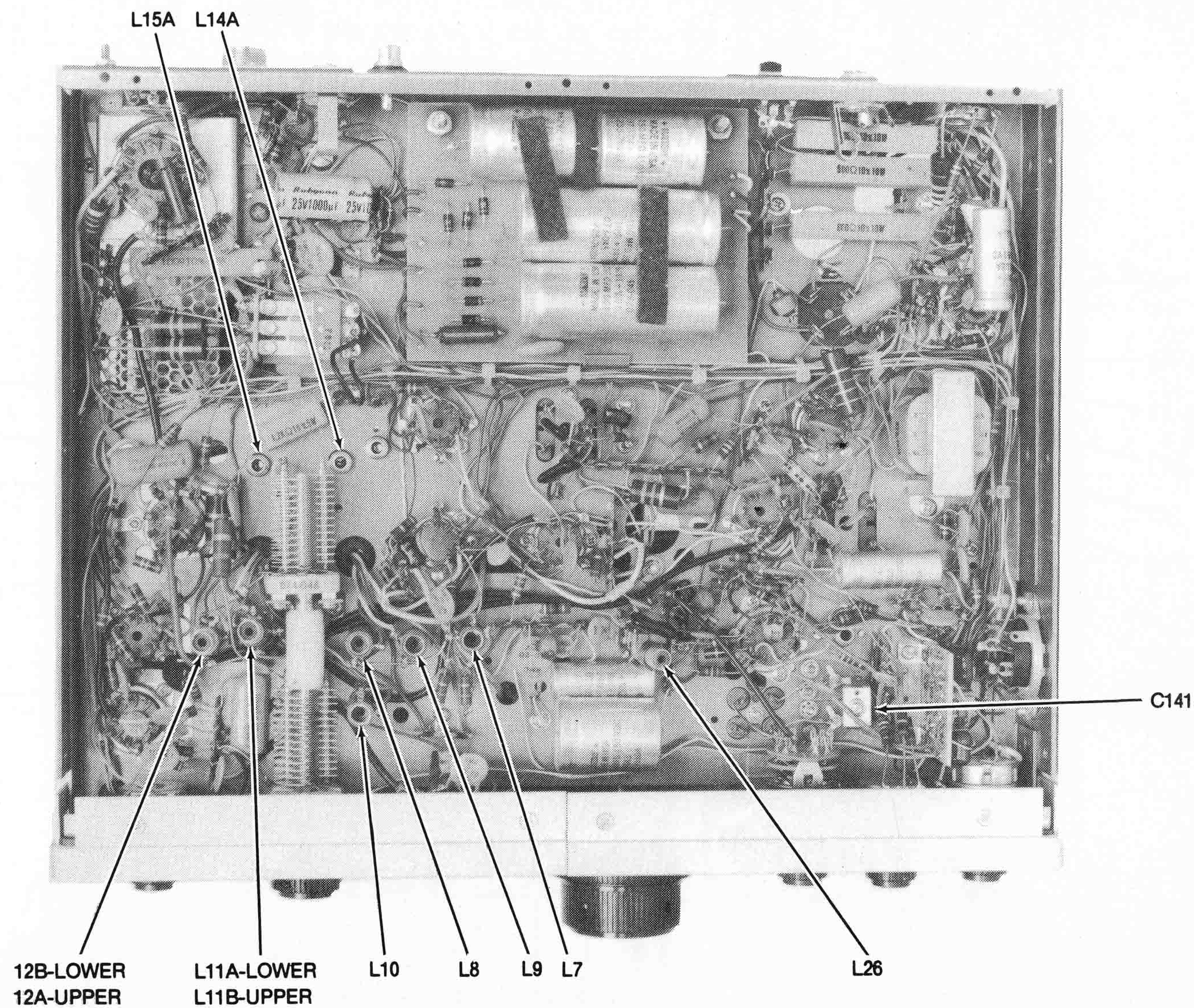


Figure 9. Bottom View of 350D Showing Adjustments.

PARTS LISTS

Table 7. Replaceable Parts List, Models 350B and 350D Main Chassis.

CAPACITORS	
C1	5 pfd.
C2	120 pfd., DM-15, Silver Mica
C3	3-30 pfd., Ceramic Trimmer
C4	0.1 ufd., 50V, Ceramic Disc
C5	0.01 ufd, 100V, Ceramic Disc
C6	0.1 ufd., 12V, Ceramic Disc
C7	Not a Physical Capacitor
C8	Factory Selected
C9	Factory Selected
C10	0.01 ufd., 100V, Ceramic Disc
C11	1.2-4.2 pfd., Trimmer
C12	Factory Selected
C13	1.5-9.1 pfd., Air Dielectric Trimmer
C14	Factory Selected
C15	1.8-16.7 pfd., Air Dielectric Trimmer
C16	Factory Selected
C17	1.8-16.7 pfd., Air Dielectric Trimmer
C18	Factory Selected
C19	1.8-16.7 pfd., Air Dielectric Trimmer
C20	Factory Selected
C21	4.5-11.5 pfd., Air Dielectric Trimmer
C22	2 pfd., Miniature Air Dielectric Trimmer (350B Only)
C23	0.01 ufd., 100V, Ceramic Disc
C24	Factory Selected
C25	91 pfd., DM-15, Silver Mica
C26	91 pfd., DM-15, Silver Mica
C27	2 pfd., NPO
C28	0.01 ufd., 100V, Ceramic Disc
C29	0.01 ufd., 100V, Ceramic Disc
C30	0.01 ufd., 100V, Ceramic Disc
C31	0.01 ufd., 500V, Ceramic Disc
C32	Factory Selected
C33	100 pfd., NPO
C34	0.002 ufd., 500V, Ceramic Disc
C35	Factory Selected
C36	0.01 ufd., 500V, Ceramic Disc
C37	20 pfd., NPO
C38	39 pfd., N220
C39	0.002 ufd., 500V, Ceramic Disc
C40	50 pfd., Air Dielectric Trimmer
C41	39 pfd., NPO Disc
C42	150 pfd., N1500 Disc
C43	0.01 ufd., 500V, Ceramic Disc
C44	0.05 ufd., 500V, Ceramic Disc
C45	0.002 ufd., 500V, Ceramic Disc
C46	470 pfd., DM-19, Silver Mica
C47	1 pfd., 10%, Type QC
C48	3.3 pfd., 10%, Type QC
C49	270 pfd., DM-15, Silver Mica
C50	50 pfd., Air Dielectric Trimmer
C51	150 pfd., N1500, Disc
C52	39 pfd., NPO, Disc
C53	0.002 ufd., 500V, Ceramic Disc
C54	510 pfd., DM-19, Silver Mica
C55	20 pfd., Air Dielectric Trimmer
C56	3.3 pfd., 10%, Type QC
C57	0.002 ufd., 500V, Ceramic Disc
C58	0.001 ufd., 500V, Ceramic Disc
C59	0.002 ufd., 500V, Ceramic Disc
C60	100 pfd., 6KV, Ceramic Disc
C61	0.002 ufd., 2KV, Ceramic Disc
C62	2 x 180 pfd., Air Dielectric Trimmer
C63	0.01 ufd., 500V, Ceramic Disc
C64	0.01 ufd., 500V, Ceramic Disc
C65	100 pfd., 6KV, Ceramic Disc
C66	100 pfd., 6KV, Ceramic Disc
C67	0.002 ufd., 2KV, Ceramic Disc
C68	2 x 410 pfd., Air Dielectric Trimmer
C69	510 pfd., DM-19, Silver Mica
C70	510 pfd., DM-19, Silver Mica
C71	100 pfd., DM-19, Silver Mica
C72	0.01 ufd., 500V, Ceramic Disc
C73	80/80/5/5 ufd., 400 WVDC, Electrolytic
C74	0.01 ufd., 500V, Ceramic Disc
C75	0.01 ufd., 500V, Ceramic Disc
C76	30 pfd., N1500, 1KV, Ceramic Disc
C77	430 pfd., DM-19, Silver Mica
C78	0.01 ufd., 500V, Ceramic Disc
C79	220 pfd., DM-15, Silver Mica
C80	82 pfd., DM-15, Silver Mica
C81	0.01 ufd., 500V, Ceramic Disc
C82	0.01 ufd., 500V, Ceramic Disc
C83	50 pfd., N330, Ceramic Disc
C84	2 pfd., NPO, Ceramic Disc
C85	0.01 ufd., 500V, Ceramic Disc
C86	0.01 ufd., 500V, Ceramic Disc
C87	0.01 ufd., 500V, Ceramic Disc
C88	2 ufd., 450 WVDC, Electrolytic
C89	0.01 ufd., 500V, Ceramic Disc
C90	50 pfd.,N330, Ceramic Disc
C91	0.01 ufd., 500V, Ceramic Disc
C92	50 pfd., N330, Ceramic Disc
C93	2 ufd., 450 WVDC, Electrolytic
C94	220 pfd., Ceramic Disc
C95	0.002 ufd., 500V, Ceramic Disc
C96	150 pfd., N2200, Ceramic Disc
C97	1000 pfd., 2%, DM-15 Silver Mica
C98	0.001 ufd.
C99	33 ufd., 25V, Electrolytic
C100	100 ufd., 25V, Electrolytic
C101	1000 pfd., 2%, DM-15, Silver Mica
C102	0.001 ufd., 500V, Ceramic Disc
C103	0.002 ufd., 500V, Ceramic Disc
C104	0.002 ufd., 500V, Ceramic Disc
C105	500 pfd., 500V, Ceramic Disc
C106	220 pfd., 500V, Ceramic Disc
C107	0.002 ufd., 500V, Ceramic Disc
C108	20 ufd., 30 WVDC, Electrolytic
C109	0.01 ufd., 1000V, Paper
C110	2 ufd., 450 WVDC, Electrolytic
C111	0.01 ufd., 150V, Ceramic Disc
C112	1000 ufd., 25 WVDC, Electrolytic
C113	0.1 ufd., 50V, Ceramic Disc
C114	0.0047 ufd., 1400V AC, Ceramic Disc
C115	0.0047 ufd., 1400V AC, Ceramic Disc
C116	10 ufd., 25 WVDC, Electrolytic
C117	100 ufd., 350 WVDC, Electrolyic
C118	100 ufd., 350 WVDC, Electrolytic
C119	150 ufd., 150 WVDC, Electrolytic
C120	150 ufd., 150 WVDC, Electrolytic
C121	0.002 ufd., 2KV, Ceramic Disc
C122	150 ufd., 150 WVDC, Electrolytic
C123	0.01 ufd., 500V, Ceramic Disc
C124	0.01 ufd., 500V, Ceramic Disc
C125	100 pfd., N1500, Ceramic Disc
C126	0.1 ufd., 400V, Molded Paper
C127	0.01 ufd., 500V, Ceramic Disc
C128	0.1 ufd., 400V, Molded Paper
C129	0.01 ufd., 500V, Ceramic Disc
C130	0.01 ufd., 500V, Ceramic Disc
C131	47 ufd.
C132	0.001 ufd., 500V, Ceramic Disc
C133	0.001 ufd., 500V, Ceramic Disc
C134	0.001 ufd., 500V, Ceramic Disc
C135	0.001 ufd., 500V, Ceramic Disc
C136	0.001 ufd., 500V, Ceramic Disc
C137	0.001 ufd., 500V, Ceramic Disc
C138	0.001 ufd., 500V, Ceramic Disc
C139	100 pfd., N1500, Ceramic Disc
C140	5-30 pfd., Ceramic Trimmer
C141	7-60 pfd., Mica Compression Trimmer
C142	5-30 pfd., Ceramic Trimmer
C143	0.1 ufd., 12V, Ceramic Disc
C144	270 pfd., DM-15, Silver Mica
C145	270 pfd., DM-15, Silver Mica
C146	1400 pfd., DM-19, Silver Mica

(Continued)

Table 7. (Continued)

C147	0.01 ufd., 500V, Ceramic Disc
C148	0.047 ufd., 200V, Molded Paper
C149	0.047 ufd., 200V, Molded Paper
C150	1 ufd., 50 WVDC, Electrolytic
C151	0.01 ufd., 500V, Ceramic Disc
C152	0.01 ufd., 500V, Ceramic Disc
C153	0.01 ufd., 500V, Ceramic Disc
C154	0.01 ufd., 500V, Ceramic Disc
C155	10 ufd., 25 WVDC, Electrolytic
C156	0.01 ufd., 100V, Ceramic Disc
C157	0.1 ufd., 12V, Ceramic Disc
C158	0.1 ufd., 12V, Ceramic Disc

DIODES

CR1	1N914
CR2	1N4005
CR3	1N914
CR4 – CR13	1N4005
CR14	ZBC-12
CR15	1N4742
CR16	1N914
CR17	1N914
CR18	1N914
CR19	1N914
CR20	1N4005

RESISTORS

R1	1.5K Ohms, 1/4 Watt, 5%
R2	1.5K Ohms, 1/4 Watt, 5%
R3	2.2K Ohms, 1/4 Watt, 5%
R4	470K Ohms, 1/4 Watt, 5%
R5	4.7K Ohms, 1/4 Watt, 5%
R6	4.7K Ohms, 1/4 Watt, 5%
R7	100 Ohms, 1/4 Watt, 5%
R8	330 Ohms, 1/4 Watt, 5%
R9	330K Ohms, 1/4 Watt, 5%
R10	100K Ohms, 1/4 Watt, 5%
R11	100 Ohms, 1/4 Watt, 5%
R12	1K Ohms, 1/4 Watt, 5%
R13	47 Ohms, 1/4 Watt, 5%
R14	15K Ohms, 1/4 Watt, 5%
R15	3.3K Ohms, 1/4 Watt, 5%
R16	27 Ohms, 1/4 Watt, 5%
R17	1.7K Ohms, 1/2 Watt, 10%
R18	82 Ohms, 1/2 Watt, 10%
R19	4.7K Ohms, 1/2 Watt, 10%
R20	2.7K Ohms, 1/2 Watt, 10%
R21	56 Ohms, 1/2 Watt, 10%
R22	47K Ohms, 1/2 Watt, 10%
R23	10K Ohms, 2 Watt, 10%
R24	27K Ohms, 1/2 Watt, 10%
R25	100K Ohms, 1/2 Watt, 10%
R26	100K Ohms, 1/2 Watt, 10%
R27	2.7K Ohms, 1 Watt, 10%
R28	100K Ohms, 1/2 Watt, 10%
R29	100K Ohms, 1/2 Watt, 10%
R30	100 Ohms, 1/2 Watt, 10%
R31	25K Ohms, A Taper, Potentiometer
R32	15K Ohms, 1/2 Watt, 10%
R33	4.7K Ohms, 1/2 Watt, 10%
R34	1K Ohms, 1/2 Watt, 10%
R35	0.47 Ohm, 2 Watt, 5%
R36	100 Ohms, 10 Watt, 10%
R37	100 Ohms, 1/2 Watt, 10%
R38	170K Ohms, 1/2 Watt, 10%
R39	10K Ohms, 2 Watt, 10%
R40	470K Ohms, 1/2 Watt, 10%
R41	10K Ohms, 2 Watt, 10%
R42	100K Ohms, 1/2 Watt, 10%
R43	1K Ohms, 1/2 Watt, 10%
R44	470K Ohms, 1/2 Watt, 10%
R45	330 Ohms, 1/2 Watt, 10%
R46	680 Ohms, 1/2 Watt, 10%
R47	100K Ohms, 1/2 Watt, 10%
R48	1K Ohms, 1/2 Watt, 10%
R49	100K Ohms, 1/2 Watt, 10%
R50	1K Ohms, 1/2 Watt, 10%
R51	4.7K Ohms, 1/2 Watt, 10%
R52	10K Ohms, 1/2 Watt, 10%
R53	47K Ohms, 1/2 Watt, 10%
R54	270 Ohms, 1/2 Watt, 10%
R55	270K Ohms, 1/2 Watt, 10%
R56	910K Ohms, 1/4 Watt, 5%
R57	22K Ohms, 1/4 Watt, 5%
R58	1.8M Ohms, 1/4 Watt, 5%
R59	1K Ohms, 1/4 Watt, 5%
R60	1K Ohms, 1/4 Watt, 5%
R61	220 Ohms, 1/4 Watt, 5%
R62	910K Ohms, 1/4 Watt, 5%
R63	22K Ohms, 1/4 Watt, 5%
R64	1.8M Ohms, 1/4 Watt, 5%
R65	47K Ohms, 1/2 Watt, 10%
R66	1M Ohms, 1/2 Watt, 10%
R67	10M Ohms, 1/2 Watt, 10%
R68	100K Ohms, 1/2 Watt, 10%
R69	1M Ohms, Composition, A Taper Potentiometer with Switch
R70	2.7K Ohms, 1/2 Watt, 10%
R71	5.8K Ohms, 1 Watt, 10%
R72	100K Ohms, 1/2 Watt, 10%
R73	680 Ohms, 1/2 Watt, 10%
R74	1M Ohms, 1/2 Watt, 10%
R75	270 Ohms, 1/2 Watt, 10%
R76	150K Ohms, 2 Watt, 10%
R77	150K Ohms, 2 Watt, 10%
R78	800 Ohms, 10 Watt, 10%
R79	1.7K Ohms, 1/2 Watt, 10%
R80	800 Ohms, 10 Watt, 10%
R81	500 Ohms, 10 Watt, 10%
R82	1.2K Ohms, 5 Watt, 10%
R83	47K Ohms, 1/2 Watt, 10%
R84	2.2M Ohms, 1/2 Watt, 10%
R85	470K Ohms, 1/2 Watt, 10%
R86	270K Ohms, 1/2 Watt, 10%
R87	1M Ohm, Compositon, A Taper Potentiometer.
R88	47K Ohms, 1/2 Watt, 10%
R89	150K Ohms, 1/2 Watt, 10%
R90	1K Ohms, 1/2 Watt, 10%
R91	4.7K Ohms, 1/4 Watt, 5%
R92	4.7K Ohms, 1/4 Watt, 5%
R93	4.7K Ohms, 1/4 Watt, 5%
R94	470 Ohms, 1/4 Watt, 5%
R95	470 Ohms, 1/4 Watt, 5%
R96	6.8K Ohms, 1/4 Watt, 5%
R97	10K Ohms, 1/4 Watt, 5%
R98	5K Ohms, Composition, Linear Taper Potentiometer
R99	10K Ohms, 1/4 Watt, 5%
R100	5K Ohms, PC Mount Potentiometer
R101	680 Ohms, 1/4 Watt, 5%
R102	4.7K Ohms, 1/4 Watt, 5%
R103	6.8K Ohms, 1/4 Watt, 5%
R104	27K Ohms, 2 Watt, 10%
R105	4.7K Ohms, 1/4 Watt, 5%
R106	47 Ohms, 1/2 Watt, 10%
R107	4.7K Ohms, 1/2 Watt, 10%
R108	6.8K Ohms, 1/2 Watt, 10%
R109	1K Ohms, 1/2 Watt, 10%
R110	15K Ohms, 1/2 Watt, 10%
R111	47K Ohms, 1/2 Watt, 10%
R112	170K Ohms, 1/2 Watt, 10%
R113	10K Ohms, 1/2 Watt, 10%
R114	25K Ohms, Composition Linear Taper Potentiometer
R115	470 Ohms, 1/2 Watt, 10%
R116	1M Ohms, 1/2 Watt, 10%
R117	10M Ohms, 1/2 Watt, 10%
R118	10K Ohms, 1/2 Watt, 10%
R119	470K Ohms, 1/2 Watt, 10%
R120	220K Ohms, 1/2 Watt, 10%
R121	100K Ohms, 1/2 Watt, 10%
R122	47K Ohms, 2 Watt, 10%
R123	25K Ohms, Linear Taper Potentiometer
R124	15K Ohms, 1/2 Watt, 10%
R125	150K Ohms, 1/2 Watt, 10%
R126	33K Ohms, 2 Watt, 1%
R127	1K Ohms, 1/4 Watt, 5%
R128	25K Ohms, Linear Taper PC Mount Potentiometer
R129	10K Ohms, 1/4 Watt, 5%
R130	15K Ohms, 1/4 Watt, 5%
R131	69K Ohms, 1/4 Watt, 5%
R132	470 Ohms, 1/4 Watt, 5%
R133	2.2K Ohms, 1/4 Watt, 5%

(Continued)

Table 7. (Continued)

R134	10K Ohms, Linear Taper PC Mount Potentiometer
R135	33K Ohms, 1/4 Watt, 5%

TRANSISTORS

Q1	40673
Q2	2N5670
Q3	MPS-H10
Q4	MPS-H10
Q5	2N5355

INTEGRATED CIRCUITS

A1	7400	(350B Only)
A2	7490	(350B Only)
A3	7490	(350B Only)
A4	7474	(350B Only)
A5	78M05 Regulator	(350B Only)
A6	MC1458P2	
A7	78M08 Regulator	
A8	MC1496P	

INDUCTORS

L1	10 Meter Tuning Coil, VFO
L2	15 Meter Tuning Coil, VFO
L3	20 Meter Tuning Coil, VFO
L4	40 Meter Tuning Coil, VFO
L5	80 Meter Tuning Coil, VFO
L6	47 uhy. Choke
L7	15 Meter Tuning Coil, VFO Amp.
L8	10 Meter Tuning Coil, VFO Amp.
L9	80/40/20 Meter Tuning Coil, VFO Amplifier
L10	80 Meter Tuning Coil, Transmit Mixer
L11	40/20 Meter Tuning Coil, Transmit Mixer
L12	15/10 Meter Tuning Coil, Transmit Mixer
L13	80 Meter Tuning Coil, Driver
L14	40/20 Meter Tuning Coil, Driver
L15	15/10 Meter Tuning Coil, Driver
L16	82 uhy. Choke
L17	82 uhy. Choke
L18	55 uhy. Choke
L19	Pi-L Filter Tuning Coil
L20	4 uhy. Torroid
L21	30 uhy Choke
L22	1st IF Tuning Coil
L23	2nd IF Tuning Coil
L24	17 uhy. Choke
L25	200 uhy. Choke
L26	Carrier Oscillator Tuning Coil
L27	200 uhy. Choke

TRANSFORMERS

T1	Interstage Coupling Torroid, VFO
T2	Balanced Modulator
T3	Audio Output
T4	Power

CRYSTALS

Y1	10 MHz, Series Resonant, HC-25/U
Y2	5500 KHz, Parallel Resonant, 32 pfd., HC-6/U
Y3	5503.3 KHz, Parallel Resonant, 32 pfd., HC-6/U

TUBES

V1	12BA6
V2	12BE6
V3	6GK6
V4	6MJ6
V5	6CB6
V6	12BE6
V7	12BA6
V8	12BA6
V9	12AX7
V10	6GW6
V11	12AX7
V12	6AV6

SWITCHES

S1	Bandswitch
S2	Power (Part of R69)
S3	Slide, 2P3T, CW Filter
S4	Rotary, Function
S5	Slide, SPST, Meter

CONNECTORS

J1	Miniature Phone Jack
J2	RCA Type Phono Jack
J3	12 Pin Jones Plug
J3	Octal Socket
J4	Closed Circuit, 1/4" Phone Jack
J5	1/4" Microphone Jack
J6	Closed Circuit, 1/4" Phone Jack
P1	3 Terminal AC Plug Part of Line Cord
P2	12 Pin Jones Plug

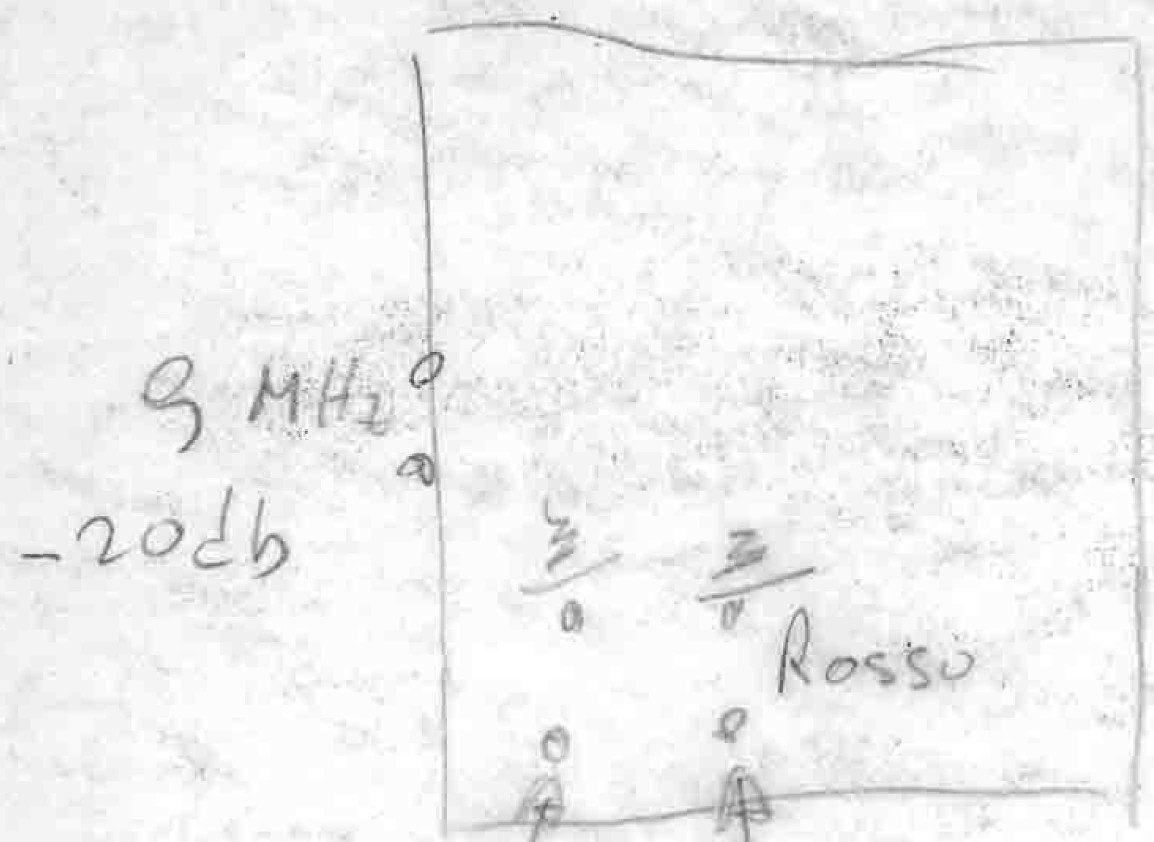
MISCELLANEOUS

DS1	Dial Lamp, #1815 (350B Only)
DS2	Dial Lamp, 12V, 40 MA., Miniature
F1	Fuse, 4A, 250V, 3AG (117V Model)
F2	Fuse, 2A, 250V, 3AG (230V Model)
FL1	5500 KHz, 2.7 KHz, 6-Pole Crystal Lattice Filter
M1	0-500 Microampere Meter
RY1	Relay, 3PDT, 12V
Z1	Network, Parasitic Suppressor

Table 8. Replaceable Parts List, Model 350D Digital Frequency Counter.

CAPACITORS	RESISTORS	TRANSISTORS
C1 0.01 mfd., 100V, Ceramic Disc	R1 47 Ohms, 1/4W, 5%	Q1 40822
C2 0.1 mfd., 12V, Ceramic Disc	R2 47 Ohms, 1/4W, 5%	Q2 40822
C3 0.10 mfd., 100V Ceramic Disc	R3 47 Ohms, 1/4W, 5%	Q3 2N5670
C4 2-22 pfd., Film Trimmer	R4 33K Ohms, 1/4W, 5%	Q4 MPS-H81
C5 30 pfd., N1500, TC	R5 10K Ohms, 8	Q5 MPS-H81
C6 50 pfd., Silver Mica	R6 47K Ohms, 1/4W, 5%	Q6 MPS-5172
C7 0.1 mfd., 12V, Ceramic Disc	R7 33K Ohms, 1/4W, 5%	Q7 MPS-5172
C8 150 pfd., Silver Mica	R8 10K Ohms, 1/4W, 5%	Q8 MPS-5172
C9 0.01 mfd., 100V, Ceramic Disc	R9 100K Ohms, 1/4W, 5%	Q9 MPS-5172
C10 0.1 mfd., 12V, Ceramic Disc	R10 270 Ohms, 1/4W, 5%	Q10 MPS-5172
C11 0.1 mfd., 12V, Ceramic Disc	R11 270 Ohms, 1/4W, 5%	Q11 MPS-5172
C12 0.01 mfd., 100V, Ceramic Disc	R12 220 Ohms, 1/4W, 5%	Q12 MPS-5172
C13 0.01 mfd., 100V, Ceramic Disc	R13 68 Ohms, 1/4W, 5%	Q13 MPS-5172
C14 0.01 mfd., 100V, Ceramic Disc	R14 68 Ohms, 1/4W, 5%	Q14 MPS-5172
C15 0.01 mfd., 100V, Ceramic Disc	R15 2.7K Ohms, 1/4W, 5%	Q15 MPS-H81
C16 2200 mfd., 25V, Electrolytic	R16 100 Ohms, 1/4W, 5%	
C17 0.1 mfd., 50V, Ceramic Disc	R17 47 Ohms, 1/4W, 5%	**INTEGRATED CIRCUITS**
C18 0.01 mfd., 100V, Ceramic Disc	R18 47 Ohms, 1/4W, 5%	
C19 0.01 mfd., 100V, Ceramic Disc	R19 1K Ohms, 1/4W, 5%	A1 78L05UC
C20 100 mfd., 16V, Electrolytic	R20 10 Ohms, 1/4W, 5%	A2 7812
C21 0.1 mfd., 12V, Ceramic Disc	R21 2.2K Ohms, 1/4W, 5%	A3 74LS02
C22 100 mfd., 16V, Electrolytic	R22 2.2K Ohms, 1/4W, 5%	A4 CD4011B
C23 0.1 mfd., 12V, Ceramic Disc	R23–	A5 CD4013B
C24 0.1 mfd., 12V, Ceramic Disc	R29 270 Ohms, 1.2W, 10%	A6 74LS00
C25 0.1 mfd., 12V, Ceramic Disc	R30–	A7 CD4011B
C26 0.01 mfd., 100V, Ceramic Disc	R36 3.3k Ohms, 1/4W, 5%	A8 74LS190
C27 0.01 mfd., 100V, Ceramic Disc	R37	A9 CD4020
C28 30 pfd., Silver Mica	R43 15K Ohms, 1/4W, 5%	A10 74C90
C29 0.1 mfd., 12V, Ceramic Disc	R44 1K Ohms, 1/4W, 5%	A11 CD4013B
C30 10 mfd., 25V, Electrrolytic	R45 150 Ohms, 1/4W, 5%	A12 CD4023B
C31 0.1 mfd., 12V, Ceramic Disc	R46 1K Ohms, 1/4W, 5%	A13 MC1416P
C32 0.1 mfd., 12V Ceramic Disc	R47 3.3K Ohms, 1/4W, 5%	A14 50398
C33 1200 pfd., Silver Mica	R48 22K Ohms, 1/4W, 5%	A15 555
C34 0.001 mfd., 500V 25U	R49 6.8K Ohms, 1/4W, 5%	
C35 0.1 mfd., 12V, Ceramic Disc	R50 10K Ohms, 1/4W, 5%	**INDUCTORS**
C36 0.1 mfd., 12V, Ceramic Disc	R51 1K Ohms, 1/4W, 5%	
	R52 330 Ohms, 1/2W, 10%	L1 47 uHy
DIODES	R53 33K Ohms, 1/4W, 5%	L2 5.6 uHy
	R54 1K Ohms, 1/2W, Potentiometer (Front Panel Control)	L3 18 uHy
CR1 1N4005	R55 680 Ohms, 1/4W, 5%	
CR2 1N4005		**MISCELLANEOUS**
CR3 1N4005		
CR4 1N4005		Y1 Crystal 5.242880 MHz
CR5 1N914		Z1 7-Segment Display, MAN-74A
CR6 1N914		Z2 7-Segment Display, MAN-74A
CR7 1N914		Z3 7-Segment Display, MAN-74A
CR8 1N914		Z4 7-Segment Display, MAN-74A
		Z5 7-Segment Display, MAN-74A
		Z6 7-Segment Display, MAN-74A

MK 50398 N



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Swan Electronics Corporation warrants this equipment against defects in material or workmanship, except for tubes amd solid-state devices, under normal service for a period of one year from original purchase date. Tubes and solid-state devices are warranted for a period of ninety (90) days. This warranty is valid only if the enclosed warranty registration card is properly completed and mailed to the factory within ten (10) days of purchase date.

If warranty service is required, do not ship equipment to the factory without prior authorization obtained from Swan Electronics Corporation. This warranty is limited to repairing or replacing the defective parts only and is not valid if the equipment has been tampered with, misused or damaged.

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