INSTRUCTION BOOK

MODEL 6100

BARKER & WILLIAMSON, INC.

BRISTOL, PENNSYLVANIA

WARRANTY

Barker & Williamson, Inc. warrants each Model 6100 Transmitter to be free from defective material and workmanship and agrees to remedy any such defect or to furnish a new part in exchange for any part of any unit of its manufacture which under normal installation, use and service discloses such defects, provided the transmitter is delivered by the owner, to the authorized dealer, from whom purchased, intact, for their examination, with all transportation charges prepaid. This warranty is valid only within 90 days from the date of purchase and is limited to a new equipment.

This warranty does not extend to a transmitter which has been subjected to misuse, neglect, accident, improper installation, or to use in violation of instructions furnished by us, nor extend to a unit which has been repaired or altered outside of our factory, nor in cases where the serial number has been removed, defaced or changed, nor to accessories used therewith not of our own manufacture.

This warranty is in lieu of all other warranties expressed or implied and no representative or person is authorized to assume for us any other liability in connection with the sale of our products.

CLAIM FOR DAMAGE IN SHIPMENT

INSPECT AND TEST THE EQUIPMENT AS SOON AS IT IS RECEIVED. WHERE EQUIPMENT HAS BEEN DAMAGED IN SHIPMENT, AN IMMEDIATE CLAIM SHOULD BE FILED WITH THE CARRIER WHO MADE DELIVERY TO YOUR PREMISES.

OUR COMPANY IS NOT RESPONSIBLE FOR SHIPPING DAMAGE.

Barker & Williamson, Inc. reserves the right to make improvements and changes in design at any time without incurring the obligation of installing same in units previously manufactured.

Illustrations

INTRODUCTION

You are now the owner of an outstanding transmitter. The B&W 6100 has been designed and built to give you the ultimate in single sideband and CW operation. The Model 6100 Transmitter is a crystal lattice filter type transmitter with a radically new type of variable frequency control.

This transmitter contains no free running oscillators as encountered in previous types of amateur transmitters. The frequency control unit of this transmitter is a "frequency synthesizer" whose stability is considerably better than anything heretofore available in the amateur class of equipment.

The 6100 Transmitter covers all amateur bands from 80 through 10 meters, with considerable coverage above each amateur band to permit operation on many of the MARS frequencies.

In order to achieve the fine performance inherent in your instrument, we urge you to spend sufficient time with this manual to familiarize yourself with the purpose and function of the controls and their relationship to the signal you put on the air.

	Sideband Generator.
tional Function	SSB, Linear AM, CW.
ency Control	Crystal Controlled Frequency Synthesizer.
ency Coverage	3.5-4.1, 7.0-8.0, 14.0-15.0, 21.0-22.0, 28.0-29.0, & 29.0-30.0 Mcs.
ency Stability	In normal operating environment (room temperature) drift during the first 15 minutes not in excess of 100 cycles. During any hour of operation thereafter within ±25 cycles.
Accuracy	Better than ±1 Kc on any band after calibration. Dial resetability ±100 cycles.
rtion Products	40 DB below peak signal (140 PEP input) with voice signal input and ALC in operation.
er Suppression	50 DB below peak output.
and Suppression	50 DB below peak output Upper or Lower Sideband.
ous Mixture nals	More than 50 DB down.
nonic Output	Second harmonic down better than 43 DB. Third harmonic down better than 55 DB.
ual Hum and ise	More than 55 DB down.
Distortion	Less than 5% with ALC
	Input Maximum
	CW . . . 180 wa Input Maximu
	AM . . . 90 watts Maximum.
Power Output	SSB . . . 100 watt inal.
	CW . . . 100 watt inal.
	AM . . . 20 watts AM operation.
Receiver Disabling	100 volts minus vided, VOX o contacts — two and one SPST against ground ceive).
Output Impedance	Will match 30-1 resistive loads.
Power Consumption	Standby — 185 Transmit — 425
Primary Power	Designed for o from 115 V, cycle, single ph The transforme ary is also tap 105 and 125 v
Tube and Diode Complement	Frequency Synth 2-6CB6, 1-6A 1-5763.
	Speech Amplifier Circuits: 2-6C 1-6AL5.
	Main Chassis: 2 2-6BA6, 1-6C 12AU7, 1-12B 6146, 1-6AL5, ched Diodes,

SECTION II UNPACKING

1. After removing the transmitter from the carton, examine the unit carefully for damage due to mishandling in transit. Your 6100 transmitter has been carefully packed to insure safe delivery at its destination. If damage during shipment is apparent, notify the carrier immediately, outlining the total extent of damage.

a. Place the transmitter on the table or a bench with one end overhanging sufficiently to allow removal of screws holding the transmitter to the shipping pallet. Remove the two screws from the opposite side in a similar manner. Remove pallet from underneath the transmitter.

b. Place a towel, blanket or some other soft material adjacent to the right hand side of the transmitter. Tilt the transmitter up on the padding.

c. Remove the mounting feet and the hardware from the bag. Install the long mounting feet in the front of the cabinet and the two short feet in the rear. Use the flat washers under the heads of the screws. Tighten all four screws.

SECTION III INSTALLATION

1. Refer to figure 1 for external connections to the 6100 transmitter.

a. No hard-and-fast rule can be given for connections and control of external equipment. This, of course, depends on the type of equipment being used by the individual.

b. Figure 1 indicates connections between terminal strip TB1 and the relay contacts of relay K1. It should be noted that the contact connected to terminal 2 of TB1 is grounded during receive (unenergized)

f. The 6100 transmitter has been provided with a low impedance (600 ohm) "phone patch" facility, available between terminal 12 of TB1 and ground. This input may be used for any phone patch system whose output impedance lies between 500 and 800 ohms.

g. Connect the station ground bus to the ground stud located on the rear apron of the transmitter.

2. If your 6100 transmitter will be used to drive a linear amplifier, it is recommended that

SECTION III INSTALLATION

1. Refer to figure 1 for external connections to the 6100 transmitter.

a. No hard-and-fast rule can be given for connections and control of external equipment. This, of course, depends on the type of equipment being used by the individual.

b. Figure 1 indicates connections between terminal strip TB1 and the relay contacts of relay K1. It should be noted that the contact connected to terminal 2 of TB1 is grounded during receive (unenergized) conditions. Since most receivers are disabled during transmit periods by ungrounding a particular circuit, terminal 2 of TB1 may be used for receiver disabling. Two sets of single pole double throw contacts are available on TB1.

c. A control voltage of –100 VDC is available (through a 100K 1/2 watt isolation resistor) at terminal 1 of TB1. This voltage may be used for supplying cut-off bias in a zero bias amplifier, or for receiver muting when used in conjunction with a suitable voltage divider or potentiometer. DO NOT ALLOW GRID CURRENT TO FLOW IN THE –100V INTERNAL CIRCUIT. This may be prevented by connecting terminals 1 and 4 (of TB1) together and obtaining the –100 volts from terminal 3. Terminal 5, therefore, may be connected to the external receiver muting circuit.

d. Terminals 9 and 10 of TB1 are connected internally across the primary of the "anti-trip" transformer T11. Connections must be made from this pair of terminals to your speaker voice coil. There is, of course, no polarity to this circuit.

e. Terminal 11 of TB1 is connected in parallel with pin no. 2 of MIC connector J1. By placing the OPERATION switch in the PTT (Push-to-talk) position, the transmitter can be put on the air by operating the push-to-talk switch on your microphone or by shorting terminal 11 of TB1 to ground with an external hand- or foot-operated switch.

f. The 6100 transmitter has been provided with a low impedance (600 ohm) "phone patch" facility, available between terminal 12 of TB1 and ground. This input may be used for any phone patch system whose output impedance lies between 500 and 800 ohms.

g. Connect the station ground bus to the ground stud located on the rear apron of the transmitter.

2. If your 6100 transmitter will be used to drive a linear amplifier, it is recommended that you use RG-11 or RG-59 coaxial cable between the 6100 Transmitter and the amplifier. It is desirable, of course, that the interconnecting cable be kept as short as possible. In any event, do not use more than 6 feet of cable in this application. A PL-259 male connector is required to match with the SO-239 RF OUTPUT connector on the transmitter.

3. Before plugging your transmitter into the AC power receptacle, it is important that you determine the AC line voltage present at the power receptacle.

a. If the line voltage is between 110 and 118, place the AC line compensating switch in the 115 VAC position. If the reading is above 118 volts, place the switch in the 125 volt position.

b. Should the voltage be less than 110 volts, it will be necessary to remove the bottom cover from the transmitter and locate the wire, (color coded black with white tracer) taped to one of the two wires connected to the line compensating switch. Remove the black wire with the yellow tracer from the switch and replace it with the white tracer wire. Tape the exposed end of the wire removed. Replace the bottom cover.

c. Do not attempt to squeeze a few more watts out of your transmitter by operating under high line voltage conditions, with the power transformer primary connected for 105 volts. The end results will not justify this kind of abuse.

4. Place operation switch in the OFF position and plug the AC line into the power receptacle.

a. Place the transmitter at your operating position in such a manner as to provide adequate ventilation on both sides. Do not place other equipment or papers, books, etc. on top of the transmitter. Your transmitter had been carefully designed to eliminate the need for a fan or blower with its attendant noise and maintenance problems.

SECTION IV OPERATING CONTROLS

Your 6100 Transmitter has the following controls:

1. Operation Switch
2. Audio Gain
3. Carrier Level
4. Emission
5. Meter Switch
6. Meter Zero
7. Anti-Trip
8. VOX Sens (VOX Sensitivity)
9. Delay (VOX Delay)
10. Cal (Calibration)
11. Car Bal (Carrier Balance)
12. ALC MTR ZERO (Automatic Level Control Meter Zero)
13. ALC THR (Automatic Level Control Threshold)
14. Frequency Control
    X1
    X10
    X100
15. Band Sel (Band Selector)
16. Driver Tuning
17. Amplifier Tuning
18. Amplifier Loading

OPERATION — This switch has the following positions:

a. STBY — This position is used for warm-up prior to operation. It is also recommended that the standby position be used when called away from the equipment temporarily. On STBY, all power supplies are running and the power drain is about 185 watts.

b. MAN (Manual) — In this position, all stages of the transmitter are receiving power and, if you are properly tuned, it is putting out power. This position is used for tuning up and for CW transmissions.

c. CAL (Calibrate) — In this position, the exciter stages only are operating, the final not being excited. The CAL position permits you to bring the transmitter exactly to the frequency on which your receiver is set and to listen to the beat note through your loudspeaker. Interference is not transmitted.

d. VOX (Voice Control Operation) — In this position, the voice operated relay is actuated by speech through the microphone and any manual operation or push-to-talk is unnecessary. With the proper microphone switch, push-to-talk operation is also provided with the switch in this position.

e. PTT (Push-to-Talk) — Use this switch position for strictly push-to-talk operation. For operating in surroundings with a high noise level, this position is recommended rather than VOX.

AUDIO LEVEL — This control varies the level of audio signal in the 6C10 cathode follower, output stage. Its setting will depend upon the type of microphone, the strength of the operator's voice, and the distance that you choose to speak from the microphone.

CARRIER LEVEL — This control varies the amount of carrier inserted when the transmitter is used for tuning up and for AM operation.

EMISSION — This control selects the sideband, CW, or AM types of emission. When the switch is placed in the AM/TUNE position, the ALC (Automatic Level Control) is inoperative. In tuning up, it is recommended that the switch always be on the AM/TUNE position; otherwise, the ALC will be in the circuit and will give a feeling of rubbery tuning.

METER SWITCH — This switch has the following positions:

a. OUTPUT, Top Scale — This range is used to peak the driver tuning, amplifier tuning and amplifier loading for maximum output. It is also used for balancing out the carrier. While in this position, the meter is functioning as an RF voltmeter.

b. PL CUR (Plate Current), Middle Scale — This scale is calibrated in milliamperes and reads cathode current in the 6146's.

c. ALC (Automatic Level Control), Lower Meter Scale — The meter is functioning as a DC voltmeter and indicates the ap-

proximate amount of ALC compression that is being used.

METER SENS — This control is used to set the meter to full scale when the carrier is inserted during tune-up periods.

ANTI-TRIP — This control varies the amount of loudspeaker signal fed into the anti-trip terminals of your 6100 to prevent cycling by the loudspeaker.

VOX SENS (VOX Sensitivity) — This control varies the sensitivity of the voice control relay. Advancing this control clockwise increases the sensitivity.

DELAY (VOX Delay) — This control varies the amount of hold-in time of the VOX relay. Rotating this control clockwise decreases the delay.

CAL (Calibration) — This control functions only when the OPERATION switch is in the CAL position. By turning this control clockwise, you can vary the magnitude of the signal provided for zeroing in on a station.

CAR BAL (Carrier Balance) — This control balances the balanced modulator for minimum residual carrier. For complete balance the CAR BAL knob must be adjusted in conjunction with the chassis mounted balancing capacitor, C25, labelled CAR BAL. C25 should be adjusted after warm-up and should be checked every month or two.

ALC MTR ZERO (Automatic Level Control Meter Zero) — With the meter switch on ALC, the EMISSION switch on either upper or lower sideband, and the CARRIER LEVEL at 0, this control should be adjusted until the needle of the meter is on the first index line (below zero) on left end of the bottom scale. As you talk under normal operation, this needle will bounce slightly, indicating the amount of ALC voltage that is being developed (dependent upon the setting of the ALC THR). If this needle is peaking above 3 as you speak, we suggest that you reduce the audio level control, otherwise, you will be transmitting an excessive amount of background, such as blower noise, room reverberation, etc.

ALC THR (Automatic Level Control Threshold) — With this control fully advanced clockwise, the transmitter output is maximum. This control should be turned counterclockwise so that the drive to the final is limited and over-drive of the 6146's (or a power amplifier, if used) does not occur. Optimum adjustment of this control will probably require a scope. Since the ALC is particularly effective, the advantages to be derived from fully utilizing this feature will be worth the time necessary to achieve proper adjustment.

FREQUENCY CONTROL — The frequency is varied by the following controls:

a. X1 — Varies the frequency of the exciter continuously throughout a 10 KC range.

b. X10 — Varies the frequency of the exciter in 10 KC increments.

c. X100 — Varies the frequency of the exciter in 100 KC increments.

BAND SEL (Band Selector) — This control selects the desired operating band. The red numerals on the top of the scale of the X100 knob are used for reading the first two numerals of the output frequency on the 80 meter band. On all other bands, the lower scale of this dial is used.

DRIVER TUNING — This control gang tunes the grid circuit of the final and the stages preceding the final. These tuned circuits are of exceptionally high Q and, therefore, quite selective. This control should be repeaked when the operating frequency is changed.

AMPL TUNING (Amplifier Tuning) — This control tunes the amplifier to resonance.

AMPL LOADING (Amplifier Loading) — This is the pi-network loading control and in searching for the proper loading position, this control should be started at 10 and moved in small increments counterclockwise. AMPL LOADING operates a variable capacitor which is fully meshed when the dial reads 10.

SECTION V OPERATION

1. Before tuning up, let's spend a little time becoming familiar with the frequency controls. The frequency "read-out" system is quite simple and can be learned as rapidly as you can read this discussion.

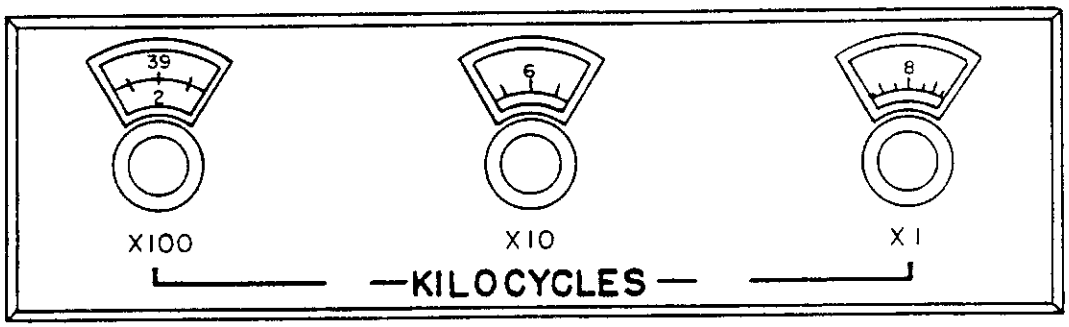
   a. You will note that the BAND SEL control is marked in terms of megacycles for all bands except 80 meters. For 40 meter operation, 7 mc becomes the first significant figure of the output frequency. For the remaining bands (20, 15, 10A and 10B) 14 mc, 21 mc, 28 mc and 29 mc become the first and second significant figures of the output frequency.

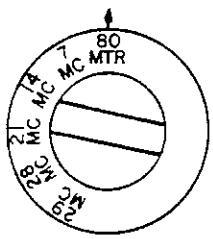
   b. On 80 meters, we have a somewhat different situation. In this position, the BAND SEL control is marked 80 MTR and is printed in red letters and numbers. This is related to the red numbers on the X100 scale of the synthesizer. Therefore, frequency read-out on 80 meters is indicated by the 3 dials of the frequency synthesizer only.

   c. Several examples are given to further illustrate. It is suggested that you practice these settings before operating the transmitter.

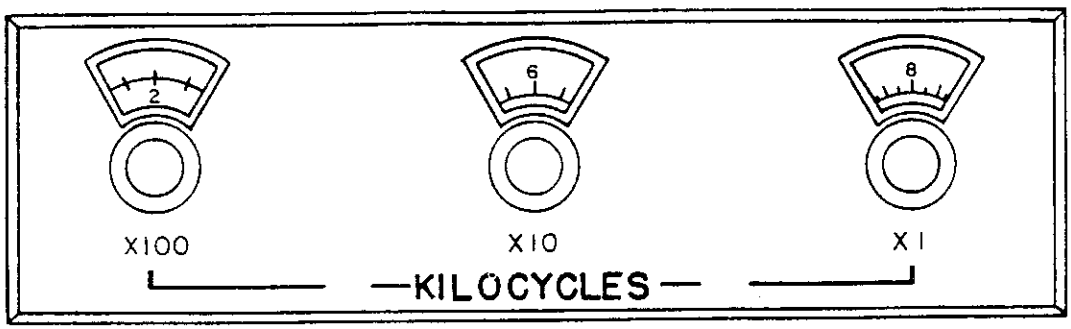
   d. Do not attempt to operate your transmitter above 4.1 mc (4100 kc). You will observe a red band starting slightly past "41" on the X100 scale and continuing to the end. Its purpose is to remind you not to use this portion when the BAND SEL is set to 80 MTR.

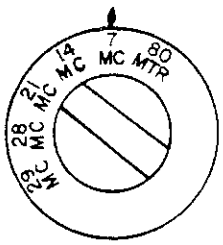
2. For operation in the 80 meter band on a frequency of 3968 mc, the three frequency controls are set as illustrated.



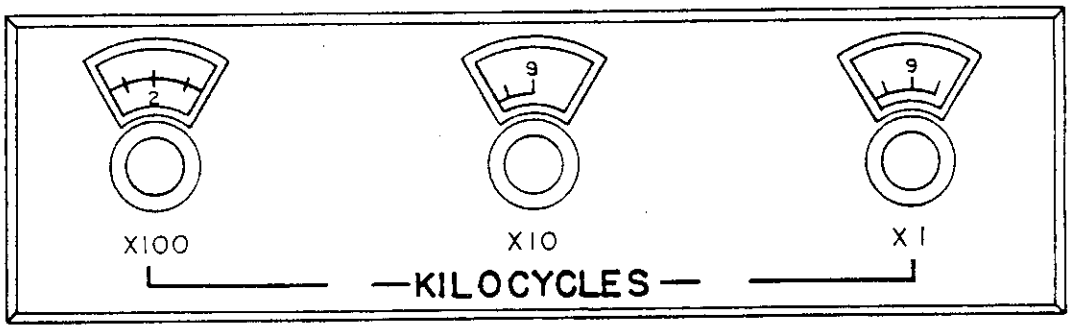


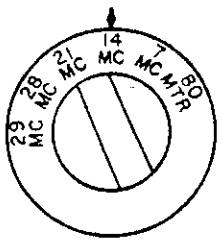
For 40 meter operation on a frequency of 7268 kc, they are set:





For 20 meter operation a frequency of 14299 kc, they are set:





DO NOT ATTEMPT TO TUNE OR LOAD THE TRANSMITTER WITHOUT TERMINATING IT IN A SUITABLE LOAD, EITHER DUMMY OR ACTUAL ANTENNA OF PROPER LENGTH FOR YOUR OPERATING FREQUENCY.

3. It is beyond the scope of this instruction manual to recommend one type of antenna over another type. The owner is referred to numerous handbooks on this subject.

a. Your transmitter has been designed to load into antennas whose impedance lies between 30 and 100 ohms, without the need for special matching devices.

b. Many attempts have been made to minimize the effects of high VSWR. Aside from the loss in radiated power that results, another unfortunate situation develops that can be very disastrous.

c. If an amplifier is supplying 1 KW PEP to a well matched 50 ohm antenna system, with a VSWR of 1:1, a peak voltage of approximately 225 volts will appear across the RF output terminals of the amplifier.

$$E = \sqrt{PR}$$

d. If the same antenna system is changed to cause a VSWR of 2:1, the peak voltage will increase to 450 volts. An increase of VSWR to 4:1 will increase the peak voltage to 900 volts! ! ! If a low pass filter, TR switch or change-over relay is used, it is being subjected to abuse.

SSB OPERATION

4. Set BAND SEL, DRIVER TUNING and frequency control dials to the desired operating frequency. Set the remaining controls in the following positions.

OPERATION	STBY
CARRIER LEVEL	6
EMISSION	AM/TUNE
AMPL. LOADING	10
AMPL. TUNING	10
METER SW	OUTPUT
METER SENS	10
AUDIO LEVEL	0

5. Tune up as follows:

a. Turn OPERATION switch to MAN (Manual).

b. Turn DRIVER TUNING back and forth to obtain maximum reading on the meter.

c. Alternately rotate AMPL TUNING and AMPL LOADING controls counterclockwise in small steps to obtain maximum meter reading. Turn METER SENS control counterclockwise if meter needle goes off scale. Set to approximately two-thirds scale.

d. Repeat steps b. & c. until maximum meter reading is obtained.

e. Set METER SW to PLA CUR. and rotate CARRIER LEVEL control fully clockwise. If meter reading indicates more than 300 MA., turn AMPL LOADING control slightly clockwise and redip with AMPL TUNING control.

f. Repeat step b. above.

g. Set METER SW to OUTPUT and adjust METER SENS to indicate a full scale (top scale) reading of the meter.

h. Turn CARRIER LEVEL control counterclockwise until red CARRIER light goes out.

i. Open front panel access door and adjust CAR. BAL. control for the lowest possible reading on the meter.

6. This completes the initial tuning-up procedure prior to going on the air. Connect microphone to transmitter and advance AUDIO LEVEL control to approximately 6. Place OPERATION switch in VOX position.

VOX SENSITIVITY

7. Assuming you are using a dummy load to eliminate unnecessary interference to other stations, talk into microphone in a normal voice, while adjusting the VOX SENS (VOX SENSITIVITY) control for the desired sensitivity. The correct position is obtained when the transmitter is activated each time you speak into the microphone.

VOX DELAY

8. The proper setting of this control involves several factors which must be considered, such as recovery time of the receiver, type of antenna changeover device, etc. Therefore, the delay control must be set for your individual set of conditions. In general, it should be a compromise that keeps the transmitter energized between words of a spoken sentence and yet allows the receiver to become activated when you stop talking, in sufficient time to prevent missing the first or second word of the received signal.

a. If a phone patch is used in conjunction with your transmitter, you will probably require a somewhat different setting of the VOX DELAY control.

ANTITRIP

9. Tune in a typical SSB signal on your receiver, setting the volume to normal listening level. Place microphone in approximately the same area as you would use it during operation. Set AUDIO LEVEL as required for your normal use.

a. If insufficient antitrip voltage is being developed, the transmitter will probably be activated by the speaker signal being picked up by the microphone. This will require a readjustment of the ANTITRIP control, and is accomplished by rotating this control clockwise until the speaker signal no longer activates the transmitter.

b. Do not advance this control any farther than necessary, since an excessive setting will interfere with proper VOX operation. Use the lowest possible setting.

CAL. (CALIBRATION)

10. With the OPERATION switch set to CAL, the CAL control determines the level of transmitter signal heard in the station receiver. This signal is used to zero beat to a desired frequency. Advancing the CAL control in a clockwise direction will increase the level of the signal heard in the receiver.

ALC THR. (ALC Threshold)

11. This is the automatic level control threshold adjustment. With this control fully advanced clockwise, transmitter output is maximum. This control should be turned counterclockwise so that drive to the final is limited and over-drive of the 6146's (or a separate power amplifier, if used) does not occur. Optimum adjustment of this control will probably require a scope. The ALC of the 6100 is particularly effective and the advantages to be derived from full utilization of this feature will be worth the time necessary to achieve proper adjustment. It may be adjusted in the following way:

a. Terminate RF output connector of your 6100 into a 50-ohm dummy load.

b. Connect vertical plates of oscilloscope to 6100 transmitter output. Set oscilloscope sweep control to approximately 40 cycles per second.

c. Position 6100 controls as follows:
AUDIO LEVEL control to 7
OPERATION switch to MANUAL
EMISSION switch to USB or LSB

d. Speaking at a normal distance from the microphone, at typical speech levels, rotate the ALC control counterclockwise until flattening of the peaks disappears and the peaks are sharp and clearly defined. This will occur slightly before the amplitude of the peaks shows an appreciable decrease.

It should be noted that the output of the 6100 transmitter may be reduced to less than 10 watts when the ALC control is rotated to its full counterclockwise position. This unique feature will allow the 6100 transmitter to be used as a driver for amplifiers requiring less than 20 watts of drive, without the need for grid swamping or other forms of power wasting devices.

CW OPERATION

12. CW operation with the 6100 transmitter is relatively simple, requiring only a slight change in the positioning of two controls, from that used for SSB operation.

Full "break-in" operation is possible with your transmitter. It functions in much the same manner as the VOX system functions in SSB operation.

13. Set BAND SEL, DRIVER TUNING and frequency control dials to the desired operation frequency. Set the remaining controls in the following positions:

OPERATION	STBY
CARRIER LEVEL	6
EMISSION	AM/TUNE
AMPL LOADING	10
AMPL TUNING	10
METER SW	OUTPUT
METER SENS	10
AUDIO LEVEL	0

14. Tune up as follows:

a. Turn OPERATION switch to MAN.

b. Turn DRIVER TUNING back and forth to obtain maximum reading on the meter.

c. Alternately rotate AMPL TUNING and AMPL LOADING controls counterclockwise in small steps to obtain maximum meter reading. Turn METER SENS control counterclockwise if meter needle goes off scale. Set to approximately two-thirds scale.

d. Repeat steps b. and c. until maximum reading is obtained.

e. Rotate CARRIER LEVEL control full clockwise and set METER SENS control for exactly full scale reading on the meter.

f. Rotate EMISSION switch to CW and insert your key plug in KEY jack.

15. You are now ready to operate under CW conditions. You will note that the VOX relay functions each time you start to key a series of code characters. This relay will stay energized for a period of time, depending on the setting of the VOX DELAY control. This is a normal function of your transmitter which enables you

to operate true break-in. Set the VOX DELAY control for the desired delay time, depending on your keying speed.

16. If you propose to operate full break-in or use your receiver as a keying monitor, it will be necessary to operate the appropriate control or switch of your receiver from "standby" to "on".

AM LINEAR OPERATION

17. Set all controls as outlined under paragraphs 13 and 14a to 14d inclusive.

a. Rotate CARRIER LEVEL control fully clockwise and set METER SENS control for exactly full-scale reading on the meter. Now, rotate CARRIER LEVEL control counterclockwise until meter reading drops to 6 db (upper scale).

b. While observing meter reading, speak into microphone in a normal level and adjust AUDIO LEVEL until needle just barely flicks. This is the correct setting for AM LINEAR operation. Advancing AUDIO LEVEL beyond this point will introduce distortion which leads to excessive bandwidth.

SECTION VI THEORY OF OPERATION

Circuit Operation

Refer to the block diagram, Figure 2, for the following description. The single sideband signal is generated at a carrier frequency of 3.2 megacycles. The microphone speech amplifier drives the two-diode balance modulator and generates a double-sideband suppressed carrier signal at the carrier-oscillator frequency of 3.2 mc. The crystal-lattice filter passes the upper sideband while attenuating the lower sideband, thus generating an upper-sideband signal with a suppressed carrier frequency of 3.2 mc.

This USB signal is amplified in the first ALC amplifier at 3.2 mc. This stage is a variable-gain stage which is one of the two stages used in the ALC system. This stage drives Balanced Modulator #2 which forms the mixture of the 3.2 mc upper sideband signal and either the 6.0 mc or 12.4 mc sideband-switching crystal oscillator signal. Using this system, a new intermediate frequency of 9.2 mc is generated. For upper-sideband, the 6.0 mc crystal is used (3.2 mc USB +6 mc = 9.2 mc USB). For lower sideband, the 12.4 mc crystal is used (12.4 mc -3.2 mc USB = 9.2 mc LSB). This 9.2 mc SSB signal is amplified in the second ALC amplifier.

Note that the Frequency Synthesizer output frequency covers the range of 4.7 to 5.7 mc. To cover the 80 meter band, the 9.2 mc signal is heterodyned with the synthesizer output. This is accomplished by operating the 1st Mixer/Amplifier as a "straight-through" amplifier and disabling the Heterodyne Oscillator. This is accomplished in the 80 MTR position of the band switch. Thus, the 80 meter signal is formed by heterodyne difference between the synthesizer frequency and the 9.2 mc first IF frequency — (9.2 mc LSB — 5.2 mc = 4.0 mc LSB).

For operation on all other amateur bands, a new second-intermediate frequency must be generated for each band used. To do this, the sum mixture of the 9.2 mc SSB 1st IF signal and the various heterodyne oscillator crystal frequencies is formed. See the chart below for these relations for each amateur band.

BAND	1ST IF	HET. OSC. FREQ.	2ND IF
80 MTRS	9.2 mc	None	9.2 mc
40	9.2 mc	3.5 mc	12.7 mc
20	9.2 mc	10.5 mc	19.7 mc
15	9.2 mc	17.5	26.7 mc
10 low	9.2 mc	24.5	33.7 mc
10 high	9.2 mc	25.5	34.7 mc

Noting the above list of 2nd IF signal frequencies, it can be seen that each amateur band may be covered by subtracting the synthesizer frequencies (4.7 to 5.7 mc) from the corresponding 2nd IF sideband signal.

The output of the 2nd Mixer/Amplifier stage covers the amateur band in use. The Driver Amplifier and Final Amplifier stages, of course, operate straight through on the amateur band frequency.

Frequency Synthesizer Operation

Generation of a variable frequency by artificial "synthetic" means is by no means new. Systems employing frequency synthesis have been employed in military equipment of high stability for the last several years. The B&W Frequency Synthesizer is an adaptation of one of the simpler schemes available.

The basic principle is one of heterodyning a fixed crystal against another crystal whose frequency can be varied over a relatively small range. In this case, the fixed-crystal frequencies are spaced exactly 100 kc apart near the 25 mc portion of the spectrum. The variable crystals are 10 kc apart and whose unpulled frequencies lie between 20.01 and 20.1 mc. Each of the 20 mc crystals is varied downward 10 kc so that continuous coverage is achieved. By taking the heterodyne difference between the fixed and variable crystals, the range of 4.7 to 5.7 mc may be covered continuously. The crystals are very carefully temperature-matched so that any equipment temperature changes that take place affect all crystal frequencies by the same amount so that the difference frequency does not change. The variable 20 mc crystals are mounted on the "tens" frequency switch and are inside the frequency synthesizer sub-chassis.

ALC Circuit Operation

The ALC Detector, V11, is connected to the grid circuit of the P.A. stage and conducts only when the ALC bias voltage is exceeded. This bias voltage is set by the ALC threshold (ALC THR) control inside the small door. Each half of the 6AL5 is connected to a separate diode load

of a different time constant. The slow ALC bus signal (1.5 second time constant) holds the gain between words, and the fast time constant (.03 second) follows the rapid variations of each syllable. Each bus is connected to a separate ALC amplifier and the overall gain is controlled so that the pre-set excitation level is not exceeded at the 6146 grids. This is true for even a "wide open" setting of the speech amplifier gain setting. However, it is not recommended that more than a nominal amount of ALC compression be used because it will produce a background "pumping" effect and a certain amount of in-band speech distortion. The ALC is intended to prevent accidental overdrive of the amplifier stage and to give a moderate amount of average power increase while preserving the system linearity.

VOX Circuit Operation

The VOX circuit operation is conventional and only a brief description will be presented. The microphone speech signal is amplified, rectified and used to turn on a d-c relay control tube, V2-C, by applying a positive control voltage to its grid. The antitrip circuit derives its audio signal from the station receiver and amplifies it, rectifies it and places a negative voltage on the relay control tube. This negative bias holds the VOX relay deactivated when a signal from the receiver loudspeaker is picked up by the microphone.

Phone-Patch Operation

The 6100 is equipped with a separate low impedance audio input terminal on the terminal strip on the rear skirt of the transmitter. Phone patcnes of high impedance may be connected in through the microphone connector if desired. If the low-Z input is used, isolation of the input from stray r-f in the shack or on the phone lines must be insured. Use of r-f chokes and disc ceramic .001 mfd bypass capacitors is recommended. The microphone should be shorted out or disconnected when using the low-Z phone patch connection. All gain control and VOX control functions are normal when using the low-Z patch method.

Power Supply Circuitry

All power supplies in the 6100 transmitter use silicon rectifiers rated at 750 ma and 600 volts inverse-peak voltage per rectifier unit. The use of silicon rectifiers eliminates approximately 50 watts of heat dissipation within the transmitter cabinet, thus keeping the transmitter temperature down without forced draft cooling. The +750 volt and the +300 volt supplies as well as the –100 volt bias supply operate from a common secondary winding with a common ground center tap. Each silicon rectifier has a .001 mfd capacitor in parallel for surge protection.

SECTION VII ALIGNMENT

Realignment of the 6100 circuits should be necessary only after a considerable period of time or after replacement of tubes. The use of a wideband oscilloscope is desirable, but since few ham shacks are so equipped, a general coverage receiver with a 100 KC calibrator and dummy load/power meter such as the B&W Matchmaster will suffice. See figures 3 & 4 for location of alignment controls.

Alignment of Low-Level Stages

3.2 MC Carrier Oscillator and Buffer Stage — Remove the bottom plate from your 6100 by removing the six screws which fasten it to the chassis. Tune up your 6100 to any band and place the EMISSION switch in the USB or LSB position. Place a short antenna near the oscillator tube. Tune a general coverage receiver to 3.2 MC and turn on its calibrator (the calibrator should be zero beat with WWV). Adjust the 3.2 MC crystal trimmer, C14, until the carrier oscillator is zero beat with the standard. See figures 3 & 4 for locations of alignment controls.

For the following adjustments there should be NO carrier inserted. The 3.2 MC Oscillator tuned circuits should be tuned by adjusting C23 for maximum output as indicated by maximum deflection of the power meter. THIS ADJUSTMENT SHOULD BE MADE UNDER CONDITIONS OF AUDIO INPUT INTO THE MICROPHONE JACK. An audio oscillator or steady whistle into the microphone may be used.

3.2 MC ALC Amplifier Alignment — The 3.2 MC ALC Amplifier plate circuit should be tuned by adjusting C32 with the CARRIER LEVEL control half-advanced for maximum indication on the power meter.

Sideband Switching Oscillator — With the transmitter output tuned to any band and the CARRIER LEVEL control adjusted for about half-scale indication, make the following adjustments: With the EMISSION switch in the LSB position, adjust C43 of the sideband switching oscillator for maximum output as indicated by the power meter. Now locate C46 and adjust this control for maximum output. Note that the oscillator may cease to oscillate, in which case it will be necessary to readjust C43 and then readjust C46. Switch the EMISSION from LSB to USB a few times to make sure that the crystal will readily start. If it does not, offset C43 a little till the oscillator starts reliably. Now turn the EMISSION switch to USB and adjust C44 for maximum output.

Realignment of the sideband switching oscillator will probably cause the frequencies to vary. To adjust the frequency, tune your receiver to 9.2 MC, place the EMISSION switch in LSB position and adjust C34 till it is zero beat with the calibrator. Now turn the EMISSION switch to USB and adjust C33 till it is zero beat with the calibrator. Note that it will be necessary to insert carrier to make the above adjustments.

9.2 MC ALC Amplifier Alignment — The CARRIER LEVEL control should be half advanced. The 9.2 MC Filter, FL2, should now be adjusted for maximum output in the following manner: First adjust the top capacitor (with an insulated alignment tool) for maximum power; then adjust the bottom capacitor for maximum power reading. DO NOT ADJUST BOTH AT THE SAME TIME AS IT IS POSSIBLE TO TUNE THIS FILTER TO AN UNWANTED SIGNAL. Readjust the top and bottom capacitors until there is no improvement in the power output. A receiver tuned to 9.2 MC should also be used in this procedure. It should be noted that as the filter is tuned, the "S" meter on the receiver gives higher readings. Now proceed to peak C55 for maximum power output.

1st Mixer-Output Circuit Alignment — The 1st mixer circuits are double-tuned transformers. With the output frequency set on each band, align the associated 1st mixer output circuit for maximum power output. Example: 80 meter operation, adjust the 9.2 MC transformer, T5, top and bottom slugs; 40 meters, 12.7 MC transformer, T6; 20 meters, 19.7 MC transformer, T7; 15 meters, 26.7 MC transformer, T8; 10A 33.7 MC transformer, T9; and 10B, 34.7 MC transformer, T10. If for any reason it is felt that the various 1st mixer transformers are tuned to an incorrect frequency, use a general coverage receiver and tune to the appropriate correct frequency and couple the receiver lightly (a short piece of wire near the chassis) and peak the transformer in question for an "S" meter maximum indication.

2nd Mixer and Driver Amplifier Alignment — Since the 2nd mixer and the following stages have their output frequencies on each ham band, the alignment of the 2nd mixer and driver stages will

be concerned with the proper tracking of the ganged tuned circuits.

Conventional alignment procedure is used in this case, where both slug-tuned coils and trimmer capacitors are available for each band except 80 meters. The slugs are peaked for maximum output at the low end of the ham bands and the trimmer capacitors are peaked for maximum at the high end of the ham band. This procedure must be repeated several times to insure optimum tracking of the ganged circuits. The 80 meter band is an exception because no slug-tuned coil is used. Instead, a very high Q pair of fixed inductances are used. On 80 meters, if the two trimmer capacitors are peaked in the middle of the ham band, tracking will be almost perfect over the whole band. On all other bands follow the rule — "Align slugs on the low end and capacitors on the high end." An example follows: Band — 40 meters; Set the frequency synthesizer for 7.0 MC and tune the driver and final for maximum transmitter output. Reduce the magnitude of inserted carrier to half-scale on the OUTPUT meter. With the bottom cover removed, peak the two 40 meter slugs (2nd mixer, L7, and driver amp, L12) on the underside of the coil boxes. Move the transmitter frequency to 7.3 MC and peak ganged DRIVER TUNING and P.A. plate tuning controls to the new frequency. Now adjust the two 40-meter trimmer capacitors on top of the mixer (C130) and driver (C157) coil boxes (top of chassis) for maximum output. Return to 7.0 mc and repeat peaking with slugs and then again to 7.3 mc for repeaking of capacitors. Continue this procedure until no further improvement is possible. This same procedure should be followed for each ham band low end and high end adjustment.

Final Amplifier Alignment

The final amplifier bias control, R86, should be adjusted for an idling cathode current of 70 ma as read when the MTR SW is set in the PL CUR position and the OPERATION switch in MAN. (No carrier inserted).

Final Amplifier Neutralization

The P.A. is normally neutralized on either of the ten-meter band positions. Tune up the 6100 on any frequency in the 10 meter band, peaking all circuits for maximum output. Turn off AC power. With bottom cover removed, unsolder the two jumper wires, which removes the B+750 volts on the plates and B+250 volts on the screens of the 6146 tubes. Turn on AC power, switch to MAN, insert full carrier and use a sensitive r-f voltmeter or station receiver tuned to transmitter frequency and coupled to antenna terminal. Rotate neutralizing capacitor, C163, for minimum signal out of the final amplifier. Repeat AMPL TUNING control and re-null neutralizing capacitor. Shut off power and reconnect the two jumper wires to the supply voltages.

Driver-Amplifier Neutralization

The 12BY7A driver stage is neutralized on each band to insure stable drive conditions without severe tank circuit swamping.

The neutralization procedure is the same on each of the amateur bands and is as follows: Tune up the transmitter on the amateur band in question using the AM/TUNE and MAN switch positions. Full carrier should be inserted. Shut off the AC power and unsolder the +300 volt jumper for the 12BY7A stage. This appears between two tie points on the bottom terminal strip in the driver shielded compartment. Turn on the AC power and by using a sensitive RF-VTVM connected to the 50-ohm output of the transmitter, adjust the appropriate neutralizing capacitor for a null in output indication. See the under-chassis view, figure 4, for locations of the various neutralizing condensers and the B+ jumper wire. A well shielded receiver may also be used to monitor the output during neutralization. Care must be exercised so as not to overload the receiver. Lightly couple the receiver to the 50-ohm dummy load at the transmitter output and set the receiver RF gain for a usable S-meter indication. Normally, replacement of tubes should not necessitate reneutralization in either the driver or final amplifier stage.

Frequency Calibration of the 6100 Synthesizer

WARNING: Adjustment of any crystal frequency or oscillator tuning controls should not be attempted without first being thoroughly familiar with the principle involved and should not be attempted without proper frequency-standard test equipment. The frequency synthesizer has been factory adjusted by using a decade-counter frequency meter and should not be changed unless actual trouble exists.

Routine Operating Calibration

The synthesizer is factory adjusted to be within specification when the movable fiducial pointer on the X1 dial is set in the middle of the "ones" window.

If band-edge operation is desired, the unit should be calibrated against a 100 kc band-edge marker oscillator by using the station receiver. The transmitter should be "zero beat" with the appropriate 100 kc check point and the sliding fiducial pointer mover to coincide with the "O" line on the X1 dial.

Overall Recalibration of Synthesizer

Test equipment required: Station receiver — H.F. general coverage preferred. Frequency standard — 100 kc oscillator with harmonic output up to 30 mc. Procedure: Transmitter always loaded into a 50-ohm dummy load and running at low output during tests (20 watts or less). Refer to top-chassis view, figure 3, for 25 mc — 100 kc — step crystal oscillator controls (C213 thru C222). Note that one set of ten ceramic piston capacitors tunes the oscillator plate circuit for each 100 kc step and that the other set of ten piston capacitors are frequency adjusting trimmers across each crystal. Note that there are no external controls on the 20 mc variable crystals — all the circuit parameters are changed by the X1 tuning dial.

Initial adjustments are made on the 80 meter band. Tune transmitter to 3500 kc by carefully setting synthesizer to read 3500 kc on dials. Compare this frequency against the 3500 kc check point obtained from the 100 kc frequency standard as monitored in the station receiver.

With a screwdriver check the plate tuning capacitor, C213, on the "35 hundred" or "0 hundreds" crystal. Note: On 80 meters the "35" and "0" hundreds crystal are the same (first step on the X100 dial). Adjust the plate tuning piston capacitor for maximum output but set for reliable oscillation (just a little on the screwed-out side of maximum output). Next adjust C200, the "0-crystal" trimmer for zero-beat of the transmitter frequency wtih 3500 kc as referenced by the 100 kc standard.

Move the X100 dial to read 3600 kc. Retune the transmitter for resonance on driver and final controls. Compare frequency to 3600 kc reference standard point on receiver. Check tuning of plate condenser, C214, for #2 crystal on "hundreds" dial and zero-beat crystal trimmer, C201, for 3600 kc transmitter output.

Continue this procedure for each 100 kc step crystal on the X100 dial, adjusting the plate circuit and frequency trimmer for each. Note that the plate tuning capacitor affects the frequency of the crystal and the crystal trimmer should be adjusted last in setting the frequency of each crystal.

On the 80 meter band, the above procedure will continue up to 4100 or 4200 kc, where the driver tuning range will run off scale. Calibration of the remainder of the X100 crystals can be accomplished on some other band range.

Next, reset the X100 dial to 3500 and ascertain that the frequency is still zero-beat with the 3500 kc crystal check point. Now, leaving the synthesizer dial setting on 3500 kc (80 meter indication), switch the band switch, BAND SEL, for 7 mc operation, the transmitter thus being automatically set for 7000 kc operation. Tune the driver and P.A. controls for resonance and compare transmitter frequency with the 7000 kc check point from the 100 kc standard in the receiver. If in error, adjust the Heterodyne Oscillator crystal trimmer, C56, which is used on the 40 meter band — adjust the 3.5 mc crystal trimmer for zero beat on 7000 kc. Leaving all synthesizer dials set on "0-0-0", switch to 14 mc operation and repeat calibration at 14000 kc by adjusting 10.5 mc heterodyne oscillator crystal trimmer, C58. Likewise for 28000 kc and 24.5 mc crystal trimmer, C59. Repeat at 29000 kc with the 25.5 mc crystal trimmer, C60. This completes the extent of frequency calibration that the operator should undertake.

SECTION VIII TROUBLE SHOOTING

The operator should make every effort to become familiar with the block diagram, figure 2, and refer to it frequently when checking for an inoperative stage. When trouble occurs, it can usually be traced to a defective tube or component in a particular stage, rather than a general failure.

Failure of the transmitter on one band with normal operation on all other bands could probably be traced to a defective band switch connection or defective heterodyne crystal. It would be useless, therefore, to check any stage up to and including the 9.2 mc ALC amplifier stage.

Lack of output on all bands, could, of course, be traced to any stage including the power supply. If a visual check of all tubes, indicates that all filaments are lighted, rotate EMISSION switch from USB to LSB. If the transmitter still fails to function, the sideband oscillator may be eliminated.

Since the heterodyne oscillator does not function on the 80 meter band, this stage may also be eliminated.

With the use of a general coverage receiver or frequency meter, troubles can be further isolated. For example: if the receiver or frequency meter is coupled to the synthesizer by wrapping a few turns of wire around the 5763 stage, (V204) it can be quickly determined that the synthesizer is (or is not) furnishing output voltage over its operating range (4.7 to 5.7 mc). The same technique may be used to check the 3.2 mc carrier oscillator. Again, this technique, applied to the 9.2 mc ALC amplifier, could isolate the trouble to a section of the transmitter.

Since tube failure is a frequent cause of equipment failure, it is wise to replace the tube in the suspected stage rather than depend on the questionable merits of a tube tester.

A complete set of charts, figures 7 & 8, showing voltage and resistance measurements is provided to guide the trouble shooter to the faulty component. Repair or replacement of any frequency determining or tuning element will require readjustment of the affected circuit. Refer to the section on alignment for correct procedure.

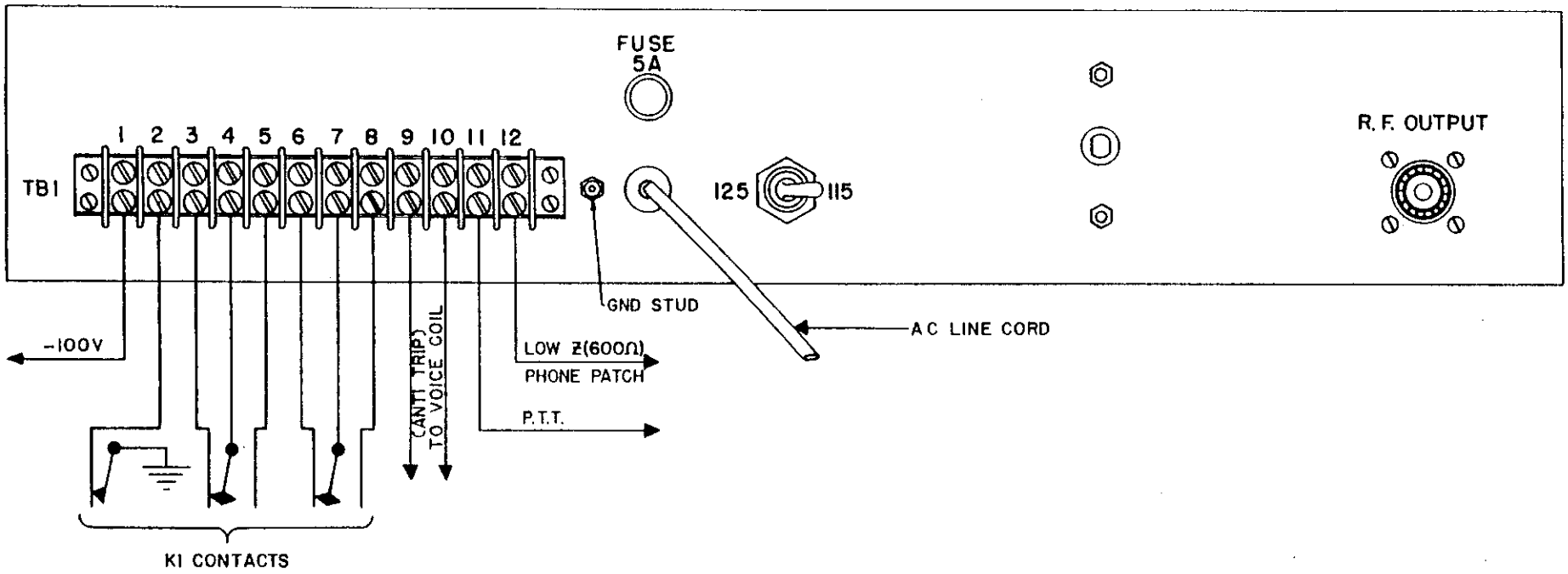


Figure 1. External Connection Diagram

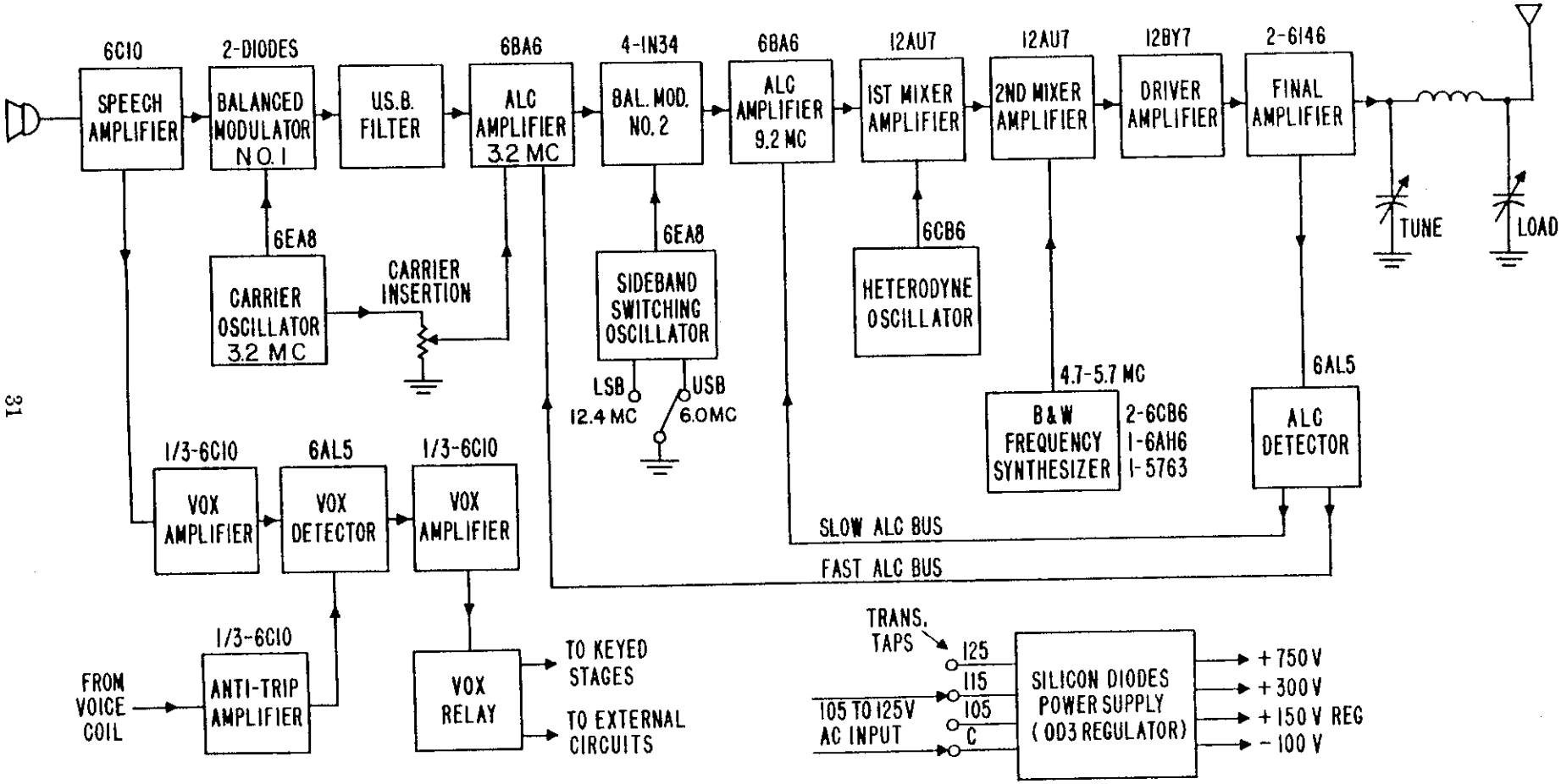


Figure 2. Block Diagram

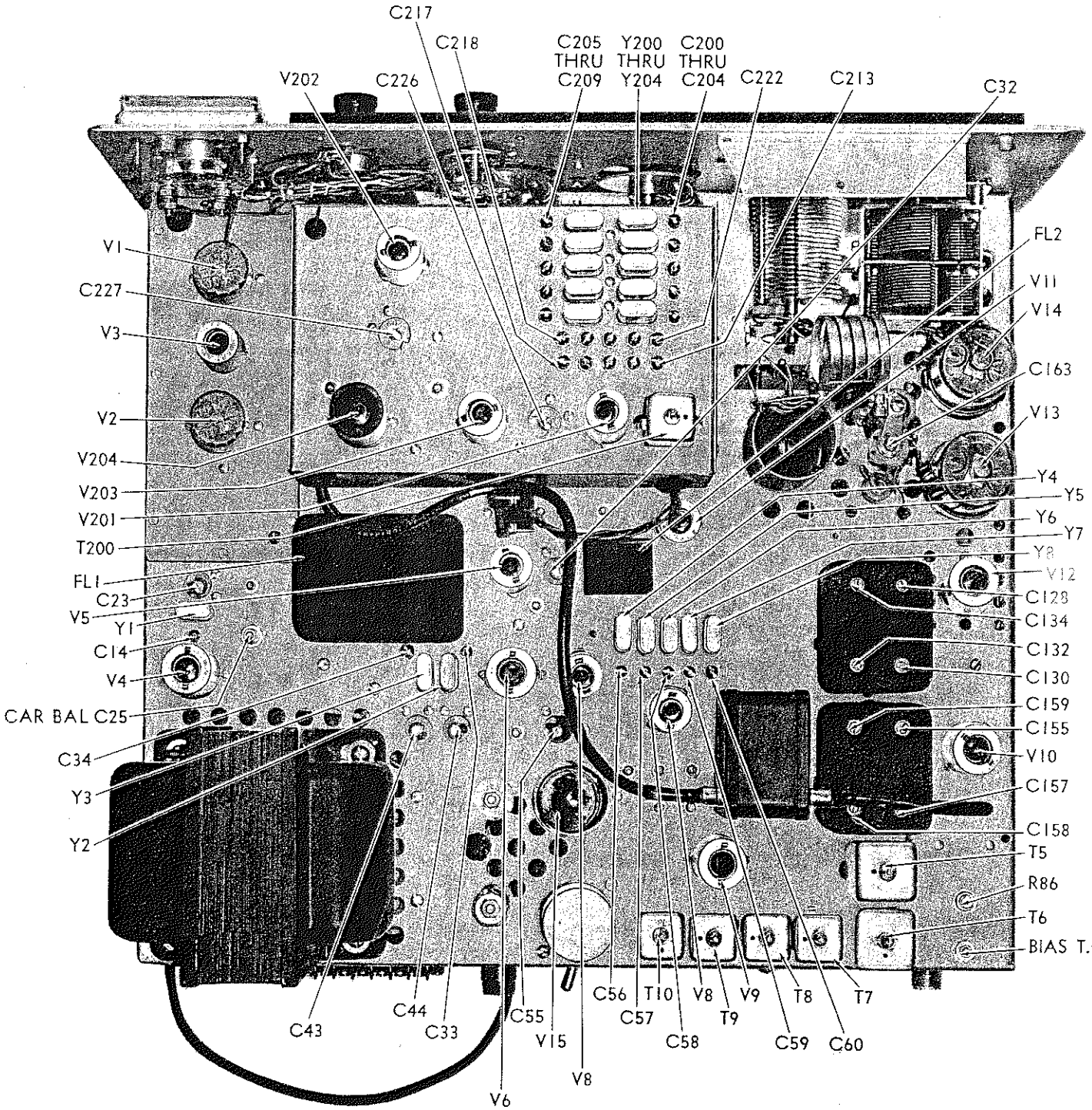


Figure 3. Top Chassis View

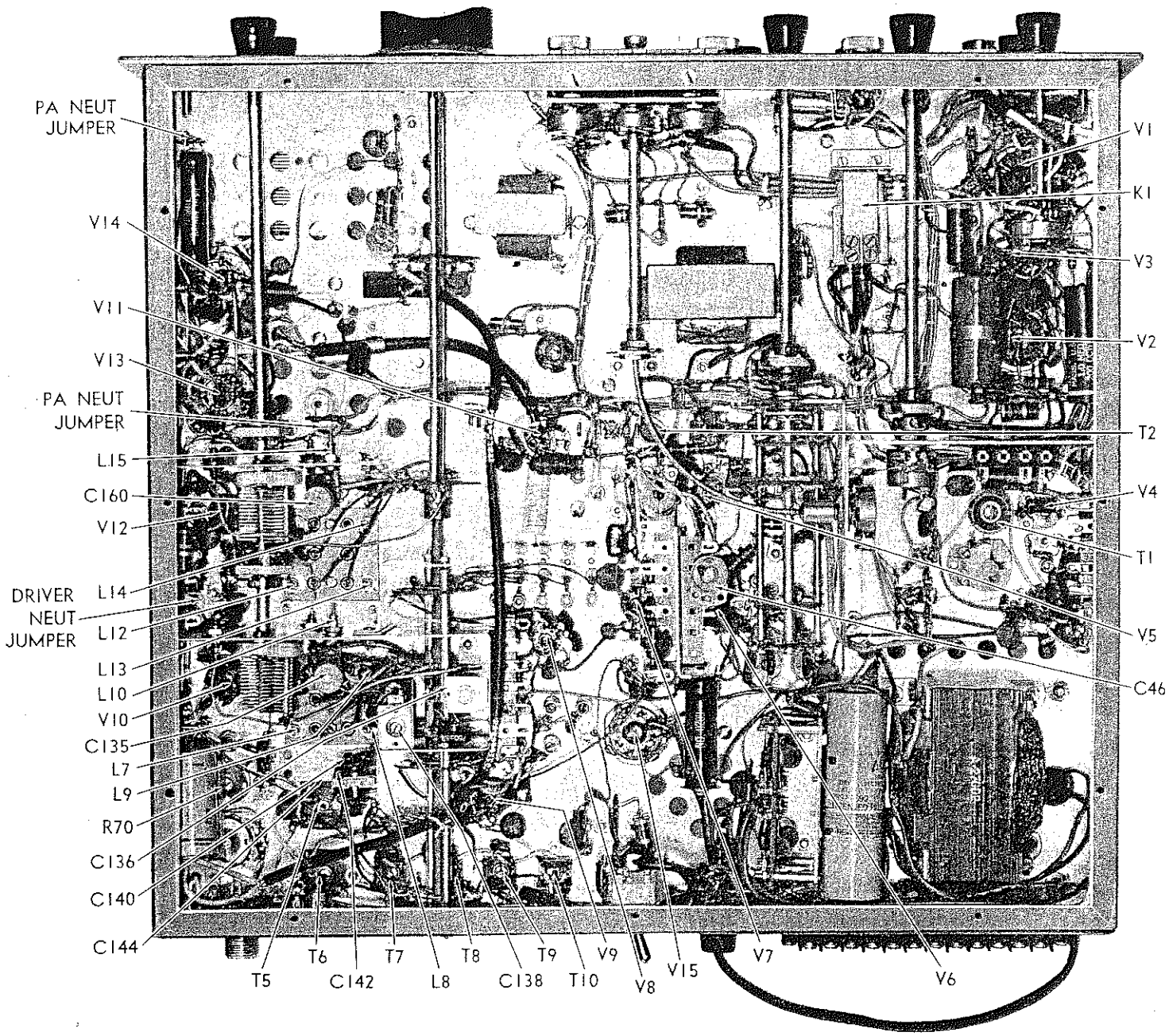


Figure 4. Bottom Chassis View

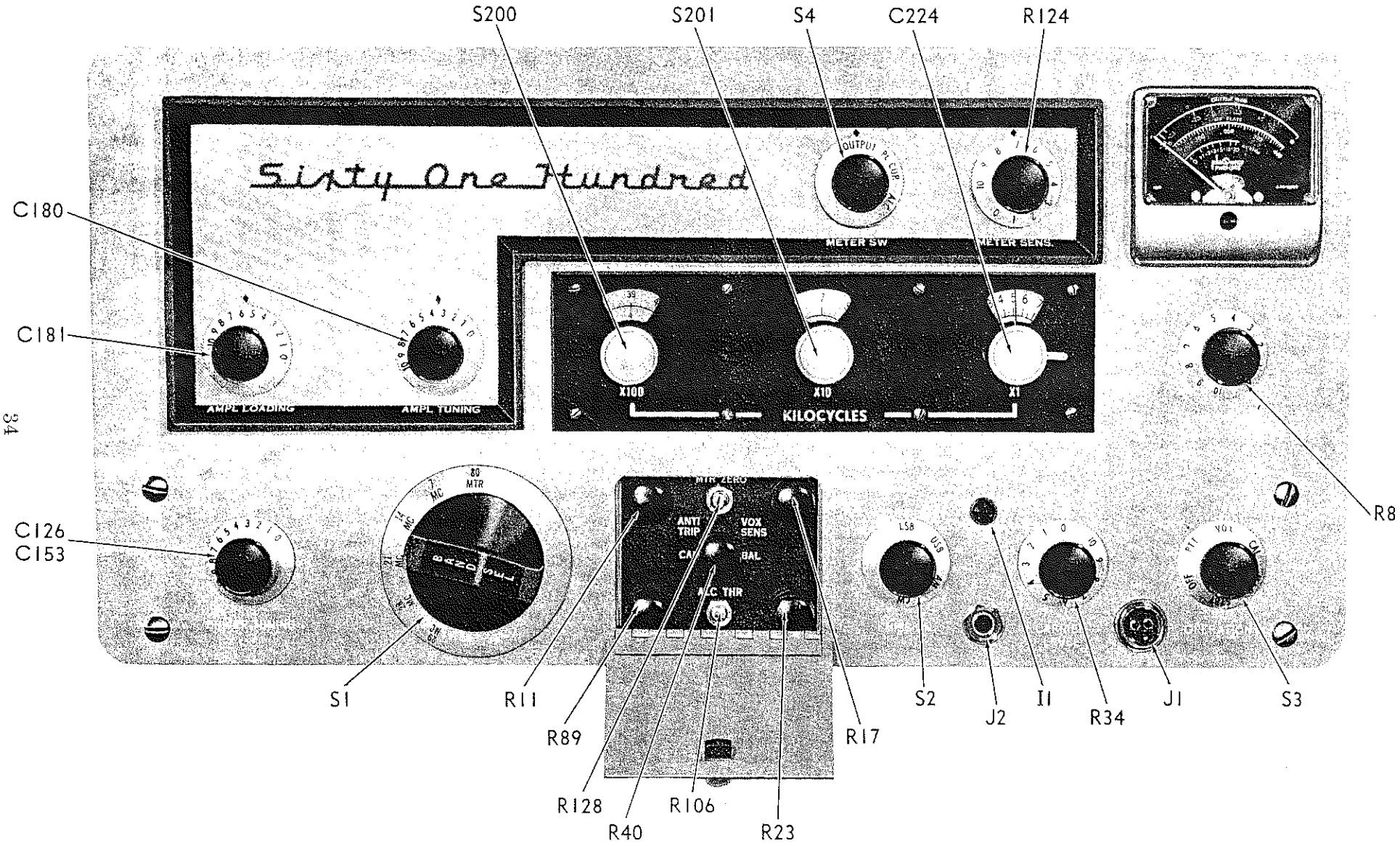
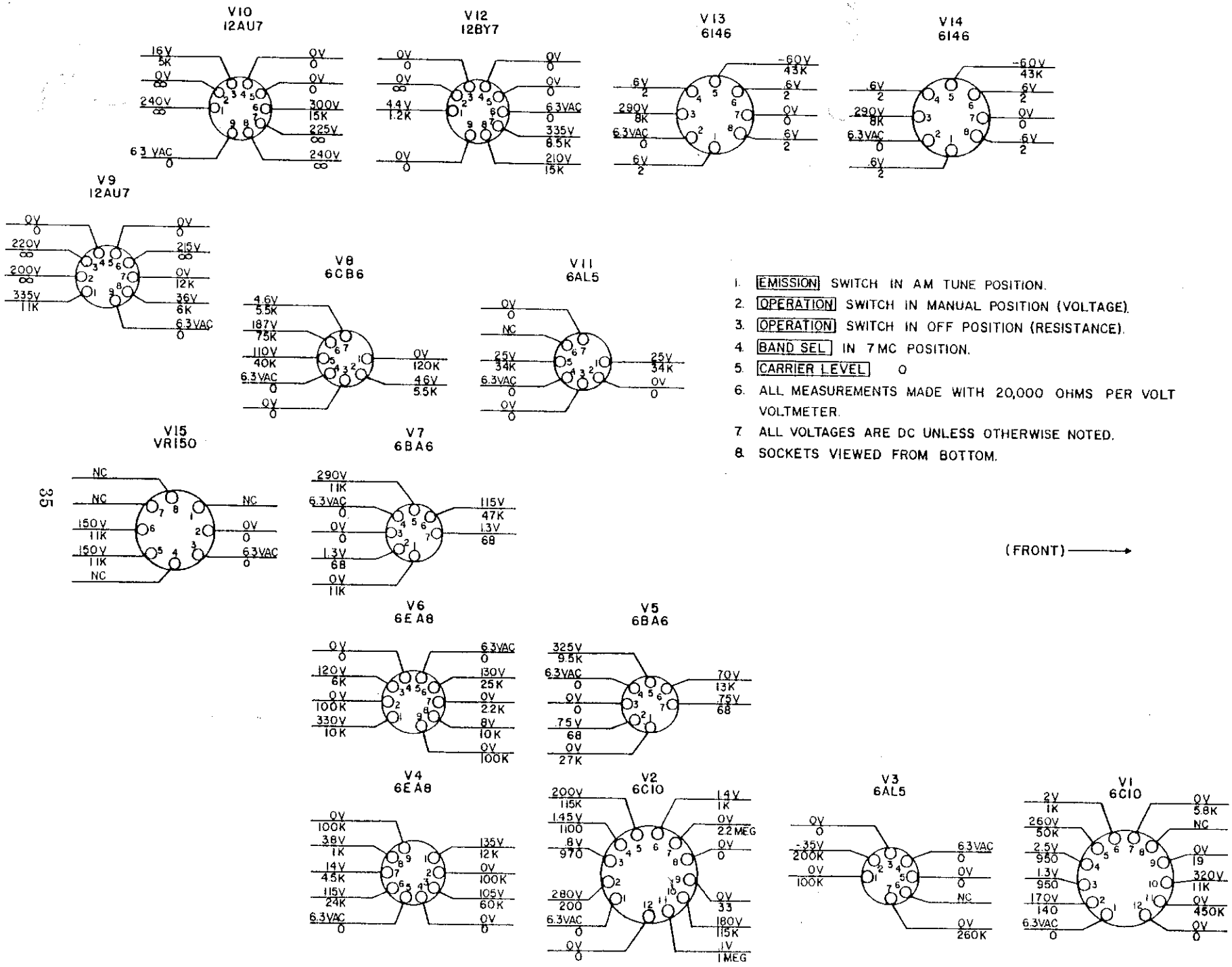
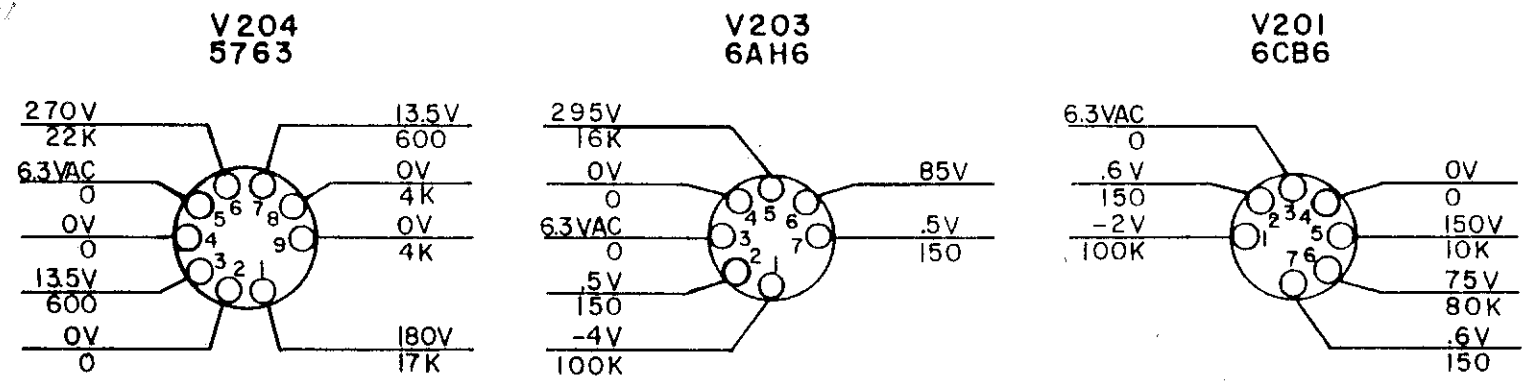


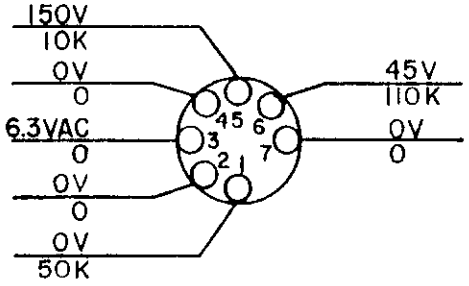
Figure 5. Front Panel Controls



1. EMISSION SWITCH IN AM TUNE POSITION.
2. OPERATION SWITCH IN MANUAL POSITION (VOLTAGE).
3. OPERATION SWITCH IN OFF POSITION (RESISTANCE).
4. BAND SEL IN 7MC POSITION.
5. CARRIER LEVEL 0
6. ALL MEASUREMENTS MADE WITH 20,000 OHMS PER VOLT VOLTMETER.
7. ALL VOLTAGES ARE DC UNLESS OTHERWISE NOTED.
8. SOCKETS VIEWED FROM BOTTOM.

Figure 6. Main Chassis Voltage Resistance Chart





1. EMISSION SWITCH IN AM TUNE POSITION.
2. OPERATION SWITCH IN MANUAL POSITION (VOLTAGE).
3. OPERATION SWITCH IN OFF POSITION. (RESISTANCE),
4. BAND SEL IN 7MC POSITION.
5. CARRIER LEVEL 0
6. ALL MEASUREMENTS MADE WITH 20,000 OHMS PER VOLT VOLTMETER.
7. ALL VOLTAGES ARE DC UNLESS OTHERWISE NOTED.
8. SOCKETS VIEWED FROM BOTTOM.

(FRONT)

Figure 7. Frequency Synthesizer Voltage Resistance Chart