

32V-1

AMATEUR TRANSMITTER

INSTRUCTION BOOK

INSTRUCTION BOOK

for

32V-1 AMATEUR TRANSMITTER

Manufactured By

COLLINS RADIO COMPANY, Cedar Rapids, Iowa

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FIGURE I-1 MODEL 32V-1 AMATEUR TRANSMITTER

SECTION 1

GENERAL DESCRIPTION1.1. GENERAL.

1.1.1. This instruction book has been prepared to assist in the proper installation, adjustment, operation and maintenance of the Collins 32V-1 amateur transmitter.

The type 32V-1 is a transmitter designed for those amateurs who want medium power, bandswitching, and VFO control in a small cabinet. It may be used for either permanent or portable installations. All that is needed for putting it into operation is a 115 volt ac source, an antenna, and a key or microphone. The 32V-1 can also be used to drive a kilowatt final amplifier.

The 32V-1 transmitter is designed for table mounting. The complete transmitter is housed in a single cabinet 21-1/8" wide, 12-7/16" high and 13-7/8" deep and weighs approximately 105 lbs. Ventilating openings are provided in the back two sides and bottom of the cabinet to assure adequate ventilation for all heat producing elements.

The components of the transmitter are so arranged that unit construction is possible and are broken down in five units as follows:

70E-8A Oscillator
R-F Unit
Output Network
Speech Amplifier and Modulator
Power Supply

All wiring is independent of the cabinet, and the complete unit may be removed from the cabinet for inspection or maintenance.

Complete coverage of the 80, 40, 20, 15, 11 and 10 meter bands is obtained with the 32V-1. Quick band-change is accomplished by bandswitching on all stages. The permeability tuned circuits of the 1st, 2nd and 3rd multiplier have their tuning controls ganged with the oscillator. The final tank consists of a pi-network with two separate controls located on the front panel, one for tuning and one for loading. A "coarse" loading adjustment is located inside the cabinet near the top and is accessible by raising the cabinet door.

Two heavy duty toggle switches control the low voltage and high voltage circuits. The switches are arranged so that the high voltage cannot be applied until the low voltage circuits have been energized. A push-to-talk switch, associated with the microphone, may be used to apply the high voltage instead of the HV toggle switch for added convenience.

A CW sidetone oscillator is incorporated in this unit with which CW transmissions can be monitored.

An additional feature, the receiver muting connection, can be used to silence a type 75A receiver during CW transmission for CW break-in operation.

A meter selector switch on the front panel enables the operator to meter all important circuits of the transmitter. This switch can be rotated to five different positions. Each position inserts a meter into the selected circuit to be metered. A separate meter reads FINAL AMPLIFIER plate current only. The CW-CAL-PH switch is used to select the type of emission desired and to calibrate the accuracy of the dial reading against a known standard frequency. In the CW position, the modulator is disabled, the master oscillator operates continuously with the HV switch on and the CW sidetone oscillator is connected to the audio amplifier stages. On "CAL" position a signal of strength suitable for zero-beating with incoming signals may be heard in the associated receiver without operating the final amplifier. On phone position, the key is closed and the modulator is operative. Keying is accomplished by means of grid block keying of the buffer stages. This keying is done on the buffer and first and second multiplier stages.

The AUDIO GAIN Control is used to control the level of modulation and the strength of CW sidetone output.

1.2. REFERENCE DATA.

Power Source: 115 volts ac 50/60 cps single phase.

Power Input Requirements: The maximum overall input power requirement is 500 watts at 90% power factor.

PA Plate Power Input: The nominal rated power input of the 32V-1 is 120 watts on phone and 150 watts CW.

Audio Distortion: Audio distortion is less than 8% at 90% modulation with a 1000 cps input frequency.

Frequency Response: Within 2 db from 200-3000 cps.

1.3. TUBE COMPLEMENT.

<u>Quantity</u>	<u>Tube Type</u>	<u>Function</u>
1	6SJ7	Oscillator
1	6AK6	Buffer Amplifier
1	6AG7	First Multiplier
1	7C5	Second Multiplier
1	7C5	Third Multiplier
1	4D32	RF Power Amplifier
1	6SL7	Audio Amplifier
1	6SN7	Audio Driver
2	807	Modulators
1	5Z4	LV Rectifier
2	5R4GY	HV Rectifier
1	VR-75	Bias Regulator
1	6SL7GT	CW Sidetone Oscillator
2	OA2	Screen voltage limiters

SECTION 2

INSTALLATION2.1. UNPACKING.

After the unit has been removed from the packing box, inspect the unit for loose screws or bolts. Be certain all controls, such as switches, dials, etc. work properly. In case of damage, file all claims promptly with the transportation company. If a claim for damage is to be filed, the original packing case and material must be preserved. Check all tubes to see that they are fully in their sockets. See figure 2-1 for tube placement.

2.2. PLACING TRANSMITTER.

The console type cabinet is designed to be placed on the operating table along with the receiving equipment. Allow enough space at the rear for making the necessary external connections and for replacement of fuses. Sufficient clearance at the sides should be provided for full circulation of air.

2.3. EXTERNAL CONNECTIONS.

Place the two power switches in the off position before attempting to make any external connections. The external connections are as follows:

(1) AC Power Line	(5) Receiver Disabling Circuit
(2) Microphone and Key	(6) CW Sidetone
(3) Radiation System	(7) Receiver Muting
(4) Remote Relay	

2.3.1. POWER LINE. - The 32V-1 operates from a 115 volt, single phase, 50/60 cycle power source. The supply line should be checked for these specifications. The maximum power required from the line is 500 watts. Insert the 115 volt plug into a convenient standard outlet.

2.3.2. MICROPHONE AND KEY. - The microphone plug is inserted in the microphone jack J201 on the front of the transmitter. Make sure the clamping ring on the microphone plug is tightly turned on the thread around the input receptacle. Push-to-talk control connections are made to pin number 2 to ground in the microphone plug where the microphone being used is equipped with a push-to-talk switch. When using a microphone that does not have such a switch, the transmitter can still be controlled from a remote position by running a pair of leads from terminals 11 and 12 on the rear terminal strip (E308) to a switch box located at some point convenient to the operator.

CAUTION

Do not get the microphone and push-to-talk connections reversed when assembling the microphone plug since the relay voltage present could damage certain types of microphones.

The telegraph key is plugged into the key jack, J101, on the front panel.

2.3.3. RECEIVER DISABLING CIRCUIT. - Terminals 13 and 14 on the rear terminal strip (E308) are connected to normally closed contacts on the carrier control

relay and are to be used for connections to the receiver disabling circuit. Remove the jumper on the receiver terminals and connect terminals 13 and 14 to these two terminals. The receiver can then be made inoperative when the push-to-talk switch is pressed or whenever the HV switch is operated.

2.3.4. REMOTE RELAY CONNECTIONS. - Terminals 7, 8, 9 and 10 on the rear terminal strip may be used for operating an antenna change-over relay or a relay for turning on the plate power of a power amplifier stage when the 32V-1 is used as an exciter. If a 115 volt ac type relay is used, connect the leads from the relay coil to terminals 7 and 10. In this manner, the relay coil will be energized thru contacts 8 and 9 of relay K301 whenever the push-to-talk switch or HV switch is operated. If a dc type of relay is used, remove the jumper from terminals 8 and 9 and use terminals 9 and 10 to control the operations of the remote relay thru the contacts of the transmitter relay.

CAUTION. - Do not use the RECEIVER DISABLING CIRCUIT AND REMOTE RELAY CONNECTIONS for conducting large currents, as damage to the relay contacts may results.

CAUTION. - For safety reasons, remove the 115 volt plug from the AC power outlet while making connections to the rear terminal strip.

Switch pi S101H, located at the rear of the band switch, can be used to automatically operate antenna selector relays, etc., as the band switch is turned. Connections to this switch section will have to enter the cabinet through a ventilation slot at the side of the cabinet.

2.3.5. CW SIDETONE. - Any 500 ohm or higher impedance headphone or 500 to 1000 ohm speaker can be connected between terminals 16 and 12 (gnd) at the rear of the unit for sidetone output. The sidetone will be operative when the EMISSION switch is in the CW position. Sidetone pitch is controlled from within the top door while the volume is controlled by the AUDIO GAIN control.

2.3.6. RECEIVER MUTING. - If a Collins Model 75A receiver is used for receiving, CW break-in operation can be improved by connecting terminal B on the receiver to terminal 15 on the 32V and terminal G to terminal 12 (gnd). This connection mutes the receiver audio when the key is pressed. For CALIBRATION, the receiver limiter switch should be in the OUT position.

2.3.7. RADIATION SYSTEM. - The output pi-network will match impedance of 26 to 600 ohms on the 80 meter band and 13 to 600 ohms on the 40, 20, 15, 11 and 10 meter bands. It will tune out inductive or capacitive reactances normally encountered. The output network is unbalanced with respect to ground and may be used to feed directly into unbalanced systems. Coaxial transmission lines can be used with good efficiency. Do not end feed antennas which are multiples of 1/2 wave in length directly from the antenna terminals; rather, use an external antenna tuner.

2.3.8. EXTERNAL ANTENNA TUNER. (Not Supplied)

To feed balanced transmission lines, tuned or untuned, couple the transmitter to the transmission line with a simple tuned circuit illustrated below. This arrangement will match a wide range of impedances. Figure 2-2 illustrates an antenna tuner which will function satisfactorily in this application. The

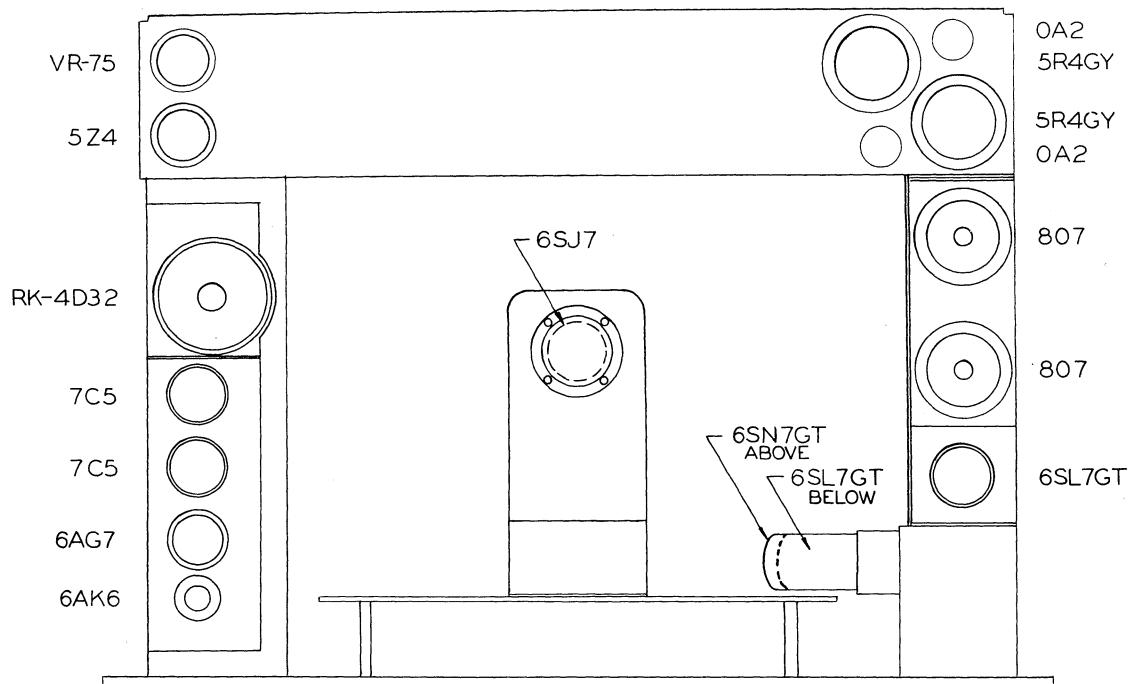


Figure 2-1 Tube Placement Diagram

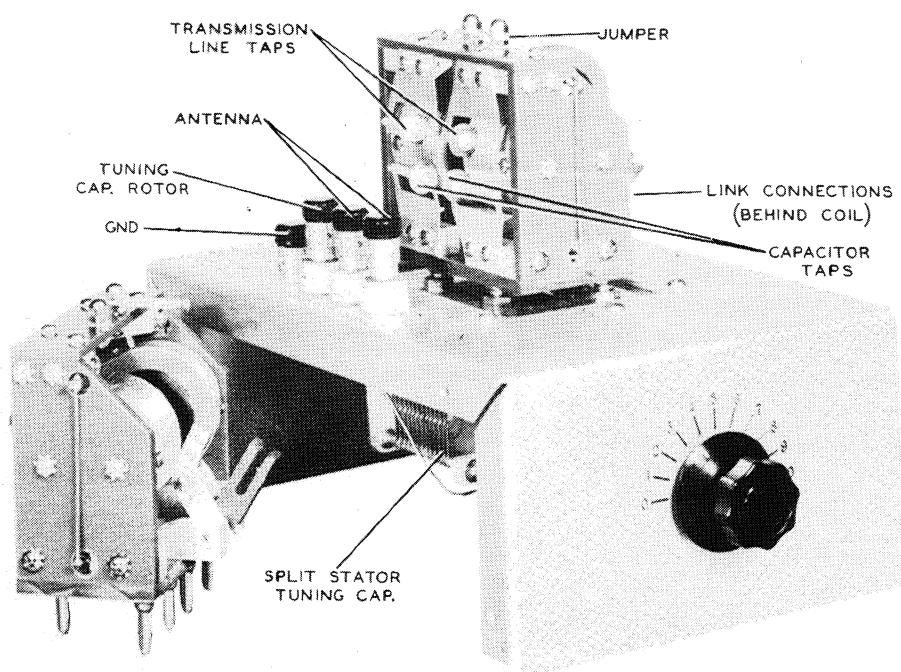


FIGURE 2-2 TYPICAL ANTENNA TUNER
(NOT SUPPLIED)

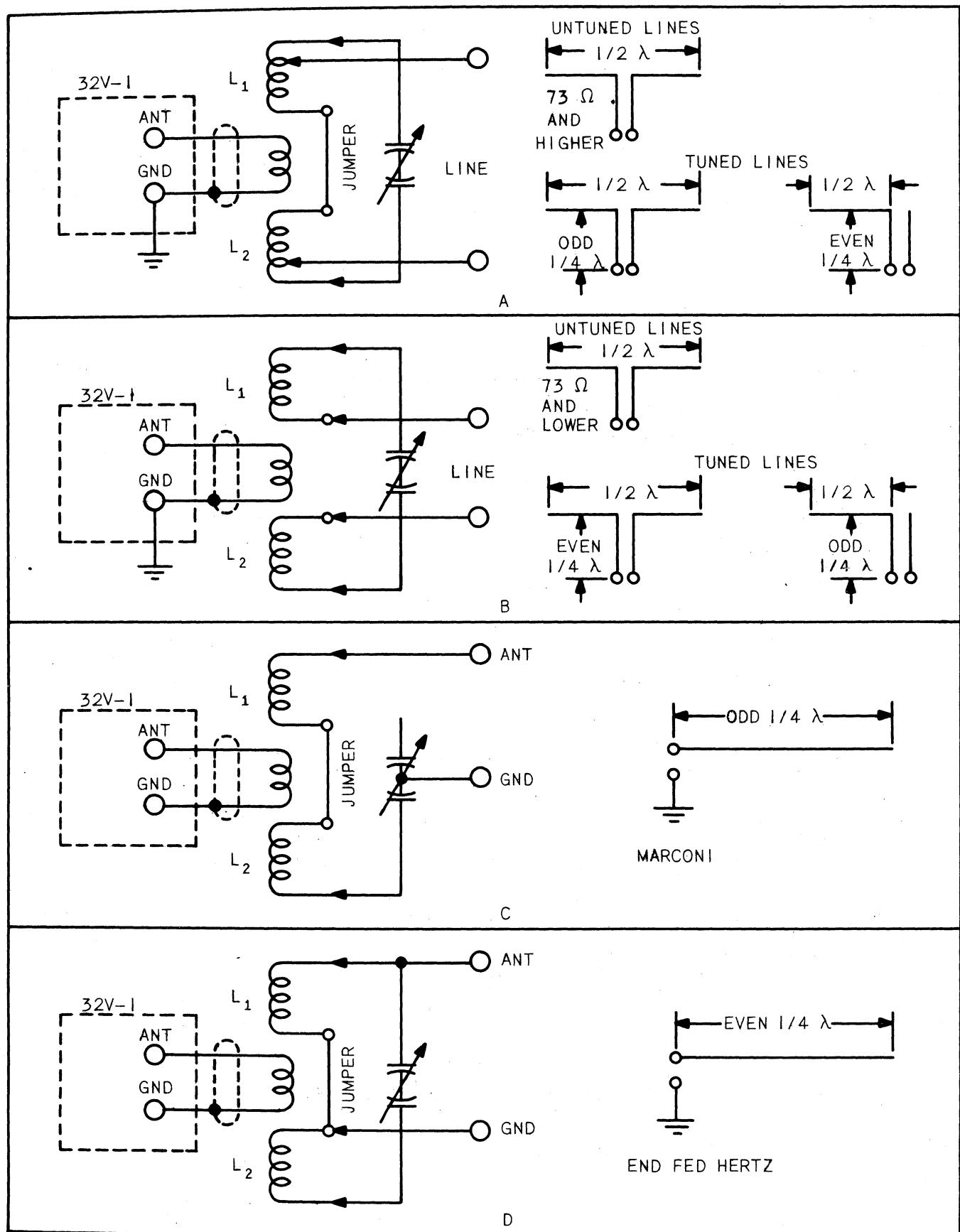
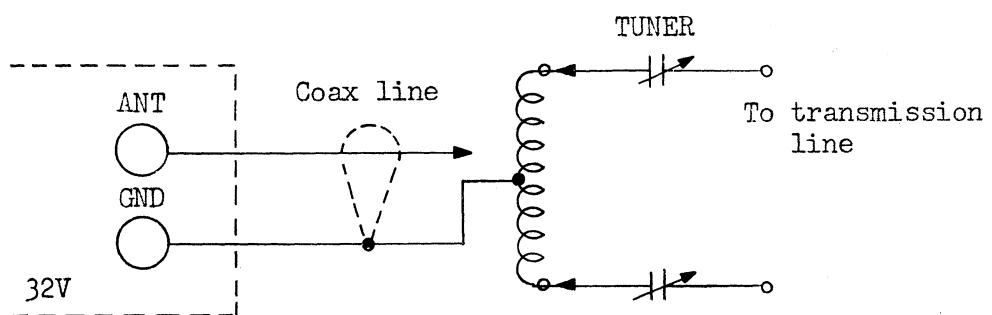
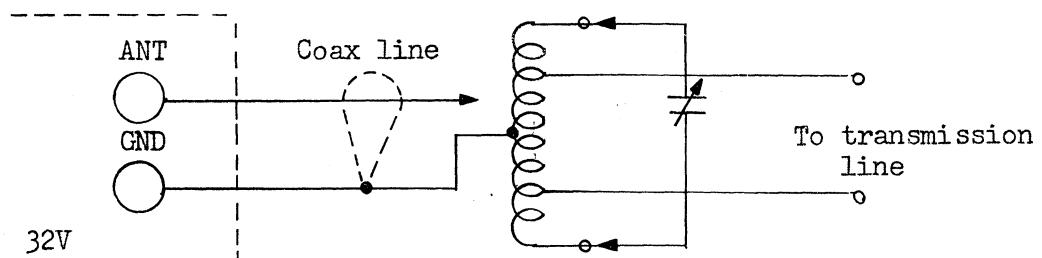


Figure 2-3 Typical Antenna Tuner Circuits



SERIES TUNING



PARALLEL TUNING

AN ALTERNATE ANTENNA TUNER CIRCUIT

impedance of the transmission line is matched by choosing proper taps on the inductances L1 and L2. The coupling link is coupled as tightly as possible and all loading adjustments are done with the LOADING control on the 32V-1.

a. UNTUNED HIGH IMPEDANCE TRANSMISSION LINE. - If the line has a characteristic impedance of 73 ohms or more, parallel tuning of the antenna coils L1 and L2 should be employed. For parallel tuning, the little jumper seen above the antenna coils should be closed. The transmission line taps should be set on the same turns as the capacitor taps to start with, then varied towards the center of the coils until proper loading is obtained. The transmission line taps are those at the top of the coils while the capacitor taps are those nearer the bottom. In this type of operation, low values of capacitance and high values of inductance for the operating frequency generally are best. See illustration A., figure 2-3.

b. UNTUNED LOW IMPEDANCE TRANSMISSION LINES. - Transmission lines having a characteristic impedance of less than 50 ohms require series tuning of the antenna coils. This is done by opening the small jumper above the coils and moving the transmission line tap arms to the inside coil turns. The capacitor taps should be set at the outside turns and varied towards the inside turns until proper loading is obtained. Higher values of tuning capacity usually work out best in this type of operation. See illustration B., figure 2-3.

c. VOLTAGE FED TUNED LINES. - Transmission lines which have a high voltage point at the transmitter should be connected and tuned identically with instructions given in a. above. It is recommended that tuned lines be cut to multiples of a quarter wave in length.

d. CURRENT FED TUNED LINES. - Transmission lines having high current at the transmitter end should be connected and tuned identically with instructions given in b. above. These lines should also be cut to exact multiples of a quarter wave in length.

e. QUARTER WAVE MARCONI. - Series tuning is indicated for quarter wave Marconi antennas. In this type of operation, the antenna tuning circuit should be connected so that the two sections of the antenna coil and one half of the antenna tuning capacitor are in series. To do this, place a grounding jumper to the rotor of the antenna tuning capacitor, connect the antenna to one end of the antenna coil, connect one stator of the tuning capacitor to the other end of the antenna coil and disconnect the other stator completely. (Place a piece of insulation material between the tap rotor and the coil turns.) See illustration C., figure 2-3. In event r-f voltage appears on the cabinet, it can be minimized by extending the ground wire to 1/2 wave length and series tuning it until resonance is obtained.

f. END FED HALF WAVE. - This tuner can be used to tune this type of antenna also. Parallel tuning should be employed for this type operation. The antenna should be connected to one end of the antenna coil, a ground connection should be made to the inside turn of one of the antenna coils and the little jumper on top of the coils should be closed. The tuning capacitor taps should be equally spaced from each end of the antenna coils for proper tuning at the operating frequency. See illustration D., figure 2-3.

SECTION 3

ADJUSTMENT AND OPERATION3.1. ADJUSTMENT.

3.1.1. 600 v - 700 v SWITCH. - This switch, located in the primary of the power transformer, has been placed at the rear of the transmitter to select output voltages of either 600 or 700 volts. It is recommended that this switch be placed in the 600 volt position for initial adjustments.

3.1.2. CALIBRATION. - To check dial calibration, proceed as follows:

- (a) Turn the equipment ON as outlined in steps (a) and (b) paragraph 3.2.3.
- (b) Tune a communications receiver to WWV at 10 mc. The BFO in the receiver should be OFF.
- (c) Rotate the BAND switch to 80 meter band. (lowest scale)
- (d) Rotate the TUNING dial to 4.0 mc.
- (e) Rotate the CW-CAL-PH control to CAL. This turns the VFO, buffer, first and second multiplier stages ON so that a calibration signal can be heard. Close the telegraph key.
- (f) Continue to rotate the TUNING dial about 4.0 mc until the calibration signal is zero beat with WWV.
- (g) Turn the FIDUCIAL screw until the hair line is on 4.0 mc.
- (h) In like manner, the dial can be calibrated on 15,000 kc by setting the communications receiver at WWV on 15 mc and the 32V-1 TUNING dial at 15 mc on the 20M BAND position. See the following table.

<u>WWV Frequency</u>	<u>Dial Setting</u>	<u>Oscillator Frequency</u>	<u>Oscillator Harmonic</u>
10 mc	4,000	2,000	5th
15 mc	15,000	1,875	8th
15 mc	7,500	1,875	8th

3.2. OPERATION.

3.2.1. GENERAL. - The operation of this equipment is exceedingly simple once the functions of the controls are understood. The function of the controls is hereby given, followed by a step-by-step procedure for operating the equipment.

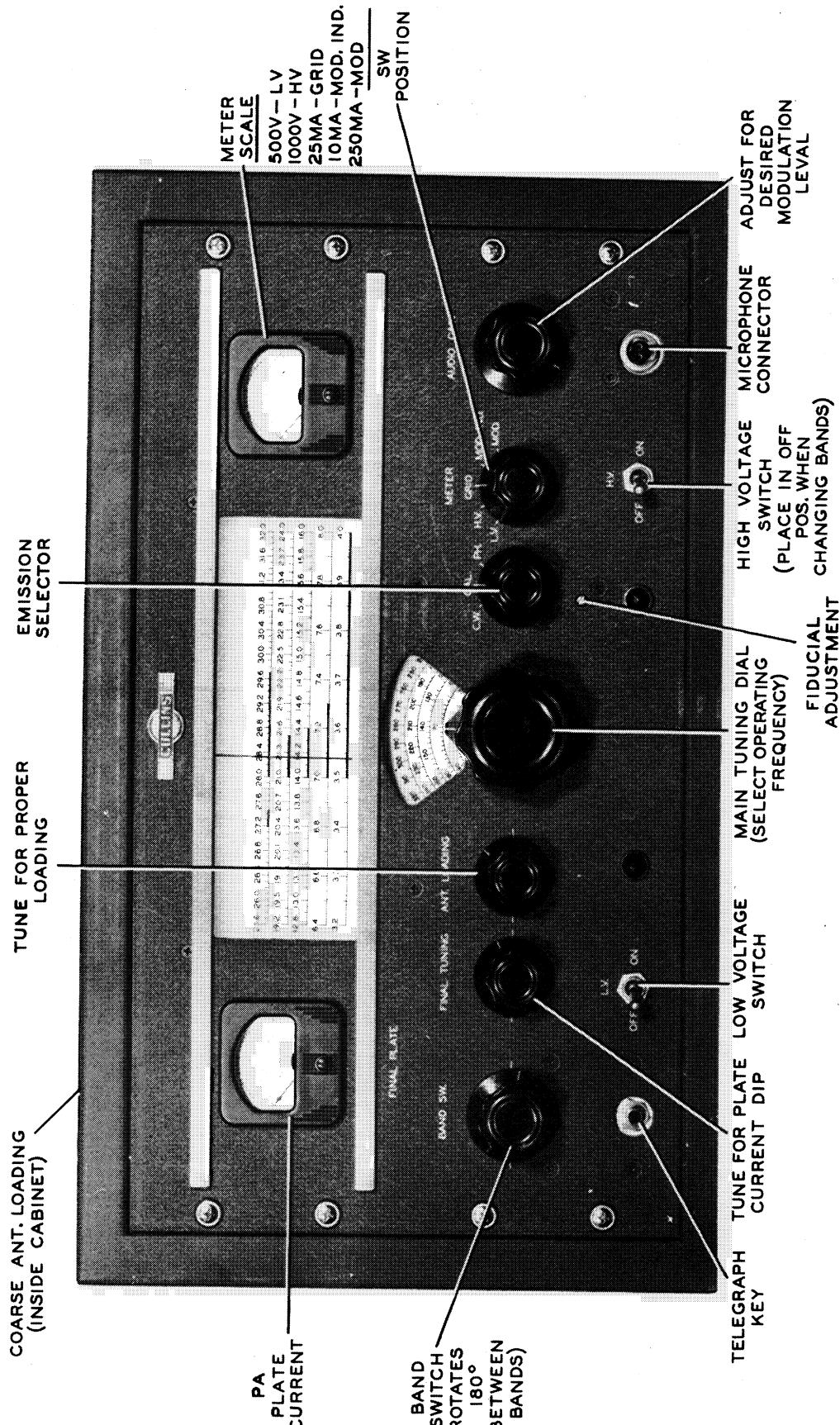


FIGURE 3-1 32V-1 CONTROL FUNCTIONS

3.2.2. FUNCTION OF CONTROLS.

(a) BAND SWITCH. - This control selects the proper tuning elements in all stages for the amateur band upon which operation is desired. The knob rotates 180 degrees between adjacent bands. Clockwise rotation selects higher frequency bands. The band selected is indicated by the band lighted slide rule dial.

(b) TUNING Control. - This control operates both the slide rule dial and the vernier dial to select the exact frequency upon which operation is desired.

(c) CW-CAL-PH Switch. - This three position switch selects the type of emission required. In the CW position, the secondary of the modulation transformer is short circuited, the screen voltage is removed from the modulator tubes, a bleeder is placed between the PA screen grid to ground and the carrier-control relay is connected so that it can be operated by the HV switch. The transmitter is ready for CW operation when the key is inserted in the KEY jack. In the CAL position, the VFO, buffer, first and second multiplier stages are in operation to supply a signal of suitable strength for zero-beating against received signals without causing interference to other stations. The carrier control relay is disconnected from the HV switch so that the associated receiver and antenna changeover relay will be in the "Receive" condition. In the PH position, the switch opens the short circuit on the secondary of the modulation transformer, closes the keying circuit, applies screen voltage to the modulator tubes and connects the carrier control relay so that it can be operated by the HV switch or a push-to-talk switch on a microphone.

(d) METER Switch. - The METER switch selects various circuits to be metered by the meter directly above the switch. This meter has 3 scales: 0-250; 0-500 and 0-1000. The table below indicates how it is used:

METER SWITCH POSITION	CIRCUIT METERED	FULL SCALE DEFLECTION READS
LV	Low voltage	500 volts
HV	High voltage	1000 volts
GRID	PA grid current (DC)	25 ma
MOD IND	Mod. grid current	10 ma
MOD	Mod. plate current	250 ma

The meter on the left reads PA Plate current only. Full scale deflection reads 500 ma.

(e) AUDIO GAIN. - This control adjusts the level of modulation in phone operation and the volume of the sidetone signal in CW operation.

(f) LV Switch. - The LV switch turns the filaments and the low voltage plate and bias supply on. (Plate voltage is not applied to the r-f exciter tubes; however, until the HV switch is turned on, except when the CW-CAL-PH switch is on CAL position.)

(g) HV Switch. - The HV switch turns on the high voltage supply and connects plate voltage to the r-f exciter tube thru operation of carrier control relay K301. The push-to-talk connections are in parallel with this switch.

(h) FINAL TUNING. - This control is used to obtain resonance of the PA plate circuit. It must be reset after each adjustment of the ANT. LOADING controls.

(i) ANT. LOADING. - This control is used along with the COARSE ANT. LOADING control inside the transmitter to obtain correct antenna tuning and loading. Start with this control in the counterclockwise position. It provides fine adjustment of loading between the steps of the COARSE ANT. LOADING control.

(j) COARSE ANT. LOADING. - This control is a tap switch located within the transmitter. Access to it is through the top cover. Larger values of capacity are connected to the points of this tap switch. These capacities are successively placed in parallel with the ANT. LOADING control as the switch is rotated counterclockwise. This control should also be in the counterclockwise position at the start of tuning operations. This gives minimum loading.

(k) FIDUCIAL. - This control, a small screwdriver adjustment located directly under the CW-CAL-PH knob, is used to move the vernier dial index during calibration adjustments. Once it has been set, further adjustment will be unnecessary over long periods of time.

(l) 600 - 700 v SWITCH. - This switch, located at the rear of the chassis, is used to select either 600 or 700 volts (approx.) for application to the PA plate.

(m) SIDETONE PITCH. - The sidetone pitch control is located within the cabinet near the modulator tubes. This adjustment should be set at the position which produces the most desirable tone according to individual taste.

3.2.3. OPERATION PROCEDURE.

(a) Operate the LV switch to the ON position. Allow two minutes for the tubes to heat.

(b) Turn the AUDIO GAIN to the counterclockwise stop. (off)

(c) Turn the ANT. LOADING and the COARSE ANT. LOADING controls to the counterclockwise positions. (minimum loading)

CAUTION

For 10 and 11 meter operation, set COARSE ANT. LOADING control on position "6" or damage to the equipment may result.

(d) Place the CW-CAL-PH control in the position indicating the desired emission.

(e) Rotate the BAND switch to the band containing the desired operating frequency.

(f) Rotate the TUNING dial to the desired frequency.

(g) Place the METER selector switch in the GRID position and close the telegraph key. (If PH emission was selected, it will not be necessary to close the key.)

(h) Observing the FINAL PLATE meter, turn the HV switch ON and quickly turn the FINAL TUNING to resonance, i.e. minimum plate current dip.

(i) Observe the GRID current reading on the right hand meter. This should be between 5 and 15 ma.

(j) Operate the ANT. LOADING control clockwise until proper loading is obtained (180 ma. for 600 v position of 600 - 700 v switch at rear) and return the FINAL TUNING to resonance. Repeat this procedure until 180 ma reading is obtained with complete resonance of PA. If it is impossible to load to 180 ma PA plate current, open the lid of the cabinet and rotate the COARSE ANT. LOADING control one step at a time clockwise until proper loading is obtainable on the ANT. LOADING control. Close the cabinet lid to continue tuning, since the interlock switch removes the HIGH voltage when the lid is open.

WARNING

Operation of this equipment involves the use of high voltages which are dangerous to life. Observe all safety regulations. Do not change tubes or make adjustments inside equipment with the high voltage supply ON. Do not depend upon door interlocks for protection but always turn the high voltage supply OFF. SWITCH TO SAFETY.

(k) If CW emission was selected, the telegraph key can be opened and the transmitter keyed. If PH (phone) emission is selected, turn the METER switch to MOD. and observe the static (resting) modulator plate current. This should be about 50 ma for the 600 v position of the 600 - 700 v switch at rear (55 ma on the 700 v position). Advance the AUDIO GAIN control while speaking in normal tones into the microphone until the modulator plate current swings to about 100 ma on peaks. This will result in approximately 100% modulation with voice input. If desired, a more exact check of modulation level can be made with an oscilloscope while observing the proper meter swing for the voice of the individual operator.

With sine wave input, the modulator plate current will read about 200 ma for 100% modulation.

With the METER switch set to MOD. IND., a slight kick of the needle indicates approximately 100% modulation on voice peaks. This is useful as an alternate method of indicating modulation level, since no deflection occurs on the meter until the modulation level reaches approximately 55%. The level at which the meter kicks depends somewhat upon the loading of the final amplifier and characteristics of the modulator tubes.

NOTE

In step (g) above, the key plug can be pulled from the key jack since this is a closed circuit type jack.

CAUTION

When changing BANDS, place the HV switch in the OFF position. Also place the PUSH-TO-TALK switch in the OFF position.

NOTE

If the 600 - 700 v switch is placed in the 700 v position, the PA plate current should be 220 ma.

3.2.4. TYPICAL METER READINGS. (PH position without modulation.)

	<u>LV</u>	<u>HV</u>	<u>GRID</u>	<u>MOD</u>	<u>FINAL PLATE</u> <u>BOTH PHONE & CW</u>
600 v	240	580	10	50	180
700 v	240	720	10	50	220

3.2.5. DIAL CALIBRATION. - When changing BANDS, the proper scale on the slide rule dial is illuminated automatically as the BAND switch is rotated. At the same time the vernier dial fiducial moves up or down the vernier dial face and stops at the corresponding scale to which the slide rule dial is positioned.

The dial is read by combining the vernier dial reading with the slide rule dial reading. The exact method varies somewhat from the low frequency bands to the high frequency bands and can best be learned by referring to figure 3-2.

3.2.6. ANTENNA LOADING TABLE. - This table indicates the approximate position for the coarse antenna loading control for loading into various antenna impedance on the different bands.

POSITION OF COARSE ANT. LOADING CONTROL (for resistive loads)						
FREQ MC	13 Ω LOAD	26 Ω LOAD	50 Ω LOAD	73 Ω LOAD	300 Ω LOAD	600 Ω LOAD
3.5	--	1	2	3	4	5
4.0	1	2	3	4	5	5
7.0	2	3	3	4	5	5
7.3	3	4	4	4	5	5
14.0	5	5	5	6	6	6
14.4	5	5	5	6	6	6
21.0	6	6	6	6	6	6
21.45	6	6	6	6	6	6
27.2	6	6	6	6	6	6
28.0	6	6	6	6	6	6
29.7	6	6	6	6	6	6

NOTE

In step (g) above, the key plug can be pulled from the key jack since this is a closed circuit type jack.

CAUTION

When changing BANDS, place the HV switch in the OFF position. Also place the PUSH-TO-TALK switch in the OFF position.

NOTE

If the 600 - 700 v switch is placed in the 700 v position, the PA plate current should be 220 ma.

3.2.4. TYPICAL METER READINGS. (PH position without modulation.)

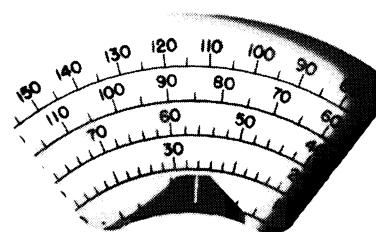
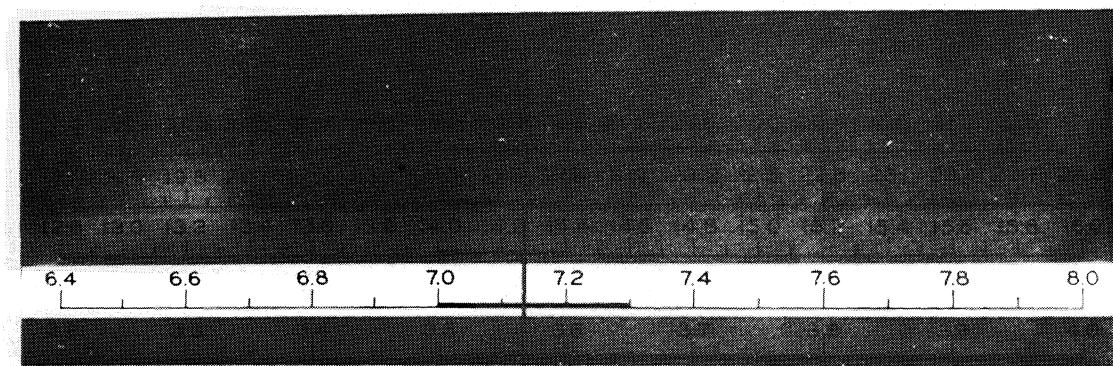
	<u>LV</u>	<u>HV</u>	<u>GRID</u>	<u>MOD</u>	FINAL PLATE BOTH PHONE & CW
600 v	240	580	10	50	180
700 v	240	720	10	50	220

3.2.5. DIAL CALIBRATION. - When changing BANDS, the proper scale on the slide rule dial is illuminated automatically as the BAND switch is rotated. At the same time the vernier dial fiducial moves up or down the vernier dial face and stops at the corresponding scale to which the slide rule dial is positioned.

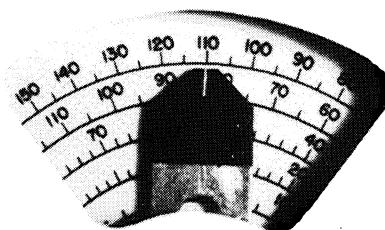
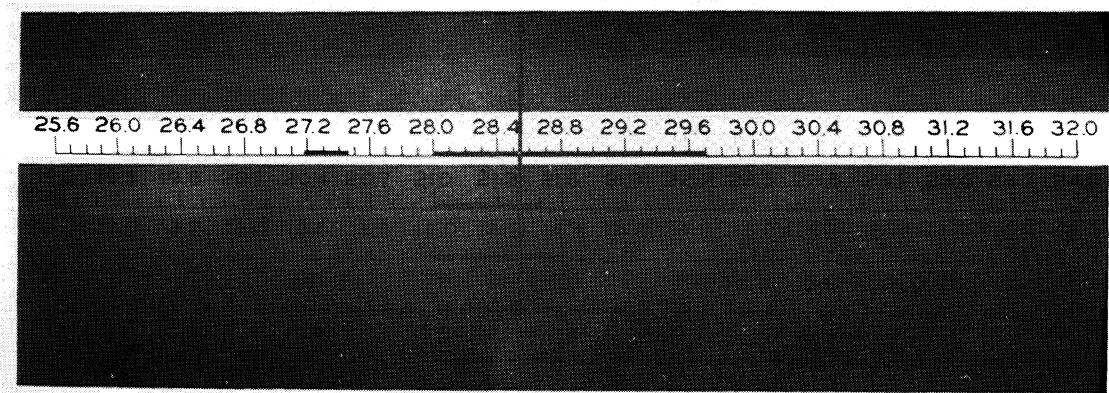
The dial is read by combining the vernier dial reading with the slide rule dial reading. The exact method varies somewhat from the low frequency bands to the high frequency bands and can best be learned by referring to figure 3-2.

3.2.6. ANTENNA LOADING TABLE. - This table indicates the approximate position for the coarse antenna loading control for loading into various antenna impedance on the different bands.

POSITION OF COARSE ANT. LOADING CONTROL (for resistive loads)						
FREQ MC	13 Ω LOAD	26 Ω LOAD	50 Ω LOAD	73 Ω LOAD	300 Ω LOAD	600 Ω LOAD
3.5	--	1	2	3	4	5
4.0	1	2	3	4	5	5
7.0	2	3	3	4	5	5
7.3	3	4	4	4	5	5
14.0	5	5	5	6	6	6
14.4	5	5	5	6	6	6
21.0	6	6	6	6	6	6
21.45	6	6	6	6	6	6
27.2	6	6	6	6	6	6
28.0	6	6	6	6	6	6
29.7	6	6	6	6	6	6



FREQ. = 7128 KC



FREQ. = 28510 KC

FIGURE 3-2 TYPICAL DIAL READINGS

SECTION 4

CIRCUIT DESCRIPTION

4.1. GENERAL. - The following paragraphs have been written to enable the owner of a 32V-1 to understand the functioning of his transmitter more fully. This section should be read and understood before any extensive servicing is attempted.

4.2. CIRCUIT DESCRIPTION.

4.2.1. RF CIRCUITS.

(a) OSCILLATOR. - A type 6SJ7 tube is employed in a highly stabilized master oscillator circuit to generate the controlling radio frequency voltage. This frequency generating unit is a linearly - tuning permeability tuned oscillator with a range of 1.6 to 2 megacycles. Sixteen turns of the main tuning dial cover this range. This provides 50 KC per revolution on the second harmonic (3.2 to 4 mc band). With the end points properly set up, the tuning curve is linear within one dial division of the ideal tuning curve on any of the bands in the operating range. The oscillator circuit is compensated for temperature changes and is entirely enclosed in a heavy aluminum case.

(b) INTERMEDIATE STAGES. - Following the master oscillator, a type 6AK6 is employed in an untuned, Class A amplifier stage. This stage completely isolates the master oscillator from the remaining tuned stages. The 6AK6 drives a series of three frequency multiplier tubes, the first of which is a type 6AG7. The operating frequencies at the plate of the multiplier tubes for the different bands is given in the following table:

	1ST MULT. 6AG7	2ND MULT. 7C5	3RD MULT. 7C5
80M	3.5 mc	3.5 mc	3.5 mc
40M	3.5 mc	3.5 mc	7 mc
20M	3.5 mc	7 mc	14 mc
15M	5.75 mc	10.5 mc	21 mc
11M	6.8 mc	13.6 mc	27 mc
10M	7 mc	14 mc	28 mc

Plate screen and filament power for these stages is obtained from the low voltage power supply. Gang tuning of the multiplier stages is obtained by moving powdered iron cores, attached to a common platform, in and out of the plate coils which are wound to give linear tuning. This platform to which the iron cores are attached is also ganged to the master oscillator tuning for complete single control tuning of the exciter stages. Band switching is accomplished by adding extra padding capacity across coils by means of the band switch in all cases excepting the 14 mc output of the third multiplier where an inductance is switched in parallel with the existing 40 meter inductor to lower the tuning inductance for 14 mc output.

(c) POWER AMPLIFIER STAGE. - A type 4D32 tetrode power amplifier tube is used in the PA stage. This tube always operates as a straight amplifier. The plate circuit is tuned by a pi-network which is band-switched along with the multiplier stages. In order to cover a complete range of output impedances, the

output capacitance of the network is composed of a 300 mmf variable capacitor for fine adjustment and a bank of fixed capacitors selected by a tap switch for coarse adjustment. The screen grid and plate of the 4D32 are both modulated in phone transmission. Plate and screen voltage is obtained from the high voltage supply while filament power is obtained from the low voltage plate supply transformer. The tube is biased with 75 volts of fixed bias plus some grid leak bias.

4.2.2. AUDIO CIRCUITS. - The first and second audio amplifier consists of a type 6SL7 tube operated as a cascade amplifier. A volume control, R205, is located in the grid circuit of the second amplifier stage. The driver stage employs a type 6SN7 tube with the two triode sections operated in parallel to drive the modulator stage. The modulator stage utilizes a pair of type 807 tubes connected in a push pull circuit and operating class AB₂. The output of the modulator is coupled to the final amplifier by transformer, T202, to modulate the plate and screen of that stage. During CW operation, the secondary of the modulation transformer is shorted out by S302A. Bias for the modulator tubes is adjustable by R305, and obtained from the low voltage supply and regulated by the voltage regulator tube, V304, type VR-75. The secondary of the modulation transformer has a 500 ohm tap provided for supplying 60 watts of audio power to an external load.

4.2.3. HIGH VOLTAGE SUPPLY. - The high voltage transformer is energized when the contacts of relay, K301, are closed. The high voltage supply employs two type 5R4GY rectifier tubes connected in parallel in a full wave circuit. The output is filtered by a single section choke input filter. This supply furnishes voltage for the plate and screen of the final amplifier and plate voltage for the modulator tubes. The amount of output voltage from this supply may be either 600 volts or 700 volts depending on the position of the tap switch, S305, in the primary winding of the high voltage transformer, T302. For the same power input, the efficiency of the final amplifier improves with the higher operating voltage. The tube manufacturer recommends no more than 600 plate volts for phone operation, but this is for CCG rating.

4.2.4. LOW VOLTAGE SUPPLY. - Transformer, T301 furnishes power for both the low voltage plate supply and the filament of all tubes in the transmitter. T301 is energized by closing the LV switch, S304. Three separate windings on transformer, T301, furnishes filament power to the tubes. The low voltage plate supply employs a type 5Z4 rectifier tube in a full wave circuit with a two section choke input filter. This supply has a total output voltage of approximately 315 volts. 240 volts is supplied to the audio amplifier, oscillator, buffer and multiplier stages. Bias voltage for the modulator and final amplifier stage is furnished by this supply. It also supplies voltage for the operation of relay, K301.

4.2.5. RECEIVER MUTING CIRCUIT. - Users of the Collins Model 75A receiver can take advantage of the cw muting circuit contained therein. This muting is accomplished by blocking the noise limiter circuit in the receiver with a positive voltage. In the 32V-1 transmitter this positive voltage is obtained from the voltage drop across the cathode resistor of the second multiplier tube, V103. The receiver limiter switch should be in the OUT position during CALIBRATION adjustments of the 32V-1.

SECTION 5

MAINTENANCE5.1. INSPECTION.

5.1.1. GENERAL. - This radio equipment has been constructed of materials considered to be the best obtainable for the purpose and has been carefully inspected and adjusted at the factory to reduce maintenance to a minimum. However, a certain amount of checking and servicing will be necessary to maintain efficient and dependable operation. The following section has been written to aid in checking the equipment.

5.1.2. ROUTINE INSPECTION. - Routine inspection schedules should be set up for periodic checks of this equipment. This inspection should include examination of the mechanical system for excessive wear or binding and of the electrical system for electrical defects and deterioration of components.

If the routine inspection of the equipment is carried out faithfully, the chances of improper operation of the equipment are greatly minimized. It is suggested that this inspection be made as frequently as possible and it should be sufficiently thorough to include all major electrical circuits of the equipment as well as the mechanical portion.

(a) CLEANING. - The greatest enemy to uninterrupted service in equipment of this type is corrosion and dirt. Corrosion, itself, is accelerated by the presence of dust and moisture on the component parts of the assembly. It is impossible to keep moisture out of the equipment in certain localities, but foreign particles and dust can be periodically removed by means of a soft brush and a dry, oil-free jet of air. Remove the dust as often as a perceptible quantity accumulates in any part of the equipment. It is very important that rotating equipment, such as variable condensers and tap switches, be kept free from dust to prevent undue wear. Likewise, variable condenser plates should be kept free from dirt to avoid flashover.

One of the greatest sources of trouble in equipment located in a salt atmosphere is corrosion. Corrosion resulting from salt spray or salt laden atmosphere may cause failure of the equipment for no apparent reason. In general it will be found that contacts such as tap switches, tube prongs, cable plug connectors, and relay contacts are most affected by corrosion. When it is necessary to operate the equipment in localities subject to such corrosive atmosphere inspection of wiping contacts, cable plugs, relays, etc., should be made more frequently in order to keep the equipment in good condition.

(b) VACUUM TUBES. - Make a check of emission characteristics of all tubes. After the emission check, examine the prongs on all tubes to make sure that they are free from corrosion. See that all tubes are replaced correctly and fully in their sockets, and a good electrical contact is made between the prong of the tube and the socket. Use caution in removing and replacing grid or plate caps

on tubes so equipped. Before a tube is discarded, make certain that the tube is at fault and the trouble is not a loose or broken connection within the equipment. A complete set of tested tubes of the same type specified should be kept on hand at all times. If faulty operation of the transmitter is observed and tube failure suspected, each tube may be checked by replacing it with a tube known to be in good condition. Defective tubes causing an overload in power circuits may usually be located by inspection. It will be found that excessive heating or sputtering within the vacuum tubes is a good indication of a fault in the tube circuit.

If tubes have been in use for a period of time equal to or exceeding the manufacturer's tube life rating, it is suggested that they be replaced. A marked improvement in the performance of the equipment is usually noticeable after the weak tubes have been replaced.

(c) PRECAUTIONS FOR SATISFACTORY TUBE LIFE.

- (1) Before any tube is removed from the equipment, make certain the primary power is disconnected from the equipment.
- (2) Operate all tubes within $\pm 5\%$ of rated filament voltage.
- (3) Do not exceed the rated plate current of any tube during normal operation of the equipment.

(d) TUBE REPLACEMENT PRECAUTIONS.

- (1) All tubes are removed by pulling them straight away from the chassis.
- (2) Remove plate cap connectors, from tubes so equipped, with great care to prevent breaking the seal around the plate cap.
- (3) Before a tube is inserted, make certain that the type of tube is correct for the socket into which it is being placed.

NOTE

Changing master oscillator tubes (V001) may cause a slight change in master oscillator calibration.

(e) TUBE TABLE.

<u>SYMBOL</u>	<u>TYPE</u>	<u>FUNCTION</u>	<u>RATED FIL. VOLTAGE</u>
V001	6SJ7	Master oscillator	6.3
V101	6AK6	Buffer amplifier	6.3
V102	6AG7	Frequency multiplier	6.3
V103	7C5	Frequency multiplier	6.3

TUBE TABLE

<u>SYMBOL</u>	<u>TYPE</u>	<u>FUNCTION</u>	<u>RATED FIL. VOLTAGE</u>
V104	7C5	Frequency multiplier	6.3
V105	4D32	Power Amplifier	6.3
V201	6SL7	Audio Amplifier	6.3
V202	6SN7	Audio driver	6.3
V203	807	Modulator	6.3
V204	807	Modulator	6.3
V205	6SL7GT	Sidetone Oscillator	6.3
V301	5Z4	LV Rectifier	5.0
V302	5R4GY	HV Rectifier	5.0
V303	5R4GY	HV Rectifier	5.0
V304	VR75	Bias Regulator	---
V305	OA2	Screen Voltage Limiter	---
V306	OA2	Screen Voltage Limiter	---

(f) RELAYS. - All relays should be inspected at regular intervals. Check the contacts for proper alignment, pitting and corrosion. Use a burnishing tool to clean contacts - never use sandpaper or emery cloth.

5.2. TROUBLE SHOOTING.

5.2.1. GENERAL. - The most general cause of improper operation of radio equipment is tube failure. Refer to paragraph 5.1.2., (b) in this section for comments concerning vacuum tube replacement. Defective tubes causing an overload in power circuits may usually be located by inspection. High voltage arcs may be caused by bent condenser plates, corrosion or dust. Corrosion resulting from operating the equipment in a salt laden atmosphere may cause failure of the equipment for no apparent reason.

In general, trouble encountered in radio apparatus may be isolated by means of various tests and measurements, and the section of the transmitter determined in which the trouble is located. If this is done, the components in the associated circuit may be checked and the trouble located. Refer to the tables of meter readings and resistance measurements.

No one but an authorized and competent service man equipped with proper test facilities should be permitted to service this equipment.

5.2.2. FUSES.

(a) GENERAL. - This equipment is supplied with fuses of the correct rating in each position. Fuse failures should be replaced with spares only after the circuit in question has been carefully examined to make certain that no permanent fault exists. Always replace a fuse with the rating specified in the following table:

FUSE TABLE

<u>SYMBOL</u>	<u>LOCATION</u>	<u>TYPE</u>	<u>RATING</u>
F301	LV Power supply primary	Cartridge (3AG)	3 amp.
F302	HV Power supply primary	Cartridge (3AG)	5 amp.

5.3. ALIGNMENT.

5.3.1. GENERAL. - Should, for any reason, the exciter stages get out of alignment, it is recommended that the unit be realigned at once. Improper operation might result in damage to valuable equipment.

5.3.2. HIGH FREQUENCY OSCILLATOR. - Should trouble develop in the high frequency master oscillator, the unit should be returned to the factory for servicing. However, the unit can be serviced and realigned by persons understanding such techniques providing accurate test equipment is at hand. A crystal controlled frequency standard with outputs at 1700 and 2000 kc with an accuracy of better than .015 percent, must be used for setting the band edges.

(a) PROCEDURE.

- (1) Apply power to the transmitter and let the MO warm up for about 30 min. then check the oscillator frequency on a receiver. Operate the transmitter with the emission control in the CAL position and the key closed.
- (2) Couple a receiver to the output of the oscillator.
- (3) Set the vernier index to exact center of the dial window.
- (4) Tune receiver to output of 1700 kc freq. standard.
- (5) Rotate MO to vicinity of 3400 kc on the exciter dial and zero beat with the signal from the standard. Write dial reading down for use as a reference.
- (6) Rotate the MO dial toward 4 mc exactly 12 turns.
- (7) Tune the receiver to the 2000 kc output of the standard.
- (8) The MO should zero beat with the 2000 kc output of the standard at exactly 12 turns of the MO dial.
- (9) If such is the case but the dial reading is incorrect, loosen the set screws in the oscillator coupler and turn the dial to the correct reading (4000 kc) after which tighten the set screws again. If the MO does not zero beat with the standard at 4 mc, proceed as follows:
 - (10) Read the kc difference (the difference of where the signal appeared from where it should have appeared after 12 turns) and multiply it by 5. Add this figure to the actual beat note dial setting if the beat note was less than 12 turns or subtract it if the beat note occurred at more than 12 turns. Now set the dial to this new frequency, remove the trimmer plug from the top of the oscillator, and turn the adjustment until zero beat is again reached. It will be found that the high and low ends are very nearly 12 turns apart. Repeat the above procedure until such is the case; remember that a new reference point will occur at the low end of the dial each time.

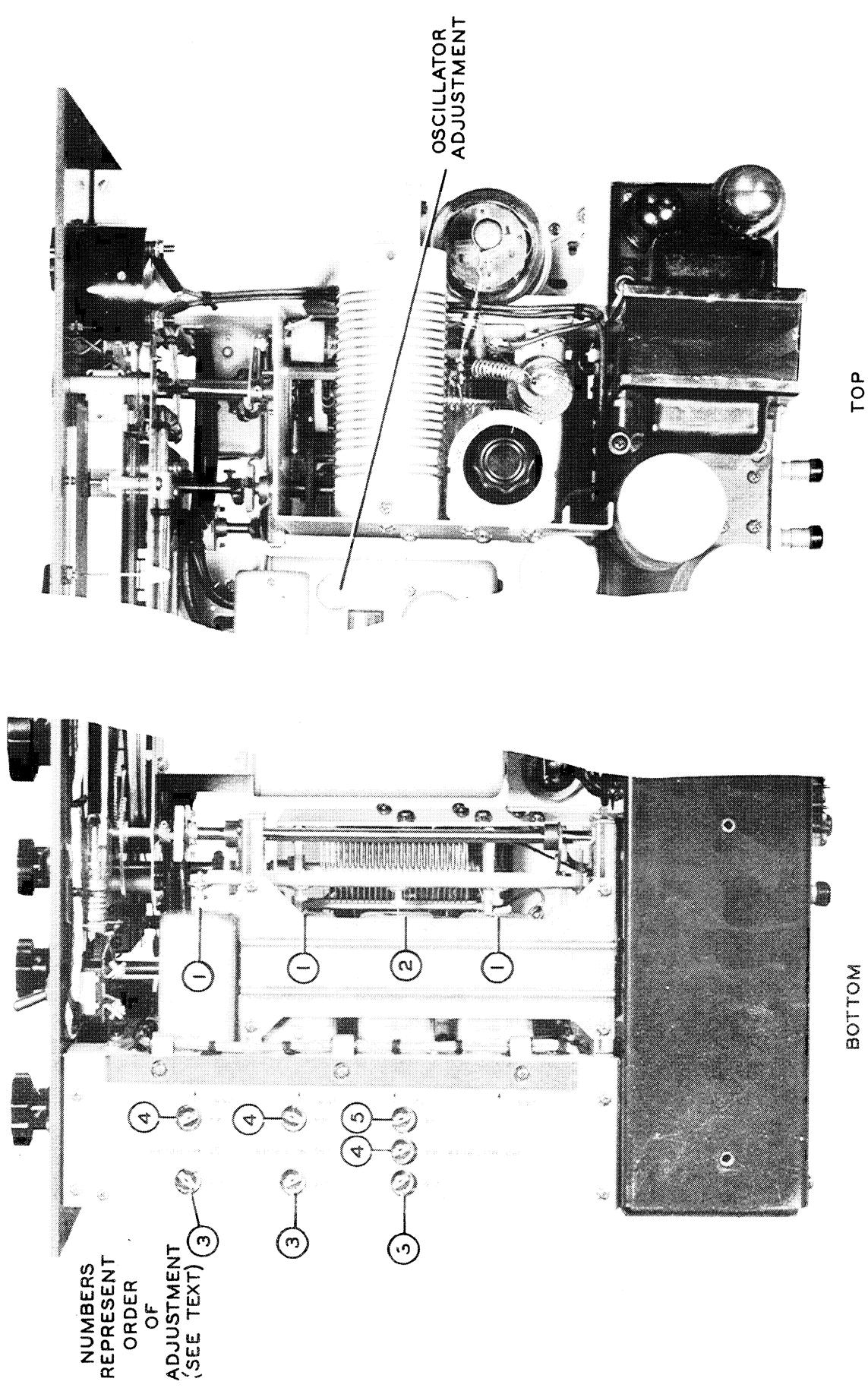


FIGURE 5-1 ALIGNMENT ADJUSTMENTS

Examples of above operations:

#1

Beat note at low end of dial	= 3402 kc
Reading at which beat note should appear after 12 turns of dial	= 4002 kc
Actual dial reading	= 4003 kc
Difference frequency (4003 - 4002)	= 1 kc
Multiplied by 5	= 5 kc
Subtracted from 4003 (since beat note occurred at more than 12 turns)	= 3998 kc

After setting dial to 3998 kc and zero beating the MO to the standard with the trimmer adjustment, the low end beat note should appear at 3398 kc.

#2

Beat note on low end of dial	= 3498 kc
Reading at which dial should appear after 12 turns	= 3998 kc
Actual dial reading	= 3996 kc
Difference frequency (3998 - 3996)	= 2 kc
Multiplied by 5	= 10 kc
Added to 3996 (since beat note occurred at less than 12 turns of the dial)	= 4006 kc

After setting the dial at 4006 and zero beating the MC to the standard with the trimmer adjustment, the low end beat note should appear at 3406 kc.

(11) After the oscillator has been adjusted to cover the range 3400 to 4000 kc in exactly 12 turns, the coupler set screws can be loosened and the dial set on frequency.

NOTE

The above method of adjustment is that which is used at the factory. This is a short cut method and proves very reliable. Actually, the object is to get the 1700 kc and the 2000 kc outputs of the oscillator exactly 12 turns apart and it can be attained by using the slower method of moving the trimmer capacitor in one direction or the other and checking the results until the desired answer is obtained. Be sure to replace the trimmer cover plug after alignment.

NOTE

Somewhat greater accuracy can be obtained if the oscillator end points are set using harmonic operation i.e. listen in the 14 or 28 mc region for the harmonics of the 1700 and 2000 kc signals and set the corresponding harmonic of the MO to zero beat with these. Do this only after obtaining a very close adjustment as outlined above.

5.3.3. MULTIPLIER STAGES. - Should the grid drive to the final fall below 5 ma on the meter due to change of tubes or aging of components, the transmitter r-f circuits should be realigned. Proceed as outlined below only after the master oscillator has been checked and recalibrated as outlined in paragraph 5.3.2.

A small fiber screwdriver and a 1/4" open end wrench are required for these adjustments.

(a) PROCEDURE.

- (1) Remove the transmitter from the cabinet and tip it up on end. (RF section up).
- (2) Remove the fuse from the HV primary. (This allows the low voltage supply to be turned on while the HV supply remains turned off.)
- (3) Turn the LV and HV power switches ON.
- (4) Place the CW-CAL-PH switch in the PH position.
- (5) Place the METER selector switch in the GRID position.
- (6) Adjust for maximum grid current using the adjustments and conditions listed below in order from top to bottom of the list. (Refer to figure 5-1 for adjustment identification.)

<u>ORDER OF ADJUSTMENT</u>	<u>BAND SW SET AT</u>	<u>TUNING SET AT</u>	<u>ADJUSTMENT</u>
1.	10M	28,800	3 Slugs marked "28.8"
2.	40M	7,200	1 Slug marked "7.2"
3.	15M	21,600	3 Trimmers marked "21.6"
4.	20M	14,250	3 Trimmers marked "14.4"
5.	80M	3,750 kc	1 Trimmer marked "3.6"

NOTE

In item 4 under ADJUSTMENT, the mistracking of the third multiplier plate circuit will result in low grid current when the main tuning dial is set much outside the limits of the amateur 20 meter band (14 to 14.4 mc). Proper grid current can be obtained at any frequency on the range 12.8 - 16 mc by adjustment of trimmer C137 (marked 14.4) on the third multiplier.

5.3.4. MODULATOR BIAS ADJUSTMENT. - The modulator bias can be adjusted by turning the screwdriver slot equipped potentiometer R305. For best distortion characteristics, the static, or resting, modulator plate current should be 55 ma with the 600 - 700 v switch in the 700 v position. Potentiometer R305 is located within the top of the cabinet near the filter capacitors, therefore, the interlock switch

will have to be held closed while making this adjustment. Take great care to avoid touching any components carrying high voltage'.

The proper bias for the modulator grids is approximately minus 25 volts.

5.4. LUBRICATION. - The following parts should be lubricated annually or whenever the need arises by brushing a thin film of the indicated lubricant on the points of mechanical contact. Don't over-lubricate.

(a) PA Bandswitch Contacts: MOBILE PD535A (Socony Vacuum Oil Co.)

(b) Panel Bushings: MOBILE PD 535A (Socony Vacuum Oil Co.)

5.5. OSCILLATOR TUBE REMOVAL. - Replacing an oscillator tube requires the breaking of the seal around the shield and it will then become necessary to reseal the shield. If it becomes necessary to replace an oscillator tube, use a glyptal cement or a generous portion of Duco cement to reseal the shield.

5.6. DESICCANT CAPSULE. - A silica-gel tube is mounted on the top of the oscillator shield. The silica-gel absorbs moisture from within the oscillator and aids in retaining the oscillator calibration. Moisture causes the color of the silica-gel to change from blue to pink. The silica-gel tube is screwed into a hole in the shield. The plastic tube should be replaced by a new tube of silica-gel when all of the material within the tube has changed from blue to pink. New tubes of silica-gel may be ordered from the Collins Radio Company.

NOTE

The seal around the oscillator tube shield and the silica-gel tube is more easily broken if the parts are warm. This can be done safely with a light bulb or infra-red lamp placed close to the oscillator.

TYPICAL TEST VOLTAGES

DC Voltages to Ground measured with Volt-ohmyst. Conditions: Phone - No Mod. Readings taken at LF end of each band.

Tube	Pin	R. F.					
		3.5	7.0	14.0	21.0	27.2	28.0
V101	6AK6						
G1	1	-17.0 ²³	-16.5	-1.0	-0.9	-1.0	-0.9
K	2, 7	1.0 ¹⁵	1.0	2.9	2.85	2.85	2.9
P	5	235 ⁷⁰	230	230	225	225	225
G2	6	155 ¹⁵⁵	150	65	65	65	65
V102	6AG7						
K	1, 3, 5	2.6 ⁶⁵	2.6	3.9	3.2	3.4	3.2
G1	4	-18. ¹⁸	-18.	-36	-36	-38	-36
G2	6	220 ²¹⁵	215	205	205	205	210
P	8	230 ²¹⁵	230	220	220	225	225

Tube	Pin	R. F.					
		3.5	7.0	14.0	21.0	27.2	28.0
V103	7C5	280 235 265	235	215	210	215	215
P	2	205 235	200	195	190	190	190
G2	3						
G1	6	-45 -24 -43	-23.	-56.	-21.	-69.	-51.
K	7	30 25. 29	25.	27.	27.	26.	26.
V104	7C5	280 225 250	220	215	215	215	215
P	2	180 220	180	175	175	165	165
G2	3						
G1	6	-115 -125	-110	-170	-175	-150	-150
K	7	-6 -59 -65	-56	-52	-52	-51	-50
V105	RK-4D32	305 285	300	300	300	295	295
G2	2	0	0	0	0	0	0
K	4, 5						
G1	6	-100 -120 -105	-100	-93	-105	-105	-102
P	Cap	600 690	680	690	690	690	690

DC Voltages to Ground in Audio System (Volt-ohmyst)

4D32 Plate Current = 220 MA

E_p = 700 V

Key Down

Audio Amplifier V201, 6SL7GT				Driver V202, 6SN7GT		Modulator V203, & 4, 807		Sidetone Osc. V205, 6SL7GT			
	PH	CW		PH	CW		PH	CW	PH	CW	
Pin 1	G	-0.6	-0.8	G	0	0			G	-.5	-3.0
2	P	88.	-0.9	P	235	235	G2	235	P	-.8	25
3	K	0	0	K	7.4	7.4	G1	-25	K	0	0
4	G	0	0	G	0	0	K	0	G	-.3	-0.5
5	P	100	100	P	235	235	--	--	P	-.8	24
6	K	0.8	0.8	K	7.4	7.4	P	720	K	0	--
7											
8											

Key up Key down

Key up - key down conditions of V105 (4D32)

Plate E 820 740

CW operation

Plate I 0 220

f = 7 mc

Screen E 300 300