Amperex electronic corp.

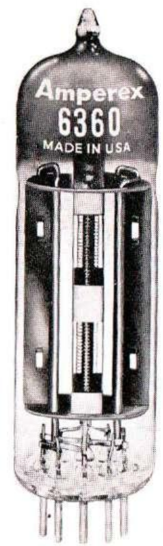
230 Duffy Avenue, Hicksville, L. I., New York

Printed in U.S.A.

Cat. No. APP. 3-460

APPLICATION BULLETIN

Amperex®



TUBE TYPE 6360

Amperex® electronic corp.

230 Duffy Avenue, Hicksville, L. I., New York

PREFACE

Mobile transmitters operating at frequencies above 110 Mc/s are preferably designed with push-pull output stages because this type of circuit is advantageous for:

1. Ease of neutralization
2. Low parasitic capacitance
3. Low radiation
4. Minimum power consumption
5. Simple construction

When the two tubes are incorporated in a single envelope, as in the Amperex 6360, the inductance between the cathode and the screen grid can be minimized by having a common cathode, and a common screen grid. This idea has been successfully applied by Amperex to its twin tetrode series encompassing the 5894, 6252, 6907 and 6939. The 6360 with its small dimensions and rigid construction is an important addition to the line.

The 6360 is excellent for use in mobile equipment as a push-pull amplifier, frequency tripler, and modulator. It can also be used as a frequency multiplier with a multiplication factor of 16 obtainable by correct use of circuit parameters.

Additional information concerning similar and other applications is available upon request from the Amperex Application Engineering Department.

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DESCRIPTION

The 6360 is a twin tetrode with an indirectly heated cathode, and is intended for use in low power transmitter stages operating at frequencies up to 200 Mc/s. It can be used as a class C amplifier and oscillator, and in push-pull circuits as an output tube, driver, or frequency tripler. Higher frequency multiplication can be obtained by connecting the tube sections in cascade. Moreover the 6360 can be used as a modulator output tube, with one 6360 in class C being modulated by another 6360.

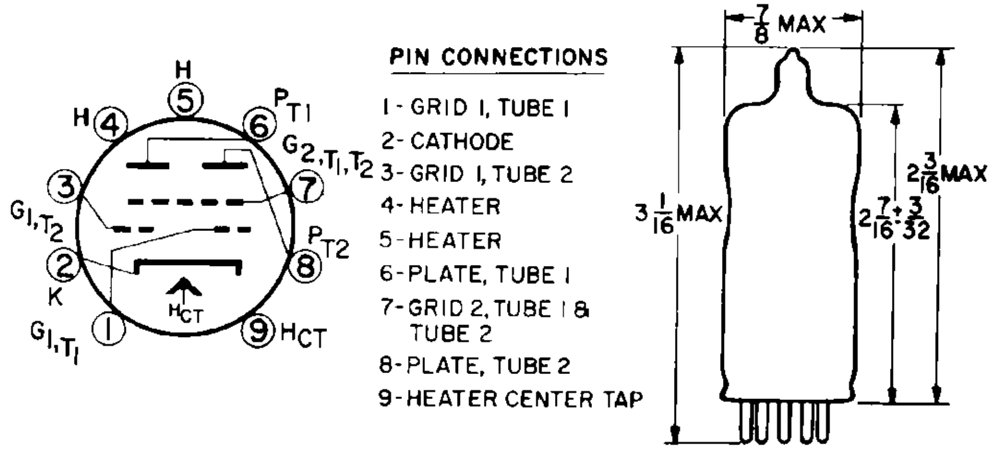


Figure 1.

FEATURES

1. Cathode

The cathode of the 6360 is oxide coated and has a center tapped heater, the sections of which can be used either in parallel or in series. In parallel the heater current is 0.82 amps at 6.3 volts, and in series the heater current is 0.41 amps at a voltage of 12.6 volts. To cope with changing values of supply voltage in mobile equipment (charging and discharging periods) the heater of the 6360 has been designed so that it can withstand occasional operation within the limits of 5.3 volts to 7.8 volts for parallel operation and 10.6 volts to 15.6 volts with series connected heaters, without the tube life being adversely affected.

2. Electrode Structure

Figure 2 shows a cross section of the electrode structure of the 6360. The common cathode (k) is rectangular in cross section and is coated only on its larger sides. The inductance of the intercathode connection is made negligible by using a common cathode and connecting the two

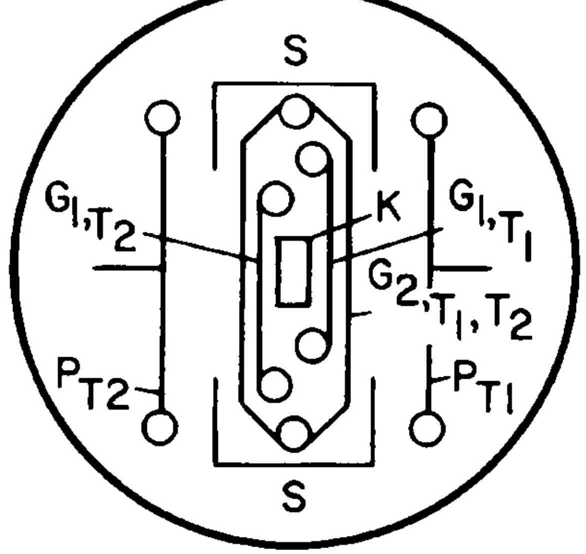


Figure 2.

emitter surfaces by the shorter sides. The control grids and the screen grid are "shadowed" which means that the screen grid wires are placed behind the control grid wires in the direction of the electron flow. This measure promotes the formation of a radial beam and ensures the correct space charge condition between the screen grid and the plate. This type of construction leads to a relatively low screen grid current.

A shield is placed alongside the rods of the common screen grid and extends into the space between the plates and the screen grid; the extending part acts as a beam plate and prevents secondary emission. The shield is connected to the cathode.

3. High Plate Dissipation

The plates are Zirconium coated and have cooling fins, both of which contribute to the relatively high plate dissipation.

4. Internal Neutralization

Internal neutralization is effected by connecting the grid of each section to the base pin below the plate of the other. Because of this the capacitances are sufficiently well balanced for neutralization to be effective over a wide range, thus greatly simplifying equipment layout.

5. Tube Assembly

The tube assembly is mounted on a noval base. The bulb is precision shrunk around the squarish shaped mica spacer so that the inner structure is rigidly supported against the bulb.

6. Output Power

With 300 volt supply voltage and both sections operating in push-pull Class C, one 6360 twin tetrode can deliver 12 watts useful power to the load when used in continuous commercial service (CCS) and 16 watts in intermittent commercial or amateur service (ICAS), in both cases at frequencies up to 200 Mc/s.

TABLE 1: OUTPUT POWER

frequency	RF class C					
	telegraphy			plate and screen grid modulation		
Mc/s	plate voltage (volts)	output power (watts) ① ②		plate voltage (volts)	output power (watts) ① ②	
		CCS	ICAS		CCS	ICAS
200	300 250 200	12 9 7.4	16 11.2 9	200	7.1	8.8

frequency	RF class C frequency tripler		
Mc/s	plate voltage (volts)	output power (watts) ① ②	
		CCS	ICAS
66.6/200	300 250 200	3.5 3 2.8	4.8 4.2 3.5

AF class AB amplifier or modulator ①		
plate voltage (volts)	output power (watts)	
	AB 1	AB 2
300 250 200	12 9.3 7	17 14 8.7

① Two units in push-pull.
② Useful power output in load.

APPLICATION NOTES

I. OPERATIONAL

A. Maximum Values

The maximum values listed in the Technical Data are absolute and must never be exceeded. The equipment designer should compensate for possible variations in supply voltage, load and components in order to avoid exceeding the maximum values.

B. Overload Protection

When adjustments are made to a transmitter or when a new circuit is tested, it is advisable to reduce the plate and screen grid voltages to prevent overload. Protective devices such as fuses, series resistors, or overload relays should be used, not only to protect the plates but also the screen grid against overload. The relays or fuses should cut off the plate and screen grid voltages when the corresponding currents reach higher than permissible values.

C. Shielding

Shielding is required between the plate and grid leads. Figure 5 shows the recommended position for the shield across the tube socket.

D. Cooling

The maximum permissible bulb temperature is 225°C. Natural cooling is sufficient for all normal operating conditions.

NOTE

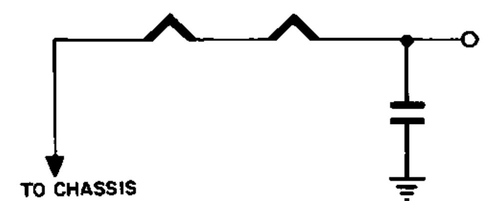
Never enclose the 6360 in a closed shielding can (other than a bulb temperature reducing type) as this will invariably raise the temperature beyond permissible levels.

II. CIRCUIT DESIGN

1. Heater

One heater connection can be directly grounded. At 200 Mc/s, the other connection must be bypassed or else the drive power must be increased by 60 per cent to obtain the normal plate current. Therefore one heater connection should be connected directly to the chassis, and the other should be capacitively grounded.

Figure 3.



HEATER CONNECTION

Heater current can be reduced during standby by keeping only one heater section on. The other section should be switched on at the same time as the plate voltage. About 50 to 60 per cent of the maximum output will be immediately available, and the full output should be available in about 10 to 20 seconds.

2. *Cathode Connections*

Inductance in the cathode circuit, whether bypassed or not, may influence the stability of the tube by giving rise to parasitic oscillations. The cathode is preferably connected directly to ground.

3. *Center Tap on the Plate Coil*

When the layout of the plate circuit is perfectly symmetrical, the center tap of the plate coil can be capacitively grounded, irrespective of whether the plate supply is connected directly to the center tap of the coil or via a choke. However when there is some imbalance and the center tap of the plate coil is bypassed, part of the RF current flows to ground through the bypass capacitor and is lost. The plate circuit should therefore be fed via a choke that is not bypassed. See Figure 4.

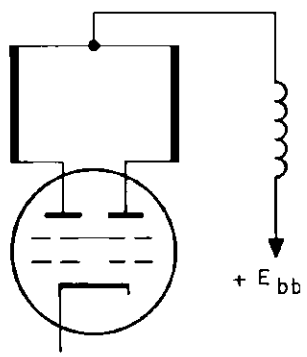


Figure 4.

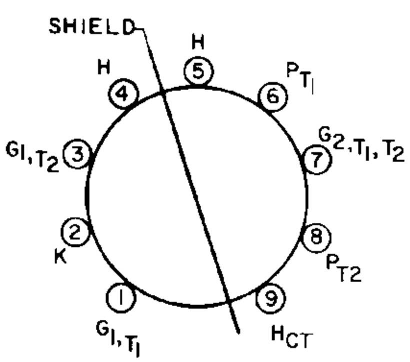


Figure 5.

4. *Shielding Between Input and Output Circuits*

When used as an amplifier, correct shielding is essential between the input and output circuits. It is usually necessary to use a vertical shield across the base of the tube holder between the grid and plate pins. See Figure 5.

5. *Bypassing of the Screen Grid*

When the screen is fed correctly (Figure 6) it is immaterial whether the screen grid is bypassed or not. Some designers use a circuit in which the screen dropping resistor is bypassed and the screen grid is fed through a choke. This circuit may encourage parasitic oscillation unless the choke is properly designed. Generally for best results, the screen grid voltage is fed through a series resistor, it should be an adjustable type, and should not be bypassed.

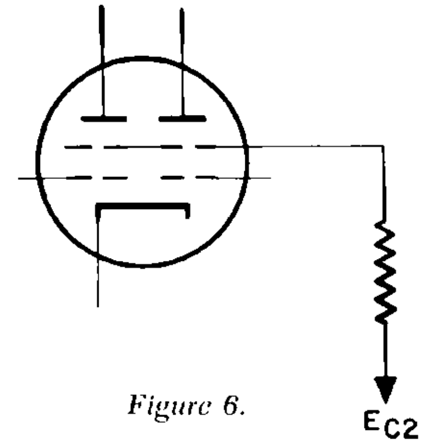


Figure 6.

6. *Center Tap on the Grid Coil*

The effect of mismatch on the tube characteristics is almost eliminated when the center tap of the grid input coil is grounded. The driving voltages in the two sections of the coil become substantially equal and independent of the input capacitances of each section, providing the layout is symmetrical and there is optimum coupling to the preceding stage. When the grid resistor is not bypassed, mismatch of the input capacitances may cause imbalance in the grid circuit. The best symmetry is obtained when a single common grid leak resistor is bypassed to ground.

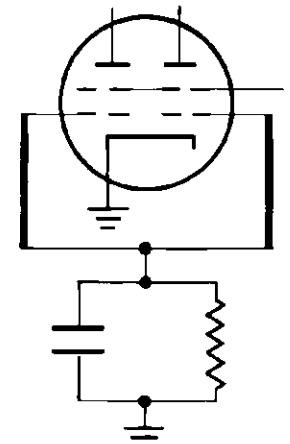


Figure 7.

7. ***Protection Against Overload with Loss of Drive***

The 6360 is normally biased by voltage built up across a common grid resistor. Under certain conditions plate current might exceed the maximum rating due to:

a. Loss of drive
b. Failure in one of the preceding stages.

In frequency multipliers the screen grid resistor is usually high enough in value to prevent the plate current from becoming excessive.

The output stages can be protected by using either cathode or fixed bias. However the higher supply voltage required for cathode bias is objectionable in mobile equipment. The 12 volt supply is a convenient source for the bias. With the grid bias derived partly from the flow of grid current and partly from the 12 volt supply, there is no risk of overloading when loss of drive takes place.

8. *Conclusion*

Best performance will be obtained when:

a. The center tap of the plate coil is connected to the high voltage supply by an RF choke.
b. The screen grid is fed by an unbypassed dropping resistor.
c. The center tap of the grid circuit is capacitively grounded.
d. A single grid resistor is used for biasing both control grids.
e. The cathode is connected directly to the chassis.
f. One heater pin is connected directly to the chassis and the other via a capacitor to ground.
g. The amplifier stage is constructed as symmetrically as possible.

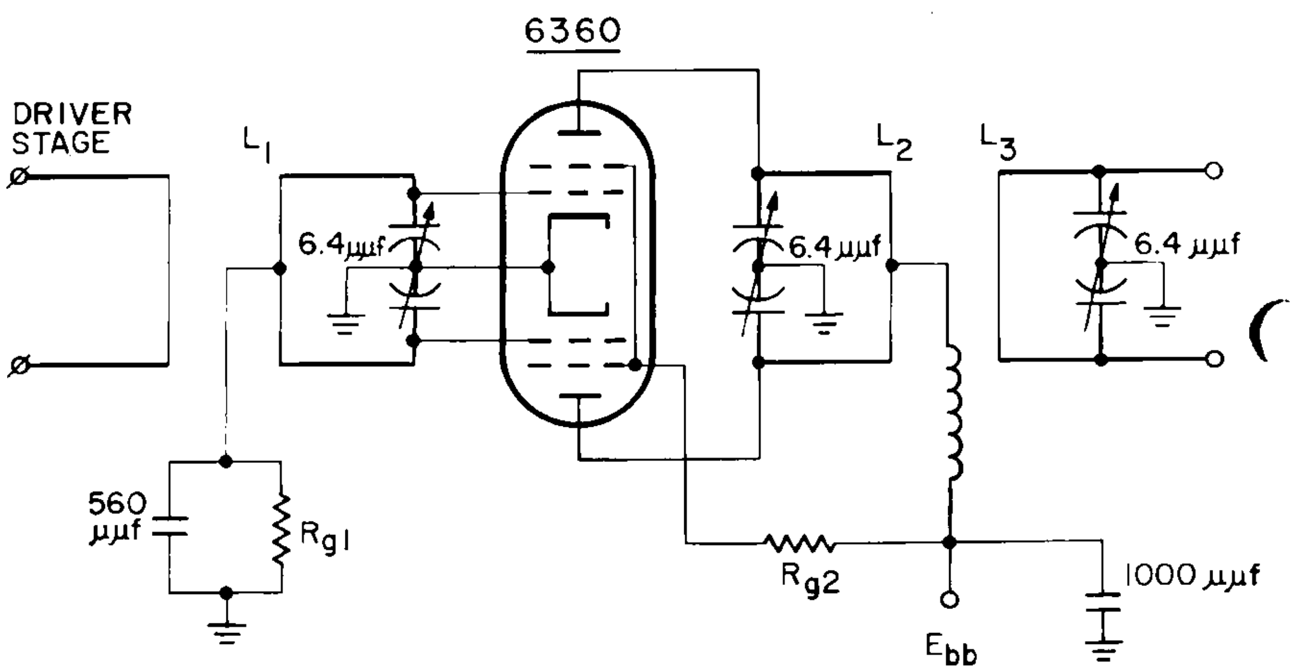


Figure 8. Push-pull output stage using 6360.

Figure 8 shows a typical push-pull output stage using a 6360 incorporating all the features necessary for best performance.

APPLICATIONS

Two Stage Frequency Multiplier

Figures 9, 10, 11 show the 6360 connected in cascade as a two stage frequency multiplier. The multiplication factor of each section can be chosen as 1, 2, 3, or 4, so that from two section, multiplication factors of 2, 3, 4, 6, 8, 9, 12, or 16 can be obtained.

Table 2 (p. 10) gives various operating conditions for the circuits shown in Figures 9, 10, 11.

The total capacitance, C_{tot}, in parallel across the coils, consists of the stray capacitance of the coil, the parasitic capacitances of the circuit, and the tuning capacitance.

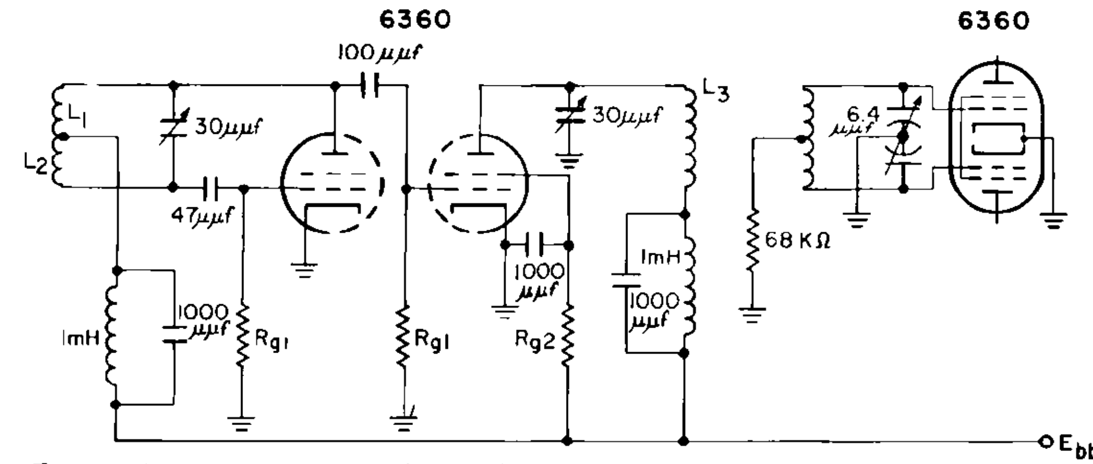


Figure 9. Basic circuit for a frequency multiplier in which the first section functions as an oscillator.

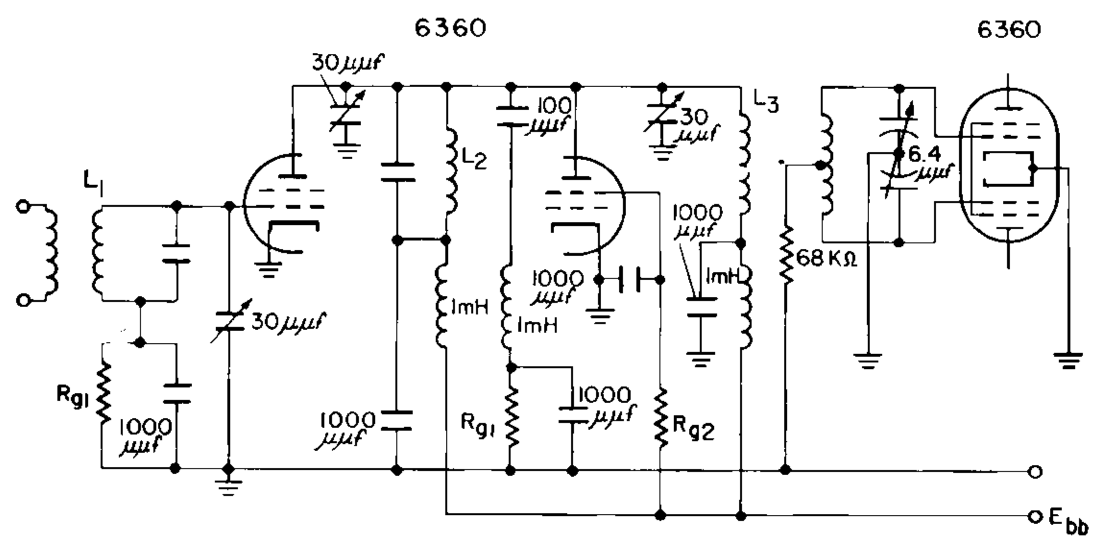


Figure 10. Basic circuit for a frequency multiplier in which the first section has a multiplication factor of 3 or 4 and the second section is a doubler or trebler.

TABLE 2: OPERATING CONDITIONS FOR MULTIPLIER STAGES (Figures 9, 10, 11)

multiplying factor			frequency (Mc/s)	R_{g1} (kΩ)		R_{g2} (kΩ)	I_{g2} (mA)	I_b (mA)		I_{g1} (mA)		circuit	coil number		
section I	section II	total		section I	section II			section I	section II	section I	section II	fig. no.	L_1	L_2	L_3
1 oscil-lator	2	2	33-1/3 66-2/3	82	82	120	1.1	10	9	0.5	0.9	9	8 turns 33 gauge (B&S) tap 3 turns from grid $d = 0.47$ in. $l = 0.75$ in. $C_{tot} = 39\mu\mu f$		8 turns 33 gauge (B&S) $d = 0.47$ in. $l = 0.75$ in.
1 oscil-lator	3	3	22-2/9 66-2/3	82	82	120	1.1	9	10.5	0.33	1	9	10 turns 33 gauge (B&S) tap 3 turns from grid $d = 0.47$ in. $l = 0.87$ in. $C_{tot} = 82\mu\mu f$		8 turns 33 gauge (B&S) $d = 0.47$ in. $l = 0.75$ in.
1 oscil-lator	4	4	16-2/3 66-2/3	82	82	68	1.7	11.5	12	0.45	1.1	9	10 turns 25 gauge (B&S) tap 3 turns from grid $d = 0.47$ in. $l = 0.20$ in. $C_{tot} = 47\mu\mu f$		8 turns 33 gauge (B&S) $d = 0.47$ in. $l = 0.75$ in.
3	2	6	11-1/9 66-2/3	82	82	150	0.8	13	9.5	0.75	0.7	10	15 turns 25 gauge (B&S) $d = 0.47$ in. $l = 0.31$ in. $C_{tot} = 68\mu\mu f$	8 turns 33 gauge (B&S) $d = 0.47$ in. $l = 0.75$ in. $C_{tot} = 27\mu\mu f$	8 turns 33 gauge (B&S) $d = 0.47$ in. $l = 0.75$ in.
4	2	8	8-1/3 66-2/3	82	82	220	0.6	11	8	0.85	0.5	10	25 turns 25 gauge (B&S) $d = 0.47$ in. $l = 0.51$ in. $C_{tot} = 56\mu\mu f$	8 turns 33 gauge (B&S) $d = 0.47$ in. $l = 0.75$ in. $C_{tot} = 27\mu\mu f$	8 turns 33 gauge (B&S) $d = 0.47$ in. $l = 0.75$ in.
3	3	9	7-11/27 66-2/3	82	82	150	0.8	12	10.5	0.6	0.85	10	25 turns 25 gauge (B&S) $d = 0.47$ in. $l = 0.51$ in. $C_{tot} = 68\mu\mu f$	8 turns 33 gauge (B&S) $d = 0.47$ in. $l = 0.75$ in. $C_{tot} = 100\mu\mu f$	8 turns 33 gauge (B&S) $d = 0.47$ in. $l = 0.75$ in.
4	3	12	5-5/9 66-2/3	82	82	120	0.9	14.5	11	1.1	0.7	10	42 turns 25 gauge (B&S) $d = 0.47$ in. $l = 0.51$ in. $C_{tot} = 33\mu\mu f$	8 turns 33 gauge (B&S) $d = 0.47$ in. $l = 0.75$ in. $C_{tot} = 120\mu\mu f$	8 turns 33 gauge (B&S) $d = 0.47$ in. $l = 0.75$ in.
4	4	16	4-1/6 66-2/3	82	82	27	2.4	22	21.5	1.35	1.25	11	50 turns 25 gauge (B&S) $d = 0.47$ in. $l = 0.51$ in. $C_{tot} = 33\mu\mu f$	10 turns 33 gauge (B&S) $d = 0.47$ in. $l = 0.20$ in. $C_{tot} = 47\mu\mu f$	8 turns 33 gauge (B&S) $d = 0.47$ in. $l = 0.75$ in.

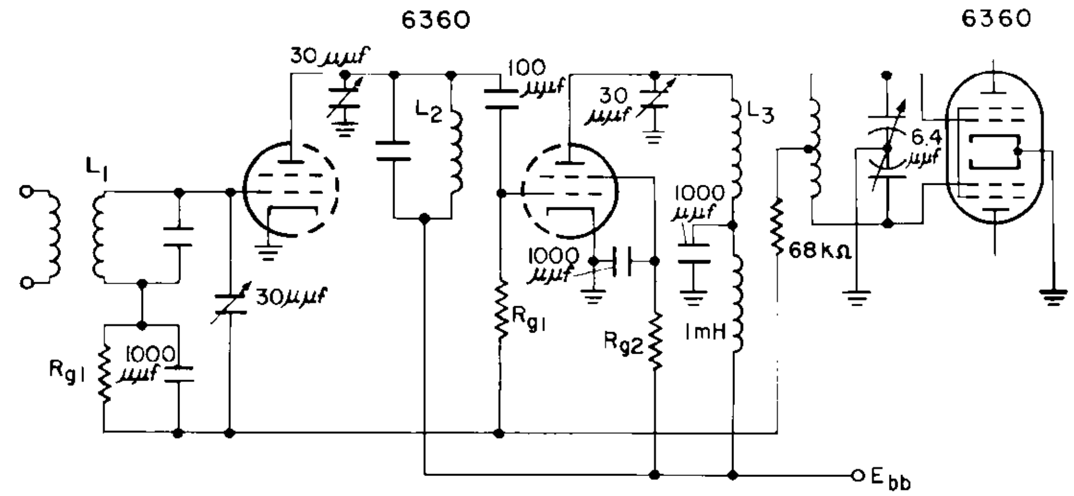


Figure 11. Basic circuit for a frequency multiplier in which both sections have a multiplication factor of 4.

Mobile Transmitter at 220 Mc/s

The narrow band FM transmitter described in this section is designed for operation at 220 Mc/s. It is of conventional design using a crystal controlled master oscillator operating at an output signal frequency of 220 Mc/s. A cascade frequency multiplier stage (x 16) and a tripler (x 3) furnish a frequency multiplication of 48. The power output, measured in an artificial load is 7 watts.

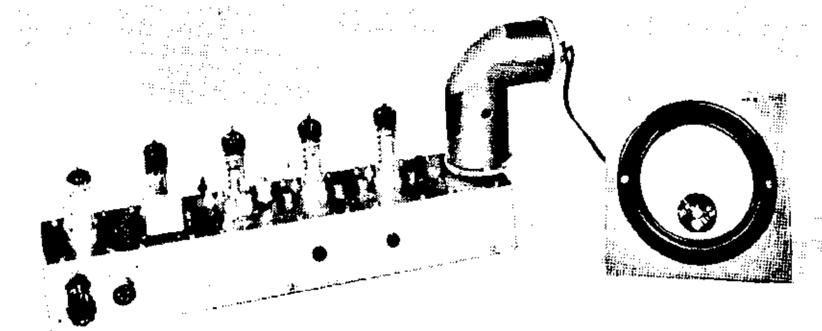


Figure 12. 220 Mc/s transmitter with artificial load and phototube output meter.

Circuit Description

Figure 13 shows the schematic diagram of the transmitter. One section of the 6085 is employed as a crystal controlled master oscillator with interelectrode feedback between plate and grid furnishing the necessary in phase voltage. The oscillator output is capacitively coupled to the frequency multiplier stage. The two sections of the 6360 are used in cascade and produce a frequency multiplication of 16. The output of the multiplier is inductively coupled to the tripler which is utilized as a driver for the push-pull RF amplifier output stage.

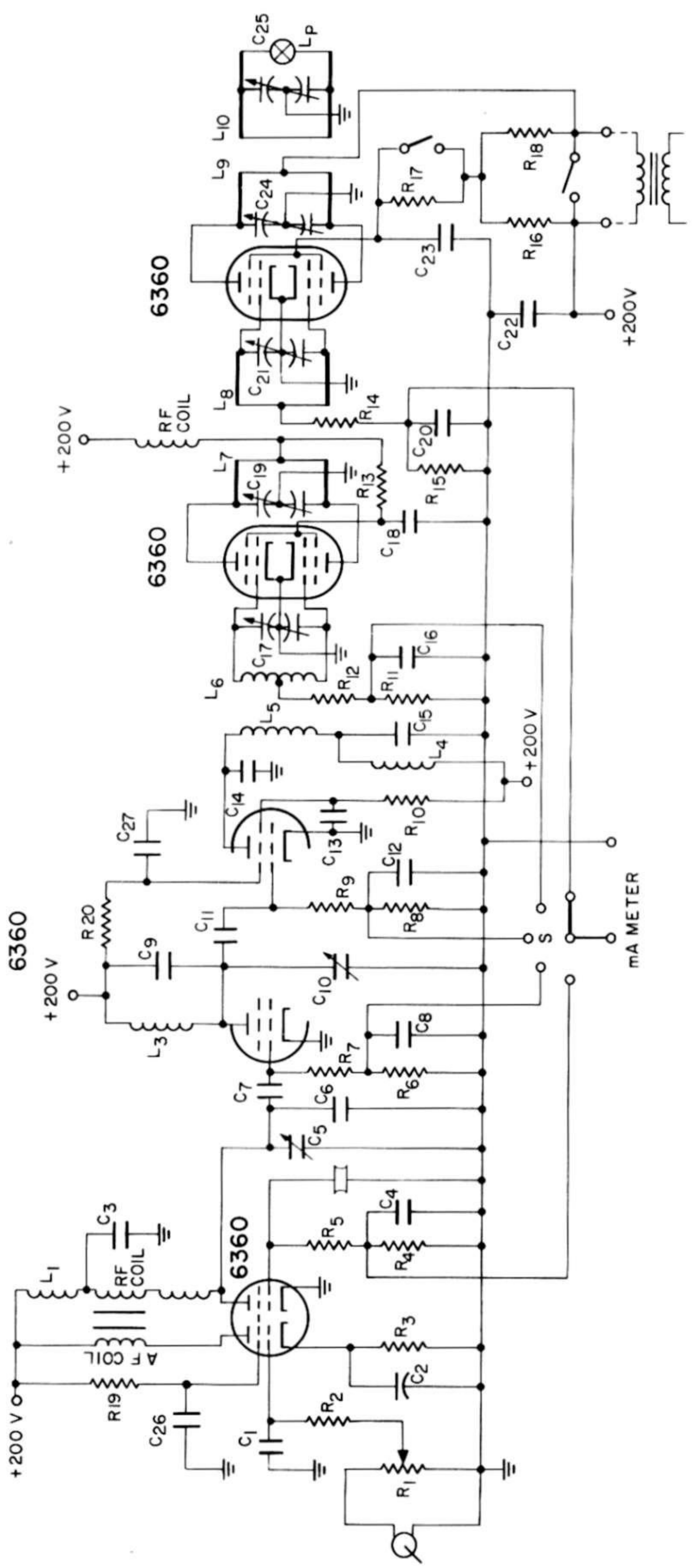


Figure 13. Schematic diagram of the 220 Mc/s transmitter using three 6360 twin tetrodes.

LIST OF PARTS

R_1 = 1 mΩ	R_{11} = 1 kΩ	C_1 = 180 μμf	C_{10} = 25 μμf	C_{19} = 6.4 μμf
R_2 = 100 kΩ	R_{12} = 68 kΩ	C_2 = 25 μf°	C_{11} = 150 μμf	C_{20} = 1000 μμf
R_3 = 470 kΩ	R_{13} = 68 kΩ	C_3 = 1000 μμf	C_{12} = 1000 μμf	C_{21} = 6.4 μμf
R_4 = 1 kΩ	R_{14} = 33 kΩ	C_4 = 1000 μμf	C_{13} = 1000 μμf	C_{22} = 1000 μμf
R_5 = 22 kΩ	R_{15} = 1 kΩ	C_5 = 25 μμf	C_{14} = 25 μμf	C_{23} = 1000 μμf
R_6 = 1 kΩ	R_{16} = 39 kΩ	C_6 = 27 μμf	C_{15} = 1000 μμf	C_{24} = 6.4 μμf
R_7 = 82 kΩ	R_{17} = 120 kΩ	C_7 = 150 μμf	C_{16} = 1000 μμf	C_{25} = 6.4 μμf
R_8 = 1 kΩ	R_{19} = 47 kΩ	C_8 = 1000 μμf	C_{17} = 6.4 μμf	C_{26} = 1000 μμf
R_{10} = 27 kΩ	R_{20} = 47 kΩ	C_9 = 47 μμf	C_{18} = 1000 μμf	C_{27} = 1000 μμf

° 25 V

Modulator

Since a crystal controlled oscillator usually cannot be frequency modulated, phase modulation is transformed into frequency modulation in the following manner: Phase modulation is obtained by employing a variable inductance in the plate circuit of the oscillator tube. This is achieved by winding part of the coil on a Ferroxcube rod which is placed on a U-shaped, laminated iron core, carrying the AF coils on the legs. (See Figure 14.) The plate current flow of the modulator passes through the AF coils in such a manner that the inductance of the coil varies with the AF signal, and phase modulation of the oscillator output voltage is obtained.

Phase modulation is converted into frequency modulation by making the amplitude of the modulated signal inversely proportional to the frequency. This is achieved by connecting filter R_2C_1 in series with the grid of the modulator tube.

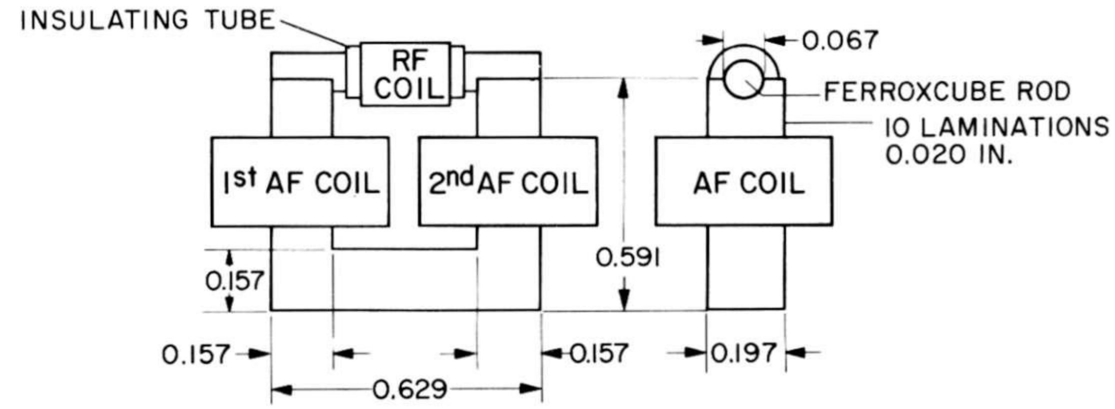


Figure 14. Diagram and dimensions (inches) of the modulation transformer.

The operating conditions of the 6085 are tabulated below.

6085	E_b	I_p	R_g	I_g	E_g
Oscillator	200 V	11.5 mA	22 kΩ	1.95 mA	—

Alternate Modulation Circuit

An alternate modulation circuit is shown in Figure 15. One section of the 6085 is connected as a variable reactance, and is shunted across the plate circuit of the oscillator section. The components of the oscillator feedback circuit are so selected that the required phase shift is introduced employing the reactance tube section as a variable capacitor.

The phase modulated signal is transformed into a frequency modulated signal by use of an RC network in the input circuit of the oscillator section.

The 6084 pentode is used as a pre-amplifier for the AF input.

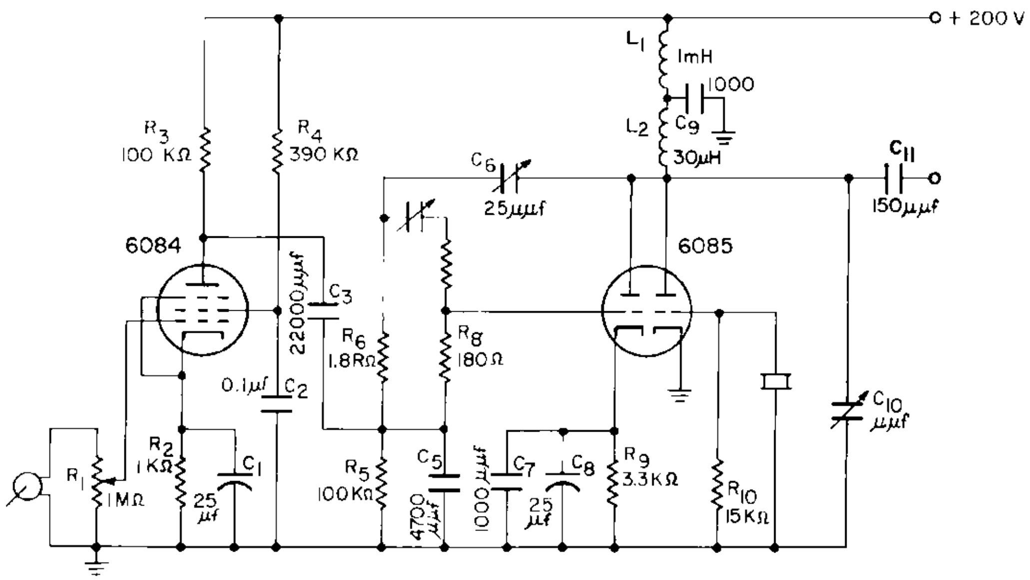


Figure 15. Alternate modulator stage of the 200 Mc/s transmitter.

The operating conditions of the oscillator and modulator stages are tabulated below.

Tube	E_b (V)	I_p (mA)	R_{g2} (kΩ)	I_{g2} (mA)	E_k (V)	I_g (mA)
6084	200	1.5	390	0.3	1.8	—
6085 first section	200	2.4	—	—	7.9	—
6085 second section	200	12.6	—	—	—	2.15

With either modulator stage a frequency sweep of 2 x 15 kc/s can be obtained at the output of the transmitter.

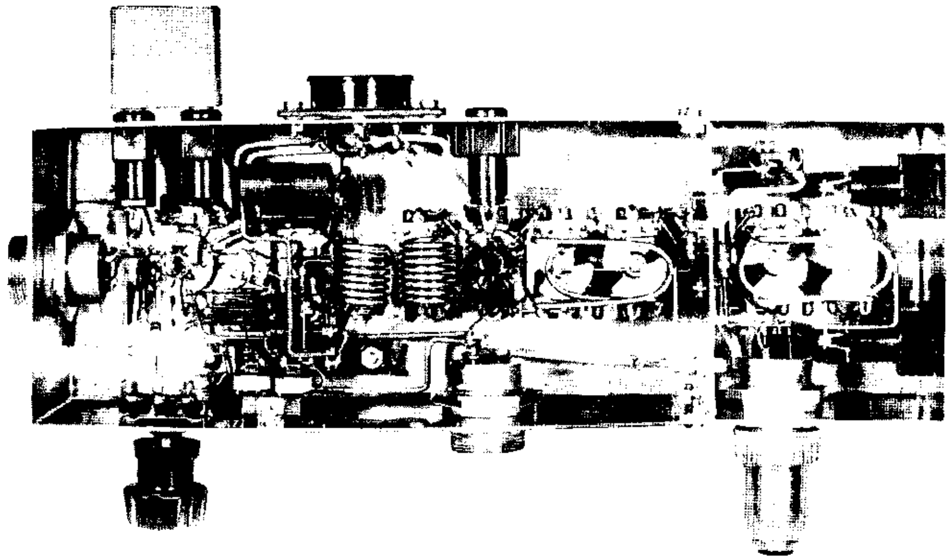


Figure 16. Chassis of the 200 Mc/s transmitter seen from below.

Amplitude Modulation

Amplitude modulation can be applied to the output stage by the use of a combined plate and screen grid form of modulation. A 6360 operated in push-pull and utilized as a modulator tube operating in Class AB_1 or AB_2 can be employed for this purpose. Note AM modulator in 2 meter band application that follows.

The Frequency Multiplier

The frequency multiplier stage is a 6360 using both sections in cascade in a circuit similar to Figure 11. The input circuit, however, is capacitively coupled to the oscillator.

The control grid resistors of both tube sections are 82 k ohm, the screen grid resistor is 27 k ohm. Employing these values the operating conditions of the multiplier stage are tabulated below. The negative grid bias of the first tube section is 102 volts and that of the second section 110 volts. The screen grid voltage is 92 volts.

Tube	Multi-plying factor	E_b (V)	I_p (mA)	I_{g2} (mA)	I_{g1} (mA)
6360 first section	4	200	22	4	1.35
6360 second section	4	200	21.5		1.25

Push-Pull Tripler

The push-pull tripler performs 2 functions; that of a frequency multiplier, and as a driver for the output stage.

The plate coil in the final quadrupler stage has an inductance of 6.2 μH and is tuned with a 25 μμf trimmer to the required frequency of 73.57 Mc/s. The plate loop consists of a loop of #13 B & S gauge wire, the width of the loop is 0.71 inches and the length is 2.36 inches. The loop is provided with a center tap for connection to the plate supply.

Push-Pull Output Stage

The output stage is coupled to the tripler by a loop of #15 B & S gauge wire, with a width of 0.71 inches and a length of 1.57 inches. The loop is also center tapped for connection to the common grid leak resistor. The input circuit is tuned with a similar capacitor as that used in the output circuit of the tripler. Coupling between the two stages is obtained by mounting the two loops one above the other, and they can be adjusted by slight bending.

The plate circuit coil has the same dimensions as that used in the tripler and is also provided with a center tap for connection to the supply voltage.

Tube	I_p (mA)	I_{g2} (mA)	I_{g1} (mA)
Output tube 6360	67	2.6	1.5
Tripler 6360	34	1.1	1.65
Second quadrupler 6360 second section	21.5	4	1.25
First quadrupler 6360 first section	22		1.35
Oscillator 6085 second section	11.5	—	1.95
F.M. modulator 6085 first section	7	—	—

Power Supply

When the modulation system utilizing the Ferroxcube coil is used, the high voltage supply requirements are 200 volts, 170.7 mA. When the modulation system employs a reactance tube circuit 200 volts and 169.27 mA are required. The heater current in the first case is 3.06 amps and 3.26 amps in the latter, the voltage being 6.3 volts. During stand-by, the heater current is reduced to 1.83 amps and 2.03 amps respectively. When the heaters are fed from 12.6 volt supply, the heater currents are 1.53 amps and 1.72 amps respectively.

Overloading of Tubes by Absence of Grid Drive

All of the 6360's employed in the transmitter are biased by grid current flowing through the grid leak resistors. When a tube has no drive voltage applied however, it operates without grid bias. This has no effect on the quadrupler and the tripler tubes because the screen grid dropping resistors are sufficiently high to prevent the plate current from attaining too high a value.

In the output stage, however, absence of grid bias would result in plate current flow far in excess of admissable values. It is for this reason that an additional screen grid dropping resistor is connected in series with the other dropping resistors while the transmitter is being adjusted, and short circuited when the transmitter is ready to operate. This is no protection however against loss of grid bias due to a failure in the pre-stages. The use of a relay that cuts off when plate current increases above its limited value is recommended to protect the output tubes.

Two Meter Transmitter

The two meter transmitter illustrated in Figure 17 has been constructed with two Amperex 6360 tubes. This transmitter will run 17 watt input on phone or 30 watt input on CW.

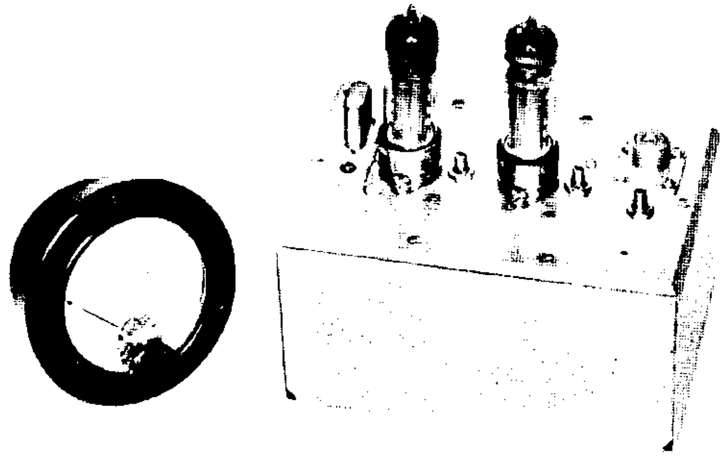


Figure 17. Top view of transmitter.

Parts Layout

The transmitter is constructed on a 4" x 6" aluminum bottom plate in order that a *Bud AC-430* 4" x 6" x 3" aluminum chassis can be used for a base and cover. This small size makes the transmitter useful for mobile work since it can be clamped to the steering wheel post, or kept in the glove compartment.

From the picture of the top of the transmitter (Figure 17), starting from the left, is the crystal, 6360 harmonic crystal-oscillator and tripler (V1), L1 is in front of V1, C2, push-pull 6360 amplifier (V2), C3, coaxial output, and C4 in front of coaxial output.

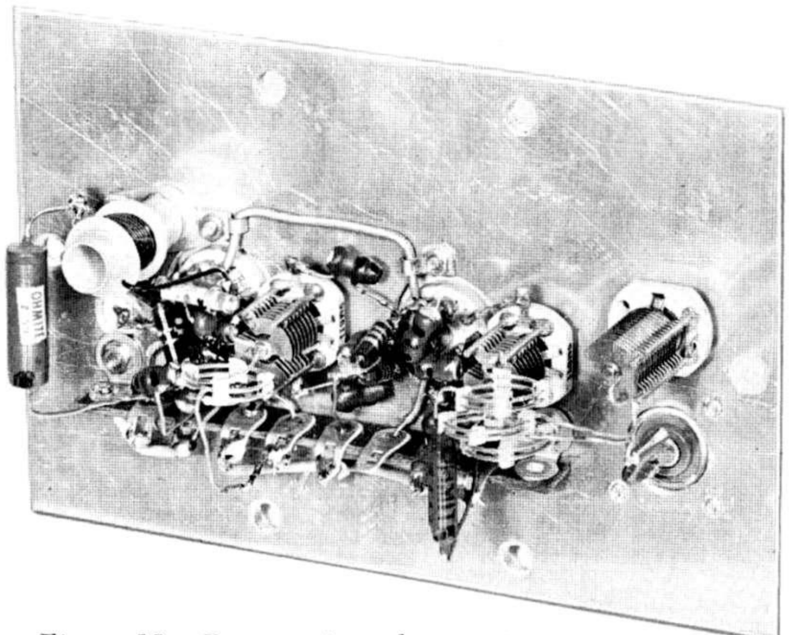


Figure 18. Bottom view of transmitter.

Circuit Description

In the schematic diagram (Figure 19) all leads are shown metered, but some of these meters could be eliminated or a single meter and switching arrangement used at the discretion of the builder. The schematic (Figure 19) shows the transmitter set for phone operation: for CW operation the plate voltage may be increased to 300 volts.

The first section of V1 is a harmonic crystal oscillator and is used with a fifth harmonic crystal (48.666 Mc). C5 and C6 form the feedback circuit. The amount of feedback is fairly critical. Making C5 smaller increases the feedback and making it larger decreases the feedback. With different make crystals the feedback may have to be adjusted. The feedback should be adjusted so that the crystal oscillates on its harmonic readily, but too much feedback will cause the oscillator to oscillate without the crystal plugged in. L1 should always be tuned for the harmonic frequency (48.666 Mc) because when L1 is off resonance the circuit acts as a Pierce-Oscillator and oscillates on the crystal fundamental frequency.

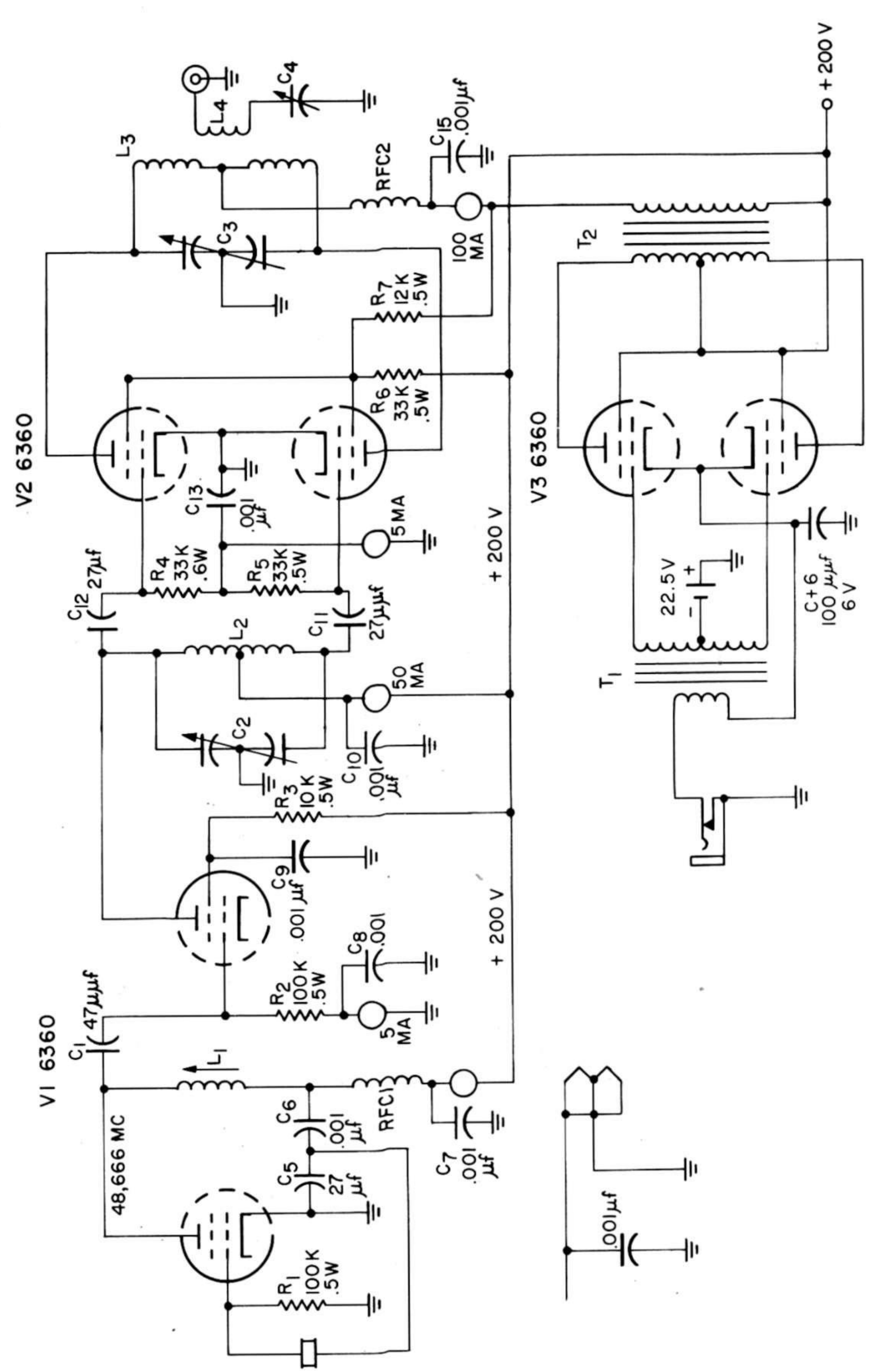


Figure 19. Schematic for the "2 on Two," with optional modulator shown.

The second half of V1 is a tripler to 146 Mc. This feeds a balanced tank circuit to provide balanced drive to V2, the push-pull amplifier.

R6 and R7 in the screen circuit of V2 are such as to provide the correct ratio of audio to appear on the screen for 100% plate modulation.

L3 is made up of two coils, each being 2 turns of B & W #3003 coil stock and spaced ½" apart to allow L4 to swing in and out.

The meter readings are approximately as follows using a 200 volt power supply.

Osc. Plate	15 mA
Trip. Grid	1 mA
Trip. Plate	25 mA
Amp. Grid	1.8 mA
Amp. Plate	70-86 mA

Parasitic Oscillation

Parasitic oscillations are eliminated in the final stage due to the fact that the 6360 is internally neutralized.

Modulator

The modulator was designed using a 6360, a condenser, a battery, and two transformers. The modulator delivers 7 watts of audio with 200 volts on the plates and screen. This can be increased to 12 watts by increasing the plate voltage to 300 volts. The screen is modulated approximately 30% of plate modulation by means of resistor network R6 and R7.

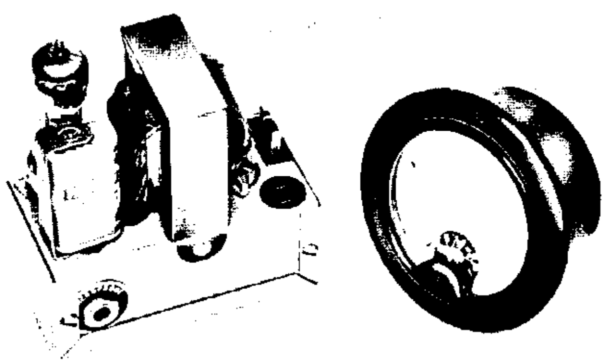


Figure 20. Modulator top view.

Modulator Parts Layout

Looking at the picture of the top view (Figure 20), the 6360 is at the rear left corner with the 22½ volt bias battery just in front. In the center is the modulation transformer. (The photograph shows an output transformer where the modulation transformer should be since at the time the photograph was taken the unit was being used as a public address system.) To the right rear is the power plug and just in front is the output plug. The jack on the front is for the single button carbon mike.

Looking at the photograph of the bottom view (Figure 21), we see the correct layout for C14 and the mike transformer (R1).

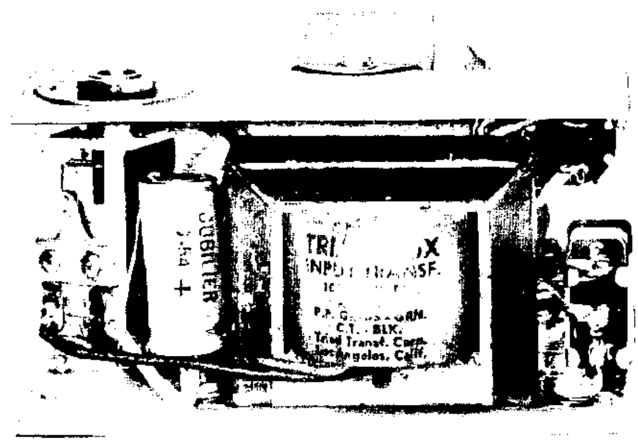


Figure 21. Modulator bottom view.

In the schematic diagram (Figure 19) it will be seen that the mike is in the cathode of V3. This eliminates the use of a mike battery with its replacement problems. However, a 22½ volt battery is used for grid bias, but the life of the battery is practically equal to its shelf life as no grid current is drawn since V3 is operated class AB1. T1 is a very high gain type in order to supply the necessary grid to grid voltage.

The modulator is built on the cover of a Premier PMC-1002 miniature aluminum case 4" x 2⅛" x 1⅝". The mike jack is a closed circuit type in order to prevent the voltage across C14 from exceeding its voltage rating when the mike is removed from the jack. Since there is no mike battery the mike may be left in the jack at all times.

For mobile use the 200 volt at 60 to 70 mA for the modulator may be obtained from the car receiver by inserting a S.P.D.T. toggle switch in the b+ lead of the receiver.

Parts List

C1	47 μμf tubular ceramic erie
C2, C3	8 μμf butterfly Johnson 9MB11
C4	32 μμf variable Johnson 30M8
C5	27 μμf tubular ceramic erie
C6 - C13	0.001 μf tubular ceramic centralab
C14	100 μf 6 volt electrolytic C.D. #BBR100-6
R1, R2	100 K ½ watt ohmite
R3	10 K ½ watt ohmite
R4, R5, R6	33 K ½ watt ohmite
R7	12 K ½ watt ohmite
RFC1	ohmite Z50 RF choke
RFC2	ohmite Z144 RF choke
T1	High gain carbon mike trans. Triad A-5X
T2	Multi-Tap modulation trans. Stancore A-3891
V1, V2, V3	Amperex 6360
Xtal	48.666 Mc international
Bat.	22½ volt Eveready #412
L1	9½ turns #20 enam. wire on National XR91 coil form
L2	2½ turns B&W #3003 tapped at center
L3	4 turns B&W #3003 ½" spacing at center
L4	2 turns B&W #3003