EIMAC
TRANSMITTING TUBES

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MANUFACTURED BY

EITEL-McCULLOUGH, INC.
SAN BRUNO, CALIFORNIA
U. S. A.

PRICE 10 CENTS

EIMAC TRANSMITTING TUBES

EIMAC transmitting tubes are the biggest forward step in design and performance in the field of radiation cooled vacuum tubes made in over a decade. Obvious mechanical and electrical weaknesses have been permanently eliminated and several features have been added that have created a new standard of safety in tubes of this type. EIMAC tubes employ an entirely new type of construction, the advantages of which are at once apparent to the most casual observer. Tubes of this caliber can only be produced by highly skilled artisans and specially designed equipment. The use of tantalum, a very costly material, has permitted EIMAC to permanently guarantee their products from ever turning gassy due to momentary overloads. While the mechanical superiority is obvious the electrical features are just as remarkable. The oversize filament made from special non-sag thoriated tungsten is the heart of the EIMAC tube. As practically all other causes for failure have been eliminated the life of the EIMAC tube is dependent primarily on the life of the filament. The filament, when operated at normal rating, has sufficient reserve to ensure extremely long life.

The importance of low inter-electrode capacities has long been recognized and this feature cannot be too highly stressed. EIMAC tubes have the lowest inter-electrode capacities of any tubes available today at anywhere near equal power ratings or capabilities.

The vertical bar grid of scientific design is the key to the exceptional performance of which EIMAC tubes are capable. The low amount of driving power required in the grid circuit of an EIMAC tube is the result of a grid design which does not pull excessive grid currents even when highly positive. The grid is fabricated of degassed tantalum so will not cause a tube failure if accidentally overloaded. Peak efficiencies of the most carefully designed tank circuits are often impaired by tubes with extremely high resistance joints caused by the use of materials to which it is impossible to weld. The use of small internal leads offer very high resistance at radio frequencies and may often burn up due to heat generated by high circulating currents. These faults have been eliminated in EIMAC tubes by the use of heavy internal leads and spot welding. Glass, when heated above a certain point, will give off gas. It is for this reason that all EIMAC tubes have glass bulbs of oversize proportions, thus the amount of heat radiated per unit area is small. As a further aid in keeping the glass cool, foreign matter is prevented from collecting on the interior of the bulb. This allows maximum radiation to take place. Interior discoloration of the bulb is caused either by dirt vaporized from the electrodes during exhaust or by the chemical agency or "getter" necessary to obtain a satisfactory vacuum when materials other than tantalum are used. By the complete elimination of all dirt and chemical "getter" it is possible to make EIMAC tubes spotlessly clean.

EIMAC tubes are extremely uniform in characteristics and for this reason no special matching is necessary in order to obtain optimum results when operated in push-pull or parallel. The low cost of EIMAC tubes is made possible only by the extremely efficient manufacturing facilities and by operating on a low margin of profit. We believe that EIMAC tubes are the finest tubes available today, regardless of price.

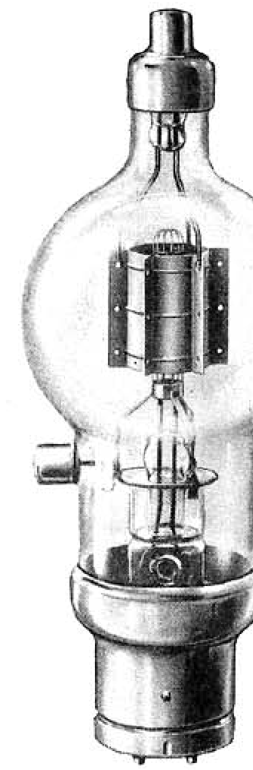
"Compare and Reflect"

TANTALUM

TANTALUM is a semi-rare metal that possesses characteristics that make it ideally suited for use in the manufacture of vacuum tubes. Tantalum, next to tungsten, has the highest melting point of any of the metals. Tantalum, unlike tungsten, is soft and readily formed and welded. The fact that tantalum can be welded makes it possible to fabricate vacuum tubes with solid joints, thus permitting the use of low resistance contacts so important in efficient high frequency work. Tantalum has an extremely low vapor pressure, permitting tantalum electrodes, when properly cleaned, to be operated at incandescency during exhaust for long periods of time without darkening the glass envelope. The unusual property, found only in tantalum, of liberating all the absorbed gases almost immediately permits the complete evacuation of the vacuum tube. The complete removal of all the gas within the tube makes it unnecessary and undesirable to use any chemical process to obtain a suitable vacuum. While tantalum gives up absorbed gas more readily than any other material at incandescency, it in exactly the reverse manner will absorb gas at any temperature less than a bright red heat. This ensures complete freedom from gas throughout the life of the tube. The high cost of tantalum has been the reason that tantalum has not been more universally accepted as an electrode material for vacuum tubes.

EIMAC 150T

THE EIMAC 150T is a medium powered radiation cooled triode. The characteristics were chosen so that optimum efficiencies could be realized at both radio and audio frequencies. The extremely low inter-electrode capacities and low resistance leads permit high outputs at high radio frequencies. The complete elimination of internal insulators and the use of tantalum as the material of which the electrodes are fabricated permits the complete evacuation of the EIMAC 150T. Extremely long tube life and complete freedom of gas caused by overloads are the result of the severe exhaust each EIMAC 150T undergoes. In order to secure ample insulation and to reduce the inter-electrode capacities the plate lead is brought out the top of the envelope and the grid lead out the side. The low values of grid current necessary for optimum excitation means the grid driver requirements are a minimum for the EIMAC 150T. Long tube life is assured by the rugged "oversize" thoriated tungsten filament of a special self-supported construction.



EIMAC 150T

EIMAC 150T CHARACTERISTICS AND RATINGS:

Filament Voltage (A.C.)	5 to 5.25 volts
Filament Current (approximate)	10 amperes
Amplification Factor (average)	13
Grid-Plate Capacitance	3.5 mmfds
Grid-Filament Capacitance	3.0 mmfds
Plate-Filament Capacitance	.5 mmfds
Bulb	GT 30 Nonex
Base	Standard 50 watt
Overall Height	10 inches
Maximum Diameter	3¾ inches

Maximum Rating for All Types of Service on Frequencies Less Than 40 Megacycles

Maximum Plate Voltage	3000 volts
Maximum Plate Current	.200 amperes
Maximum Grid Current	.050 amperes
Maximum Plate Dissipation	150 watts

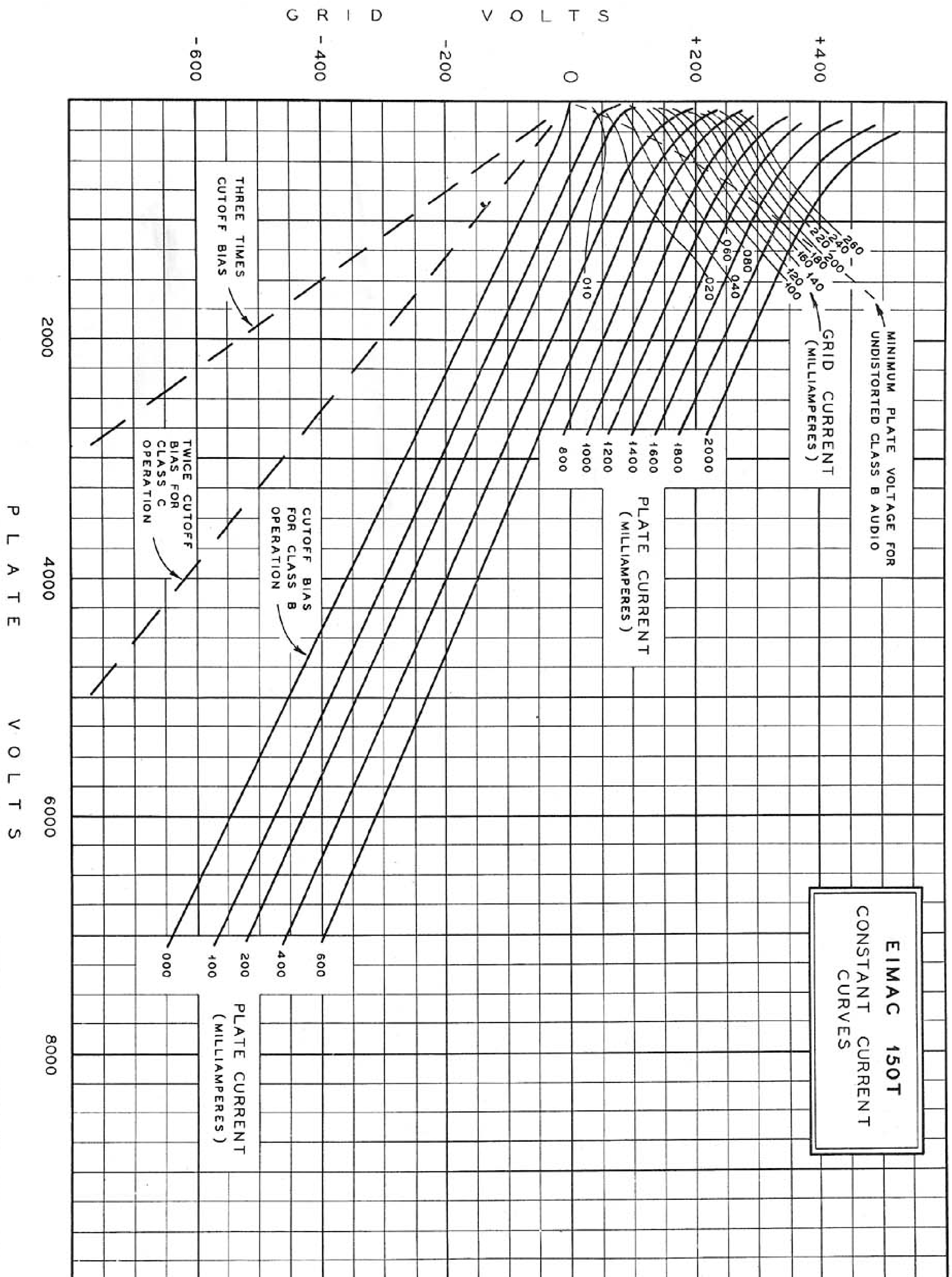
The following results can be realized under optimum circuit conditions and are suitable for 100% plate modulation.

Plate Voltage	1000	2000	3000
Plate Current (amperes)	.200	.200	.200
Grid Current (DC amperes)	.035	.035	.035
Grid Bias Voltage	—200	—400	—600
Power Output (watts) (75% eff.)	150	300	450

At voltages above 1500 volts we find that the carrier power outputs of all types of efficiency modulation when using the EIMAC 150T is dependent upon the available plate dissipation. Efficiencies of 33% for the class "B" linear amplifier and efficiencies of from 22% to 35% for the bias modulation systems are considered as maximum if linear 100% modulation is to be expected.

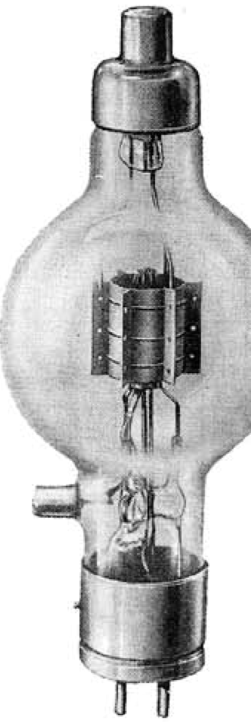
Class "B" audio characteristic can be obtained directly from the accompanying charts.

A class "B" linear amplifier following a controlled carrier modulated stage is capable of giving equivalent carrier condition of approximately two-thirds the class "B" audio power observed from the charts at the plate voltages employed.


EIMAC 150T
CONSTANT CURRENT CURVES
GRID VOLTS
-600
-400
-200
0
+200
+400
PLATE VOLTS
2000
4000
6000
8000
PLATE CURRENT (MILLIAMPERES)
000
100
200
400
600
800
1000
1200
1400
1600
1800
2000
GRID CURRENT (MILLIAMPERES)
010
020
040
060
080
100
120
140
160
180
200
220
240
260
MINIMUM PLATE VOLTAGE FOR UNDISTORTED CLASS B AUDIO
THREE TIMES CUTOFF BIAS
TWICE CUTOFF BIAS FOR CLASS C OPERATION
CUTOFF BIAS FOR CLASS B OPERATION

EIMAC 50T

THE EIMAC 50T is a small version of the EIMAC 150T and embodies all the important constructional features of the bigger tube. The EIMAC 50T will give excellent results as an oscillator, or as a Radio Frequency amplifier. The EIMAC 50T is also capable of giving high power outputs when used as a Class "B" audio amplifier. The EIMAC 50T has the lowest inter-electrode capacities of any vacuum tube at any where near equal power ratings. The plate lead is brought out the top of the envelope with the grid lead out the side. The heavy leads, coupled with the rugged filament, offers a low resistance path to high frequency currents. All these constructional features have resulted in a tube ideally suited for use at the ultra high frequencies.



EIMAC 50T

EIMAC 50T CHARACTERISTICS AND RATINGS:

Filament Voltage (A.C.)	5 to 5.25 volts
Filament Current (approximate)	6 amperes
Amplification Factor (average)	12
Grid-Plate Capacitance	2 mmfds
Grid-Filament Capacitance	2 mmfds
Plate-Filament Capacitance	.4 mmfds
Bulb	GT 25 Nonex
Base	UX 4 Pin
Overall Height	7½ inches
Maximum Diameter	3⅛ inches

Maximum Ratings for All Types of Service on Frequencies Less than 56 Megacycles

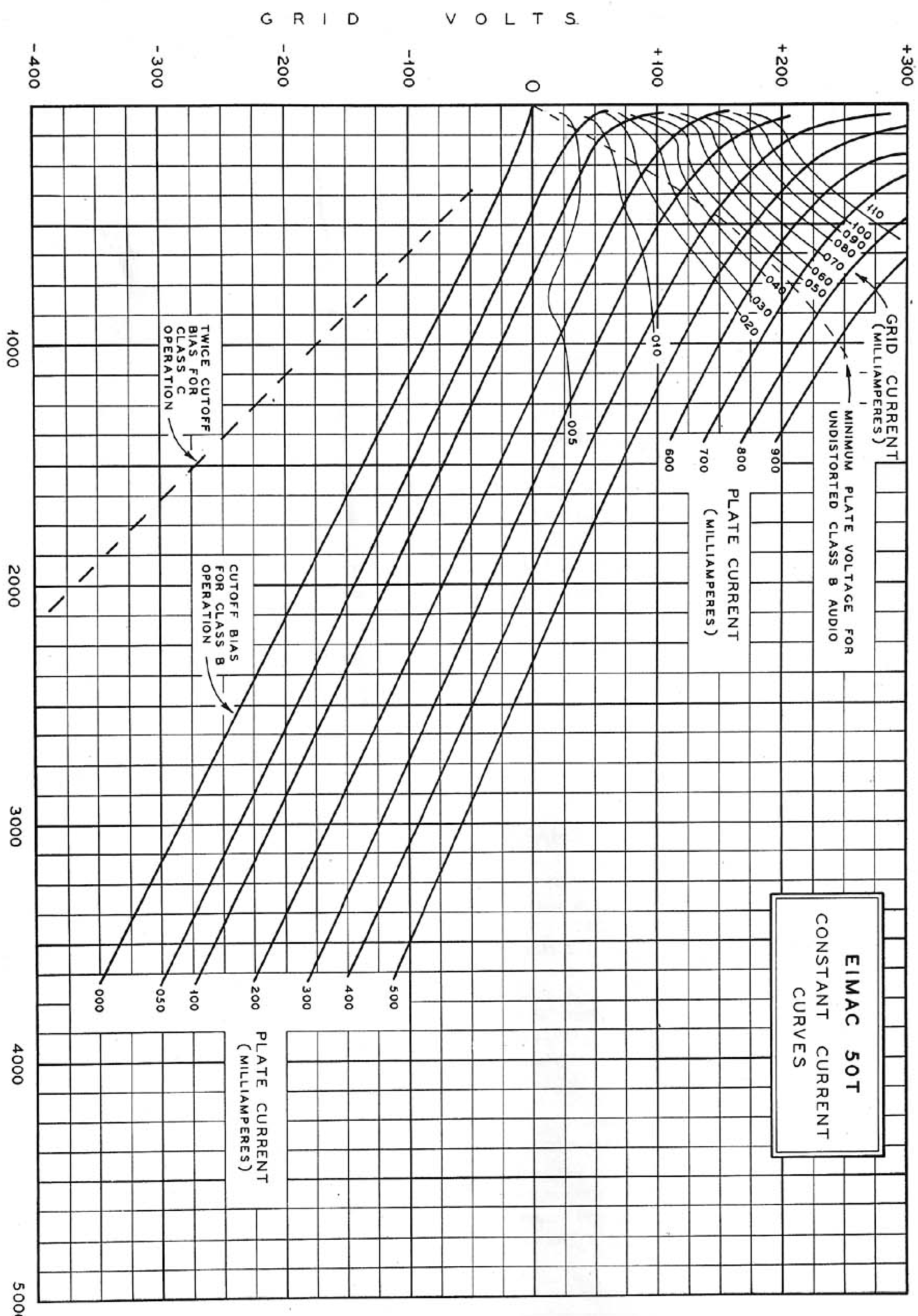
Maximum Plate Voltage	3000 volts
Maximum Plate Current	.100 amperes
Maximum Grid Current	.030 amperes
Maximum Plate Dissipation	50 watts

The following results can be realized under optimum circuit conditions and are suitable for 100% plate modulation.

Plate Voltage	1000	2000	3000
Plate Current (amperes)	.100	.100	.100
Grid Current (DC amperes)	.025	.025	.025
Grid Bias Voltage	—200	—400	—600
Power Output (75% eff.) (watts)	75	150	250

At plate voltages above 1000 volts we find that the carrier power outputs for all types of efficiency modulation when using the EIMAC 50T is dependent upon the available plate dissipation. Efficiencies of 33% for the class "B" linear amplifier and efficiencies of from 22% to 35% for the bias modulation systems are considered as maximum if linear 100% modulation is to be expected.

Class "B" audio characteristics can be obtained directly from the following charts.


EIMAC 50T
CONSTANT CURRENT
CURVES
GRID VOLTS
PLATE VOLTS
-400
-300
-200
-100
0
+100
+200
+300
1000
2000
3000
4000
5000
GRID CURRENT
(MILLIAMPERES)
110
100
090
080
070
060
050
040
030
020
010
005
MINIMUM PLATE VOLTAGE FOR
UNDISTORTED CLASS B AUDIO
PLATE CURRENT
(MILLIAMPERES)
900
800
700
600
500
400
300
200
100
050
000
TWICE CUTOFF
BIAS FOR
CLASS C
OPERATION
CUTOFF BIAS
FOR CLASS B
OPERATION

Use of Constant Current Charts

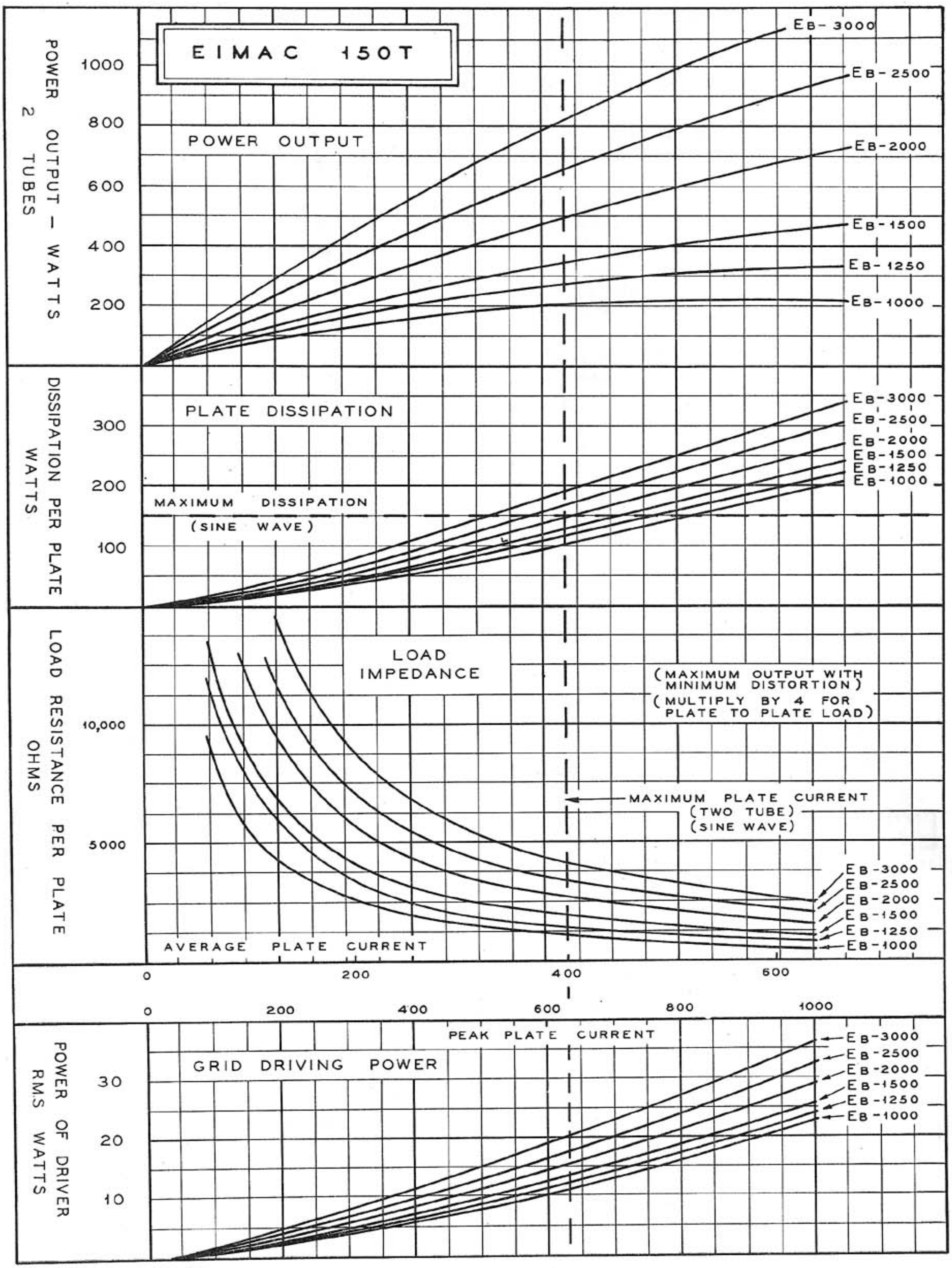
THESE extremely useful charts were first suggested by Mouromsteff and Kozanowski, both of Westinghouse. Heretofore curves showing the performance of a vacuum tube were extremely hard to analyze because they did not lend themselves readily to graphical interpretation. Only by employing a mathematical analysis was it possible to use the older types of graphs in predicting the power capabilities of a vacuum tube.

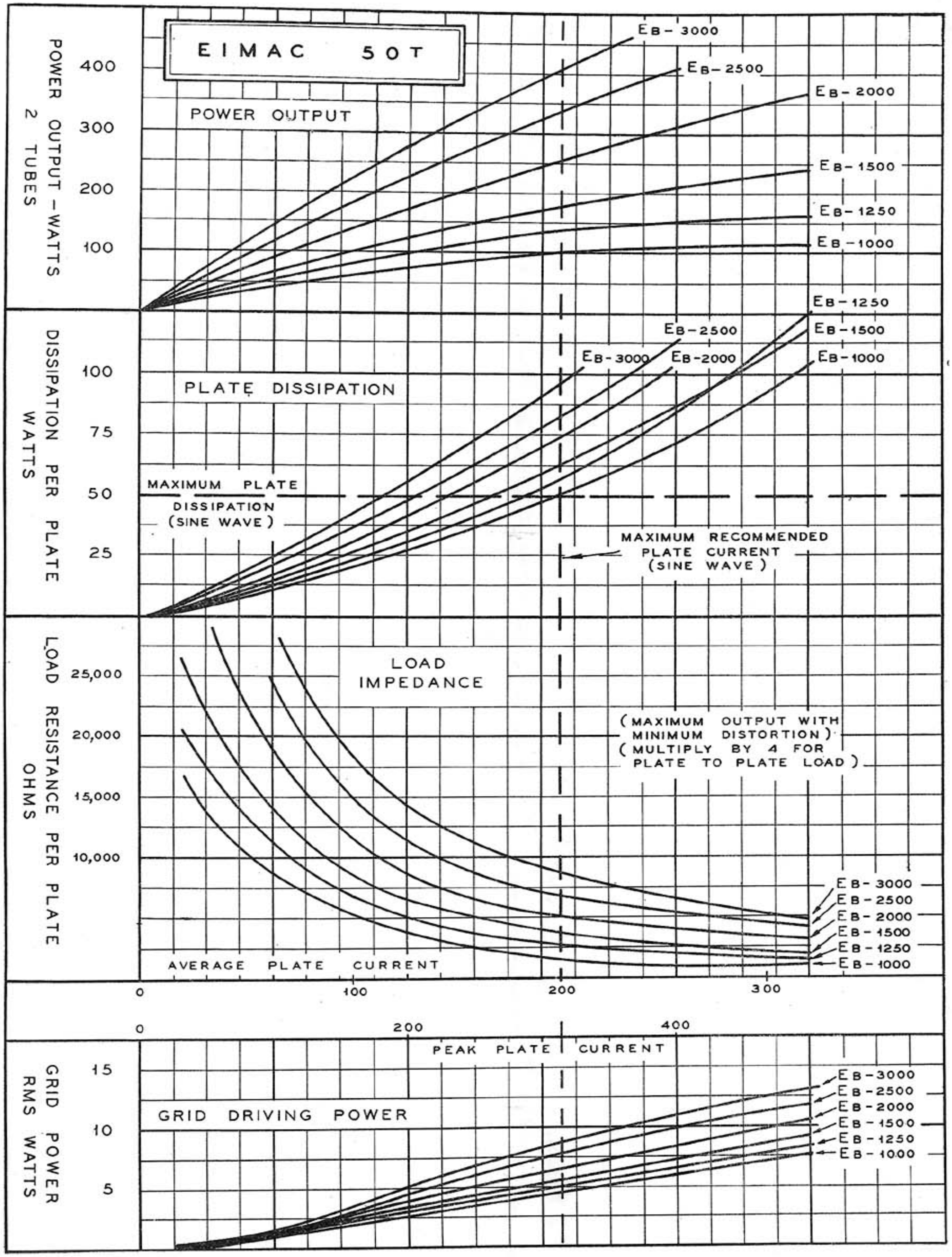
The constant current chart relates the grid voltage and grid current with the plate voltage and plate current in such a manner that it is quite simple to determine the plate power input, power output, grid voltage swing, grid current, average plate current and the value of load impedance. These values can be determined graphically by extending a line from the operating point to the point where the maximum positive grid swing coincides with the minimum plate voltage. The operating point is determined by the bias chosen and the plate voltage. The minimum plate voltage is determined by how far the grid is allowed to swing positive and the value of load impedance. It is possible to predetermine the maximum grid swing, minimum plate voltage point and thus graphically find the other unknown values.

Bias for class "B" operation (cut-off) is given approximately by observing the zero current line. For predicting the grid current and for determining the plate current when the tube is biased beyond cut-off it is necessary to integrate the values of currents over a complete half cycle. To facilitate the computing of these values of current a scale graduated in the sines of the angle from zero to ninety degrees is helpful. The complete discussion on the use of constant current curves is given by Mouromsteff and Kozanowski in the July issue of the Proceedings of the Institute of Radio Engineers. We believe this type of curve will be used universally within a short time as its many advantages are obvious.

Use of Class "B" Audio Curves

THE accompanying Class "B" audio charts show the power output for two tubes, the plate loss per tube, the proper load impedance per tube (multiply by four for two tubes), and the RMS watts consumed by the two grids and the bias supply. The load impedances are such that the minimum plate voltages developed across the tubes are high enough to prevent distortion caused by the departure of the plate current from a true linear increase occasioned by the robbing of electrons by the highly positive grid. All values shown are based on a sine wave. Somewhat higher effective power outputs can be obtained if voice waveforms are employed as the average value of power in an audio wave of this type is considerably less than that contained in a sine wave. All values shown neglect losses occasioned by the input and output transformers. Somewhat higher values of grid driving power would be desirable to overcome input transformer losses and to allow some power to be dissipated in a ballast resistor. All the curves for each tube are drawn as a function of plate current. It will be noted that two values of plate currents are given, the average value being the value read on a milliammeter, and the actual peak value. To use the chart it is simply necessary to place a straightedge following the vertical lines through each chart. Where the straightedge crosses the corresponding plate voltage line in each chart, the power output, the plate dissipation, the plate load and the RMS grid watts can be read directly from the points of intersection.


EIMAC 150T
POWER OUTPUT
POWER OUTPUT - WATTS 2 TUBES
1000
800
600
400
200
EB-3000
EB-2500
EB-2000
EB-1500
EB-1250
EB-1000
PLATE DISSIPATION
DISSIPATION PER PLATE WATTS
300
200
100
MAXIMUM DISSIPATION
(SINE WAVE)
LOAD IMPEDANCE
LOAD RESISTANCE PER PLATE OHMS
10,000
5000
(MAXIMUM OUTPUT WITH MINIMUM DISTORTION)
(MULTIPLY BY 4 FOR PLATE TO PLATE LOAD)
MAXIMUM PLATE CURRENT (TWO TUBE) (SINE WAVE)
AVERAGE PLATE CURRENT
0
200
400
600
0
200
400
600
800
1000
PEAK PLATE CURRENT
GRID DRIVING POWER
POWER OF DRIVER R.M.S WATTS
30
20
10


EIMAC 50T
POWER OUTPUT
POWER OUTPUT — WATTS 2 TUBES
400
300
200
100
EB - 3000
EB - 2500
EB - 2000
EB - 1500
EB - 1250
EB - 1000
PLATE DISSIPATION
DISSIPATION PER PLATE WATTS
100
75
50
25
MAXIMUM PLATE DISSIPATION (SINE WAVE)
MAXIMUM RECOMMENDED PLATE CURRENT (SINE WAVE)
LOAD IMPEDANCE
LOAD RESISTANCE PER PLATE OHMS
25,000
20,000
15,000
10,000
(MAXIMUM OUTPUT WITH MINIMUM DISTORTION)
(MULTIPLY BY 4 FOR PLATE TO PLATE LOAD)
AVERAGE PLATE CURRENT
0
100
200
300
0
200
400
PEAK PLATE CURRENT
GRID DRIVING POWER
GRID POWER RMS WATTS
15
10
5

Some Considerations in the Design of a Radio Frequency Amplifier

IN PRACTICALLY every instance the users of EIMAC tubes will wish to realize optimum efficiencies from the circuits in which these tubes are employed. Without going too deeply into the technical considerations we are setting forth a few suggestions that have proven helpful in many instances. The radio frequency amplifier can be divided into four parts for the convenience of illustration and discussion. 1. The grid circuit. 2. The plate circuit. 3. Neutralizing. 4. Antenna coupling.

THE GRID CIRCUIT:

The grid circuit is the control circuit. Very seldom does the stage furnishing the excitation supply an overabundance of power. In order that we do not waste too much power in the transfer from the plate circuit of the driver to the grid circuit of the amplifier it is important that some consideration be given to the losses that may occur in the grid circuit. An independently tuned grid circuit coupled to the driver with a low impedance line is the most efficient method of power transfer. By the proper matching of the low impedance line to both the driver tank and the grid tank we find that it is possible for the grid circuit to assume the maximum voltage swing permissible by the supplied power regardless of the plate voltage of the driver stage. The use of a low impedance line prevents capacity transfer back to the driver and permits complete neutralization within the amplifier. The grid circuit tank condenser may have to withstand considerable voltage if the excitation power and bias voltage on the amplifier is high. In all but the most extreme cases a double spaced transmitting condenser will prove adequate. The condenser would preferably be split stator as it lends itself well to both push-pull amplifiers, if two tubes are used, or to grid neutralizing when only one tube is used. If a split-stator plate condenser is employed with a single tube the grid condenser can be single ended. The grid coil should be designed with an idea towards efficiency so that it should not be too small or wound with too fine wire. The grid return for the bias should be tapped on the center of the coil if a split-stator arrangement is used, or to the "cold" end of the coil if a single section condenser is employed. The use of an RF choke at either point is questionable as the chokes now available usually have similar characteristics and if a choke is employed in the plate circuit there is a possibility that the two chokes will resonate with each other, causing parasitic oscillations at low radio frequencies. In order that the grid circuit be properly adjusted it is absolutely necessary that a meter be employed either permanently or temporarily in order to determine the value of grid current and to properly adjust the circuit for maximum efficiencies. The grid circuit should always be adjusted for maximum grid current.

THE PLATE CIRCUIT:

The design of the plate circuit is probably the most important one in the amplifier if optimum results are to be expected. Considerable confusion has existed regarding the proper choice of capacity for the amplifier plate tank condenser. There apparently has been two distinct schools of thought, one leaning toward extremely low capacities while the other leans just as far in the opposite direction. Any tank circuit, regardless of the inductance capacity ratio, would have infinite "Q" at resonance providing there was no reresistance in the circuit. Where there is a finite value of resistance in the circuit it is found that the circuit with the least capacity will have the highest "Q" when unloaded because the loss occasioned by the tank circuit resistance is a function of the circulating current. When we couple useful resistance into the tank circuit we find that the low capacity tank circuit loses its "Q" at a faster rate than the high capacity circuit. If the coupling is carried beyond a certain point we find that the high capacity circuit would probably have more "Q" than the low capacity circuit. It has been determined that for optimum conditions of performance the value of "Q" should not go below a certain minimum. The "Q" of the tank circuit should be higher for phone operation than for telegraphy work. We note that for every value of plate load there is a certain minimum capacity that it is undesirable to go below. In order that the same capacity-inductance ratio be maintained we find that the size of the capacity varies directly with frequency. If we maintain a constant plate current it will be found that as we raise the plate voltage the value of coupled resistance becomes higher making it possible to use a smaller size tuning capacity. Summarizing, we find that the optimum value of capacity is determined by load, frequency, plate voltage and type of service. It is also undesirable to make the capacity any larger than necessary as excessive circuit losses will result due to the high value of circulating current. This type of loss makes itself apparent by excessive heating of the tank circuit.

The tank coil should be of low loss construction. Tubes operating at high plate voltages and lightly loaded require low values of tuning capacities so that losses occasioned by circulating currents are low. The low values of circulating currents makes the use of small sizes of copper tubing or even of No. 10 wire highly desirable as losses occasioned by distributed capacities are less with resulting higher overall efficiencies. It is desirable that the tank coil fasten directly to the tank condenser. If it is impractical to do this, make the connecting leads between the coil and condenser as short and as heavy as possible. The dimensions of the coil should be reasonably large with approximately four inches as a minimum diameter in order to obtain the highest efficiencies.

NEUTRALIZING

The comparatively low values of capacities that are used with tubes operating at high plate voltages and lightly loaded, makes the tank circuit susceptible to outside influences. When operating a vacuum tube under such conditions it is absolutely imperative that neutralizing be accomplished in such a manner that practically the same values of capacity and inductance be present in the neutralizing branch as in the branch to be neutralized. To realize such a condition it is important that the node for the circuit to be neutralized occur at the electrical center. There are two schemes for neutralization which are in general use. One employs a split-stator condenser in the plate circuit. The electrical center is formed by the symmetrical capacity to ground realized by the use of a split-stator condenser. Neutralizing voltage is fed from one end of the plate tank coil to the grid of the tube through the neutralizing condenser. The grid condenser can be single ended. The second method uses a split-stator condenser in the grid circuit with the electrical center formed by the condenser. Neutralizing voltage is fed from the opposite end of the grid tank to the plate of the tube through the neutralizing capacity. When tubes are operated in push-pull a combination of the two systems is employed. In all cases where care has been taken to make everything symmetrical and the leads to the capacities short, it will be found that the capacity of the neutralizing condenser is approximately equal to the tube capacity. It is important to note that the minimum capacity of the split-stator condenser to ground should be three to four times the capacity of the connected tube electrode to ground, in order that the condenser will have sufficient capacity to determine the electrical center of the circuit.

ANTENNA COUPLING

In order to operate an amplifier at its maximum efficiency it is important that the tank circuit, when tuned to resonance, represent a pure resistance into which the vacuum tube is to work. Standing waves on the transmission line will result in a change in power factor of the tank circuit with the resulting increase of tube dissipation. Unless the standing waves are completely eliminated it is imperative that some sort of "buffer" arrangement be used between the tank circuit and the antenna. The "buffer" should consist of an impedance matching network which will correct the errors in the transmission line and reflect a pure resistance into the tank circuit. The proper loading of both sides of a push-pull tank circuit is another important consideration. Coupling to a two-wire transmission line should be effected symmetrically around the electrical center of the tank coil. If only a single wire feed is used with a push-pull amplifier a low impedance line should couple the plate tank to a second tank to which the single wire feeder is connected. This second tank will allow the proper impedance matching as well as tend to eliminate undesirable harmonics.

TYPES OF AMPLIFIERS

All the above considerations hold for all types of amplifiers regardless of their use. We find the real differentiation between the various amplifiers is in the amount of bias employed and the available excitation power. Different amounts of bias alter the performances to such an extent that the amplifier classifications are designated in terms of ratios of plate voltage to bias voltage. A class "B" amplifier is one in which the plate current is reduced practically to zero by the bias. This amplifier gives the maximum power gain with limited excitation powers. Over a good portion of the cycle the plate current varies directly with the grid voltage so that this is the type of amplification used in radio frequency linear amplifiers where modulation has been effected in some low level stage.

A class "C" amplifier is one that is biased beyond the plate current cut-off point and is noted for the somewhat higher plate efficiencies obtained. Somewhat greater grid driving power is necessary so that the power gain is less with this type of amplifier. Where modulation is effected in the plate circuit of the amplifier the bias voltage should be great enough so that a condition of twice plate current cut-off is noted if 100 per cent modulation is expected.

TUNING

The grid circuit should be tuned to maximum grid current. The plate circuit should be tuned to resonance with plate voltage off by noting the maximum deflection of the RF meter used for neutralizing. The neutralizing condenser should be adjusted until the RF meter shows minimum deflection. The plate tank circuit should then be readjusted until the RF meter shows maximum deflection. After this procedure has been repeated a few times it will be found that there is practically no indication on the RF meter regardless of the tuning of the plate tank circuit. This point is the point of neutralization. A flashlight bulb can be substituted for the RF meter but will not permit as accurate adjustment of the neutralizing. When neutralizing is complete we can apply the plate voltage. As the tank condenser is brought through resonance we will find the plate current will drop to a low minimum value. If the precautions noted in the description of the amplifier are observed the minimum plate current value should be between 10 and 20 milliamperes.

If the minimum plate current is above these values there apparently is something amiss as some factor is limiting the value of no load impedance of the tank circuit. If maximum plate efficiencies are to be realized it is important that the no load plate current be extremely low. If optimum grid current is flowing through twice cut-off bias, and the above precautions have been observed, no difficulty should be experienced in coupling sufficiently to obtain maximum rated plate currents. Plate efficiencies at the higher plate voltages will be in excess of 75 per cent. If less than optimum grid current is available it is advisable to reduce the value of grid bias until optimum current again flows. If excitation is insufficient it will be found impossible to couple up to the point of maximum plate current without excessive heating of the tube or even an actual falling off in power output. A juggling of antenna coupling and bias will result in a point of maximum power output with this limited amount of excitation. If excitation is insufficient to produce optimum grid currents, do not reduce the value below cut-off as this is the point of maximum power gain. Power inputs are limited by plate dissipation and plate current ratings. If the plate dissipation is low and maximum plate current ratings have been reached, additional power input should only be accomplished by raising the plate voltage, never by increasing the plate current above its maximum rating, if maximum tube life is to be realized.

Minimum Plate Tuning Capacities to be Used with a Single Tube, Grid Neutralized

Frequency	Plate Voltage	Plate Current	Minimum Capacity
1,750 KC	1500 volts	.200 amperes	200 mmfd
1,750 KC	3000 volts	.200 amperes	100 mmfd
1,750 KC	1500 volts	.100 amperes	100 mmfd
1,750 KC	3000 volts	.100 amperes	50 mmfd
3,500 KC	1500 volts	.200 amperes	100 mmfd
3,500 KC	3000 volts	.200 amperes	50 mmfd
3,500 KC	1500 volts	.100 amperes	50 mmfd
3,500 KC	3000 volts	.100 amperes	25 mmfd
7,000 KC	1500 volts	.200 amperes	50 mmfd
7,000 KC	3000 volts	.200 amperes	25 mmfd
7,000 KC	1500 volts	.100 amperes	25 mmfd
7,000 KC	3000 volts	.100 amperes	12.5 mmfd
14,000 KC	1500 volts	.200 amperes	25 mmfd
14,000 KC	3000 volts	.200 amperes	12.5 mmfd
14,000 KC	1500 volts	.100 amperes	12.5 mmfd
14,000 KC	3000 volts	.100 amperes	6.5 mmfd

Twice the above noted capacities should be employed for phone.

Three times the above capacities should be used for a self-excited oscillator.

When the plate current is doubled the capacity should be doubled. A single tube operating with a split stator plate neutralizing arrangement would use one-quarter the above capacities.

Two tubes in push-pull drawing twice the above noted plate current would use one-half the capacity shown.

The capacities given are minimum capacities. Smaller capacities than those shown will result in excessive harmonic radiation and poor full load efficiencies. Capacities 25% greater than those shown can be employed without a notable sacrifice in tank efficiencies. If the minimum plate current point and maximum power output point do not coincide when the tank circuit is tuned through resonance there is not sufficient capacity in the circuit. If the tank circuit becomes warm after a few minutes operation there is usually too much capacity in the circuit.

Recommended Spacings of Tank Condensers

Telegraphy D.C. Plate Voltage	Spacing	Plate Modulated Telephony D.C. Plate Voltage	Spacing
1000 volts	.070″	1000 volts	.125″
2000 volts	.200″	2000 volts	.325″
3000 volts	.375″	3000 volts	.520″

The above spacings are between adjacent rotor and stator plates, The spacing of each section of a split-stator condenser should be the same as those given for a single section condenser as when a split-stator tank circuit arrangement is used the voltage developed across the tank circuit is twice that of a single ended arrangement. The spacings shown for telegraphy will hold for all types of efficiency modulation.