KENYON

Amateur Transmitter Manual

A MANUAL

of outstanding

XMTR CIRCUITS,

including

fourteen pages of KEN-O-GRAFS

and useful radio data

25c

Edited by
J. B. CARTER

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New York, N. Y.

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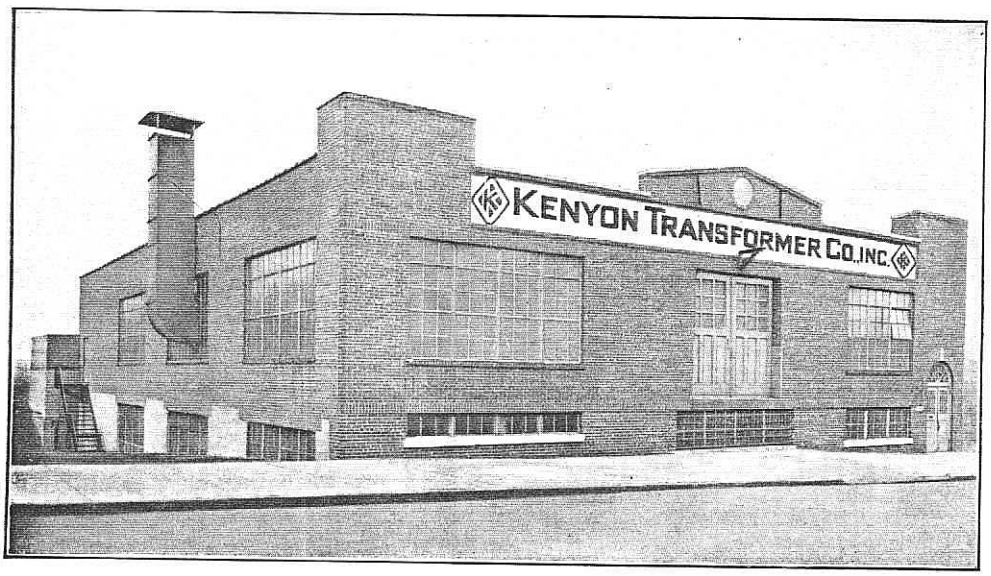
SIMONTRICE—NEW YORK

Amateur

Transmitting Manual



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KENYON TRANSFORMER CO., INC.

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New York, N. Y.

The Amateur's Code

I

The Amateur is Gentlemanly. He never knowingly uses the air for his own amusement in such a way as to lessen the pleasure of others. He abides by the pledges given by the A.R.R.L. in his behalf to the public and the Government.

II

The Amateur is Loyal. He owes his amateur radio to the American Radio Relay League, and he offers it his unswerving loyalty.

III

The Amateur is Progressive. He keeps his station abreast of science. It is built well and efficiently. His operating practice is clean and regular.

IV

The Amateur is Friendly. Slow and patient sending when requested, friendly advice and counsel to the beginner, kindly assistance and coöperation for the broadcast listener; these are marks of the amateur spirit.

V

The Amateur is Balanced. Radio is his hobby. He never allows it to interfere with any of the duties he owes to his home, his job, his school, or his community.

VI

The Amateur is Patriotic. His knowledge and his station are always ready for the service of his country and his community.

PREFACE

THIS manual has been prepared to serve a real and growing need among the amateur fraternity for a more practical transmitter manual than has heretofore been offered by existing publications.

On the following pages will be found what is probably the most carefully selected and comprehensive group of transmitting circuits ever compiled in a single book.

The various circuits were selected from among the most popular in use by thousands of amateurs all over the world. Every design shown herein is a thoroughly tested and proven circuit. While many of the circuits are comparatively new, the dependable "sure fire" circuits have also been included because for dollar value they cannot be surpassed even with the new crop of transmitting tubes.

Although some of the fundamental designs have appeared in other publications, a few modifications are included in the majority of these circuits which have resulted in greater efficiency without raising the cost of the components. By far the most prominent improvement is the use of the new triple winding plate transformer. This recent development by our laboratory staff not only improves voltage regulation but lowers the cost of the most expensive unit in the transmitter, namely—the power supply.

Another noteworthy innovation is the inclusion of fixed bias wherever possible without increasing the cost. This eliminates one of the most outstanding difficulties encountered in amateur radio. While many use batteries for this service, a careful check has shown that due to the back EMF from the various transmitter circuits, batteries have a somewhat varying voltage and a comparatively short life. However, the inclusion of fixed bias entirely eliminates this evil.

In the preparation of the text, theoretical discussions have been given little space as this is amply covered in existing "Handbooks" without which no station is complete. However, the pages devoted to graphical solutions of the many and varied problems are included with the realization that every amateur is not an electrical engineer.

The author desires to acknowledge his indebtedness to A.R.R.L., All Wave Radio and Radio News for loan of cuts and material used in the preparation of the manuscript. Grateful acknowledgment is also due to the large number of amateurs who offered their opinions and criticisms of the material needed to make this manual what the amateur wants.

It is fully realized that a book of this nature cannot hope to satisfy the entire amateur fraternity as many no doubt have their own ideas as to what constitutes a transmitting manual. We will therefore greatly appreciate criticisms of any sort including new material or new ideas of general interest which will permit a revision of this manual.

—J. B. C.

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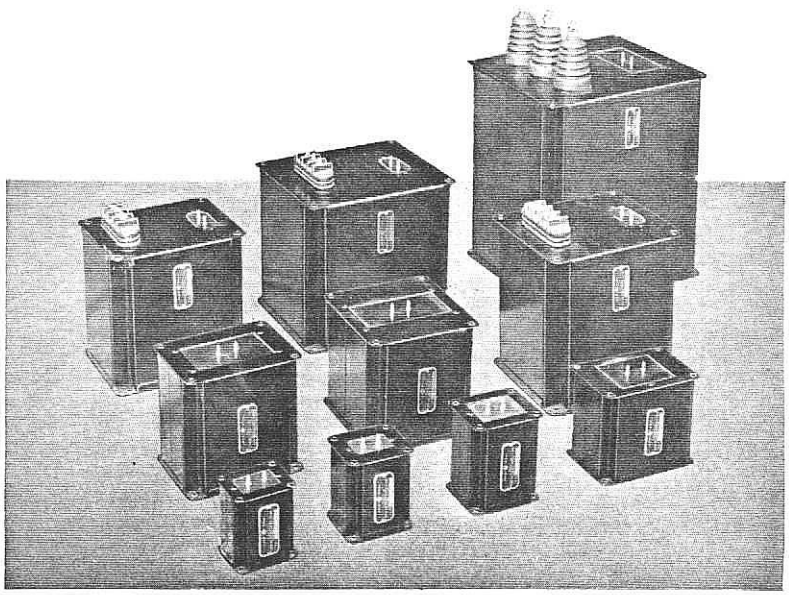
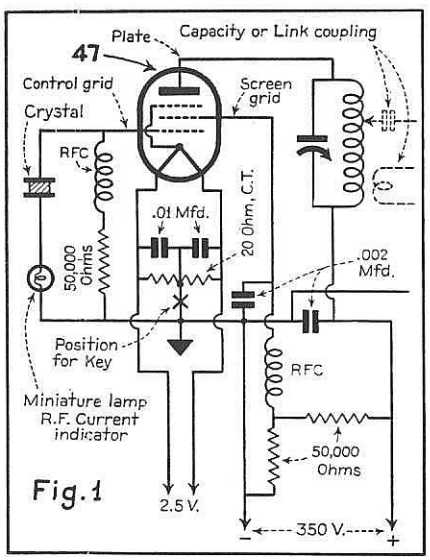


R-F OPERATION OF SCREEN-GRID TUBES

Notes on the Application of Tetrodes and Pentodes to Amateur Transmitters.

Screen-grid tubes are old in amateur practice as anyone who made use of the 865 at its introduction will testify. The general use of the screen-grid tube in the amateur transmitter did not become common, however, until the advantages of the 47 as a crystal oscillator were discovered, and the greatest step of all came with the introduction of suppressor-grid modulation to American amateurs by James Lamb in the early part of 1934. The tritet oscillator using a 59 had the advantages of a pentode screen-grid tube such as the 59. This had already been made known by Lamb and are important steps in the history of amateur transmitter development. Screen grid tubes of both the tetrode and pentode types were in common use in Europe before their introduction here and suppressor-grid modulation was first introduced there. The application of the tubes and this type of modulation to amateur radio can be credited to amateurs on this continent.

Tetrode tubes differ from triode types in that a grid known as a screen is inserted in the tube structure between the control grid and the plate. This grid, of relatively fine pitch in tubes used solely for R-F amplification, is normally by-passed to the filament or cathode so that the screen circuit contains no R-F impedance. Under these conditions the screen is an efficient electrostatic shield between the grid and plate



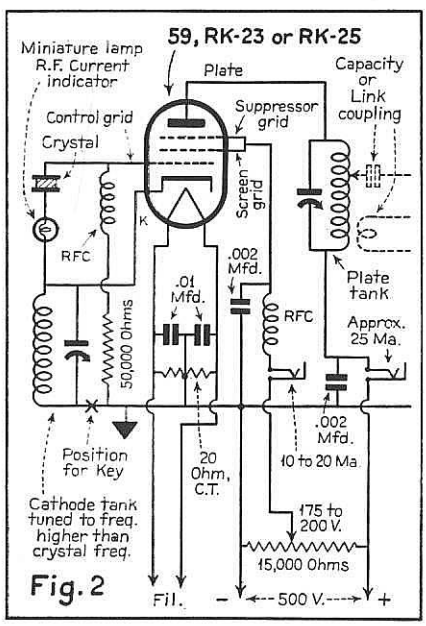
Simple Pentode Crystal Controlled Oscillator

and through the elimination of electrostatic lines of force from plate to grid, the control grid to plate capacitance is made a very small fraction of its value without the screen-grid. It has been pointed out in numerous texts that a tetrode with the screen by-passed so that it has no impedance in the external circuit is equivalent to a triode. An equivalent triode would be far beyond anything we now have along lines of conventional tube construction, however.

An examination of the family of plate-current curves for a tetrode (the old type 224 is a good example) will show that, for a fixed value of screen-grid voltage, there is little change in plate current after a plate voltage somewhat higher than the screen voltage is reached. Through the region where the plate voltage passes from a value less than the screen-grid voltage to a value above it a dip will be observed in the plate current curve for each value of control grid bias voltage.

Secondary Emission

This characteristic of the tetrode tube is caused by secondary emission from the plate surface and is made to serve a useful purpose in the dynatron oscillator. Under these conditions where the screen voltage is higher than the plate voltage, the electrons passing through the screen-grid to the plate dislodge electrons at the plate.



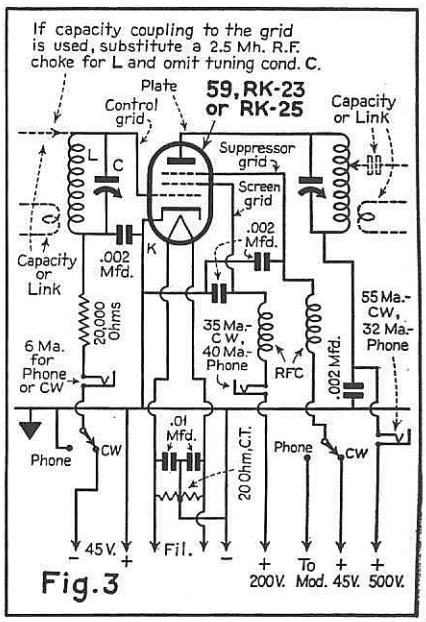
The Tritet Pentode Crystal Oscillator Current

These secondary electrons thus made free from the plate metal are more attracted by the screen than by the plate because of the higher screen-grid voltage. Therefore, the secondary electrons flow inward to the screen. In receivers, secondary emission cannot be tolerated. To eliminate this characteristic in tetrodes, those already designed were changed, principally by the substitution of carbonized nickel for bright nickel in the plate. As a result of this and other corrective changes, there are few tubes available today for dynatron oscillator use.

One very important advantage gained by the insertion of a screen-grid between the plate and control grid of a tube is an enormous gain in the voltage amplification of the tube. This applies to the tetrode as well as the pentode.

The Pentode

The pentode is the familiar tetrode with an additional grid placed between the screen-grid and the plate. This third grid is usually connected to the cathode, as in the 2A5, 41 and 42, or to the filament, as in the 47 or 33. The primary purpose of the third grid is to reduce secondary emission from the plate by placing a zero voltage barrier in front of the plate. The pitch of a suppressor-grid, as the third grid is called, is necessarily coarse to limit the effect of the grid on the flow of electrons



Low Power R-F Pentode Amplifier

from filament or cathode to the plate. In other words, the addition of the third grid at cathode potential does not greatly affect the plate resistance.

In suppressor-grid modulation, the possibility of changing the plate resistance over wide limits is used. The suppressor-grid, if by-passed to the cathode, or if connected directly to the cathode, aids the screen-grid in shielding the control grid from the plate and so makes a further reduction in the control grid to plate capacitance.

In a receiver, with the conditions strictly Class A, the control grid of a tetrode or pentode is never positive and in general remains slightly negative on signals which provide the widest grid swing. Here, the screen-grid current averages not more than 15% to 20% of the plate current. In oscillator or R-F amplifier service under Class C conditions where the control grid becomes positive for a fraction of a cycle the ratio of screen-grid current to plate current increases so that the screen current may be 50% or 60% as great as the plate current. In both of these cases, the screen-grid operates at a voltage from one-half to one-third the plate voltage.

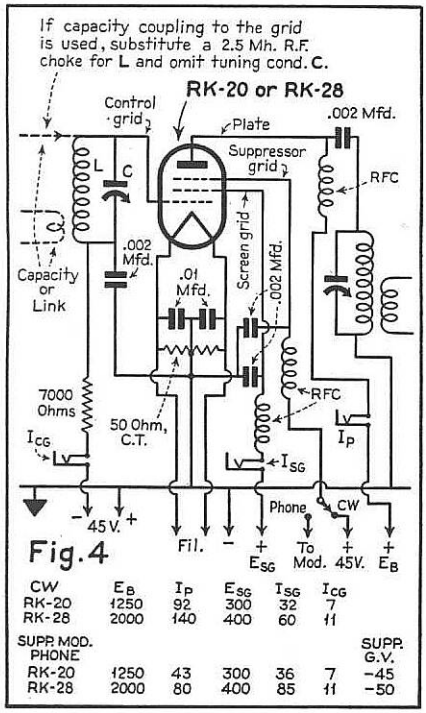


Fig.4

	E_B	I_P	E_{SG}	I_{SG}	I_{CG}	
CW						
RK-20	1250	92	300	32	7	
RK-28	2000	140	400	60	11	
SUPP. MOD. PHONE						SUPP. G.V.
RK-20	1250	43	300	36	7	-45
RK-28	2000	80	400	85	11	-50

Power R-F Pentode Amplifier

The discussion of the circuits shown can be limited because all of them are familiar to most amateurs and all have been shown from time to time in construction articles. It is hoped that the comments which follow may be of some value in the practical operation of the screen-grid tubes shown in the diagrams.

Straight 47 Crystal

Fig. 1 shows a type 47 pentode connected in the conventional straight crystal oscillator circuit. As indicated, the circuit is not adapted to doubling. A variation, used successfully over a long period of time by WIGBE has an additional plate tank tuned to twice the crystal frequency placed in series with the regular plate tank which, of course, tunes approximately to the crystal frequency. A tap from the plate end of the harmonic tank provides excitation at double frequency. It will be noted that a miniature lamp is shown connected directly in series with the crystal. This lamp, which can be a flashlight lamp or a dial lamp of the brown bead type (6V., 150 ma.) should be precalibrated by passing battery current through it and noting the brilliancy for steps of current in milliamperes up to approximately 100 ma.

When in circuit in series with the crystal, the lamp will provide a sufficiently accurate measure of R-F crystal current to warn against overloading. This arrangement has been used by many amateurs and the lamp resistance does not seem to affect crystal performance appreciably.

The Tritet

Fig. 2 shows the familiar Tritet circuit introduced by James Lamb. A great deal has been written about the Tritet and it stands out as an ideal arrangement among the circuits available for amateur use. If used as frequency-multiplying oscillator, the 59 works satisfactorily. Where operation as a straight oscillator is desired, with the plate tank tuned to approximately the crystal frequency, tubes having less grid-plate capacitance must be used. Such tubes were not available when the Tritet circuit was announced but they are today and are recommended over the 59 unless type 59 tubes tested for R-F output are available.

Of prime importance is the L/C ratio of the cathode tank circuit; the larger the capacity is made, the better the harmonic output. Most of the mediocre results are often traceable to failure to observe this important specification.

Trouble with this circuit can almost invariably be traced to a 59 tube which may be perfectly satisfactory in an audio circuit. The R-F losses due to getter material deposited on the stem, or even to the type of getter used may be responsible. It will be noted that the cathode is "hot" or carries an R-F potential. Across the cathode tuned circuit is the capacity between the heater and the cathode, but this amounts to only 4 to 5 micromicrofarads and is of little consequence. Heater-cathode leakage, if large, would affect operation and an inactive 59 should be checked for this defect.

It will be noted that a miniature lamp is shown in series with the crystal. Since the adjustment of the cathode tank circuit is

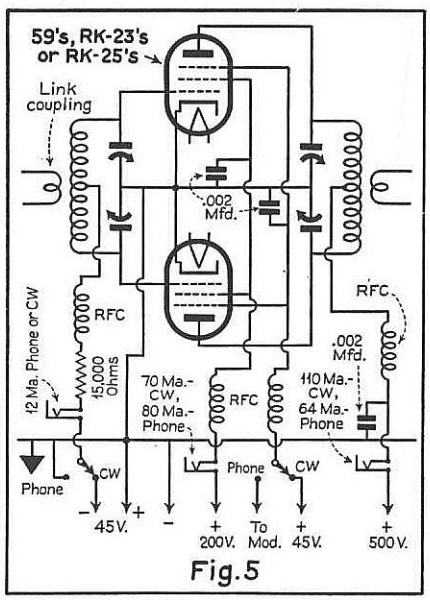


Fig.5

Push-Pull Low Power Pentode Amplifier

used to control excitation, it is highly desirable to have some knowledge of the crystal current and the lamp will be found helpful.

R-F Amplifiers

Figs. 3, 4, 5 and 6 show arrangements in which pentodes are used as R-F amplifiers. All of the tubes can be used as doublers but the 59 is not recommended for buffer service because of its relatively high grid plate capacitance.

The approximate values of current which should flow in each circuit are shown on the diagrams. The excitation should be sufficient to produce at least the current shown for the control grid circuit. With this excitation, the screen-grid current will have a value approximately as shown and it should be possible to loop the plate circuit to the current value indicated.

Over-excitation is fully as bad as under-excitation in a pentode used as an R-F amplifier. This is true because the screen-grid circuit contains no impedance to R-F and over-excitation increases the flow of screen current to values which cause overheating of the screen and the waste of considerable power. The most noticeable effect of over-excitation is a loss of power in the plate circuit due to the diverting of more than the proper share of the available filament or cathode electrons to the screen circuit. Thus, it may be seen that the screen grid current is a good indicator of proper excitation.

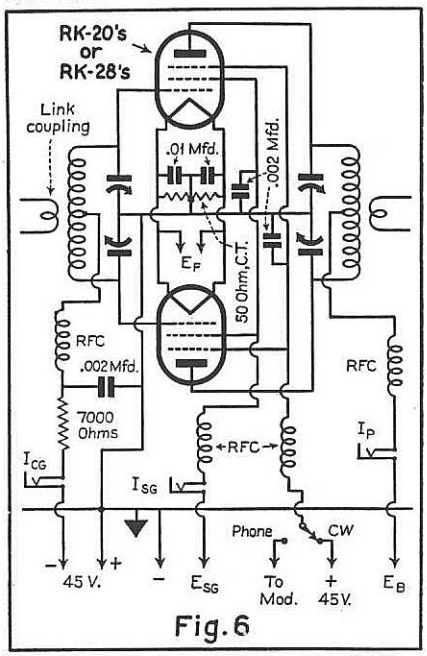


Fig.6

Push-Pull Power R-F Pentode. Values of Icg, Isg and Ip are twice corresponding current values shown in the Tables of Fig. 4. All voltages the same.

Biasing

In Figs. 3 and 5, a switch is shown in the control-grid return circuit arranged to connect the grid leak either to ground or phone or to 45 volts negative for CW. The purpose is to bring the plate and screen current to zero when the excitation is removed as in oscillator keying. Where the plate and screen voltage is cut off by the key, the grid leak can be connected direct to ground. Figs. 4 and 6, which show power arrangements, call for a fixed negative bias of 45 volts in addition to the bias developed across the grid leak. This is advisable since high voltages are used on the plate and loss of excitation would permit an undesirable high plate and screen current. While covering the subject of control-grid bias, it might be pointed out that the bias voltage required is determined by the

screen-grid voltage rather than the plate voltage. Practically all of the R-F pentodes now available to the amateur are so designed that the best control-grid bias is approximately 100 volts negative.

The coupling of the load to the plate circuit should be adjusted so that a noticeable dip occurs when the plate tuning condenser is adjusted through resonance. If the control-grid current and screen-grid current values are about as shown in the diagrams, indicating ample excitation, and the plate current fails to dip when the tank circuit is tuned through resonance, the load coupling is too tight. Loosening the plate load coupling together with retuning the plate tank will provide higher-R-F output at a lower plate current.

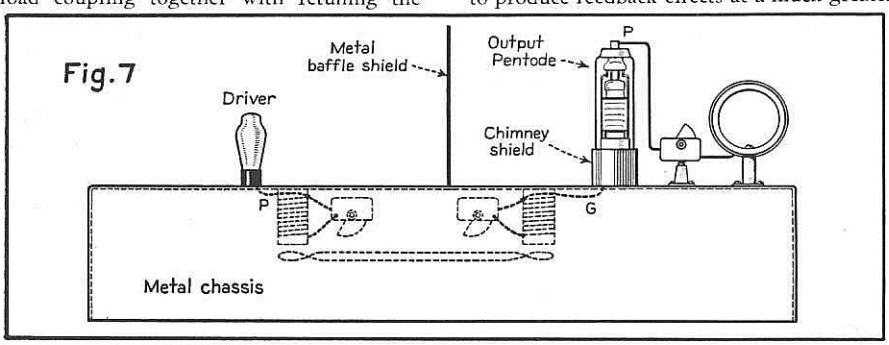
Shielding

Fig. 7 shows one desirable way to shield the input circuit of a pentode from the output circuit. With either link or capacity coupling, the plate circuit of the driver stage must be considered *a part of the input circuit of the following stage*. Therefore, the plate tank of the driver should be shielded from the field around the plate of a power pentode. This electrostatic field surrounding the plate is strong enough to light a neon lamp within three inches and to produce feedback effects at a much greater distance. The higher the operating frequency, the stronger this coupling effect becomes.

The collar surrounding the lower part of the tube and extending up to the lower internal shield should clear the bulk wall by at least one-sixteenth inch. No shielding of any kind should be placed close to the plate or at the plate end of the tube. Close shielding at these points would interfere with heat radiation and might cause destruction of the tube if a flashover from plate to shield should occur.

While the baffle shield shown in Fig. 7 may not be required on frequencies below 15 megacycles, such a shield would be of value at ten meters.

The by-pass condensers and R-F chokes associated with the screen-grid and supressor circuits should be mounted at the tube socket.



Pentode Amplifier Shielding

Oscillation Troubles

In closing this discussion of screen-grid tube circuits it might be well to suggest that suppressor grid modulation is difficult to control at frequencies above 30 megacycles and is not recommended above this frequency. Also, oscillation trouble can almost always be traced to poor shielding, insufficient control-grid bias, defective R-F chokes, or the use of electrolytic or paper by-pass condensers instead of mica.

IMPROVING MODULATION IN TRANSMITTERS

In plate or Heising modulation the modulator and the modulated amplifier is the heart of the transmitter and their adjustments are quite critical.

If the modulator is to operate as a class A tube, the plate current should be midway between that obtained by zero and cut-off bias. The tubes most suitable for use as class A modulators are those having large undistorted power output. They generally have low plate impedance and low amplification factor. When operated as class A the output wave will have the same shape as the input wave and must be able to supply a 50 per cent increase in the transmitter output power if 100 per cent modulation is desired.

The modulated tube is usually worked as a class C amplifier and the bias must be approximately twice that required to give cut-off bias and plate current saturation must be supplied by the excitation from the preceding stage. Class C modulated amplifiers require more excitation than similar amplifiers in C. W. transmitters and a surplus of excitation is very desirable.

It is just as necessary for the modulation to work into a load resistance of proper value for maximum undistorted power output as it is for an audio output tube to work into the proper load value for maximum undistorted power output; therefore, there is a proper value of class C amplifier plate current for any modulator amplifier combination and the amplifiers must be operated at this value of current if maximum undistorted modulation is to be obtained.

In class C amplifiers, by making the load resistance high compared with the plate resistance of the tube it is possible to reach near distortionless modulation regardless of remaining adjustments, although the power output is sacrificed.

When modulated, properly adjusted class C amplifiers will develop a 100 per cent modulated wave with very little amplitude distortion and no frequency or phase distortion.

The adjustment of the tank circuit should be for maximum tank current with minimum plate current. Each change in coupling or excitation to the grid may necessitate retuning of the tank circuit, likewise when the antenna coupling is made.

As the turns of the primary winding are decreased the step-up ratio of the transformer is increased, therefore the primary load impedance is decreased and the plate current increased. In any tube circuit, if the load resistance is too high, the plate current will be high without an increase in antenna current.

For best adjustment of antenna inductance start with minimum number of turns and gradually increase until proper loading is obtained but never to a point where increased plate current does not increase the antenna current.

The power amplifier tube draws more plate current when the antenna tuning is near resonance, and the change in plate current as the plate circuit tuning condenser is moved through resonance should be smooth. A sudden sharp change in plate current generally indicates the tube is breaking into oscillation and may have to be better shielded in order to eliminate this condition.

Downward modulation is caused by a reduction in power output with modulation when there should be an increase in power output. It may be due to any of the following:

Insufficient class C amplifier bias of modulated amplifier, or R-F excitation.

Excessive class C amplifier plate current causing overloading of the modulator.

Before neutralizing or tuning it is necessary to remove any parasitic oscillations that may be present.

Parasitics result from stray couplings and resonant circuits, connecting wires, etc. and absorb energy. They can be eliminated by inserting suppressor resistors in the grids of the offending stage.

To test for parasitics disconnect the power amplifier from the preceding stage. Set the power amplifier tuning condenser at maximum. Set neutralizing condenser of minimum. Change neutralizing condenser from the minimum to maximum and if meter readings do not change, no parasitics are present.

To neutralize remove plate supply from tube.

Touch neon tube to grid or plate terminal of tube and adjust tuning condenser until tube glows with neutralizing condenser set at minimum.

Increase the value of the neutralizing condenser until the neon goes out and for finer adjustment, rotate tuning condenser again; also the neutralizing condenser.

Now turn the condenser through resonance and watch the grid meter. If any flicker in the grid meter is shown make a slight adjustment to the neutralizing condenser until there is no change in the grid reading when tuning condenser is turned through resonance. The circuit is then neutralized.

A 20 WATT 160 METER PHONE TRANSMITTER

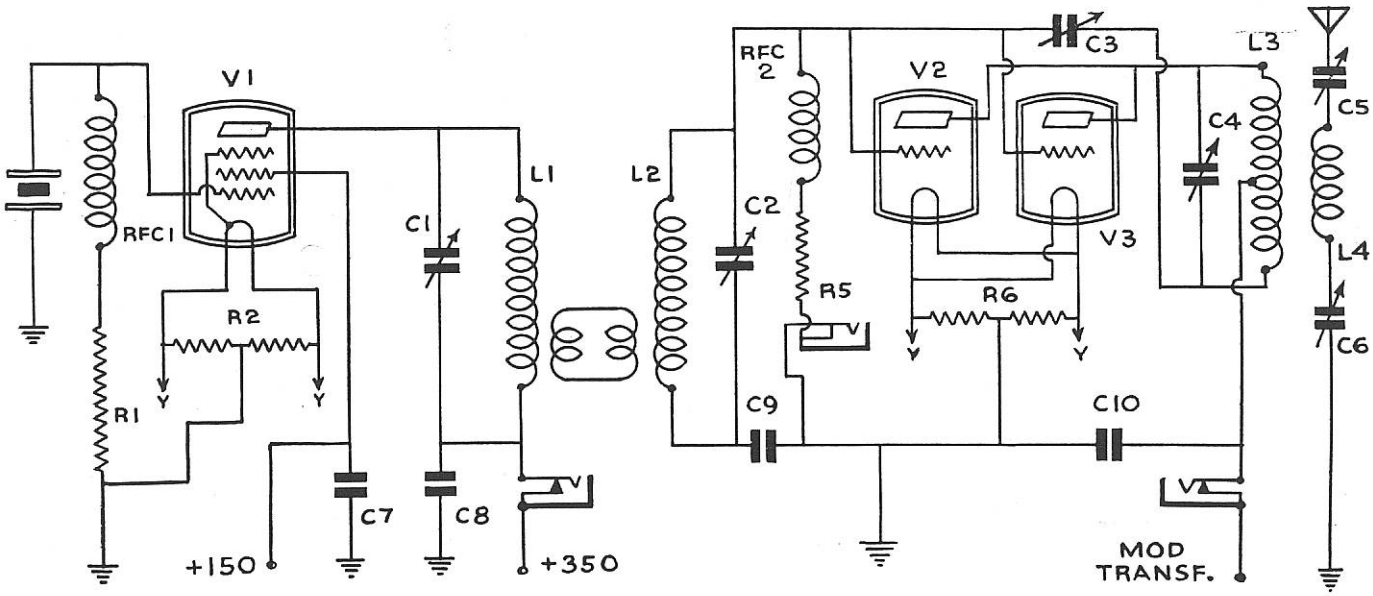
HERE is a radio phone transmitter ideally suited to the beginner in amateur radio activities. Receiving type tubes are used throughout—thus making the initial investment slight. Its features are as follows: a minimum number of tubes, few components, simple construction, and stable dependable operation.

The functions of the tubes as shown in the schematic diagrams as shown below and on the opposite page are a 2A5 oscillator link coupled to two 45's in parallel. These parallel tubes operate as a very efficient Class C amplifier supplying a full 20 watts of output. The modulator unit which is built on a separate chassis consist of a 56 followed by a 53 driver which feeds another 53 operated as a Class B amplifier. An output of 10 watts from this unit fully modulates the Class C stage 100%.

A single power supply unit using a type T-248 power transformer supplies the plate and filament voltages for all the tubes in the transmitter. The filter chokes have exceptionally fine regulation, thus providing dependable operation regardless of change in load or line voltage. While this transmitter is exceptionally efficient on the 1750 kilocycle band it should not be used on the higher frequencies. This is because the economy of the design and the lack of a buffer stage in the R.F. portion may cause severe frequency modulation with resultant broad-band, off frequency characteristics. This is in direct violation of the F.C.C. However, this does not in any way detract from the usefulness of this rig on the 160 meter band.

Data for coil construction for this simple phone transmitter can be obtained from instructions given in the coil chart. The values of all other parts are listed below. The adjustment of this transmitter is unusually easy. Tuning of the R.F. end is simply a matter of tuning tank circuit to resonance. There are no tricky adjustments of frequency doublers or neutralized buffers to complicate the job—that is what makes it an ideal unit for the beginner.

RADIO FREQUENCY SECTION



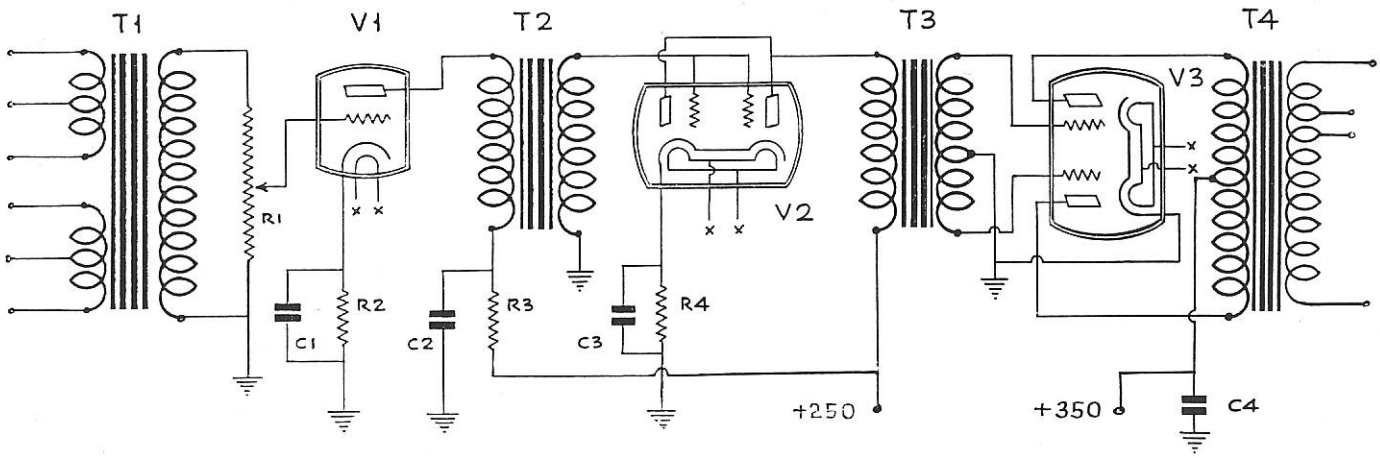
RADIO FREQUENCY SECTION

List of Parts

C1, C2, C4	250 mmfd. variable receiver type
C3	25 mmfd. variable double space
C5, C6	350 mmfd. variable receiver type
C7, C8	0.1 mfd. 500 V
C9, C10	.01 mfd. 500 V
R.F.C. 1, 2	8 millihenry radio frequency choke
See Coil Table for suitable R. F. coils.	

V1	2A5 type tube
V2, V3	45 type tube
R1	20,000 ohm 2 watt
R2, R6	30 ohm center tapped
R5	25,000 ohm 5 watt

MODULATION UNIT



MODULATOR UNIT

Kenyon Components

T1	Microphone input transformer	type T1
T2	Interstage transformer	type T55
T3	Class B input transformer	type T251
T4	Modulation transformer to 3000 and 5000 ohms	type T451

Tubes

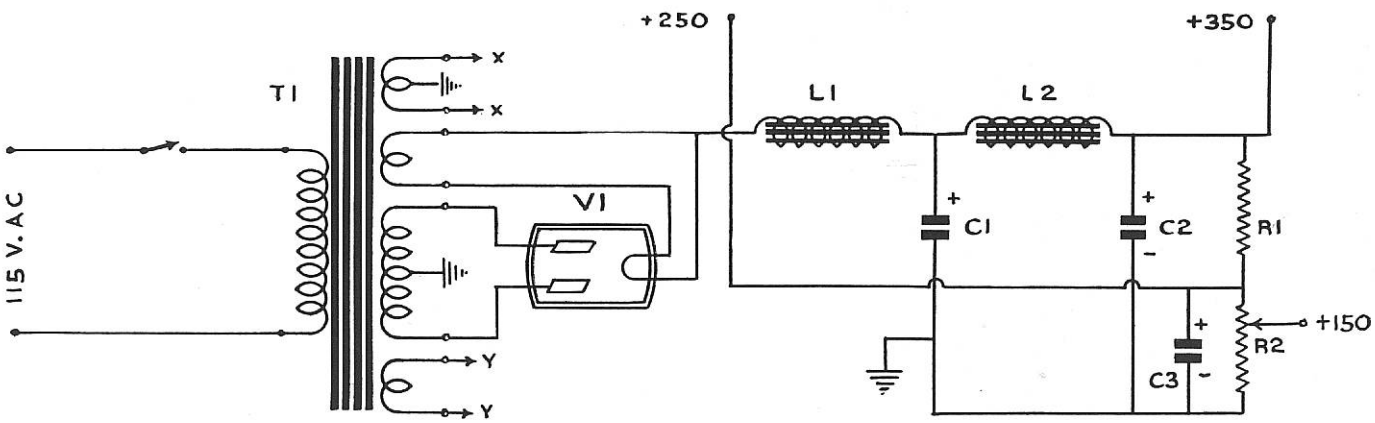
V1 56 type tube

V2, V3 type 53 tube

Miscellaneous Parts

R1	250,000 ohm potentiometer
R2	2,000 ohms 1 watt
R3	25,000 ohms 1 watt
R4	1,000 ohms 5 watt
C1	4 mfd. electrolytic 25 V
C2	1 mfd. paper 450 V
C3	4 mfd. electrolytic 25 V
C4	.1 mfd. mica 1000 V

POWER SUPPLY



POWER SUPPLY

Kenyon Components

T1	Power transformer	type T248
L1	Swinging choke	type T507
L2	Filter choke	type T164

V1 Type 83 tube

Miscellaneous Parts

C1, C2	8 mfd. electrolytic, 450 V
C3	4 mfd. electrolytic, 450 V
R1	10,000 ohms 25 watt
R2	25,000 ohms 25 watt

40 WATT C.W. AND PHONE TRANSMITTER

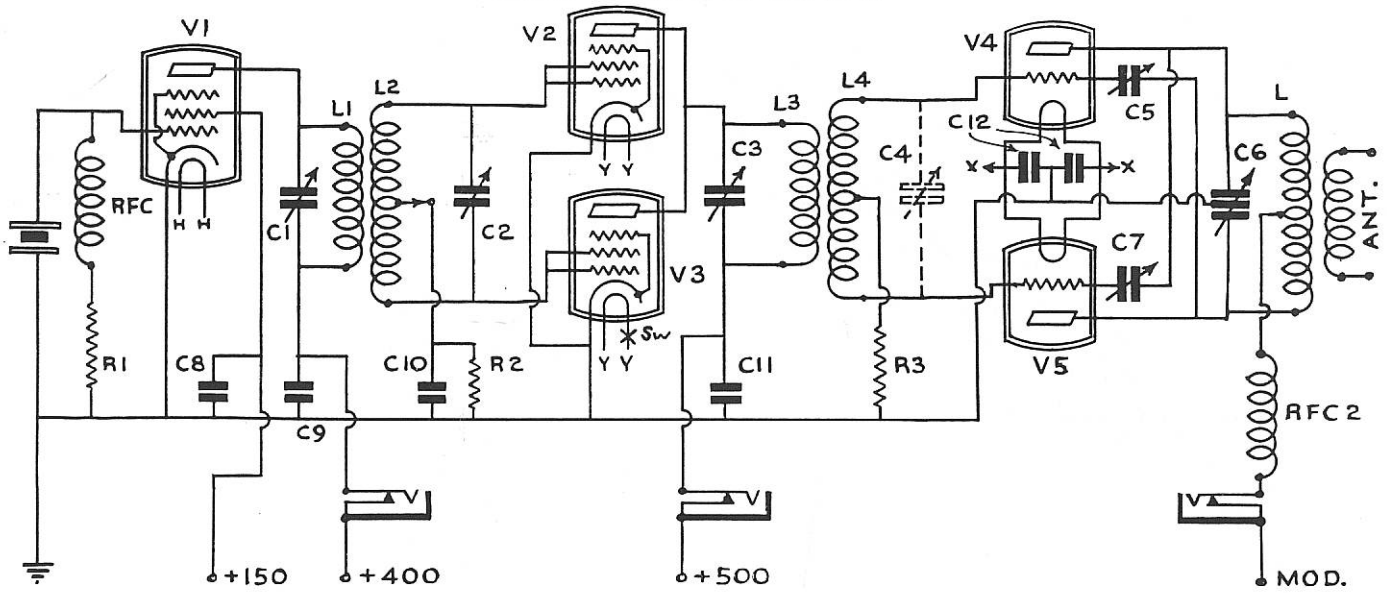
This low power transmitter may be used on 20, 40, 80 or 160 meter bands for C.W. or 20, 80 and 160 meter bands for phone.

The tube line up in the R-F end consists of a crystal control type 42 oscillator feeding two 42's which operate as frequency doublers. When used as a buffer stage on the fundamental frequency, the filament of one of the 42's is opened.

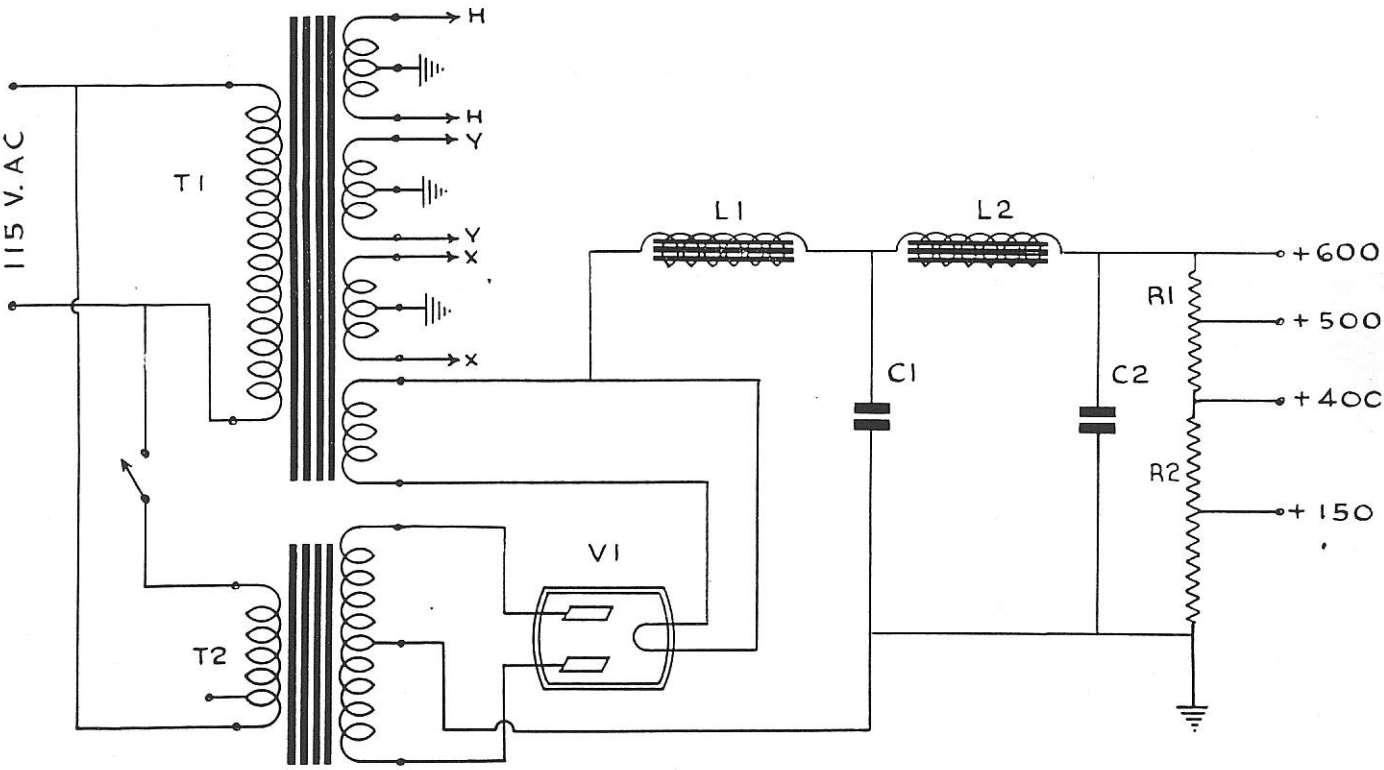
The modulator uses a type 77 tube followed by a type 59 tube which is the driver for a pair of 59's in Class "B". The power amplifier stage is conservatively rated at 20 watts which is sufficient to drive the R-F end to 100% modulation. The power supply of the audio frequency unit uses a type 83 rectifier in conjunction with a type T-248 power transformer. The fine voltage regulation of the power unit is further aided by the use of a husky swinging choke in the filter input circuit.

The power supply for the R-F section of the transmitter requires only two transformers and a single rectifier tube, thus simplifying construction and keeping the cost to a minimum.

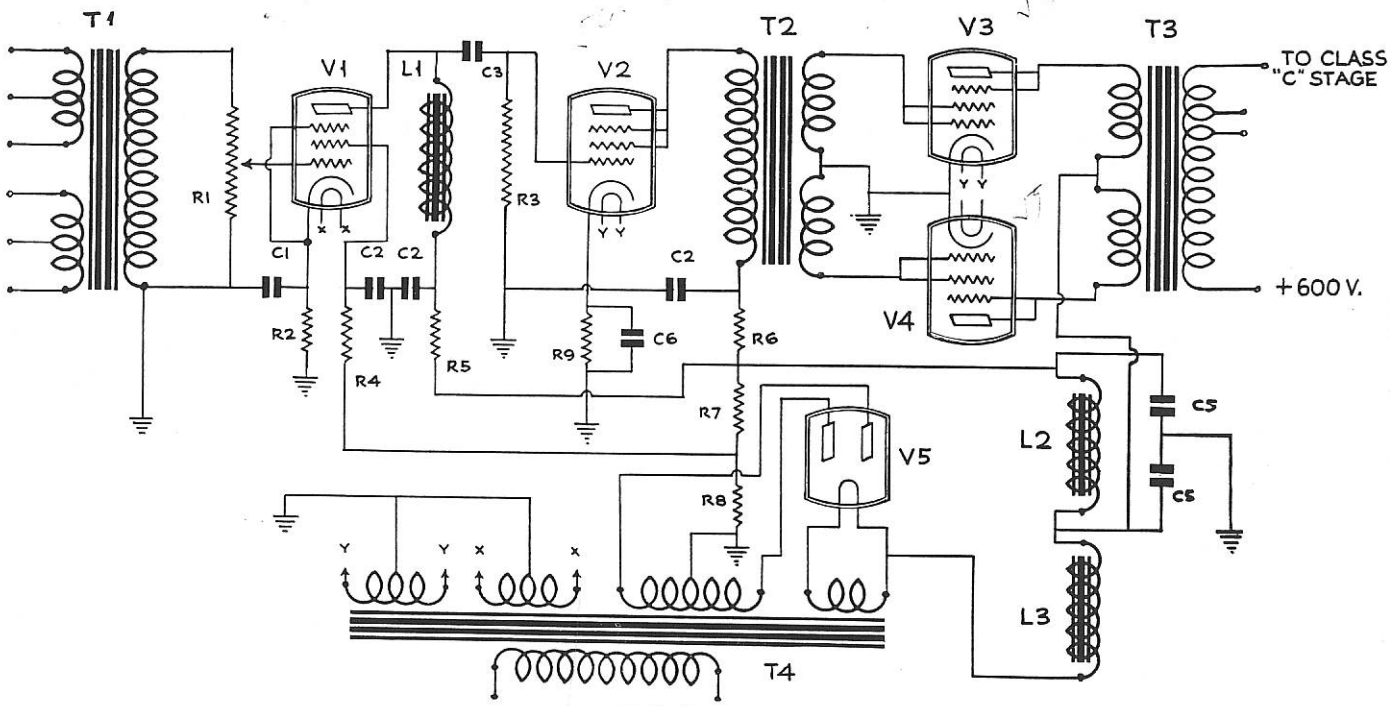
RADIO FREQUENCY SECTION



RADIO FREQUENCY POWER SUPPLY



MODULATION UNIT



Coil Data

	BAND	1.75 MC.	3.5 MC.	7 MC.	14 MC.
Oscillator					
L_1	No. of turns....	55	31	18	7
	Wire Size .....No.	26	No. 18	No. 18	No. 18
	Length of winding (in.)	0.850	1.300	0.750	0.300
	Space between L_1-L_2 (in.)	0.250	0.300	0.300	0.400
L_2	No. of turns....	40	26	12	6
	Wire Size .....No.	26	No. 26	No. 26	No. 26
	Length of winding (in.)	0.600	0.400	0.175	0.100
Buffer					
L_3	No. of turns.....	50	26	16	6
	Wire Size .....No.	26	No. 18	No. 18	No. 18
	Length of winding (in.)	0.850	1.150	0.650	0.250

	BAND	1.75 MC.	3.5 MC.	7 MC.	14 MC.
Buffer					
L_3	Space between L_3-L_4	0.100	0.200	0.250	0.400
L_4	No. of turns.....	80	60	28	12
	Wire size .....No.	26	No. 30	No. 26	No. 26
	Length of winding (in.)	1.250	0.600	0.425	0.180
Amplifier					
L	No. of turns.....	44	26	16	8
	Wire size .....No.	14	No. 12	1/8" T.	3/16" T.
	Length of winding (in.)	3.75	3.5	4.0	2.5

Oscillator and buffer coils are wound on 1½" coil forms.

RADIO FREQUENCY SECTION

R1 10,000 ohm 2 watt
R2 1,250 ohm 5 watt
R3 10,000 ohm 5 watt
C1, C2, C3, C4 100 mmfd. variable (C4 used only on 160 meters)
C5, C7 25 mmfd. variable
C6 100 mmfd. split stator
C8, C9, C10, C11 .005 mfd. 1000 volt
C12 .002 mfd. 600 volt

Tubes

V1, V2, V3 42's
V4, V5 10's or 801's

R.F. POWER SUPPLY

Kenyon Components

T1 Plate transformer type T371
T2 Filament transformer type T656
L1 Filter choke type T166
L2 Filter choke type T166

Miscellaneous Parts

R1 2,500 ohm 50 watt
R2 20,000 ohm 50 watt

C1 4 mfd. 1000 volt
C2 4 mfd. 1000 volt

Tubes

V1 type 83 tube

MODULATION UNIT AND POWER SUPPLY

Kenyon Components

T1 Input transformer type T1
T2 Class B input transformer type T253
T3 Output transformer type T454
T4 Power transformer type T248
L1 Plate reactor type T155
L2 Swinging reactor type T506
L3 Filter reactor type T157

Miscellaneous Parts

R1 100 M POT
R2 1,500 ohm 1 watt
R3 250 M ohm 1 watt
R4 10,000 ohm 1 watt
R5 25,000 ohm 1 watt
R6 5,000 ohm 20 watt
R7 35,000 ohm 10 watt
R8 10,000 ohm 10 watt
R9 1,000 ohm 10 watt

C1 10 mfd. 25 V electo. condenser
C2 2 mfd. 600 V electo. condenser
C3 .05 mfd. 600 V paper condenser
C5 8 mfd. 600 V paper condenser
C6 10 mfd. 50 V paper condenser

Tubes

V1 57 tube
V2 59 tube
V3, V4 59 tubes
V5 83 tube

100 WATT C. W.—45 WATT PHONE TRANSMITTER

CONTROL grid modulation provides the most economical method yet devised for phone use. The circuit shown below and on the opposite page exemplifies the simplicity of this application. However, this type of modulation permits an output of only approximately 45 watts when used as a phone transmitter.

The tube line-up of this grid modulated transmitter is: a 42 pentode as a crystal controlled oscillator, followed by two 46 type tubes in parallel for the buffer stage. These are coupled to a 203A triode which is grid modulated.

The audio frequency amplifier contains two type 76 tubes in cascade operating as voltage amplifiers, feeding into a type 42 pentode power amplifier which is a transformer coupled to the control grid of the 203A R.F. power amplifier.

The power supply unit for this rig uses the popular triple winding plate transformer thus providing good voltage regulation with a minimum number of parts. The output is adequately filtered by two type T168 and two type T154 filter chokes which remove all traces of A.C. ripple.

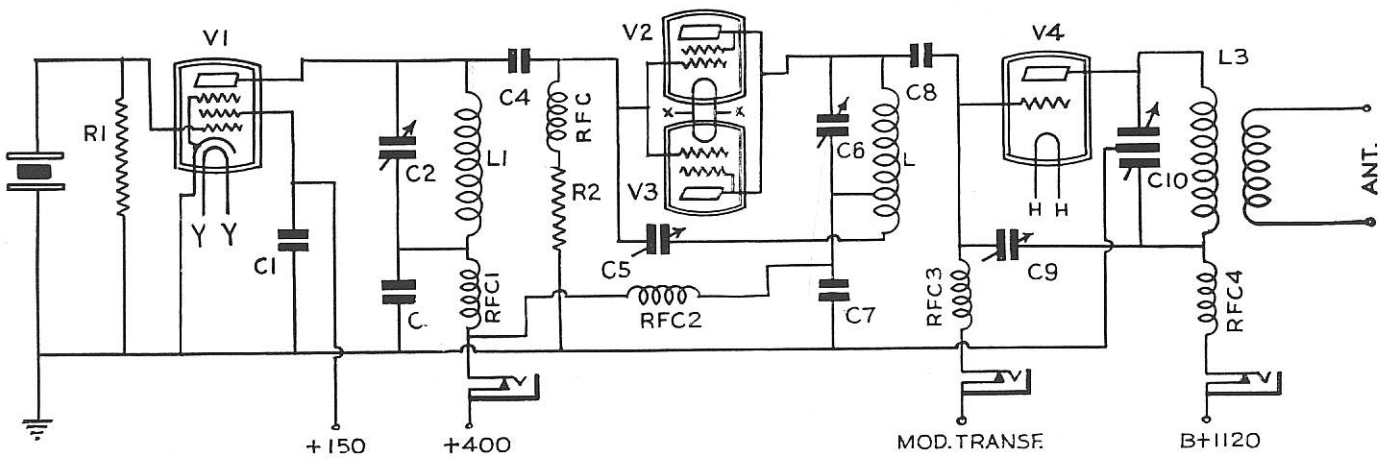
Adjustment of the R.F. Class "C" stage is accomplished by varying the bias of the 203A in order to obtain twice cut-off bias. For phone operation the antenna coupling should be increased until the 203A plate current reads approximately 200 MA. The bias is then varied until the plate current drops to about half this value. Then, with a constant pure tone signal, 100% modulation is indicated by a rise in the amplifier plate current of approximately 12 MA. With speech, the current increase is about 6 MA.

The operating conditions of the 203A amplifier tube in this circuit are as follows:

Plate voltage.....1120 volts	D.C. plate current....110 MA.
Carrier power.....45 watts	Peak power.....180 watts
Plate efficiency 34%	D.C. grid bias.....235 volts

The value of parts and coil data are listed below.

RADIO FREQUENCY UNIT



RADIO FREQUENCY UNIT

List of Parts

C2, C6	100 mmfd. variable
C5, C9	25 mmfd. variable
C10	100 mmfd. split stator
L1, L2, L3	See Coil Table (L2 tapped at 1/3)
C1, C, C7	0.1 mfd. 600 volt
C4	.0001 mfd. 1000 volt
C8	.0002 mfd. 1000 volt
R.F.C. 1, 2, 3	To suit frequency used

R1	50,000 ohm 2 watt
R2	2,500 ohm 5 watt

Tubes

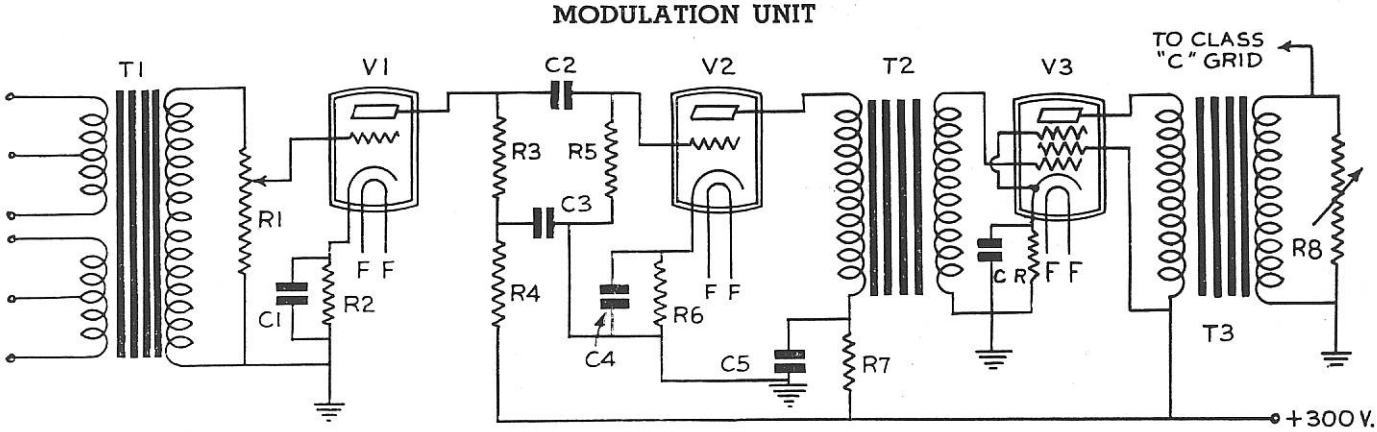
V1	type 42 tube
V2, V3	type 46 tubes
V4	type 203A tube

Coil Data

	BAND	1.75 MC.	3.5 MC.	7 MC.	14 MC.
L_1	No. of turns.....	55	31	18	7
	Wire size	No. 26	No. 18	No. 18	No. 18
	Length of winding (in.)	0.850	1.300	0.750	0.300
L	No. of turns.....	50	26	16	6
	Wire size	No. 26	No. 18	No. 18	No. 18

	BAND	1.75 MC.	3.5 MC.	7 MC.	14 MC.
	Length of winding (in.)	0.980	1.150	0.750	0.350
L_3	No. of turns.....	80	60	28	10
	Wire size	No. 26	No. 26	No. 20	No. 18
	Length of winding (in.)	1.250	0.600	0.425	0.180

MODULATION UNIT



Kenyon Components

T1	Input transformer	type T1
T2	Interstage transformer	type T51
T3	Modulation transformer	type T490

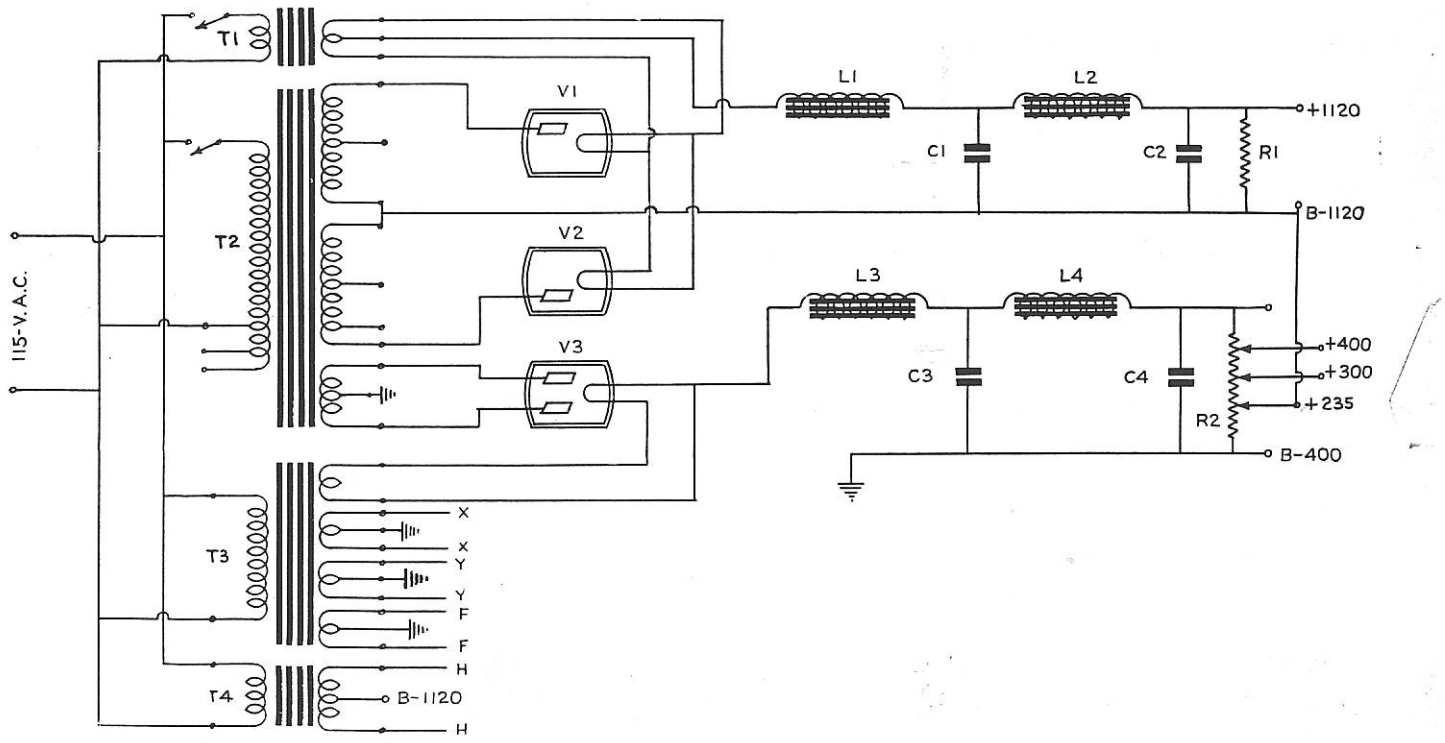
Tubes

V1 type 76 tube
V2 type 76 tube
V3 type 42 tube

Miscellaneous Parts

R	400 ohm 2 watt	R7	20,000 ohm 1 watt
R1	100,000 ohm potentiometer	R8	10,000 ohm 5 watt
R2, R6	2,000 ohm 1 watt	C1, C4	10 mfd. 25 volt
R3	100,000 ohm 1 watt	C2	.05 mfd. 450 volt
R4	50,000 ohm 1 watt	C3, C5	1 mfd. 450 volt
R5	250,000 ohm 1 watt	C	10 mfd. 50 volt

POWER SUPPLY UNIT



Kenyon Components

T1	866 Filament transformer	type T360
T2	Plate transformer	type T658
T3	Filament transformer	type T370
T4	203A Filament transformer	type T365
L1	Filter choke	type T168
L2	Filter choke	type T168
L3	Filter choke	type T154
L4	Filter choke	type T154

Tubes

V1, V2 type 866 tubes
V3 type 83 tube

Miscellaneous Parts

R1	75,000 ohm 50 watt
R2	50,000 ohm 100 watt
C1, C2	2 mfd. 1500 volt
C3, C4	8 mfd. 600 volt

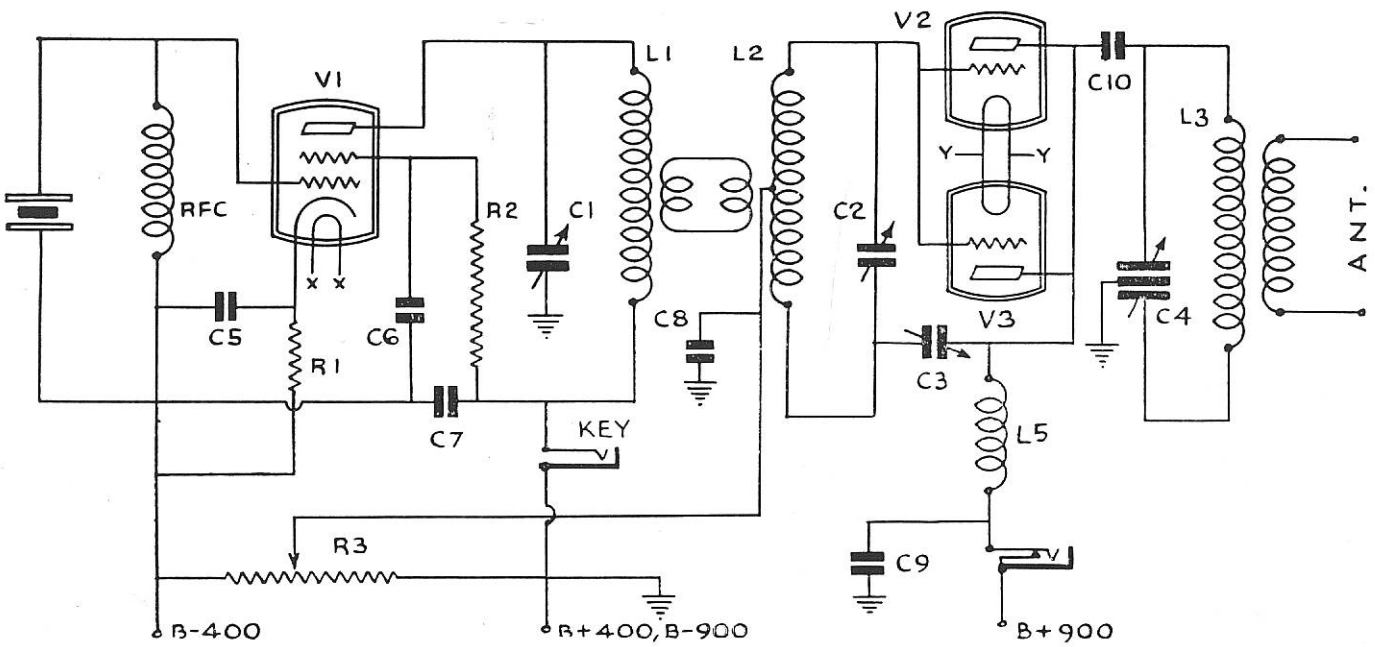
A 100 WATT C. W. TRANSMITTER

THIS transmitter is a typical dyed-in-the-wool amateur circuit, the type that developes every ounce of antenna power regardless of how soon the tubes go "west". For this reason we do not guarantee that the tubes used in this circuit will stand up for six months—but on the other hand, the transmitter will "get out" far better than larger or more expensive rigs. The operation is limited to C. W. only. It positively cannot be used for phone at the voltages specified in the schematic. An examination of the circuit shows several variations from usual practice. A type 42 pentode crystal controlled oscillator of conventional design is link coupled to two 210 tubes in parallel in the power amplifier. It will be noticed that the plate of the oscillator tube is connected to ground, which appears at first glance to be an error in the diagram. This is done for a particular purpose, however, and is correct as shown. The bias for the amplifier tubes is obtained from the oscillator power supply thus simplifying the power supply system and minimizing the number of parts which would otherwise be needed. It is also important to note that the cathode of the oscillator has a potential difference of 400 volts with respect to ground. This makes it necessary to key in the oscillator plate circuit instead of the customary cathode, to avoid a hot key.

The power supply for this transmitter derives both voltages from the one high voltage transformer. This is made possible through the use of our newly developed triple winding plate transformer. This arrangement is a sound and economical method of obtaining the required voltages.

The husky chokes used in the filter section permit minimum condenser capacity and at the same time provide adequate filtering to meet existing regulations for pure D.C.

RADIO FREQUENCY SECTION



RADIO FREQUENCY SECTION

List of Parts

C1, C2, C4	100 mmfd. variable
C3	20 mmfd. variable
C5, C6, C7, C8, C9, and C10	.01 mfd. 1500 volt
R1	4,000 ohm 10 watt
R2	50,000 ohm 2 watt
R3	50,000 ohm 50 watt
R.F.C., L5	8 millihenries
L1, L2, L3	See Coil Table on Page 33

Tubes

V1	type 42 tube
V2, V3	type 210 tubes

POWER SUPPLY UNIT

Kenyon Components

T1	Filament transformer	type T372
T2	Power transformer	type T658
L1	Filter choke	type T165
L2	Filter choke	type T154

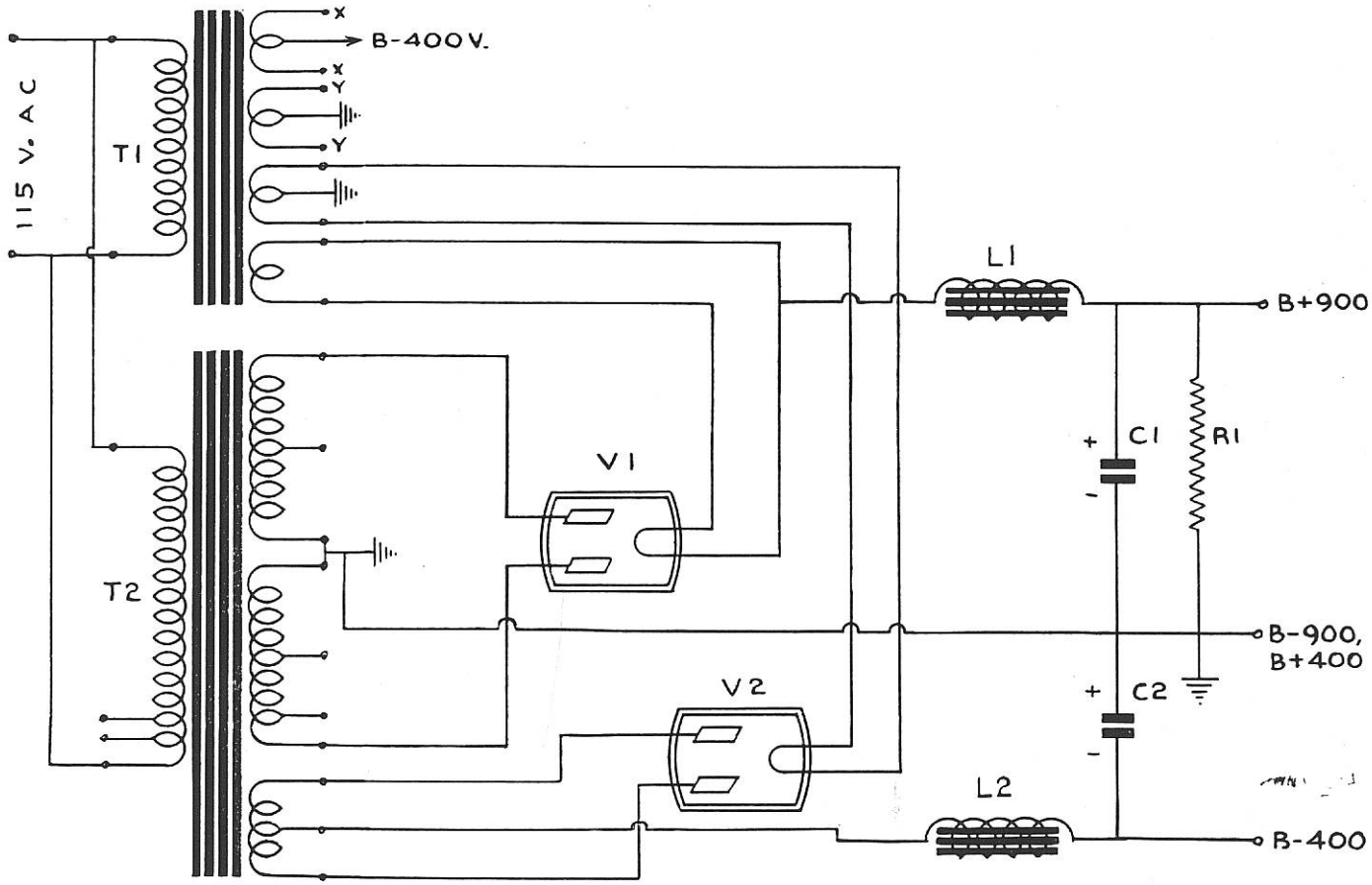
Miscellaneous Parts

R1	60,000 ohm 50 watt
C1	2 mfd. 1500 volt
C2	2 mfd. 600 volt

Tubes

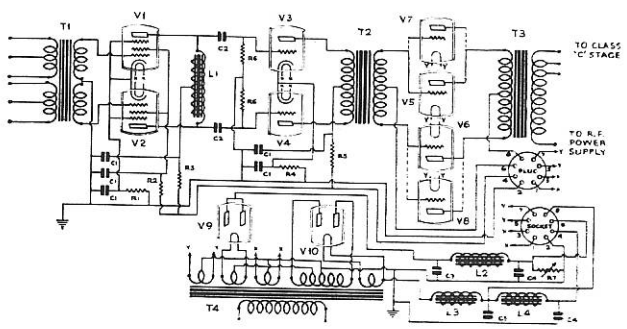
V1	type 83 tube
V2	type 5Z3 tube

POWER SUPPLY UNIT



36 WATT AMPLIFIER

This amplifier will fully modulate a 75 watt transmitter. When used in conjunction with the transmitter described on page 24, use transformer type T260 instead of T456.



Tubes

V1, V2	77 tubes
V3, V4	76 tubes
V5, V6, V7, V8	2A3 tubes
V9	82 tube
V10	83 tube

List of Parts

Kenyon Components

T1	Input transformer	type T3
T2	Input transformer	type T256
T3	Modulation transformer	type T456
T4	Power transformer	type T215
L1	Audio Reactor	type T158
L2	Filter choke	type T153
L3	Swinging choke	type T510
L4	Filter choke	type T153

Miscellaneous Parts

R1	500	ohm	2 watt
R2	250,000	ohm	2 watt
R3	10,000	ohm	2 watt
R4	1,350	ohm	2 watt
R5	5,000	ohm	2 watt
R6	250,000	ohm	1 watt
R7	3,500	ohm	25 watt
C1	1 mfd.	400 volt	paper
C2	.1 mfd.	400 volt	paper
C3	2 mfd.	400 volt	paper
C4	8 mfd.	400 volt	electro
C5	16 mfd.	400 volt	electro

A 150 WATT C. W.—35 WATT PHONE TRANSMITTER

THIS transmitter is of particular interest to the amateur who desires a medium power C. W. xmitter which can also be used for low power phone. For C. W. a full 150 watts of R.F. is available. When suppressor modulated, 35 watts of power can easily be obtained.

The tube line-up of the R.F. end is entirely conventional and consists of one section of a 6A6 tube utilized as a crystal oscillator. The other triode section of this tube is used as a frequency doubler. This application is often referred to as the "Jones System" and has been used very successfully by many amateurs. The output of this tube is fed into push-pull grids of another 6A6 tube, the plates of which are connected in parallel. This tube combination supplies ample excitation to the two RK-20's in the final amplifier operating Class "C".

The modulator system, suppressor modulates the RK-20's which reduces the size and cost of the audio frequency portion of this transmitter. This type of modulation is to be highly recommended especially when cost is of prime importance.

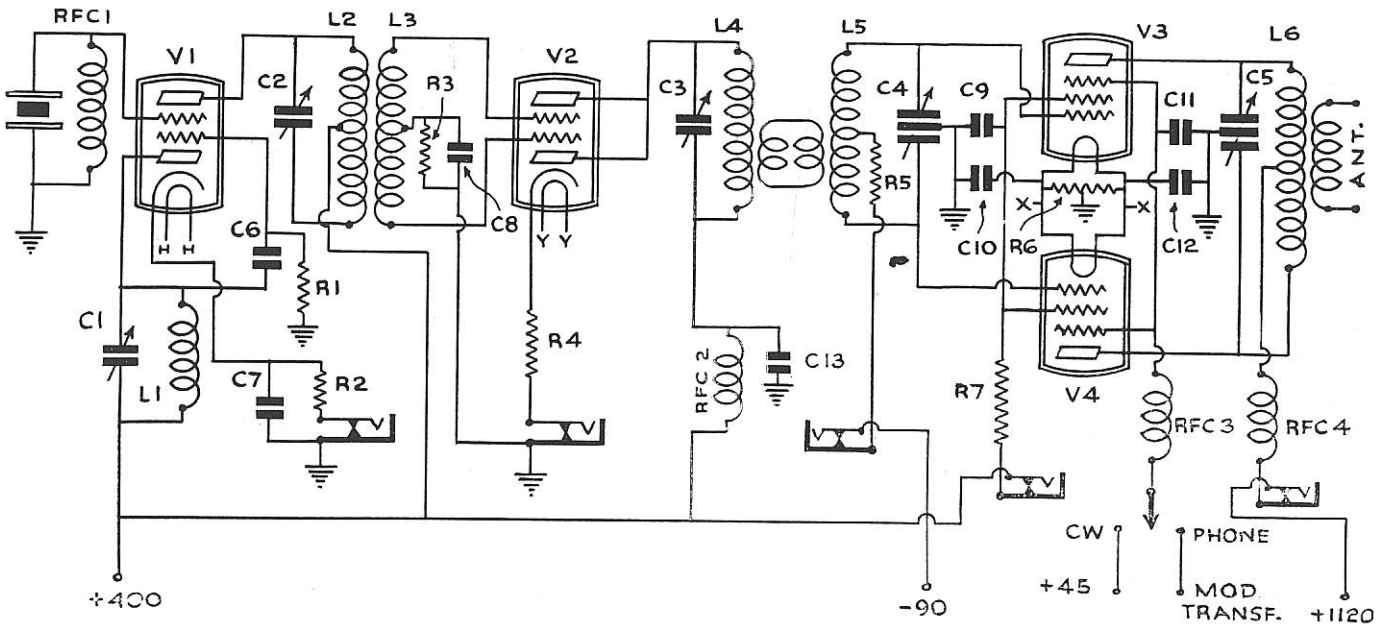
The audio frequency end is a tried and old reliable circuit. A type 76 triode tube resistance coupled to a 42 pentode tube provides a gain of 50 DB. Careful design makes the output completely hum-free. Actually the hum level is 65 DB. below maximum power output.

Two separate power supplies are used for this transmitter; one for the R.F. section and audio amplifier respectively. The R.F. section utilizes our new triple winding plate transformer to full advantage thereby materially lowering the cost of the entire unit.

The transformers and chokes used in this circuit are rated well under their safe current carrying capacity assuring absolute trouble free operation.

Coil details for the various amateur bands can be determined from the coil chart.

RADIO FREQUENCY SECTION



C1, C2, C3	140 mmfd. variable	R6	50 ohm CT	**Tubes**	
C4, C5	100 mmfd. split stator	R7	1,500 ohm 20 watt		
R1	50,000 ohm 2 watt	C6, C7 C8, C10, C12	.002 mfd. 1000 volt	V1, V2	type 6A6 tubes
R2	400 ohm 5 watt	C9, C11	.002 mfd. 2500 volt	V3, V4	type RK 20 tubes
R5	1,000 ohm 2 watt	R. F. C. 1, 2, 3, 4	2.5 millihenrys		

R.F. POWER SUPPLY

Kenyon Components

T1	Filament transformer	type T360
T2	Plate transformer	type T658
T3	Filament transformer	type T371
L1	Filter choke	type T165
L2	Filter choke	type T165
L3	Filter choke	type T154
L4	Filter choke	type T154

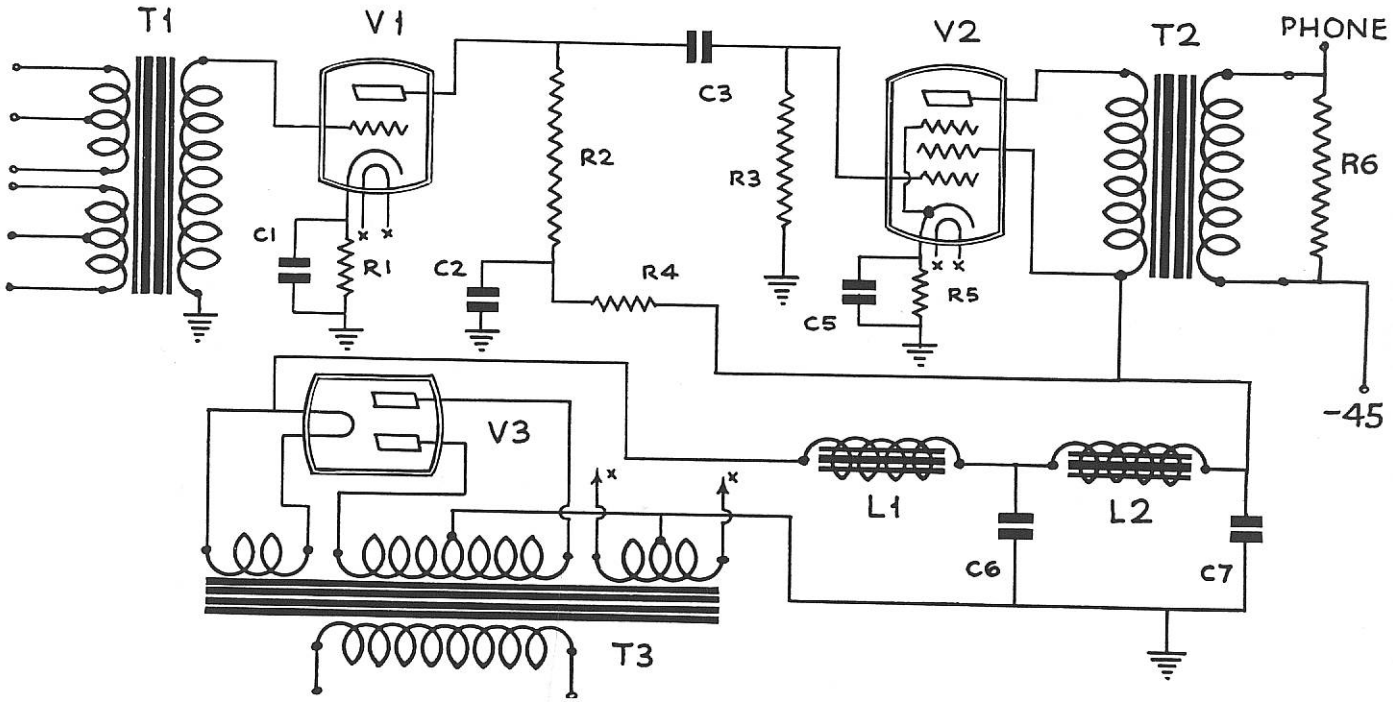
Miscellaneous Parts

C1, C2	2 mfd. 1500 volt
C3, C4	4 mfd. 600 volt
C5	8 mfd. 250 volt
R1	70,000 ohm 50 watt
R2	50,000 ohm 50 watt
R3	800 ohm 75 watt

Tubes

V1, V2	type 866 tubes
V3	type 83 tube

MODULATION UNIT



Kenyon Components

T1	Microphone input transformer	type T1
T2	Modulation transformer	type T490
T3	Power supply transformer	type T245
L1	Filter choke	type T157
L2	Filter choke	type T157

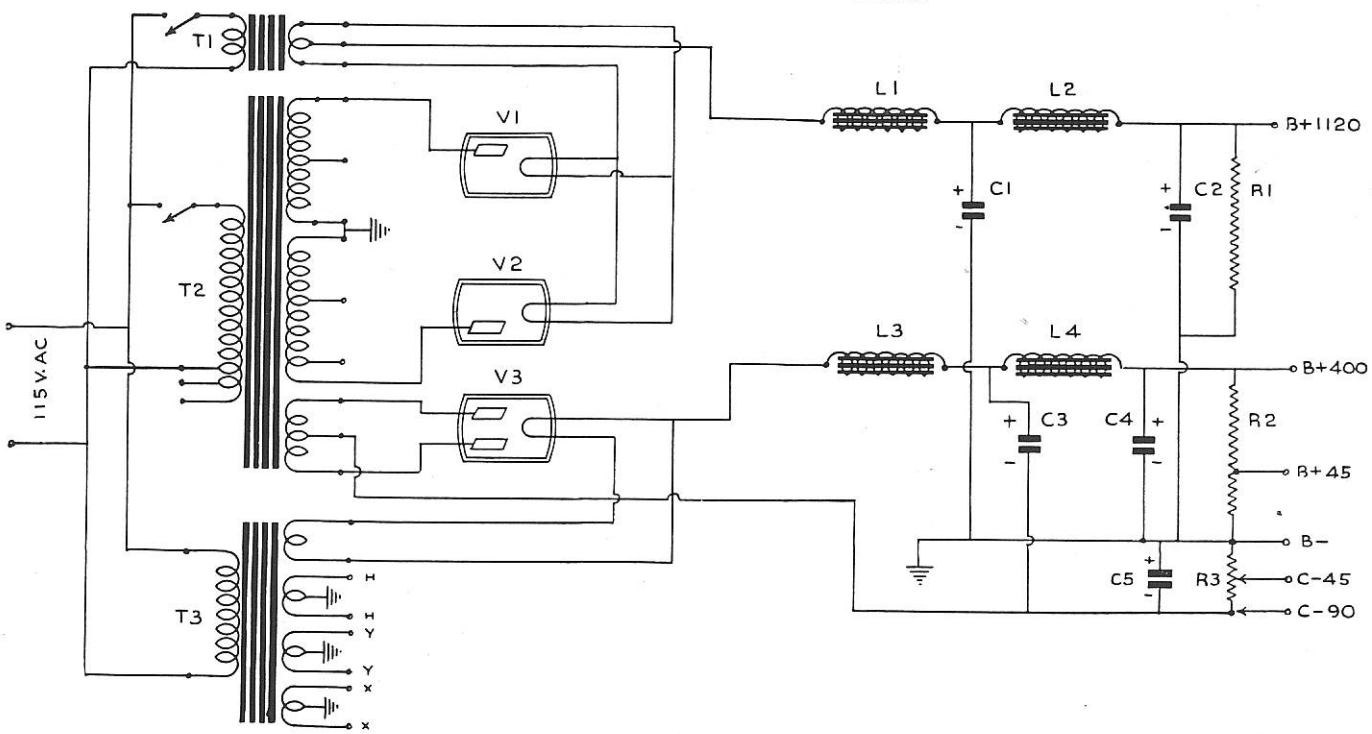
Tubes

V1	type 76 tube
V2	type 42 tube
V3	type 80 tube

Miscellaneous Parts

R1	2,000 ohm	1 watt
R2	100,000 ohm	1 watt
R3	500,000 ohm	1 watt
R4	50,000 ohm	1 watt
R5	400 ohm	2 watt
R6	10,000 ohm	25 watt
C1	10 mfd.	25 volt
C2	2 mfd.	450 volt
C3	.05 mfd.	450 volt
C5	25 mfd.	50 volt
C6, C7	8 mfd.	450 volt

RADIO FREQUENCY POWER SUPPLY



A 200 WATT C. W.—53 WATT PHONE TRANSMITTER

ONE of the outstanding features of this medium power C. W. and low power phone transmitter is the use of the 803 type pentode tube. Though the initial cost of the 803 tube is much higher than triodes the relatively few parts required to construct this modern xmitter actually effects a saving. In addition to this the final amplifier requires no neutralizing which greatly simplifies putting it on the air.

In the R.F. end of this transmitter one section of a 6A6 tube is used as a crystal oscillator and the triode section is used as a straight amplifier or frequency doubler. Due to the low excitation requirement of the 803 tube, adequate driving power is obtainable on all bands from the single 6A6 tube.

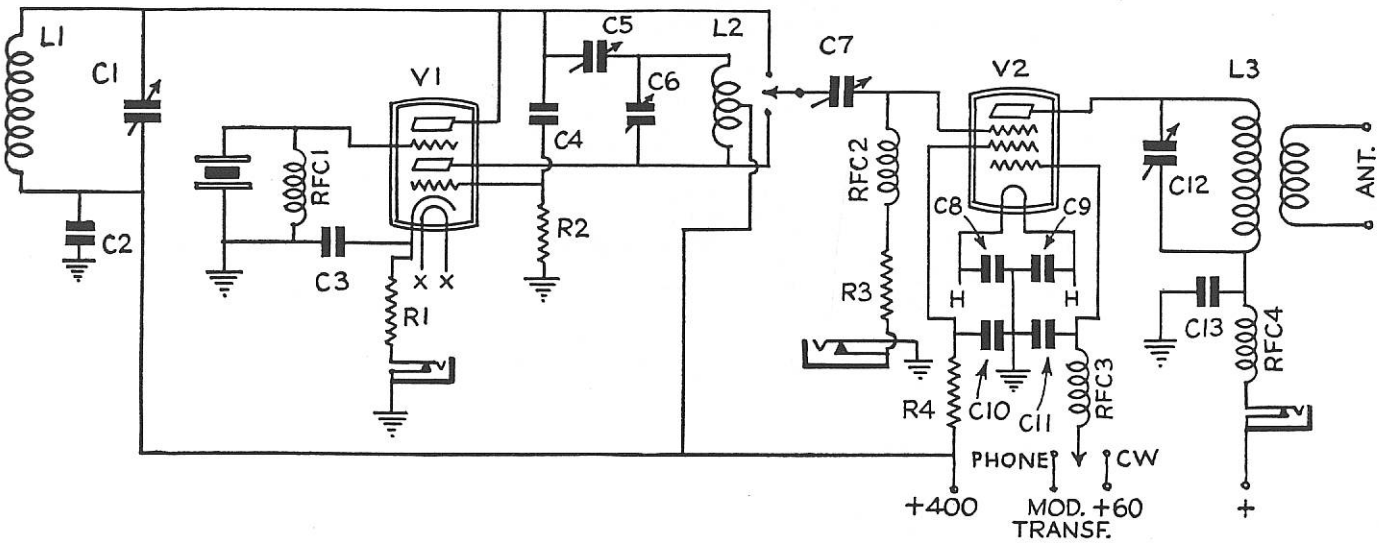
The modulator unit which is shown below the R.F. schematic has sufficient gain to fully modulate the 803 tube even when used with a low level microphone. When this unit is carefully adjusted, exceptionally fine quality is obtainable despite the opinion of many that suppressor grid modulation has too many limitations. If a crystal microphone is used in place of the carbon type, the input transformer T1 may be replaced with a 1 to 5 megohm one watt resistor.

It is interesting to note that changing from phone to C. W. operation is quickly and easily accomplished by throwing a single pole double throw switch from one side to the other.

The design of the power supply is also straight forward. Here economy is also featured due to the use of the type T657 plate transformer. The plate voltages for the low voltage stage are obtained from a separate transformer which also supplies the filaments for the modulator power amplifier and the R.F. oscillator.

The prospective builder of this xmitter should thoroughly digest the article "R.F. Pentodes" in another section of this Manual.

RADIO FREQUENCY SECTION



List of Parts

C1, C7, C12	100 mmfd. variable
C2, C3, C8, C9	.01 mfd. 1000 volt
C4	.0001 mfd. 1000 volt
C5	30 mmfd. variable
C6	150 mmfd. variable
C10, C11	.002 mfd. 1000 volt
C13	.002 mfd. 3500 volt
R1	400 ohm 5 watt
R2	50,000 ohm 2 watt
R3	5,000 ohm 10 watt
R4	50 ohm 5 watt
R. F. C.	To suit frequency used

Tubes

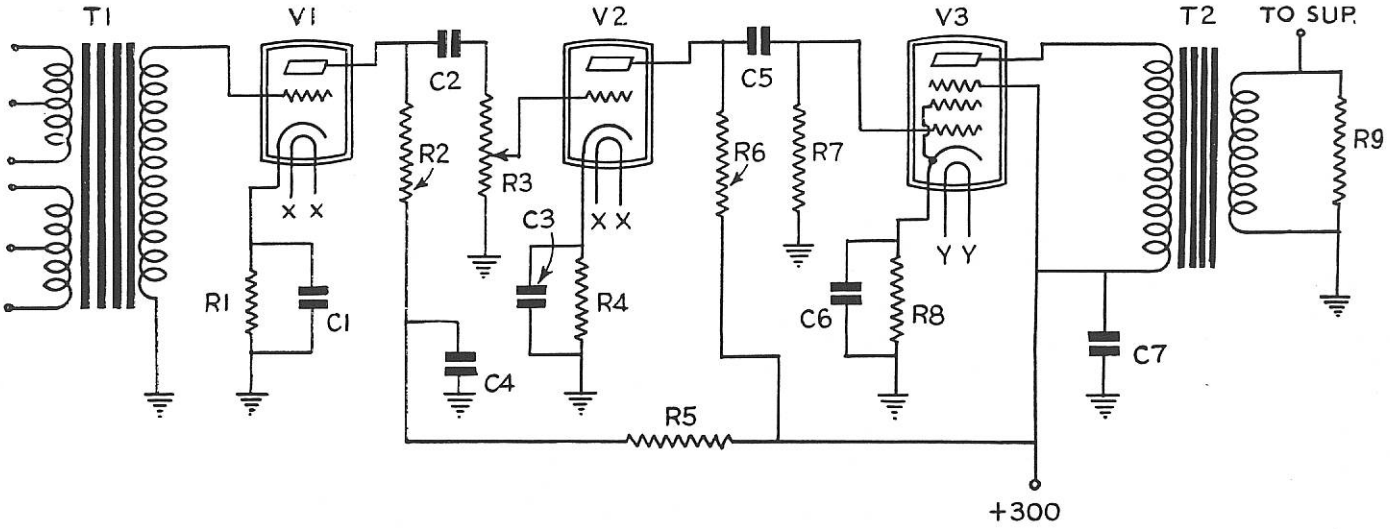
V1 type 6A6
V2 type 803

RADIO FREQUENCY COIL DATA

COIL	1.75 MC	3.5 MC	7 MC	14 MC
L1	68 turns No. 22 on 1½" form.	30 turns No. 22 on 1½" form.	14 turns No. 18 on 1½" form.	8 turns No. 18 on 1½" form.
L2	None	30 turns No. 22 on 1½" form.	14 turns No. 18 on 1½" form.	7 turns No. 18 on 1½" form.
L3	50 turns No. 14 on 2½" form.	27 turns No. 12 on 2½" form.	12 turns No. 12 on 2½" form.	6 turns No. 12 on 2½" form.

L2 center tapped.

MODULATION UNIT



Kenyon Components

T1 Input transformer type T1
T2 Modulation transformer type T490

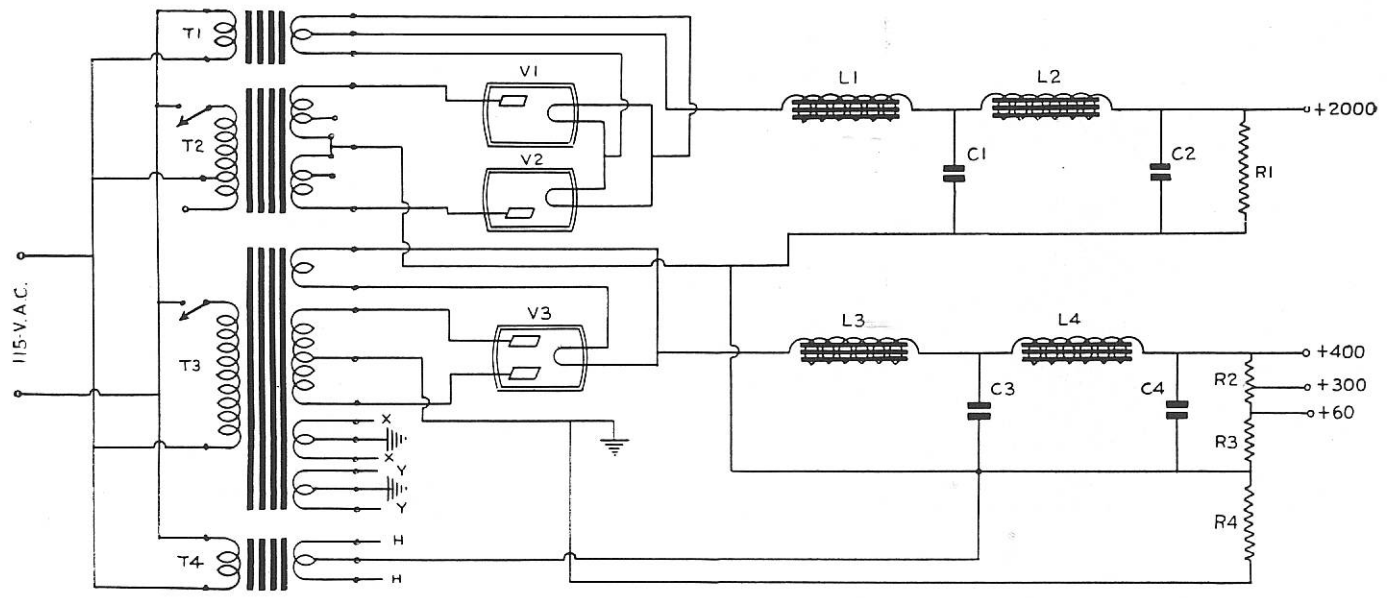
Tubes

V1 type 76 tube
V2 type 76 tube
V3 type 42 tube

Miscellaneous Parts

R1, R4	2,000 ohm	1 watt
R2, R6	100,000 ohm	1 watt
R3	250,000 ohm	potentiometer
R5	50,000 ohm	1 watt
R7	500,000 ohm	1 watt
R8	400 ohm	5 watt
R9	10,000 ohm	5 watt
C1, C3, C6	10 mfd.	50 volt
C2, C5	.02 mfd.	400 volt
C4, C7	1 mfd.	400 volt

POWER SUPPLY UNIT



Kenyon Components

T1	866 filament transformer	type T360
T2	Plate transformer	type T657
T3	Combination plate and Fil. transformer	type T247
T4	803 filament transformer	type T361
L1	Filter choke	type T175
L2	Filter choke	type T175
L3	Filter choke	type T152
L4	Filter choke	type T152

Miscellaneous Parts

R1 75,000 ohm 100 watt
R2 10,000 ohm 20 watt variable
R3 1,500 ohm 10 watt
R4 500 ohm 100 watt variable
C1 1 mfd. 2500 volt
C2 1 mfd. 2500 volt
C3 4 mfd. 600 volt
C4 4 mfd. 600 volt

Tubes

V1, V2 type 866 tubes
V3 type 83 tube

A 200 WATT PHONE AND C. W. TRANSMITTER

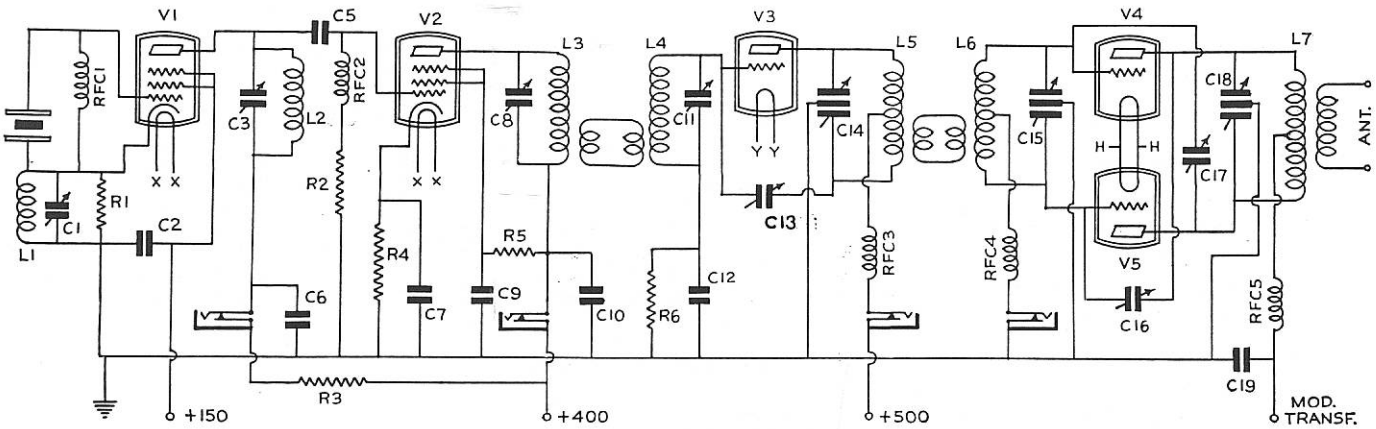
THIS rig might be termed the most popular example of a medium power amateur transmitter. It is straightforward through the entire R.F. and modulator sections. This can be attested to by its universal acceptance by the large number of amateurs who are using this identical circuit.

Functionally the xmitter is as follows: a 59 tube is used as a tri-tet oscillator which is capacitively coupled to another 59. This stage is used as a doubler or straight buffer stage depending upon the crystal used and the frequency desired in the final. The doubler or buffer stage is followed by an 841 which is link coupled to a pair of 800's in the final Class "C" stage.

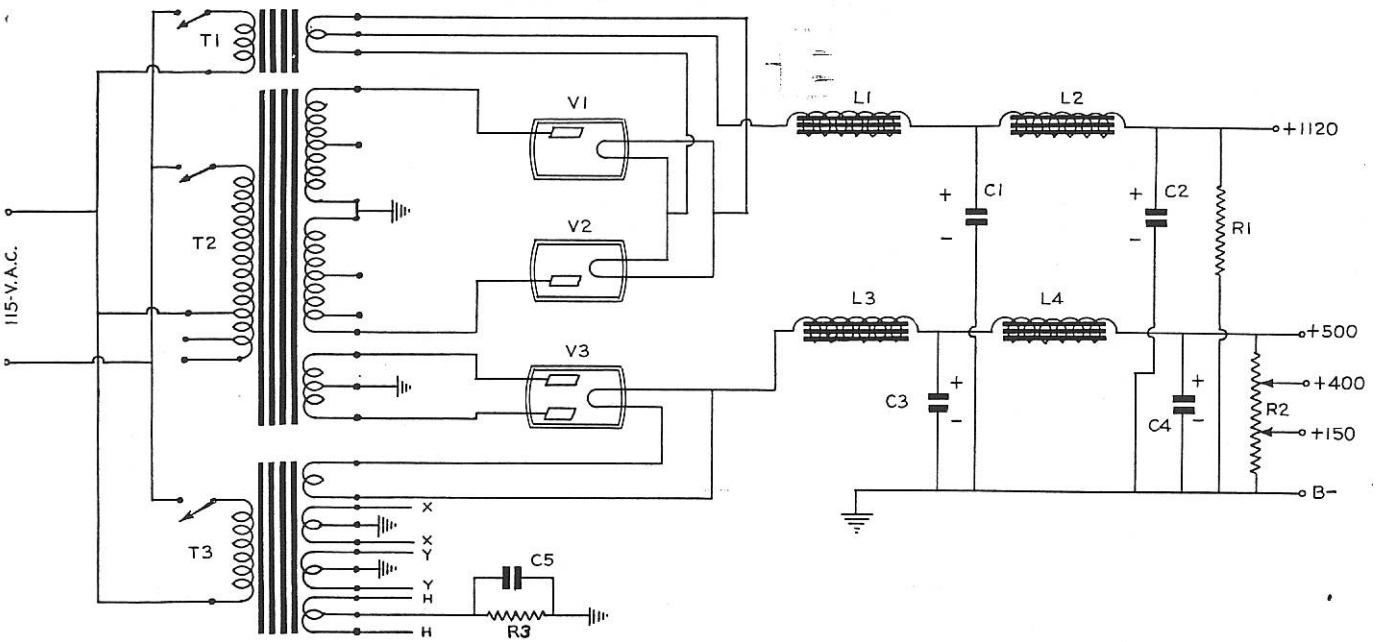
The audio system consists of a 76 resistor coupled to another 76 as voltage amplifiers. This is fed into two type 45 tubes functioning as a driver stage for the two 800's in Class "B" which produces a full 100 watts of audio power.

Two power supply units are required for this transmitter. These are very similar in design—both use the efficient triple winding plate transformer which reduces the number of transformers in the power supplies to an absolute minimum. The power supply systems are rated well over the highest power loads which will be imposed on them in this circuit.

RADIO FREQUENCY SECTION



RADIO FREQUENCY POWER SUPPLY



Kenyon Components

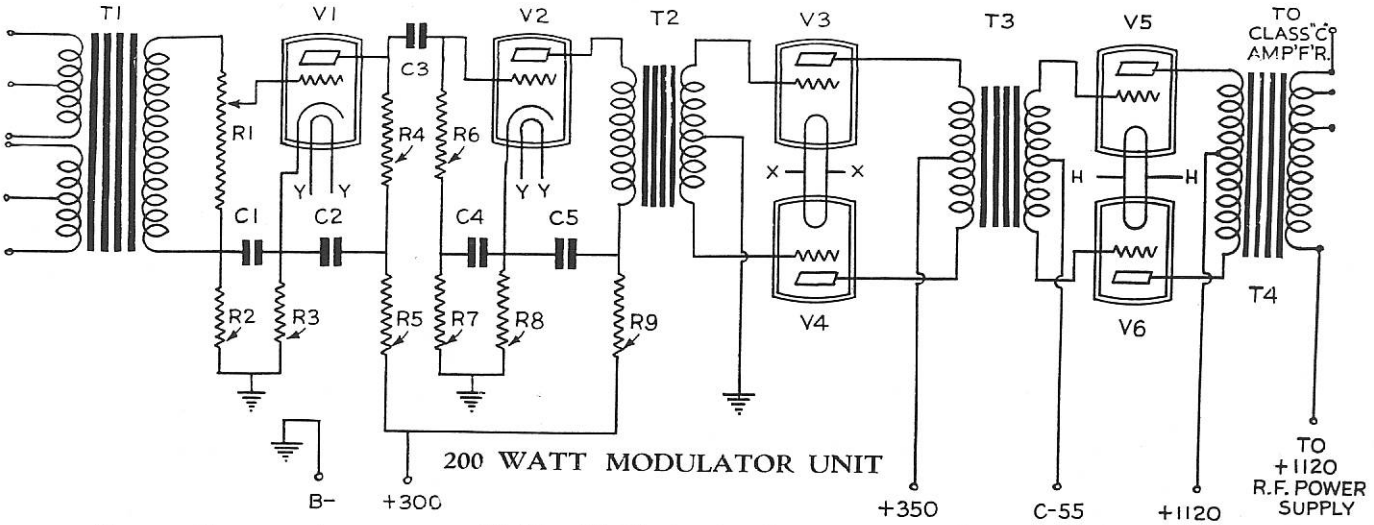
T1	Filament transformer	type T360
T2	Plate transformer	type T658
T3	Filament transformer	type T373
L1	Filter choke	type T165
L2	Filter choke	type T165
L3	Filter choke	type T154
L4	Filter choke	type T154

Miscellaneous Parts

C1, C2	2 mfd. 1500 volt condenser
C3	4 mfd. 600 volt condenser
C4	8 mfd. 600 volt condenser
C5	.1 mfd. 1000 volt condenser
R1	75,000 ohm 50 watt
R2	50,000 ohm 50 watt
R3	1,000 ohm 75 watt

Tubes

V1, V2	type 866 tubes
V3	type 83 tube



200 WATT MODULATOR UNIT

Kenyon Components

T1	Input transformer	type T1
T2	Interstage transformer	type T56
T3	P. P. 45's to 2-800's	type T258
T4	Modulation transformer	type T460

Miscellaneous Parts

R1	100,000 ohm potentiometer	
R2, R4	100,000 ohm	1 watt
R3, R8	2,500 ohm	1 watt
R5	50,000 ohm	1 watt
R6	500,000 ohm	1 watt
R7	200,000 ohm	1 watt
R9	10,000 ohm	1 watt
C1, C4	10 mfd.	25 volt
C2, C5	2 mfd.	450 volt

Tubes

V1, V2	type	76's
V3, V4	type	45's
V5, V6	type	800's

RADIO FREQUENCY UNIT

Kenyon Components

R1, R2, R5	50,000 ohm	2 watt	C1, C3, C8, C11, C14, C15, C18 } See Coil Chart
R3	4,000 ohm	2 watt	L1, L2, L3, L4, L5, L6, L7 } See Coil Chart
R4	10,000 ohm	5 watt	C2, C6, C9, C10, C12 .01 mfd. 1000 volt
R6	7,000 ohm	10 watt	C5 .0001 mfd. 1000 volt
			C7 .0005 mfd. 500 volt
			C16, C17 25 mmfd. variable
			C19 .002 mfd. 1500 volt

Tubes

V1, V2	type	59 tubes
V3	type	841 tube
V4, V5	type	800 tubes

200 WATT MODULATOR POWER SUPPLY

Kenyon Components

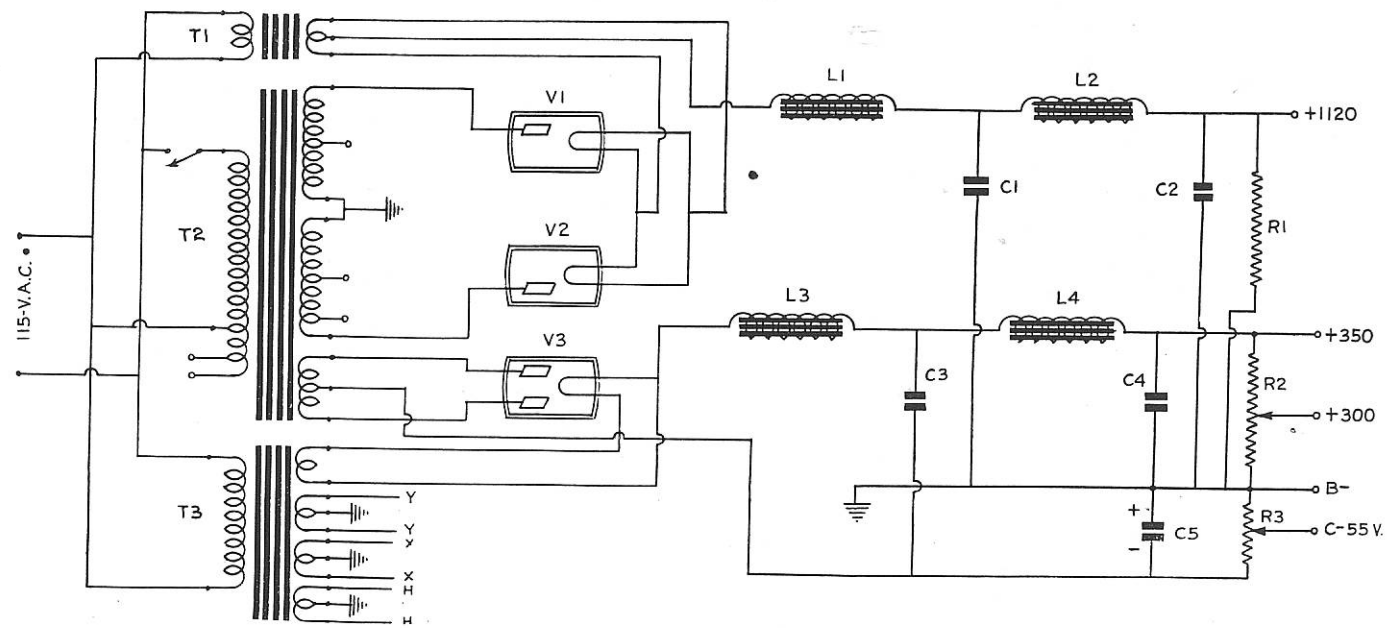
T1	Filament transformer	type T360
T2	Plate transformer	type T658
T3	Filament transformer	type T374
L1	Swinging choke	type T511
L2	Filter choke	type T165
L3, L4	Filter choke	type T154

Miscellaneous Parts

C1, C2	4 mfd.	1500 volt
C3	4 mfd.	600 volt
C4	8 mfd.	500 volt
C5	12 mfd.	200 volt
R1	75,000 ohm	50 watt
R2	30,000 ohm	50 watt
R3	1,000 ohm	50 watt

Tubes

V1, V2	866's
V3	5Z3



A 500 WATT C. W.—PHONE TRANSMITTER

THE new type 838 zero bias tubes are used to full advantage in this transmitter and because of the excellent characteristics of these tubes, this unit has become one of the most popular for amateurs who go in for high power jobs.

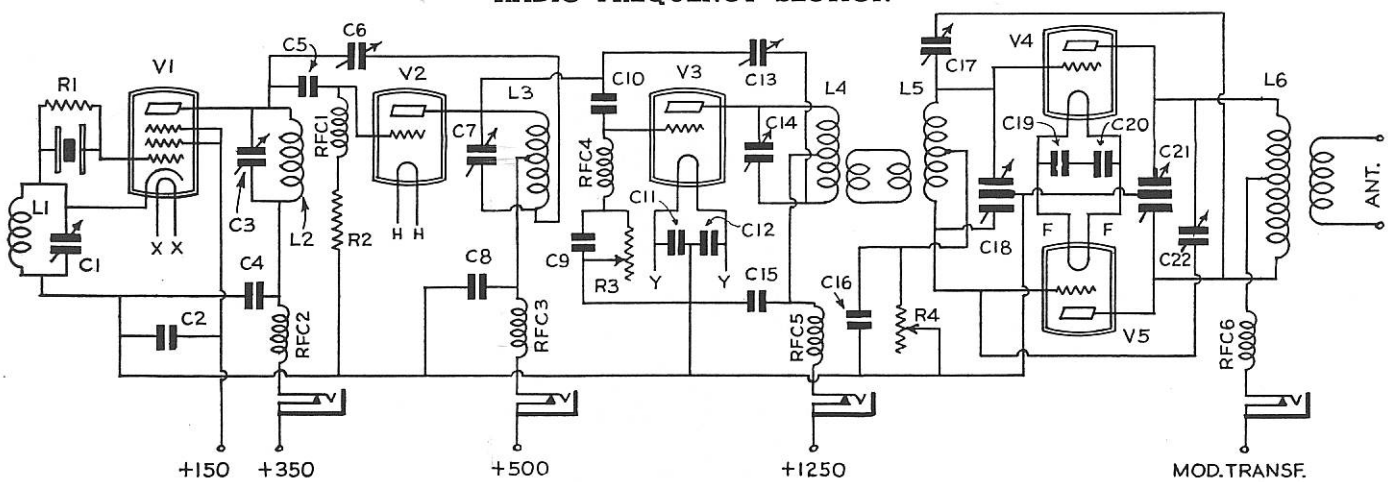
A 59 is used in the conventional tri-tet circuit followed by two buffer stages using a type 10 and type 38 tube. The output of this is fed into two type 38's Class "C" developing a "wallop" of 500 watts.

The audio end consists of a 76 feeding another 76 as a voltage amplifier which is coupled to two 2A3's in push-pull parallel. These tubes drive the two 838's in Class "B". Since no grid bias is required in the Class "B" stage, adjustments of this circuit are greatly simplified.

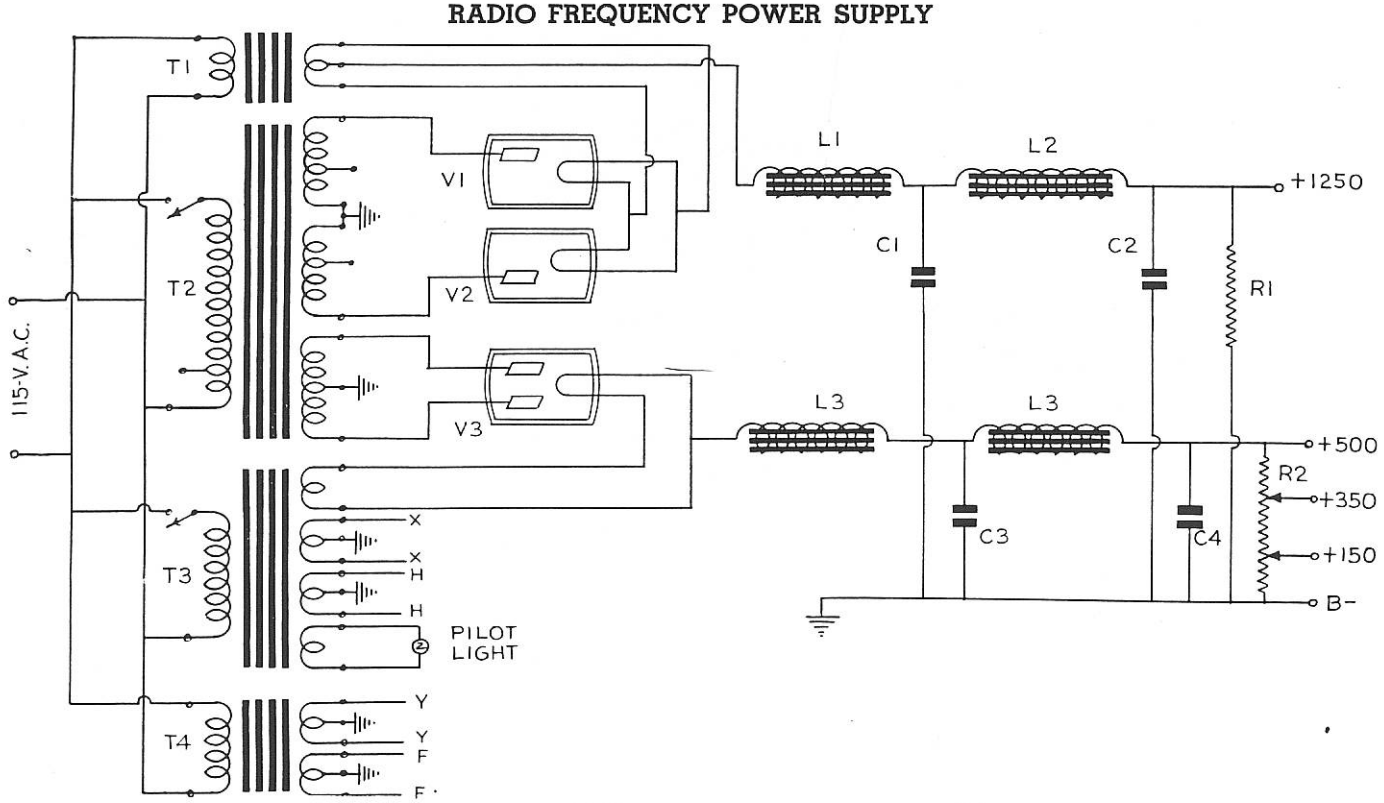
The R.F. power supply uses one of the new triple winding transformers (a new exclusive Kenyon development). By means of this unit the number of transformers is reduced to a minimum.

The power supply for the speech amplifier is similar in design to that for the R.F. section and uses the same type of transformer. The filtering afforded by the large chokes in this supply unit is adequate to eliminate entirely all objectionable ripple.

RADIO FREQUENCY SECTION



RADIO FREQUENCY POWER SUPPLY



500 WATTS R.F. UNIT

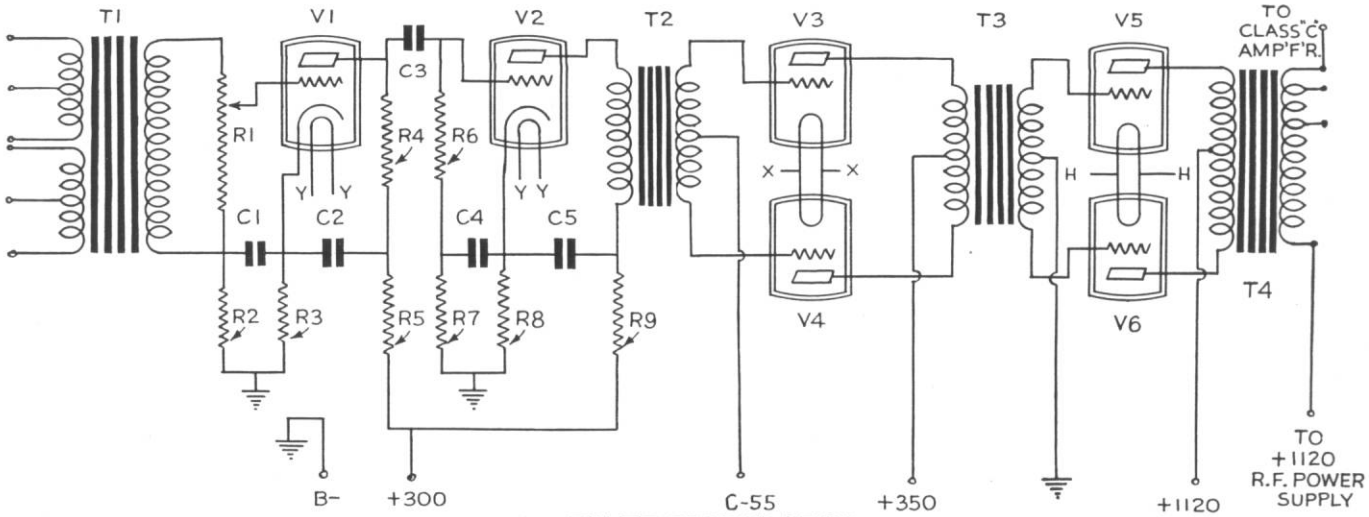
C1, C3, C7, C14, C18, C21 } L1, L2, L3, L4, L5, L6 }	See Coil Table	C15	.01 mfd. 1500 volt
C6, C13, C17, C22	15 mmfd. variable	C11, C12, C19, C20	.002 mfd. 500 volt
C2, C4	.01 mfd. 500 volt	R1	50,000 ohm 1 watt
C5, C10	.002 mfd. 2000 volt	R2	20,000 ohm 25 watt
		R3	10,000 ohm 50 watt

R4 2,000 ohm 75 watt

R. F. C. Radio Frequency chokes suitable for frequencies used.

V1	type 59 tube
V2	type 10 or 801 tube
V3, V4, V5	type 838 tubes

MODULATION UNIT



500 WATT MODULATOR

Kenyon Components

T1	Input transformer	type T1
T2	Interstage transformer	type T56
T3	P. P. 2A3's to 2-838 Class B	type T259
T4	Modulation transformer	type T465
R1	100,000 ohm potentiometer	

R2	100,000 ohm	1 watt
R3, R8	2,500 ohm	1 watt
R4, R7	100,000 ohm	1 watt
R5	50,000 ohm	1 watt
R6	500,000 ohm	1 watt
R9	10,000 ohm	1 watt

C1, C4	10 mfd.	25 volt
C2, C5	1 mfd.	450 volt
V1, V2	type 76's	
V3, V4	type 2A3's	
V5, V6	type 838's	

500 WATT R.F. POWER SUPPLY

Kenyon Components

T1	Filament transformer	type T360
T2	Plate transformer	type T660
T3	Filament transformer	type T374
T4	Filament transformer	type T363

L1, L2	Filter choke	type T177
L3	Filter choke	type T152

Miscellaneous Parts

C1, C2	2 mfd.	1500 volt

C3, C4	4 mfd.	600 volt
R1	60,000 ohm	75 watt
R2	25,000 ohm	50 watt
V1, V2	type 866 tubes	
V3	type 83 tube	

500 WATTS MODULATOR POWER SUPPLY

Kenyon Components

T1	Filament transformer	type T360
T2	Plate transformer	type T659
T3	Filament transformer	type T370
T4	Filament transformer	type T361
L1	Swinging choke	type T516

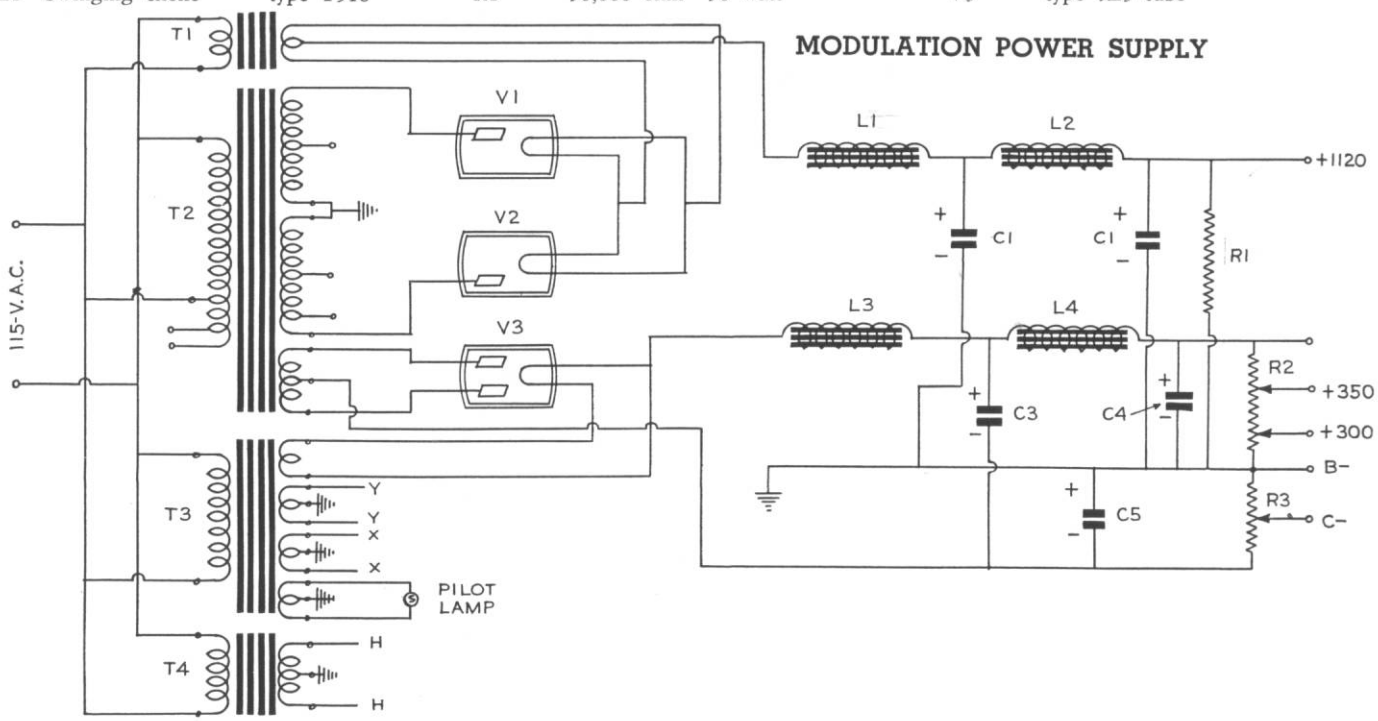
L2	Filter choke	type T167
L3, L4	Filter choke	type T154
C1	4 mfd.	1500 volt
C3, C4	8 mfd.	600 volt
C5	12 mfd.	200 volt
R1	50,000 ohm	50 watt

R2	50,000 ohm	100 watt
R3	1,000 ohm	50 watt

Tubes

V1, V2	type 866 tubes
V3	type 5Z3 tube

MODULATION POWER SUPPLY



1 KILOWATT PHONE AND C. W. TRANSMITTER

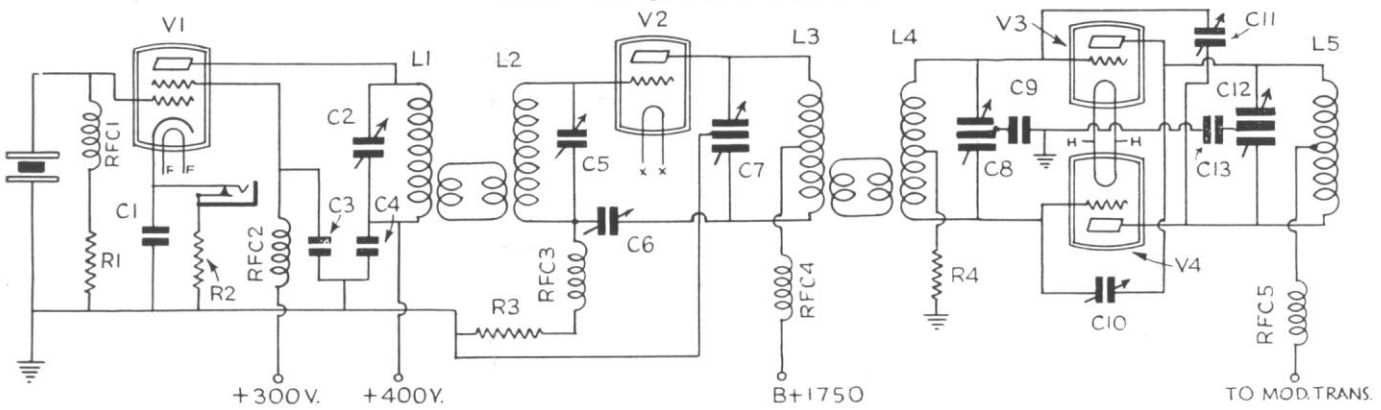
MODERN trend in high power transmitters is toward eliminating as many stages as possible, consistent with good results and superb quality. This transmitter has been designed with this point in view, as well as economy as to space requirements wherever possible.

The tube line-up in the R.F. section is a 6L6G beam power tube used as a crystal controlled oscillator, which feeds into an HF 200 buffer amplifier driving two HF 300's in the final.

The A.F. section for "phone hounds" is not shown in its entirety. Only the final output tubes are shown. These HD 203A's are capable of delivering a full 500 watts of audio power when properly driven. The reader is requested to refer to the 36 watt amplifier using four 2A3's (Page 15). This amplifier when used with a type T-260 output transformer will drive the two HD 203A's to full output with little distortion.

The husky modulation transformer is capable of carrying the full R.F. Class "C" load without attenuating the low notes—a factor to consider when constructing a transmitter of these proportions.

RADIO FREQUENCY SECTION



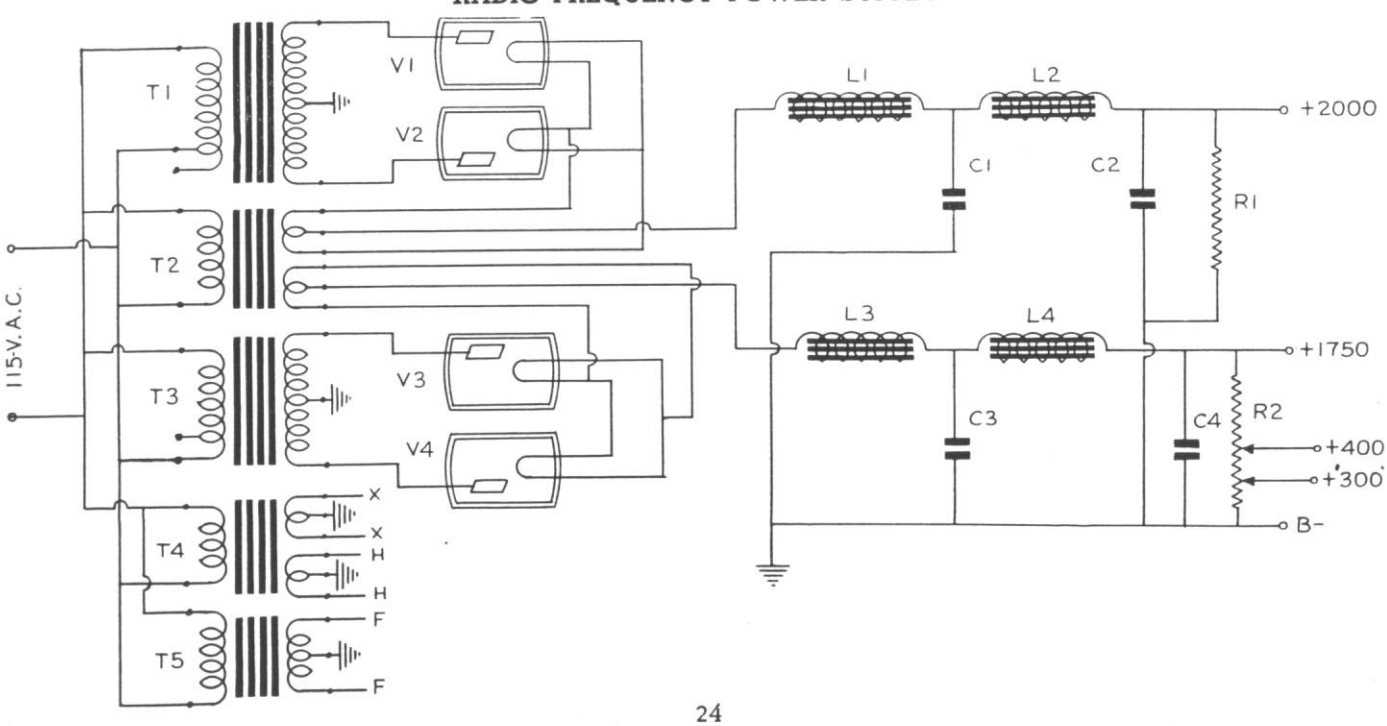
1 KILOWATT R.F. UNIT

C2, C5, C7, C8, C12 } L1, L2, L3, L4, L5 }	See Coil Table	
C6	20 mmfd.	variable
C10, C11	15 mmfd.	variable
C1, 3, 4	.1 mmfd.	1000 volt
C9	.002 mmfd.	1500 volt
C13	.002 mmfd.	7500 volt
R1	10,000 ohm	5 watt
R2	400 ohm	5 watt
R3	5,000 ohm	100 watt
R4	3,500 ohm	200 watt

Tubes

V1	6L6G
V2	HF 200
V3, 4	HF 300

RADIO FREQUENCY POWER SUPPLY



POWER SUPPLY (R.F.)

Kenyon Components

T1	Plate transformer	type T663
T2	Filament transformer	type T366
T3	Plate transformer	type T662
T4	Filament transformer	type T362
T5	Filament transformer	type T351
L1, L2	Filter choke	type T177
L3, L4	Filter choke	type T176

Miscellaneous Parts

C1, C2	2 mfd. 2500 volt
C3, C4	2 mfd. 2000 volt
R1	75,000 ohm 200 watt
R2	50,000 ohm 200 watt

Tubes

V1, V2, V3 and V4 type 866 tubes

1 KILOWATT MODULATION UNIT

Kenyon Components

T1 P. P. Parallel 2A3's to P. P. H. D. 203A's type T260
T2 P. P. H. D. 203A's to Class C type T470

A suitable speech amplifier to drive this unit is shown on page 15.

Tubes

V1, V2 HD 203A tubes

Miscellaneous Parts

C1 .002 mfd. 2500 volt mica
R. F. C. 2.5 millihenries

MODULATION POWER SUPPLY

Kenyon Components

T1	Filament transformer	type T360
T2	Plate transformer	type T661
T3	Filament transformer	type T361
T4	Bias transformer	type T220
L1	Swinging choke	type T521
L2	Filter choke	type T177
L3	Filter choke	type T166

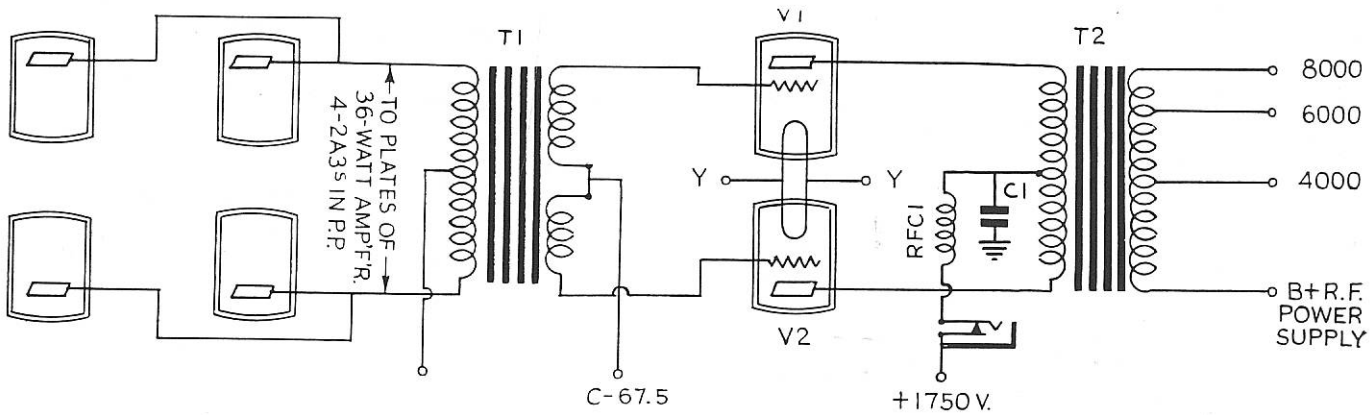
Miscellaneous Parts

C1	2 mfd. 2500 volt
C2	4 mfd. 2000 volt
C3	24 mfd. 200 volt
R1	50,000 ohms 100 watt
R2	1,000 ohms 50 watt

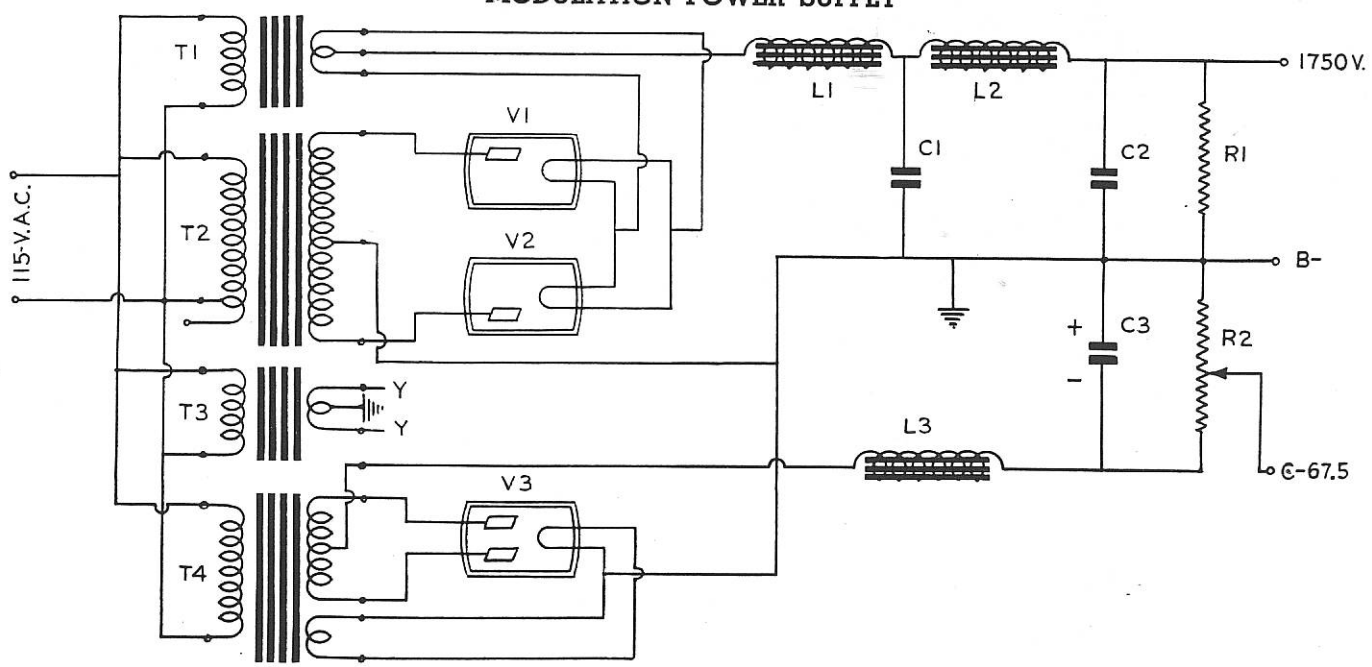
Tubes

V1, V2 type 866 tubes
V3 type 83 tube

MODULATION UNIT



MODULATION POWER SUPPLY



A 100 WATT HIGH FREQUENCY PHONE TRANSMITTER

THIS ultra modern 56 megacycle transmitter is the practical answer to frequency stability on the higher frequencies. The oscillator is a tri-tet with suppressor feed back to increase the harmonic output. The fundamental crystal frequency used to obtain 56 megacycle operation is 7 MC.

Modulation is accomplished with an audio frequency amplifier comprising four type 46 tubes in push-pull parallel in the output. This audio system conservatively develops a power of 50 watts with low distortion or harmonic content.

Two separate power supplies are used in this transmitter; one supplies plate and filament current for the R.F. portion of the circuit and the other the speech amplifier. This is necessary due to the large current fluctuation in the Class "B" circuit. The swinging choke L1 in the audio power amplifier supply provides good regulation necessary in a Class "B" circuit such as this where the current drain requirements from static load to full output are so varied.

COIL DETAILS 7 MC CRYSTAL—56 MC OPERATION

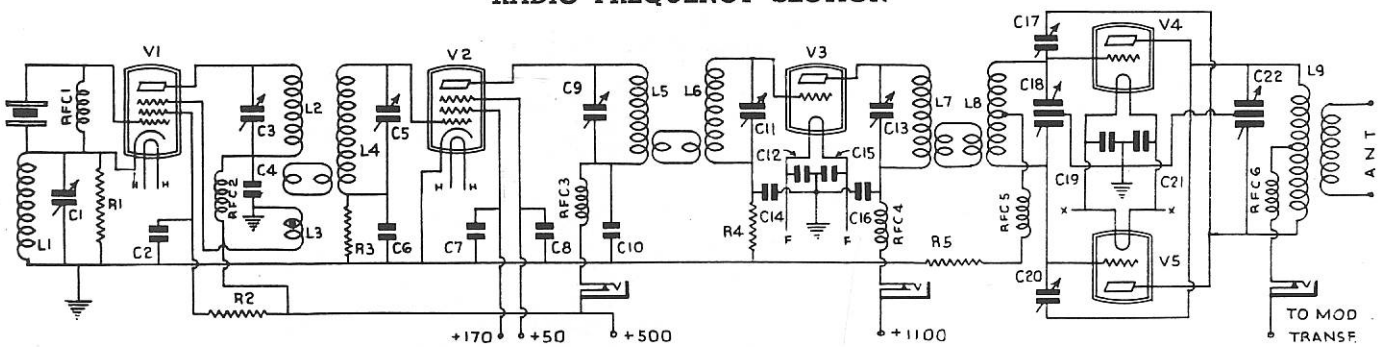
Coil	Turns	Winding Spaced To
L1	9	1 inch
L2	8	½ inch
L3	4	⅜ inch
L4	9	⅝ inch
L5	10	1 inch
L6	7	1 inch
L7	3	¾ inch
L8	4	1 inch center tapped
L9	8	1¾ inches center tapped

Coils L1 to L5 are wound on 1½ inch plug-in coil forms.

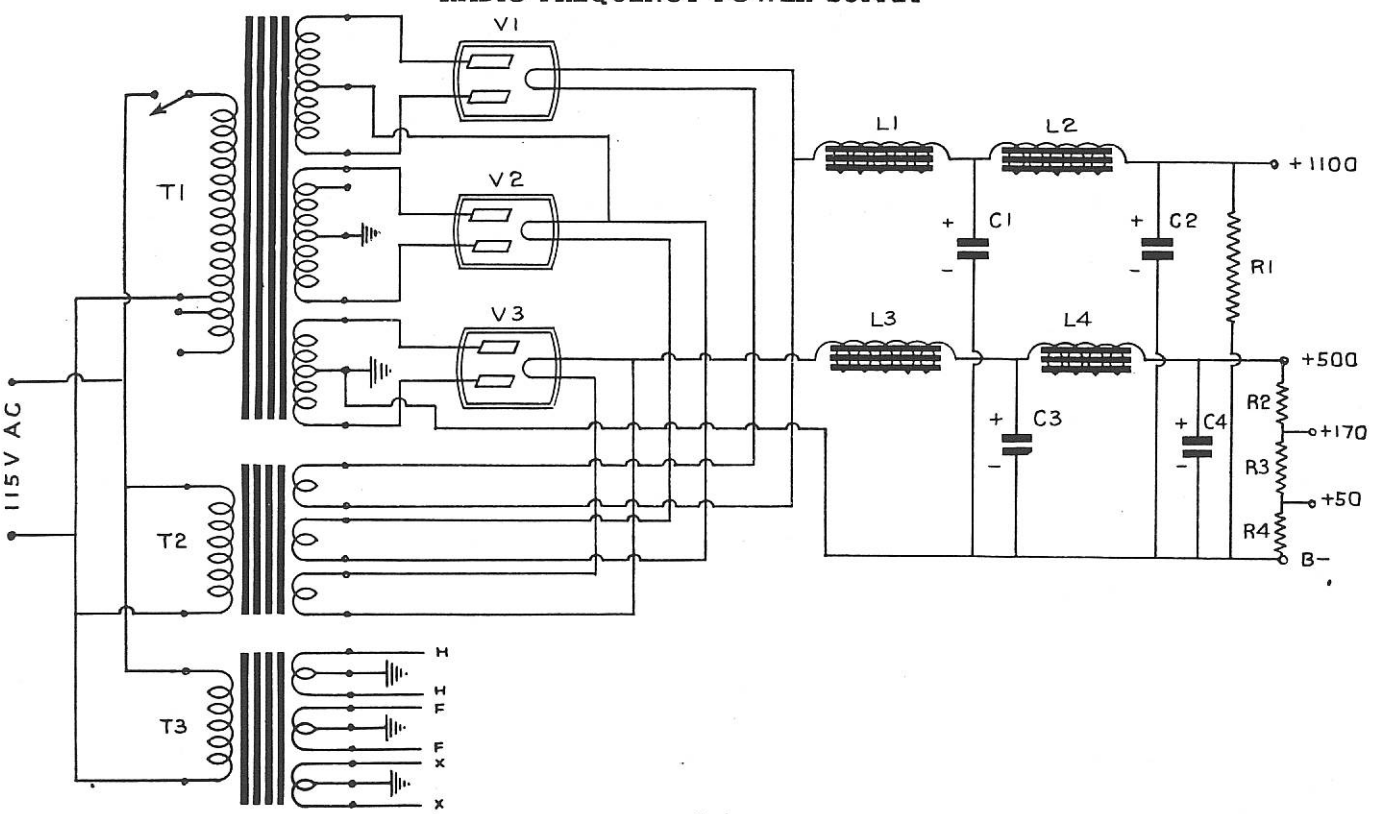
Coils L6 to L9 are wound 1¼ inches in diameter, self supporting.

Condenser C22 is a home made three plate split stator tank condenser, plates spaced ¼ inch apart. The value of other components are included in the list of parts.

RADIO FREQUENCY SECTION



RADIO FREQUENCY POWER SUPPLY



HIGH FREQUENCY 100 WATTS (R.F. SECTION)

C1	250 mmfd. variable	R5	30,000 ohm 20 watt
C3, C5, C9, C11, C13	100 mmfd. variable	C2, C4, C6, C7, C8, C10, C12, C14, C15, C19, C21	.002 mfd. 1000 volt
C18, C22	30 mmfd. split stator	C16	.01 mfd. 2000 volt
R1, R3	50,000 ohm 2 watt	C17, C20	10 mmfd. variable
R2	15,000 ohm 10 watt	RFC 1, 2, 3, 4, 5, 6	2.5 millihenry
R4	60,000 ohm 50 watt		

Tubes

V1, V2 type RK25's
V3, V4, V5 type 35T's

RADIO FREQUENCY POWER SUPPLY

Kenyon Components

T1	Plate supply transformer	type T658
T2	Power supply filament transformer	type T355
T3	Filament transformer	type T356
L1, L2	Filter choke	type T168
L3, L4	Filter choke	type T154

Miscellaneous Parts

C1, C2	2 mfd. 2000 volt
C3, C4	4 mfd. 650 volt
R1	75,000 ohm 50 watt
R2	25,000 ohm 10 watt
R3	10,000 ohm 10 watt
R4	5,000 ohm 10 watt

Tubes

V1, V2, V3 type 83 tubes

MODULATOR UNIT

Kenyon Components

T1	Microphone input transformers	type T1
T2	Single plate to push pull grid	type T52
T3	Push-pull Class B input transformer	type T257
T4	Modulation transformer to 3000, 5000 ohms and 7000 ohms	type T457

Tubes

V1, V2	type 56 tubes
V3	type 45 tubes
V5, V6, V7, V8	type 46 tubes

Miscellaneous Parts

R1	150,000 ohm potentiometer
R2, R7	2,000 ohm 1 watt
R3	100,000 ohm 1 watt
R4, R6	50,000 ohm 1 watt
R5	250,000 ohm 1 watt
R8	10,000 ohm 1 watt
R9	750 ohm 10 watt
R10	20 ohm CT 5 watt
C1, C4	10 mfd. 25 volt
C2, C5	1 mfd. 450 volt
C6	25 mfd. 100 volt

POWER SUPPLY FOR MODULATION UNIT

Kenyon Components

T1	Filament transformer	type T364
T2	Plate transformer	type T655
L1	Swinging choke	type T510
L2	Filter choke	type T153

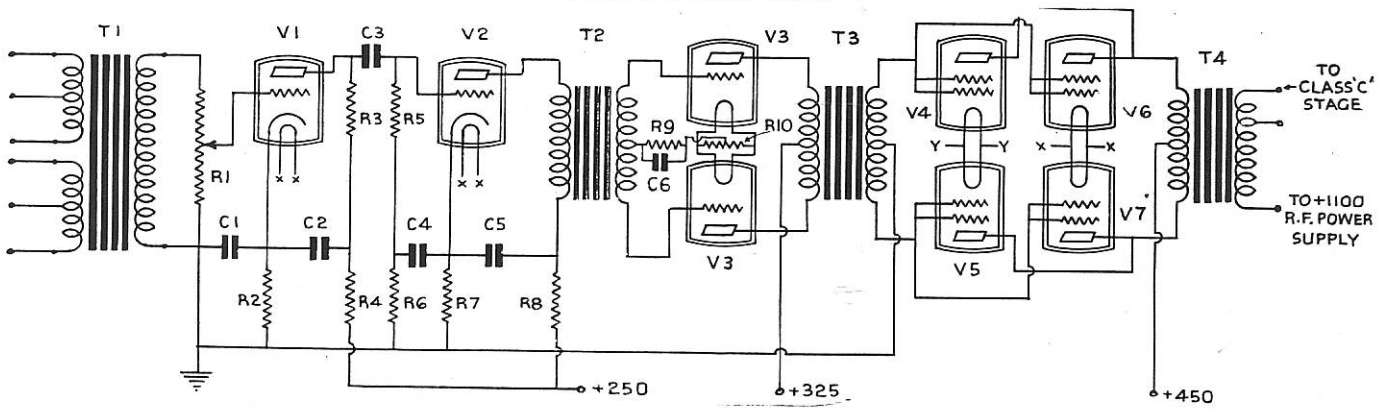
Miscellaneous Parts

R1, R2	50 ohm CT 10 watt
R3	1,500 ohm 20 watt
R4	40,000 ohm 50 watt
C1, C2	Two 8 mfd. connected in series
C3	8 mfd. 450 volt

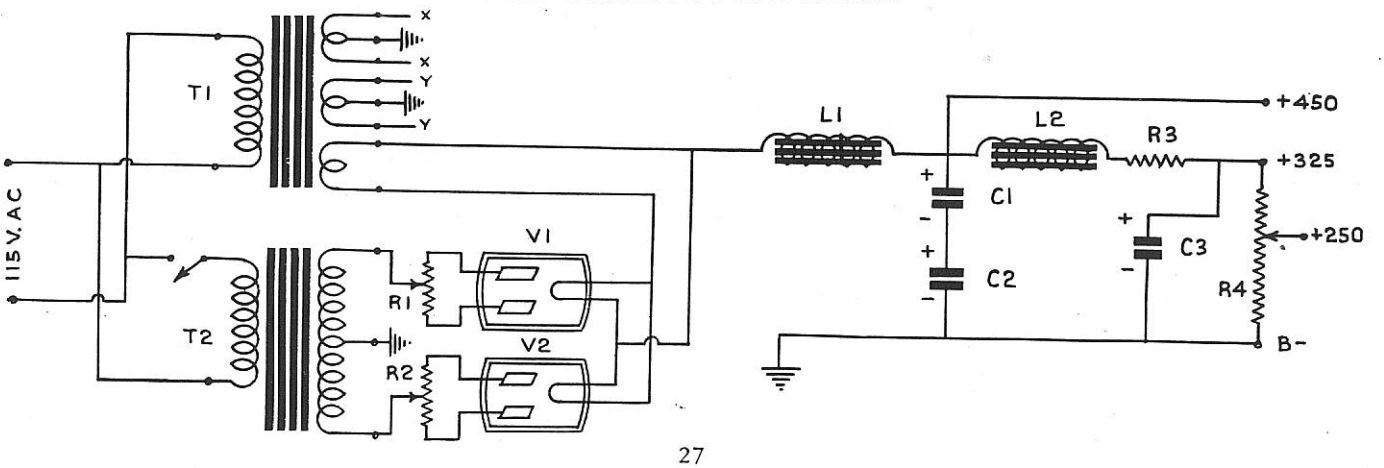
Tubes

V1, V2 type 83 tubes

MODULATION UNIT



MODULATION POWER SUPPLY



A 5 METER TRANSMITTER AND RECEIVER

THIS circuit differs from the standard transceiver in that separate tubes are used for the oscillator of the transmitter and the detector of the receiver. Because of the difference in the requirements for these two components of the system, it was found that the common method of using only one tube for both operations with a change-over switch for shifting from one to the other, was not entirely satisfactory. If the constants were adjusted for receiving, the oscillator characteristics were poor and vice-versa.

This circuit avoids this difficulty by using separate tubes, tuning circuits and even antennas so that the two circuits are entirely separate. This results in characteristics which improve the overall operation of this unit.

Since the audio frequency amplifier and modulator system are so similar in requirements and operating conditions, the same unit serves the double function. This is obtained with a double winding input transformer and a change-over switch at the output for feeding into phones or into the oscillator.

The change-over switch shunts the amplifier from "transmit" to "receive" position and also opens the filament of the detector tube for sending and the oscillator tube for receiving. The same switch also opens the microphone circuit when receiving, to economize in battery consumption.

A potentiometer connected across the secondary of transformer T1 operates as volume control in the "receive" position and as microphone gain control in the "transmit" position. A separate variable rheostat acts as a regeneration control.

TRANSCEIVER

List of Parts

Kenyon Components

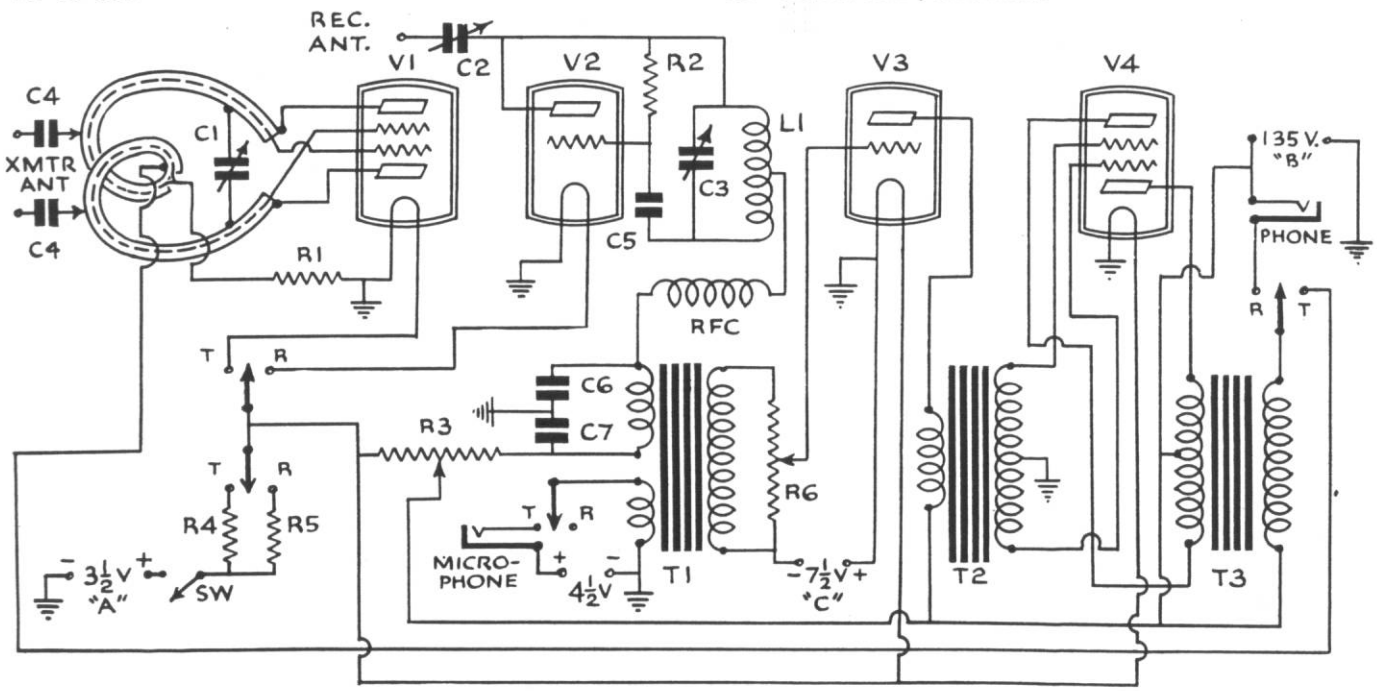
T1	Mike and interstage transformer	type T53
T2	Driver transformer 30 to 19's	type T252
T3	Modulation transformer 19's to 3,000 and 5,000 ohm	type T452

Tubes

V1	19 tube
V2	30 tube
V3	30 tube
V4	19 tube

Miscellaneous Parts

C1	15 mmfd. variable
C2	25 mmfd. variable
C3	10 mmfd. variable
C4	.0002 mfd.
C5	.00025 mfd.
C6	.003 mfd.
C7	.003 mfd.
R1	5,000 ohm 1 watt
R2	20 megohm
R3	100,000 ohm variable
R4	1 ohm 5 watt
R5	2 ohm 5 watt
R6	500,000 ohm potentiometer



A TWO-TUBE 5 METER TRANSCEIVER

THIS small transceiver, for portable use, to be thrown into the car or taken to Hamfests is a popular item due to its low cost, simplicity of design, fool-proof operation and compactness. The entire unit can be mounted in a small carrying case, which can be picked up and moved from place to place easily.

The tubes used in this unit are a 6A6 and a type 42. These tubes, by means of a switching arrangement, shown in the circuit diagram, function as oscillator and modulator for the transmitter, and detector and amplifier when used as a receiver.

Since the batteries will in all probability be contained in the same case as the transceiver the unit is ready for operation at a moment's notice by simply turning on the switch.

The actual constructional lay-out of this unit is left to the individual constructor, since there are no stringent requirements as to lay-out of parts, etc. The only requirement is that all wires be kept as short as possible and that all mounting and wiring be done in a neat and workmanlike manner. This is necessary in a portable as it is often subjected to severe abuse.

The antenna for 5 meter operation can be either a vertical rod, or a wire of suitable length elevated as high as possible.

TRANSCEIVER (5 METERS)

List of Parts

Kenyon Components

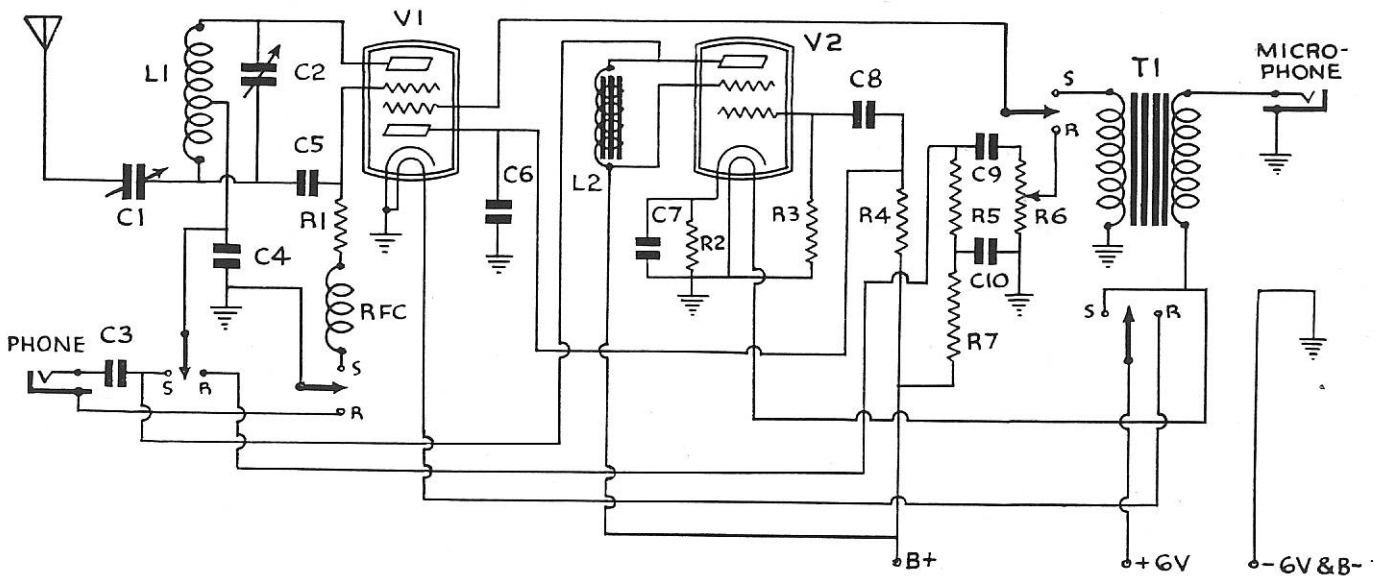
T1 Input transformer type T1
L2 Plate impedance choke type T156

Miscellaneous Parts

L1 8 turns No. 14 wire, wound on ½" form tapped at 3rd turn from grid end of coil.
RCF 80 turns of No. 34 D. S. C. on ⅜" form.
C1 25 mmfd. variable
C2 15 mmfd. variable
C3 .25 mfd. 450 volt
C4 .006 mfd. 450 volt
C5 .001 mfd. 450 volt
C6 .01 mfd. 450 volt
C7 25. mfd. 25 volt
C8 .01 mfd. 450 volt
C9 .01 mfd. 450 volt
C10 .25 mfd. 450 volt
R1 5,000 ohm 1 watt
R2 400 ohm 2 watt
R3 500,000 ohm 1 watt
R4 25,000 ohm 1 watt
R5 10,000 ohm 1 watt
R6 500,000 ohm potentiometer
R7 10,000 ohm 1 watt

Tubes

V1 type 6A6 tube
V2 type 42 tube



USEFUL RADIO DATA

Ohms Law for D.C.

$$E = IxR = \sqrt{PR} = \frac{P}{I} = \frac{I}{G}$$

$$I = \frac{E}{R} = \sqrt{\frac{P}{R}} = \frac{P}{E} = EG$$

$$R = \frac{E}{I} = \frac{E^2}{P} = \frac{P}{I^2} = \frac{I}{G}$$

$$G = \frac{I}{E} = \frac{I^2}{P} = \frac{P}{E^2} = \frac{I}{R}$$

Where

E = Voltage
I = Current — Amperes
R = Resistance — ohms
P = Power — watts
G = Conductance — mhos

Ohms Law for A.C.

$$X = \frac{E}{I}, \quad E = IX, \quad 1 = \frac{E}{X}$$

$$Xc = \frac{1}{2\pi FC}, \quad XI = 2\pi FL$$

$$Z = \sqrt{R^2 + X^2} = \sqrt{R^2 + (XL - Xc)^2}$$

$$\text{Or } Z = \sqrt{R^2 + \left(2\pi FL - \frac{1}{2\pi FC}\right)^2}$$

$$\text{Or } Z = \frac{E}{I}, \quad E = IZ, \quad 1 = \frac{E}{Z}$$

$$I = \frac{E}{\sqrt{X^2 + R^2}}, \quad E = I\sqrt{X^2 + R^2}$$

$$I = \frac{E}{\sqrt{(XL - XC)^2 + R^2}}$$

$$E = I\sqrt{(XL - Xc)^2 + R^2}$$

Where

X = Reactance — ohms
Xc = Capacitive reactance — ohms
XL = Inductive reactance — ohms
Z = Impedance — ohms
R = Resistance — ohms
L = Inductance in henries
C = Capacity in farads
F = Frequency — cycles per second
2π = 6.28

Resistor Formula

$$Rt = \frac{R_1 \times R_2}{R_1 + R_2} \text{ for two resistors}$$

$$R_1 = \frac{RtR_2}{R_2 - Rt}, \quad R_2 = \frac{RtR_1}{R_1 - Rt}$$

For three or more resistors

$$Rt = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} \text{ etc.}}$$

Resistors in Series = $R_1 + R_2 + R_3$ etc.
Resistors in Parellel —
Rt = Total resistance
R_1 = One value of R
R_2 = Another value of R

Condenser Formula

Ct = Total Capacity

For Condensers in parallel

$Ct = C_1 + C_2 + C_3$, etc.

For Condensers in Series

$$Ct \text{ for two condensers} = \frac{C_1C_2}{C_1 + C_2}$$

$$C_1 = \frac{CtC_2}{C_2 - Ct}, \quad C_2 = \frac{CtC_1}{C_1 - Ct}$$

Ct for three or more =

$$\frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} \text{ etc.}}$$

Equivalent Series Resistance of Shunt Resistance Across a Condenser

The effect of a high value of resistance connected across a condenser may be resolved into the effect of a resistance connected in series with the condenser by means of the following equation in which "r" is the shunt resistance and "R" is the equivalent series resistance.

$$R = \frac{1}{(6.28f)^2 \times C^2 \times r}$$

Resonance Formula

Formulas —

F = Frequency in Kilocycles
L = Inductance in Microhenries
C = Capacity in Microfarads

$$F^2 = \frac{25330}{LC}, \quad L = \frac{25330}{F^2C}, \quad C = \frac{25330}{F^2L}$$

Gain of Amplifier Stage

G = Gain
Mu = Amplification factor
RI = Plate load
Rp = Internal A.C. plate resistance of tube

$$G = Mu \frac{RI}{RI + Rp}$$

Impedance of resistor and either capacitive or inductive reactance in parallel.

$$Z = \frac{XR}{\sqrt{R^2 + X^2}}$$

If R and Z are known —

$$X = \frac{ZR}{\sqrt{R^2 - Z^2}}$$

If Z and X are known —

$$R = \frac{XZ}{\sqrt{X^2 - Z^2}}$$

A.C. Current and Voltage Relationships

$E_{max} = E_{eff} \times 1.414 = E_{ave} \times 1.57$
$E_{eff} = E_{max} \times .707 = E_{ave} \times 1.11$
$E_{ave} = E_{max} \times .636 = E_{eff} \times .9$

Sharpness of Resonance

The ratio between the inductive reactance of a coil and its effective resistance gives a measure of efficiency known as the "Q".

$$Q = \frac{6.28 \times f \times L}{R}$$

Frequency — Wavelength Conversion

To convert frequency in cycles to wavelength in meters.

$$\text{Wavelength in Meters} = \frac{299{,}820{,}000}{f}$$

To convert wavelength in meters to frequency in cycles.

$$\text{Frequency in Cycles} = \frac{299{,}820{,}000}{\text{Wavelength in Meters}}$$

USEFUL RADIO DATA

Abbreviations for Radio Terms

Alternating current	a.c.
Ampere (amperes)	amp.
Antenna	ant.
Audio frequency	a.f.
Centimeter	cm.
Continuous waves	c.w.
Cycles per second	~
Decibel	db
Direct current	d.c.
Electromotive force	e.m.f.
Frequency	f.
Ground	gnd.
Henry	h.
High frequency	h.f.
Intermediate frequency	i.f.
Interrupted continuous waves	i.c.w.
Kilocycles (per second)	kc.
Kilowatt	kw.
Megacycle (per second)	Mc.
Megohm	MΩ
Meter	m.
Microfarad	μfd.
Microhenry	μh.
Micromicrofarad	μμfd.
Microvolt	μv.
Microvolt per meter	μv/m.
Microwatt	μw.
Milliampere	ma.
Millivolt	mv.
Milliwatt	mw.
Modulated continuous waves	m.c.w.
Ohm	Ω
Power	P.
Power factor	p.f.
Radio frequency	r.f.
Ultra-high frequency	u.h.f.
Volt (volts)	v.
Watt (watts)	w.

Standard Symbols for Electrical Quantities

Admittance	Y, y
Angular velocity ($2\pi f$)	ω
Capacitance	C
Conductance	G, g
Current	I, i
Dielectric constant	K
Frequency	f
Impedance	Z, z
Inductance	L
Magnetic intensity	H
Magnetic flux	Φ
Magnetic flux density	B
Mutual inductance	M
Permeability	μ
Phase displacement	θ or φ
Power	P, p
Quantity of electricity	Q, q
Reactance	X, x
Resistance	R, r
Susceptance	b
Speed of rotation	n
Voltage	E, e
Watts	W

Conversion Table

Factors for Conversion, Alphabetically Arranged

Multiply	*By*	*To Get*
Amperes	× 1,000,000,000,000	micromicroamperes
Amperes	× 1,000,000	microamperes
Amperes	× 1,000	milliamperes
Cycles	× .000,001	megacycles
Cycles	× .001	kilocycles
Farads	× 1,000,000,000,000	micromicrofarads
Farads	× 1,000,000	microfarads
Henrys	× 1,000,000	microhenrys
Henrys	× 1,000	millihenrys
Kilocycles	× 1,000	cycles
Kilovolts	× 1,000	volts
Kilowatts	× 1,000	watts
Megacycles	× 1,000,000	cycles
Mhos	× 1,000,000	micromhos
Microamperes	× .000,001	amperes
Microfarads	× .000,001	farads
Microhenrys	× .000,001	henrys
Micromhos	× .000,001	mhos
Micro-ohms	× .000,001	ohms
Microvolts	× .000,001	volts
Microwatts	× .000,001	watts
Micromicrofarads	× .000,000,000,001	farads
Milliamperes	× .001	amperes
Millihenrys	× .001	henrys
Millimhos	× .001	mhos
Milliohms	× .001	ohms
Millivolts	× .001	volts
Milliwatts	× .001	watts
Ohms	× 1,000,000,000,000	micromicro-ohms
Ohms	× 1,000,000,000	micro-ohms
Volts	× 1,000,000	microvolts
Volts	× 1,000	millivolts
Watts	× 1,000,000	microwatts
Watts	× 1,000	milliwatts
Watts	× .001	kilowatts

Letter Symbols for Vacuum Tube Notation

Grid potential	E_g, e_g
Grid potential of grids 1, 2, 3, . . . Grids are numbered in order of proximity to cathode	E_{g1}, E_{g2}, E_{g3}
Grid current	I_g, i_g
Grid conductance	g_g
Grid resistance	r_g
Grid bias voltage	E_c
Plate potential	E_p, e_p
Plate current	I_p, i_p
Plate conductance	g_p
Plate resistance	r_p
Plate supply voltage	E_b
Emission current	I_c
Mutual conductance	g_m
Amplification factor	μ
Filament terminal voltage	E_f
Filament current	I_f
Filament supply voltage	E_a
Grid-plate capacity	C_{gp}
Grid-filament capacity	C_{gf}
Plate-filament capacity	C_{pf}
Grid capacity ($C_{gp}+C_{gf}$)	C_g
Plate capacity ($C_{gp}+C_{pf}$)	C_p
Filament capacity ($C_{gf}+C_{pf}$)	C_f

Small letters refer to instantaneous values.

USEFUL RADIO DATA

Inductance Calculations

The inductance of single-layer coils for transmitters and receivers are easy to calculate from the following formula:

$$L = \frac{0.2\,A^2\,N^2}{3A + 9B}$$

where L is the inductance in microhenrys

A is the mean diameter of the coil in inches

B is the length of winding in inches

N is the number of turns.

To determine the numbers of turns of a single layer coil:

$$N = \sqrt{\frac{3A + 9B}{0.2A^2} \times L}$$

Centigrade and Fahrenheit Degrees

Deg. C.	Deg. F.	Deg. C.	Deg. F.	Deg. C.	Deg. F.	Deg. C.	Deg. F.
0	32.0	26	78.8	51	123.8	76	168.8
1	33.8	27	80.6	52	125.6	77	170.6
2	35.6	28	82.4	53	127.4	78	172.4
3	37.4	29	84.2	54	129.2	79	174.2
4	39.2	30	86.0	55	131.0	80	176.0
5	41.0	31	87.8	56	132.8	81	177.8
6	42.8	32	89.6	57	134.6	82	179.6
7	44.6	33	91.4	58	136.4	83	181.4
8	46.4	34	93.2	59	138.2	84	183.2
9	48.2	35	95.0	60	140.0	85	185.0
10	50.0	36	95.8	61	141.8	86	186.8
11	51.8	37	98.6	62	143.6	87	188.6
12	53.6	38	100.4	63	145.4	88	190.4
13	55.4	39	102.2	64	147.2	89	192.2
14	57.2	40	104.0	65	149.0	90	194.0
15	59.0	41	105.8	66	150.8	91	195.8
16	60.8	42	107.6	67	152.6	92	197.6
17	62.6	43	109.4	68	154.4	93	199.4
18	64.4	44	111.2	69	156.2	94	201.2
19	66.2	45	113.0	70	158.0	95	203.0
20	68.0	46	114.8	71	159.8	96	204.8
21	69.8	47	116.6	72	161.6	97	206.6
22	71.6	48	118.4	73	163.4	98	208.4
23	73.4	49	120.2	74	165.2	99	210.2
24	75.2	50	122.0	75	167.0	100	212.0
25	77.0						

Deg C × 1.8 plus 32 equals.....deg F

Deg F — 32 ÷ 1.8 equals.....deg C

The Greek Alphabet

Various letters of the Greek alphabet appear constantly in radio formulae, charts, and diagrams.

Here is the whole alphabet for handy reference. The first column shows the capital letters, the next one the small letters.

Greek Letter	Greek Name	English Equivalent
A α	Alpha	a
B β	Beta	b
Γ γ	Gamma	g
Δ δ	Delta	d
E ε	Epsilon	e
Z ζ	Zeta	z
H η	Eta	e
Θ θ	Theta	th
I ι	Iota	i
K κ	Kappa	k
Λ λ	Lambda	l
M μ	Mu	m
N ν	Nu	n
Ξ ξ	Xi	x
O ο	Omicron	ŏ
Π π	Pi	p
P ρ	Rho	r
Σ σ	Sigma	s
T τ	Tau	t
Υ υ	Upsilon	u
Φ φ	Phi	ph
X χ	Chi	ch
Ψ ψ	Psi	ps
Ω ω	Omega	ō

Determining Meter Shunts and Multipliers

27 Ohm (0-1) Milliammeter

Scale	Use as	Resistance in Ohms of Multiplier or Shunt		Multiply old Scale by
0-10	Voltmeter	10,000	M	10
0-50	"	50,000	M	50
0-100	"	100,000	M	100
0-250	"	250,000	M	250
0-500	"	500,000	M	500
0-1000	"	1,000,000	M	1000
0-10	Milliammeter	3	S	10
0-50	"	0.551	S	50
0-100	"	0.272	S	100
0-500	"	0.0541	S	500

35 Ohm (0-1.5) Milliammeter

0-15	Voltmeter	10,000	M	'10
0-150	"	100,000	M	100
0-750	"	500,000	M	500
0-15	Milliammeter	3.89	S	10
0-75	"	0.714	S	50
0-150	"	0.354	S	100
0-750	"	0.0701	S	500

COIL CHART SPECIFICATIONS

Condenser Capacity Mmfd.	Single Section	Double per Section	Turns of 1/4" Copper Tubing Spaced 1 1/8"					Turns of No. 12 Wire Spaced One Diameter				Turns of No. 12 D.C.C. Wire Close Wound				Turns of No. 14 D.C.C. Wire Close Wound			
Coil Diameter Inches			2	2½	3	4	6	2	2½	3	3½	1½	2	2½	3	1½	2	2½	3
	250	500	.....	.....	.....	.....	21	.....	45	34	27	55	36	27	23	50	34	26	22
1715 kc.	100	200	.....	.....	.....	.....	.....	.....	.....	.....	56	.....	54	.....	42	.....	22	50	40
band	50	100	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	250	500	.....	.....	18	11	.....	20	14	12	9	18	12	10	8	16	12	10	8
3500 kc.	100	200	.....	.....	.....	22	16	40	30	22	18	34	25	18	16	30	21	18	14
band	50	100	.....	.....	.....	.....	25	.....	50	42	30	.....	40	30	25	.....	40	30	24
	250	500	10	7	6	5	4	7	6	5	4	7	6	5	.....	6	5	4	.....
7000 kc.	100	200	22	15	12	9	6	15	10	8	7	12	10	8	6	11	10	8	6
band	50	100	.....	.....	22	15	10	24	17	14	12	22	16	12	10	18	14	12	10
	250	500	4	3	.....	.....	.....	3	2	.....	.....	.....	.....	.....	.....	3	2	.....	.....
14000 kc.	100	200	8	6	5	4	.....	6	4	.....	.....	5	4	3	.....	5	4	3	.....
band	50	100	14	10	8	6	4	8	6	5	.....	8	6	5	4	8	6	5	4
	250	500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
28000 kc.	100	200	3	2	.....	.....	.....	2	2	.....	.....	.....	.....	.....	.....	2	.....	.....	.....
band	50	100	5	4	3	.....	.....	3	3	.....	.....	2	.....	.....	.....	3	.....	.....	.....

DATA FOR MATCHED IMPEDANCE, Q, COLLINS AND SINGLE-WIRE-FED ANTENNAE

Frequency in Kilocycles	*Dis. from end of radiator to feeder cap*	*Half wave Radiator*	*Quarter wave feeder section*
3,500	48′ 4″	133′ 6″	66′10″
3,600	46′ 8″	129′ 9″	64′11″
3,700	45′ 7″	126′ 5″	63′ 2″
3,800	44′ 6″	123′ ″	61′ 6″
3,900	43′ 3″	119′10″	59′11″
3,950	42′ 8″	118′ 4″	59′ 2″
4,000	42′ 1″	116′10″	58′ 5″
7,000	24′ 2″	66′ 9″	33′ 5″
7,050	23′11″	66′ 4″	33′ 2″
7,100	23′ 9″	65′10″	32′11″
7,150	23′ 7″	65′ 4″	32′ 9″
7,200	23′ 4″	64′11″	32′ 6″
7,250	23′ 3″	64′ 6″	32′ 3″
7,300	23′ 2″	64′	32′

Frequency in Kilocycles	*Dis. from end of radiator to feeder cap*	*Half wave Radiator*	*Quarter wave feeder section*
14,000	12′ 1″	33′ 5″	16′ 9″
14,100	12′	33′ 2″	16′ 7″
14,200	11′10″	32′11″	16′ 5″
14,300	11′ 9″	32′ 9″	16′ 4″
14,400	11′ 8″	32′ 6″	16′ 3″
28,000	6′	16′ 8.5″	8′ 4″
28,500	5′11″	16′ 5″	8′ 2.5″
29,000	5′10″	16′ 1.5″	8′ .05″
29,500	5′ 9″	15′10.5″	7′11″
30,000	5′ 8″	15′ 7.5″	7′ 9″
56,000	3′	8′ 4″	4′ 2″
57,000	2′11.5″	8′ 2.5″	4′ 1″
58,000	2′11″	8′ 0.5″	4′ .05″
59,000	2′10.5″	7′11″	3′11.5″
60,000	2′10″	7′ 9″	3′10.5″

HARMONIC OPERATION MULTI-BAND ANTENNAE

Contrary to general conception harmonic type multi-band antenna systems do not resonate on integral harmonics.

The table shown below gives the frequencies at which different antenna lengths resonate at various harmonics.

Length	*½ Wave*	*Fundamental*	*Harmonics 2nd*	*4th*	*8th*
133′ 6″	3,500	7,185	14,550	29,210	58,760
129′ 9″	3,600	7,390	14,970	30,130	60,450
126′ 5″	3,700	7,595	15,390	31,010	62,135
123′	3,800	7,800	15,820	31,800	65,500
119′10″	3,900	8,005	16,300	32,640	66,330
118′ 4″	3,950	8,110	16,420	33,060	67,140
116′10″	4,000	8,210	16,620	33,450	
66′ 9″	7,000	14,370	29,105	58,730	
66′ 4″	7,050	14,470	29,305	58,990	

Length	*½ Wave*	*Fundamental*	*Harmonics 2nd*	*4th*	*8th*
65′10″	7,100	14,570	29,510	59,290	
65′ 4″	7,150	14,670	29,710	59,800	
64′11″	7,200	14,775	29,940	60,260	
64′ 6″	7,250	14,880	30,130	60,640	
64′	7,300	14,985	30,365	61,110	
33′ 5″	14,000	28,720	58,180		
33′ 2″	14,100	28,950	58,640		
32′11″	14,200	29,160	59,090		
32′ 9″	14,300	29,290	59,340		
32′ 6″	14,400	29,550	59,870		

AMATEUR CALL AREAS IN THE UNITED STATES

Call area	State	County
W-1	Connecticut	All counties.
	Maine	All counties.
	Massachusetts	All counties.
	New Hampshire	All counties.
	Rhode Island	All counties.
	Vermont	All counties.
W-2	New Jersey	Bergen, Essex, Hudson, Middlesex, Monmouth, Ocean, Passaic, and Union.
	New York	Albany, Bronx, Columbia, Dutchess, Greene, Kings, Nassau, New York, Orange, Putnam, Queens, Rensselaer, Richmond, Rockland, Schenectady, Suffolk, Ulster, and Westchester.
W-3	Delaware	All counties.
	District of Columbia	All counties.
	Maryland	All counties.
	New Jersey	Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Hunterdon, Mercer, Morris, Salem, Somerset, Sussex, and Warren.
	Pennsylvania	Adams, Berks, Bucks, Chester, Cumberland, Dauphin, Delaware, Franklin, Lancaster, Lebanon, Lehigh, Montgomery, Northampton, Philadelphia, and York.
	Virginia	All counties.
W-4	Alabama	All counties.
	Florida	All counties.
	Georgia	All counties.
	North Carolina	All counties.
	Puerto Rico	All counties.
	South Carolina	All counties.
	Tennessee	All counties.
	Virgin Islands	All counties.
W-5	Arkansas	All counties.
	Louisiana	All counties.
	Mississippi	All counties.
	New Mexico	All counties.
	Oklahoma	All counties.
	Texas	All counties.
W-6	Arizona	All counties.
	California	All counties.
	Hawaii	All counties.
	Nevada	All counties.
	Utah	All counties.
W-7	Alaska	All counties.
	Idaho	All counties.
	Montana	All counties.
	Oregon	All counties.
	Washington	All counties.
	Wyoming	All counties.
W-8	Michigan	Alcona, Allegan, Alpena, Antrim, Arenac, Barry, Bay, Benzie, Berrien, Branch, Calhoun, Cass, Charlevoix, Cheboygan, Clare, Clinton, Crawford, Eaton, Emmet, Genesee, Gladwin, Grand, Traverse, Gratiot, Hillsdale, Huron, Ingham, Ionia, Iosca, Isabella, Jackson, Kalamazoo, Kalkaska, Kent, Lake, Lapeer, Leelanau, Lenaween, Livingston, Macomb, Manistee, Mason, Mecosta, Midland, Missaukee, Monroe, Montcalm, Montmorency, Muskegon, Newaygo, Oakland, Oceana, Ogemau, Osceola, Oscoda, Otsego, Ottawa, Presque, Isle, Roscommon, St. Clair, St. Joseph, Saginaw, Sanilac, Shawassee, Tuscola, Van Buren, Washtenaw, Wayne, and Wexford.
	New York	Allegany, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Cortland, Delaware, Erie, Essex, Franklin, Fulton, Genessee, Hamilton, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Montgomery, Niagara, Oneida, Onondaga, Ontario, Orleans, Oswego, Otsego, St. Lawrence, Saratoga, Schoharie, Schuyler, Seneca, Steuben, Sullivan, Tioga, Tompkins, Warren, Washington, Wayne, Wyoming, and Yates.
	Ohio	All counties.
	Pennsylvania	Allegheny, Armstrong, Beaver, Bedford, Blair, Bradford, Butler, Cambria, Cameron, Carbon, Center, Clarion, Clearfield, Clinton, Columbia, Crawford, Elk, Erie, Fayette, Forest, Fulton, Greene, Huntingdon, Indiana, Jefferson, Juniata, Lackawanna, Lawrence, Luzerne, Lycoming, McKean, Mercer, Mifflin, Monroe, Montour, Northumberland, Perry, Pike, Potter, Schuylkill, Snyder, Somerset, Sullivan, Susquehanna, Tioga, Union, Venango, Warren, Washington, Wayne, Westmoreland, and Wyoming.
	West Virginia	All counties.
W-9	Colorado	All counties.
	Illinois	All counties.
	Indiana	All counties.
	Iowa	All counties.
	Kansas	All counties.
	Kentucky	All counties.
	Michigan	Alger, Baraga, Chippewa, Delta, Dickinson, Gogebic, Houghton, Iron, Keweenaw, Luce, Mackinac, Marquette, Menominee, Ontonagon, and Schoolcraft.
	Minnesota	All counties.
	Missouri	All counties.
	Nebraska	All counties.
	North Dakota	All counties.
	South Dakota	All counties.
	Wisconsin	All counties.

These call areas should not be confused with the United States Radio Districts.

INTERNATIONAL AMATEUR PREFIXES

A—Asia **E—Europe** **SA—South America**
AF—Africa **NA—North America** **O—Oceania**

ABYSSINIA (Ethiopia) (AF)	ET
AFGHANISTAN (A)	YA
ALASKA (NA)	K7
ALBANIA (E)	ZA
ALGERIA (AF)	FA
ANDORRA (E)	PX
ANGOLA (AF)	CR6
ANTIGUA (NA)	VP2
ARGENTINA (SA)	LU
ASCENSION (AF)	ZD8
AUSTRALIA (O)	VK
AUSTRIA (E)	OE
AZORES (AF)	CT2
BAHAMAS (NA)	VP7
BAHREIN ISLAND (A)	VS8
BARBADOS (NA)	VP6
BELGIAN CONGO (AF)	ON
BELGIUM (E)	ON
BERMUDA (NA)	VP9
BOLIVIA (SA)	CP
BRAZIL (SA)	PY
BRITISH GUIANA (SA)	VP3
BRITISH HONDURAS (NA)	VP1
BR. SOLOMON ISLANDS (O)	VR4
BRITISH SOMALILAND (AF)	VQ6
BULGARIA (E)	LZ
CAMEROONS (British) (AF)	ZD2
CAMEROONS (French) (AF)	FE8
CANADA (NA)	VE
CANAL ZONE (NA)	K5, NY
CAPE VERDE (AF)	CR4
CAYMAN ISLANDS (NA)	VP5
CEYLON (A)	VS7
CHILE (SA)	CE
CHINA (A)	XU
CHRISTMAS ISLAND (O)	ZC3
COCOS ISLANDS (O)	ZC2
COLOMBIAN REPUBLIC (SA)	HJ, HK
COOK ISLANDS (O)	ZK1
COSTA RICA (NA)	TI
CUBA (NA)	CM, CO
CURACAO (SA)	PJ
CYPRUS (E)	ZC4
CZECHOSLOVAKIA (E)	OK
DANZIG (E)	YM
DENMARK (E)	OZ
DOMINICAN REPUBLIC (NA)	HI
DUTCH E. IND. (Neth. Ind.)	PK
ECUADOR (SA)	HC
EGYPT (AF)	SU
ELLICE ISLANDS (Gilbert)	VR1
ESTONIA (E)	ES
ETHIOPIA (Abyssinia)	ET
FALKLAND ISLANDS (SA)	VP8
FANNING ISLAND (O)	VQ1 (*VR3)
FAROE ISLANDS (E)	OY
FIJI ISLANDS (O)	VR2
FINLAND (E)	OH
FRANCE (E)	F3, F8
FR. EQUATORIAL AFRICA	FQ8
FRENCH GUIANA (SA)	FY8
FRENCH INDIA (A)	FN8
FRENCH INDO-CHINA (A)	FI8
FRENCH WEST AFRICA	FF8
GAMBIA (AF)	ZD3
GERMANY (E)	D4
GIBRALTAR (E)	ZB2
GILBERT & ELLICE IDS. (O)	VR1
GREAT BRITAIN (E)	G
GREECE (E)	SV
GREENLAND (NA)	OX
GUADELOUPE (NA)	FG8
GUAM (O)	K6, OM
GUATEMALA (NA)	TG
HAWAII (O)	K6
HAITI (NA)	HH
HEDJAZ (A)	HZ
HONG KONG (A)	VS6
HONDURAS (NA)	HR
HUNGARY (E)	HA
ICELAND (E)	TF
INDIA (A)	VU
IRAN (Persia) (A)	EP, EQ
IRAQ (A)	YI
IRISH FREE STATE (E)	EI
ITALY (E)	I
JAMAICA (NA)	VP5
JAPAN (A)	J
JUGOSLAVIA (E)	YT, YU
KENYA (AF)	VQ4
LATVIA (E)	YL
LIBERIA (AF)	EL
LITHUANIA (E)	LY
LUXEMBOURG (E)	LX
MACAO (A)	CR9
MADAGASCAR (AF)	FB8
MADEIRA (AF)	CT3
MALAYA (A)	VS1, VS2, VS3
MALDIVE ISLANDS (A)	VS9
MALTA (E)	ZB1
MANCHUKUO (A)	MX
MARTINIQUE (NA)	FM8
MAURITIUS (A)	VQ8
MEXICO (NA) (after 1 Jan. 1936)	XE
MIDWAY ISLAND (O)	K6
MOROCCO (AF)	CN
MOZAMBIQUE (AF)	CR7
NETHERLANDS (E)	PA, PI
NEW CALEDONIA (O)	F7 (**FK8)
NEWFOUNDLAND (NA)	VO
NEW HEBRIDES (O)	YJ (**FU8)
NEW ZEALAND (O)	ZL
NICARAGUA (NA)	YN
NIGERIA (AF)	ZD2
NIUE (O)	ZK2
NORTH BORNEO (O)	VS4
NORTHERN IRELAND (E)	GI
NORTHERN RHODESIA (AF)	VQ2
NORWAY (E)	LA
NYASALAND (AF)	ZD6
OCEAN ISLAND (Gilbert)	VR1
PALESTINE (A)	ZC6
PANAMA (NA)	HP
PARAGUAY (SA)	ZP
PERSIA (Iran)	EP, EQ
PERU (SA)	OA
PHILIPPINES (O)	KA
PITCAIRN ISLAND (O)	VR6
POLAND (E)	SP
PORTO RICO (NA)	K4
PORTUGAL (E)	CT1
REUNION (AF)	FB8 (**FR8)
ROUMANIA (E)	YR
SAINT HELENA (A)	VQ8 (*ZD7)
ST. KITTS-NEVIS (NA)	VP2
ST. PIERRE & MIQUELON (NA)	FP8
SALVADOR (NA)	YS
SAMOA (O) (U.S.)	K6
SARAWAK (O)	VS5
SEYCHELLES (AF)	VQ9
SIAM (A)	HS
SIBERIA (see U.S.S.R.)	
SIERRA LEONE (AF)	ZD1
SOMALI COAST	FL8
SOUTH AFRICA	ZS, ZT, ZU
SOUTH GEORGIA (SA)	VP8
SOUTHERN RHODESIA (AF)	ZE1
SPAIN (E)	EA
STRAITS SETTS. (Malaya)	VS1, VS2, VS3
SUDAN (AF)	ST
SURINAM (SA)	PZ
SWEDEN (E)	SM
SWITZERLAND (E)	HB
SYRIA (A)	AR
TAHITI (O)	F3 (**FO8)
TANGANYIKA (AF)	VQ3
TIBET (A)	AC4
TOGOLAND (British) (AF)	ZD4
TOGOLAND (French) (AF)	FD8
TONGA ISLANDS (O)	VR5
TRANSJORDANIA (A)	ZC1
TRINIDAD & TOBAGO (SA)	VP4
TRISTAN DA CUNHA (AF)	ZU9
TUNIS (AF)	FT4
TURKEY (E&A)	TA
UGANDA (AF)	VQ5
UNITED STATES (NA)	W
U. S. NAVAL COMMUNICATION RESERVE STATION (NA)	N
URUGUAY (SA)	CX
U.S.S.R. (E, A)	U, UE, UK, UX
VENEZUELA (SA)	YV
VIRGIN ISLANDS (NA)	K4
WESTERN SAMOA (O) (British)	ZM
ZANZIBAR (AF)	VP1

*Suggested by the British Empire Radio Union.
**Official, by French govt.

Arranged Alphabetically

AC4	TIBET
AR	SYRIA
CE	CHILE
CM	CUBA
CN	MOROCCO
CO	CUBA (fones)
CP	BOLIVIA
CR4	CAPE VERDE
CR5	PORTUGUESE GUINEA
CR6	ANGOLA
CR7	MOZAMBIQUE
CR8	PORTUGUESE INDIA
CR9	MACAO
CR10	TIMOR
CT1	PORTUGAL
CT2	AZORES
CT3	MADEIRA
CX	URUGUAY
D4	GERMANY
EA	SPAIN
EI	IRISH FREE STATE
EL	LIBERIA
EP, EQ	IRAN (ex-Persia)
ES	ESTONIA
ET	ABYSSINIA (Ethiopia)
F3	FRANCE
F7	(**FK8) NEW CALEDONIA
F8	FRANCE
FA	ALGERIA
FB8	MADAGASCAR, REUNION (**FR8)
FD8	TOGOLAND (French)
FE8	CAMEROONS (French)
FF8	FRENCH WEST AFRICA
FG8	GUADELOUPE
FI8	FRENCH INDO-CHINA
FK8	NEW CALEDONIA
FL8	SOMALI COAST
FM8	MARTINIQUE
FN8	FRENCH INDIA
FO8	FRENCH OCEANIA, TAHITI
FP8	ST. PIERRE & MIQUELON
FQ8	FR. EQUATORIAL AFRICA
FR8	REUNION
FT4	TUNIS
FU8	NEW HEBRIDES
FY8	FRENCH GUIANA
G	GREAT BRITAIN
GI	NORTHERN IRELAND
HA	HUNGARY
HB	SWITZERLAND
HC	ECUADOR
HH	HAITI
HI	DOMINICAN REPUBLIC
HJ, HK	COLOMBIAN REPUBLIC
HP	PANAMA
HR	HONDURAS
HS	SIAM
HZ	HEDJAZ
I	ITALY
J	JAPAN
K4	PORTO RICO, VIRGIN ISLANDS
K5	CANAL ZONE
K6	GUAM, HAWAII, MIDWAY ISLAND, SAMOA (U. S.), WAKE ISLAND
K7	ALASKA
KA	PHILIPPINE ISLANDS
LA	NORWAY
LU	ARGENTINA
LX	LUXEMBOURG
LY	LITHUANIA
LZ	BULGARIA
MX	MANCHUKUO
N.	U. S. NAVAL COMMUNICATIONS RESERVE STATIONS
NY	CANAL ZONE
OA	PERU
OE	AUSTRIA
OH	FINLAND
OK	CZECHOSLOVAKIA
OM	GUAM
ON	BELGIUM, BEL. CONGO
OX	GREENLAND
OY	FAROE ISLANDS

(Continued on next page)

PREFIXES ARRANGED ALPHABETICALLY

(Continued from preceding page)

OZ	DENMARK
PA	NETHERLANDS
PI	NETHERLANDS (schools)
PJ	CURACAO
PK	NETH. INDIES
PX	ANDORRA
PY	BRAZIL
PZ	SURINAM
SM	SWEDEN
SP	POLAND
ST	SUDAN
SU	EGYPT
SV	GREECE
TA	TURKEY
TF	ICELAND
TG	GUATEMALA
TI	COSTA RICA
U, UE, UK, UX	U.S.S.R.
VE	CANADA
VK	AUSTRALIA
VO	NEWFOUNDLAND
VP1	BRITISH HONDURAS
VP2	ANTIGUA, ST. KITTS-NEVIS
VP3	BRITISH GUIANA
VP4	TRINIDAD & TOBAGO
VP5	CAYMAN ISLANDS, JAMAICA, TURKS & CAICOS ISLANDS
VP6	BARBADOS
VP7	BAHAMAS
VP8	FALKLAND ISLANDS SOUTH GEORGIA
VP9	BERMUDA
VQ1 (*VR3)	FANNING ISLAND
VQ2	NORTHERN RHODESIA
VQ3	TANGANYIKA
VQ4	KENYA
VQ5	UGANDA
VQ6	BRITISH SOMALILAND
VQ8	MAURITIUS
VQ9	SEYCHELLES
VR1	GILBERT & ELLICE ISLANDS
VR2	FIJI ISLANDS
VR3	FANNING ISLAND
VR4	BR. SOLOMON ISLANDS
VR5	TONGA ISLANDS
VR6	PITCAIRN ISLAND
VS1, VS2, VS3	MALAYA
VS4	NORTH BORNEO
VS5	SARAWAK
VS6	HONG KONG
VS7	CEYLON
VS8	BAHREIN ISLAND
VS9	MALDIVE ISLANDS
VU	INDIA
W	UNITED STATES
XE (after 1 Jan. 1936)	MEXICO
XU	CHINA
YA	AFGHANISTAN
YI	IRAQ
YJ (**FU8)	NEW HEBRIDES
YL	LATVIA
YM	DANZIG
YN	NICARAGUA
YR	ROUMANIA
YS	SALVADOR
YT, YU	JUGOSLAVIA
YV	VENEZUELA
ZA	ALBANIA
ZB1	MALTA
ZB2	GIBRALTAR
ZC1	TRANSJORDANIA
ZC2	COCOS ISLANDS
ZC3	CHRISTMAS ISLAND
ZC4	CYPRUS
ZC5	PALESTINE
ZD1	SIERRA LEONE
ZD2	NIGERIA, CAMEROONS (British)
ZD3	GAMBIA
ZD4	GOLD COAST, TOGOLAND (British)
ZD6	NYASALAND
ZD7	SAINT HELENA
ZD8	ASCENSION
ZE1	SOUTHERN RHODESIA
ZK1	COOK ISLANDS
ZK2	NIUE
ZL	NEW ZEALAND
ZM	WESTERN SAMOA
ZP	PARAGUAY
ZS, ZT, ZU	SOUTH AFRICA
ZU9	TRISTAN DA CUNHA

*Suggested by the British Empire Radio Union.
**Official, by French govt.

SIGNAL STRENGTH REPORTS THE "QSA-R" SYSTEM

"Q" READABILITY SYSTEM

QSA1—HARDLY PERCEPTIBLE; UNREADABLE.
QSA2—WEAK; READABLE ONLY NOW AND THEN.
QSA3—FAIRLY GOOD; READABLE WITH DIFFICULTY.
QSA4—GOOD READABLE SIGNALS.
QSA5—VERY GOOD SIGNALS; PERFECTLY READABLE.

"R" AUDIBILITY SYSTEM

R1—FAINT SIGNALS; JUST READABLE.
R2—WEAK SIGNALS; BARELY READABLE.
R3—WEAK SIGNALS; BUT CAN BE COPIED.
R4—FAIR SIGNALS; EASILY READABLE.
R5—MODERATELY STRONG SIGNALS.
R6—GOOD SIGNALS.
R7—GOOD STRONG SIGNALS, THAT COME TRRU QRM & QRN.
R8—VERY STRONG SIGNALS; HEARD SEVERAL FEET FROM THE FONES.
R9—EXTREMELY STRONG SIGNALS.

"T" TONE SYSTEM

T1—("T3, R6,") VERY BAD 25 OR 60 CYCLE AC TONE.
T2—ROUGH 60 CY AC TONE.
T3—POOR RAC TONE. SOUNDS LIKE NO FILTER.
T4—FAIR RAC, SMALL FILTER.
T5—NEARLY DC TONE, GOOD FILTER, BUT HAS KEY THUMPS, OR BACK WAVE, ETC.
T6—NEARLY DC TONE. VERY GOOD FILTER; KEYING OK.
T7—PURE DC TONE, BUT HAS KEY THUMPS, BACK WAVE, ETC.
T8—PURE DC, NOT EQUAL TO T9.
T9—BEST STEADY, PURE CRYSTAL CONTROLLED DC TONE.

THE "R-S-T" SYSTEM

READABILITY

1—NOT READABLE
2—BARELY READABLE
3—READABLE WITH DIFFICULTY
4—EASILY READABLE
5—PERFECTLY READABLE

SIGNAL STRENGTH

1—VERY FAINT
2—VERY WEAK
3—WEAK
4—FAIR
5—FAIRLY GOOD
6—GOOD
7—MODERATELY STRONG
8—STRONG
9—VERY STRONG

TONE

1—VERY ROUGH
2—ROUGH AC NOTE
3—FAIRLY ROUGH AC
4—RATHER ROUGH MUSICAL AC NOTE
5—SLIGHT AC NOTE
6—MODULATED, SLIGHT WHISTLE
7—NEARLY DC NOTE
8—GOOD DC NOTE
9—PURE DC NOTE

Alphabetical Word List for Accurate Transmission

A — ADAMS
B — BOSTON
C — CHICAGO
D — DENVER
E — EDWARD
F — FRANK
G — GEORGE
H — HENRY
I — IDA
J — JOHN
K — KING
L — LINCOLN
M — MARY
N — NEW YORK
O — OCEAN
P — PETER
Q — QUEEN
R — ROBERT
S — SUGAR
T — THOMAS
U — UNION
V — VICTOR
W — WILLIAM
X — X-RAY
Y — YOUNG
Z — ZERO

Radiophone stations when sending messages containing initials or station call letters should use the above list to avoid errors.
Example: W2ADX is sent as WILLIAM TWO ADAM DENVER X-RAY.

Amateur Abbreviations

ABL	able
ABT	about
ACCT	account
AER	aerial
AGN	again
AHD	ahead
AMT	amount
ANI	any
ANS	answer
ART	all right
B	be
B4	before
BCL	broadcast listener
BCUZ	because
BD	bad
BI	by
BIZ	business
BK	back, break, break-in
BKG	breaking
BLV	believe
BN	between
BPL	Brass Pounders League
BST	best
BTR	better
BT	but
BUG	speed key
C	see
CANS	phones
CHGS	charges
CK	check
CKT	circuit
CL	closing station call
CLD	called
CLG	calling
CM	Communications Manager
CMG	coming
CN	can
CNT	can't
CONGRATS	congratulations
CQ	general call
CRD	card
CUD	could
CUL	see you later
CUM	come
CW	continuous wave
CY	copy
DA	day
DD	did
DE	from
DG	doing
DH	dead head message
DLD	delivered
DLR	deliver
DLY	delivery
DN	done
DX	distance
DWN	down
EM	them
ES	and
EVY	every
EZ	easy
FB	fine business
FIL	filament
FM	from
FONES	telephones
FR	for
FREQ	frequency
GA	go ahead
GB	goodbye
GUD	good
GE	good evening
GES	guess
GG	going
GM	good morning
GN	good night
GND	ground
GQA	give quick answer
GSA	give some address
GT	get, got
GTG	getting
GVG	giving
HAM	amateur
HD	had, head
HF	high frequency
HI	laughter
HM	him, home
HR	here, hear, hour
HRD	heard
HV	have
HVG	having
HVY	heavy
HW	how
IC	I see
ICW	interrupted continuous wave
K	go ahead
LID	a poor operator
LST	last, lost
LTR	later
LV	leave
LVG	leaving
MA	milliampere
MG	master generator
MI	my
MILL	typewriter
MILS	milliamperes
MIN	minute
MK	make
MNG	morning
MNI	many
MO	master oscillator
ND	nothing doing
NG	no good
NIL	nothing
NITE	night
NM	no more
NR	near, number
NT	not
NTG	nothing
NW	now
OB	old boy
OK	agreed
OL	old lady
OM	old man
OO	Official Observer
OP	operator
OPN	operation
ORS	Official Relay Station
OT	old timer
OTR	other
OW	old woman
PLS, PSE	please
PUNK	poor operator
PWR	power
PX	press
QRM	interference
QRN	static
RCD	received
RCVR	receiver
RI	Radiator Inspector
RITE	right
RM	Route Manager
RPT	report, repeat
RUF	rough
SA	say
SCM	Section Communications Manager
SEC	second
SED	said
SEZ	says
SIG	signal, signature
SINE	sign
SKED	schedule
SS	single signal
SUM	some
TC	thermocouple
TKU	thank you
TM	time, them
TMW	tomorrow
TNG	thing
TKS	thanks
TR	position, there
TS	this
TT	that
TY	they
U	you
UR	your
URS	yours
VT	vacuum tube
VY	very
WA	word after
WB	word before
WD	would, word
WDS	words
WI	with
WK	work, week
WKG	working
WL	well, will
WN	when
WO	who
WR	where
WS	was
WT	what, wait
WUD	would
WV	wavelength
WX	weather
XMTR	transmitter
YDA	yesterday
YL	young lady
YR	your, year
30	finish
73	best regards
88	love and kisses
99	keep out

U. S. Postal Rates on Q. S. L. Cards and Letters

LETTERS, 3c each ounce or fraction to United States, U. S. Possessions, Canada, Labrador and Newfoundland. 2c each ounce or fraction if for delivery in the town in U. S. where letter was mailed. AIRMAIL to U. S. and Canada: 6c each ounce or fraction.

LETTERS, 3c each ounce or fraction, CARDS 2c, to: Argentina, Balearic Islands, Bolivia, Brazil, Canary Islands, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, Guatemala, Haiti, Honduras, Mexico, Morocco (Spanish), Nicaragua, Panama, Paraguay, Peru, Salvador, Spain and its Colonies, Uruguay, Venezuela.

LETTERS, 3c each ounce or fraction to Canada, Labrador, and Newfoundland. Letters 5c each ounce or fraction to Great Britain.

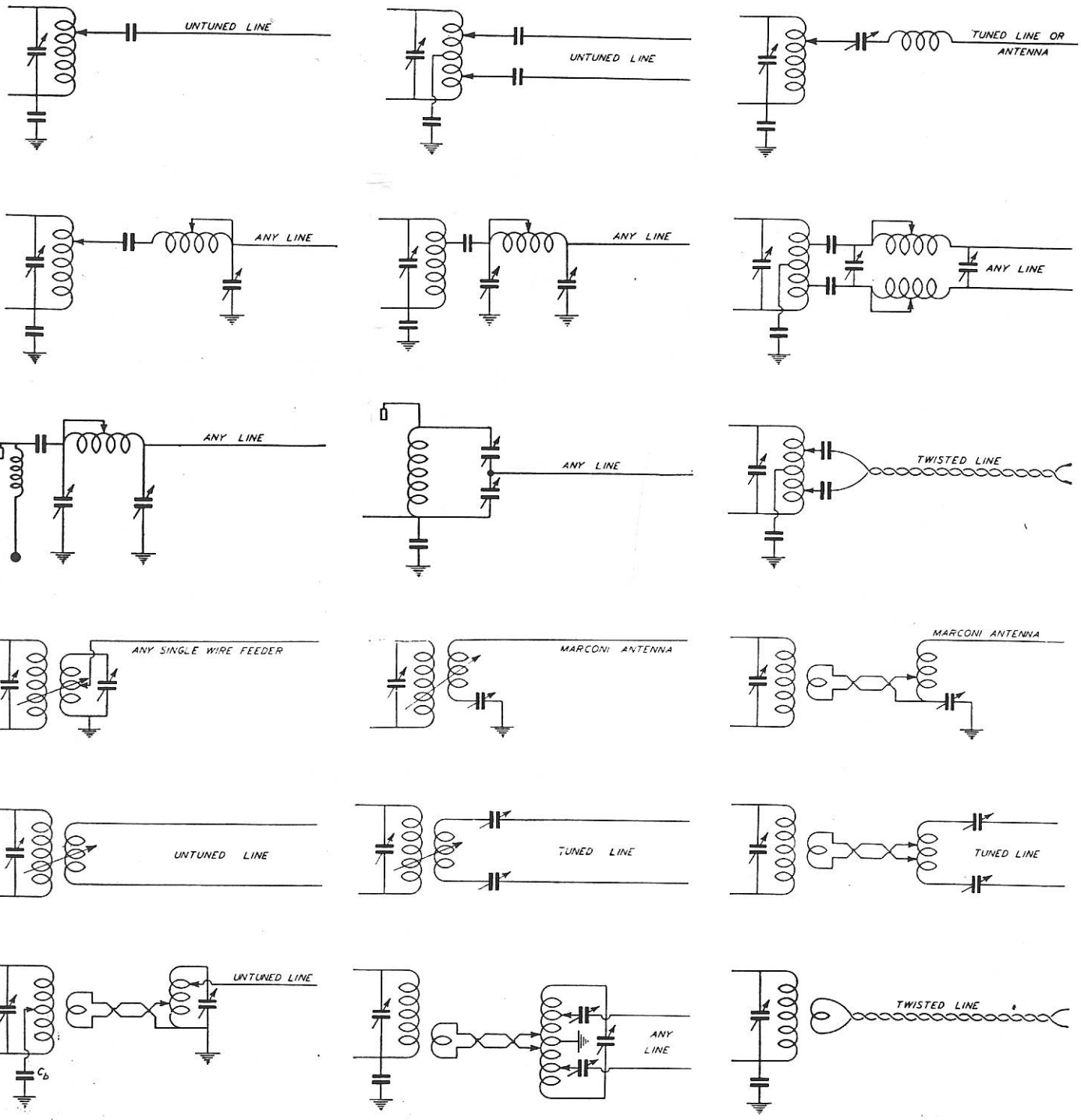
LETTERS, 5c first ounce and 3c for each additional ounce or fraction to: All other countries not in the above lists.

POST CARDS, 1c each in United States and Possessions, and 2c to countries taking 3c letter rate.

All other foreign countries, 3c each.

METHODS OF COUPLING TO THE TRANSMITTER

The various methods of coupling the antenna to the transmitter are shown in the schematics shown below. Each circuit shown, if properly adjusted can be made to give exceptionally good results. Which type you use is a matter of individual choice depending upon whether the final amplifier utilizes a split or unsplit tank circuit. The first nine methods show the more common systems of capacitative coupling. The others use inductive coupling which include the popular link systems that permit the antenna tuning controls to be placed at a distance from the transmitter final.



FEDERAL COMMUNICATIONS COMMISSION

RULES FOR AMATEUR OPERATORS AND STATIONS

The following excerpts from the Commission's rules include all that deal solely with the amateur service and certain others that apply generally.

24. *Answering notice of violation.*—Any licensee receiving official notice of a violation of Federal laws, the Commission's rules and regulations, or the terms and conditions of a license shall, within 3 days from such receipt, send a written reply direct to the Federal Communications Commission at Washington, D. C. The answer to each notice shall be complete in itself and shall not be abbreviated by reference to other communications or answers to other notices. If the notice relates to some violation that may be due to the physical or electrical characteristics of the transmitting apparatus, the answer shall state fully what steps, if any, are taken to prevent future violations, and if any new apparatus is to be installed, the date such apparatus was ordered, the name of the manufacturer, and promised date of delivery.

26. If the notice of violation relates to some lack of attention or improper operation of the transmitter, the name and license number of the operator in charge shall be given.

27. *Normal license periods.*—All station licenses will be issued so as to expire at the hour of 3 a. m. eastern standard time.

e. The licenses for amateur stations will be issued for a normal license period of 3 years from the date of expiration of old license or the date of granting a new license or modification of a license.

188. *Station.*—The term "station" means all of the radio-transmitting apparatus used at a particular location for one class of service and operated under a single instrument of authorization. In the case of every station other than broadcast, the location of the station shall be considered as that of the radiating antenna.

189. *Mobile station.*—The term "mobile station" means a station that is capable of being moved and ordinarily does move.

190. *Fixed station.*—The term "fixed station" means a station, other than an amateur station, not capable of being moved, and communicating by radio with one or more stations similarly established.

191. *Land station.*—The term "land station" means a station not capable of being moved, carrying on a mobile service.

192. *Portable station.*—The term "portable station" means a station so constructed that it may conveniently be moved about from place to place for communication and that is in fact so moved about from time to time, but not used while in motion.

a. Portable-mobile station.—The term "portable-mobile station" means a station so constructed that it may conveniently be moved from one mobile unit to another for communication, and that is, in fact, so moved about from time to time and ordinarily used while in motion.

193. *Mobile service.*—The term "mobile service" means a radio-communication service carried on between mobile and land stations and by mobile stations, communicating among themselves, special services being excluded.

194. *Fixed service.*—The term "fixed service" means a service carrying on radio-communication of any kind between fixed points, excluding broadcasting services and special services.

209. *Damped waves.*—Except for ship stations under the conditions hereinafter specified, no license will be issued for the operation of any station using or proposing to use, transmitting apparatus employing damped wave emissions.

210. *Distress messages.*—Radio communications or signals relating to ships or aircraft in distress shall be given absolute priority. Upon notice from any station, Government or commercial, all other transmissions shall cease on such frequencies and for such time as may, in any way, interfere with the reception of distress signals or related traffic.

211. No station shall resume operation until the need for distress traffic no longer exists, or it is determined that said station will not interfere with distress traffic as it is then being routed and said station shall again discontinue if the routing of distress traffic is so changed that said station will interfere. The status of distress traffic may be ascertained by communication with Government and commercial stations.

214. *Licensed operator required.*—Only an operator holding a radiotelegraph class of operators' license may manipulate the transmitting key of a manually operated coastal telegraph or mobile telegraph station in the international service; and only a licensed amateur operator may manipulate the transmitting key at a manually operated amateur station. The licensees of other stations operated under the constant supervision of duly licensed operators may permit any person or persons, whether licensed or not, to transmit by voice or otherwise, in accordance with the types of emission specified by the respective licenses.

221. *Licenses, posting of.*—In the case of amateur, portable, and portable-mobile stations the original license, or a photostat copy thereof, shall be similarly posted or kept in the personal possession of the operator on duty.

In the case of an amateur or aircraft radio operator, and operators of portable or portable-mobile stations, the original operator's license shall be similarly posted or kept in his personal possession and available for inspection at all times while the operator is on duty.

b. When an operator's license cannot be posted because it has been mailed to an office of the Federal Communications Commission for endorsement or other change, such operator may continue to operate stations in accordance with the class of license held, for a period not to exceed 60 days, but in no case beyond the date of expiration of the license.

362. *Definition, amateur station.*—The term "amateur station" means a station used by an "amateur," that is, a duly authorized person interested in radio technique solely with a personal aim and without pecuniary interest.

364. *Definition, amateur operator.*—The term "amateur radio operator" means a person holding a valid license issued by the Federal Communications Commission who is authorized under the regulations to operate amateur radio stations.

365. *Definition, amateur radio communication.*—The term "amateur radio communication" means radio communication between amateur radio stations solely with a personal aim and without pecuniary interest.

366. *Station licenses.*—An amateur station license may be issued only to a licensed amateur radio operator who has made a satisfactory showing of ownership or control of proper transmitting apparatus: Provided, however, That in the case of a military or naval reserve radio station located in approved public quarters and established for training purposes, but not operated by the United States Government, a station license may be issued to the person in charge of such station who may not possess an amateur operator's license.

a. Operator's license.—An amateur operator's license may be granted to a person who does not desire an amateur station license, provided such applicant waives his right to apply for an amateur station license for 90 days subsequent to the date of application for operator's license.

367. *Eligibility for license.*—Amateur radio station licenses shall not be issued to corporations, associations, or other organizations: Provided, however, That in the case of a bona fide amateur radio society a station license may be issued to a licensed amateur radio operator as trustee for such society.

368. *Mobile stations.*—Licenses for mobile stations and portable-mobile stations will not be granted to amateurs for operation on frequencies below 28,000 kilocycles. However, the licensee of a fixed amateur station may operate portable amateur stations (rule 192) in accordance with the provisions of rules 384, 386, and 387; and also portable and portable-mobile amateur stations (rules 192 and 192a) on authorized amateur frequencies above 28,000 kilocycles in accordance with rules 384 and 386, but without regard to rule 387.

370. *Points of communication.*—Amateur stations shall be used only for amateur service, except that emergencies or for testing purposes they may be used also for communication with commercial or Government radio stations. In addition, amateur stations may communicate with any mobile radio station which is licensed by the Commission to communicate with amateur stations, and with stations of expeditions

which may also be authorized to communicate with amateur stations.

371. *Amateur stations not to be used for broadcasting.*—Amateur stations shall not be used for broadcasting any form of entertainment, nor for the simultaneous retransmission by automatic means of programs or signals emanating from any class of station other than amateur.

372. *Radiotelephone tests.*—Amateur stations may be used for the transmission of music for test purposes of short duration in connection with the development of experimental radiotelephone equipment.

373. *Amateur stations not for hire.*—Amateur radio stations shall not be used to transmit or receive messages for hire, nor for communication for material compensation, direct or indirect, paid or promised.

374. The following bands of frequencies are allocated exclusively for use by amateurs:

1,715	to	2,000	kilocycles
3,500	to	4,000	kilocycles
7,000	to	7,300	kilocycles
14,000	to	14,400	kilocycles
28,000	to	30,000	kilocycles
56,000	to	60,000	kilocycles
400,000	to	401,000	kilocycles

a. The licensee of an amateur station may, subject to change upon further order, operate amateur stations on any frequency above 110,000 kilocycles, without separate licenses therefor, provided:

(1) That such operation in every respect complies with the Commission's rules governing the operation of amateur stations in the amateur service.

(2) That records are maintained of all transmissions in accordance with the provisions of rule 386.

375. *Types of emission.*—All bands of frequencies so assigned may be used for radiotelegraphy, type A-1 emission. Type A-2 emission may be used in the following bands of frequencies only:

28,000	to	30,000	kilocycles
56,000	to	60,000	kilocycles
400,000	to	401,000	kilocycles

376. *Frequency band for telephony.*—The following bands of frequencies are allocated for use by amateur stations using radio-telephony, type A-3 emission:

1,800	to	2,000	kilocycles
28,000	to	29,000	kilocycles
56,000	to	60,000	kilocycles
400,000	to	401,000	kilocycles

377. *Additional bands for telephony.*—Provided the station shall be operated by a person who holds an amateur operator's license endorsed for class A privileges, an amateur radio station may use radiotelephony, type A-3 emission, in the following additional bands of frequencies:

3,900	to	4,000	kilocycles
14,150	to	14,250	kilocycles

378. *Amateur television, facsimile, and picture transmission.*—The following bands of frequencies are allocated for use by amateur stations for television, facsimile, and picture transmission:

1,715	to	2,000	kilocycles
56,000	to	60,000	kilocycles

379. *Licenses will not specify individual frequencies.*—Transmissions by an amateur station may be on any frequency within an amateur band above assigned.

380. *Aliens.*—An amateur radio station shall not be located upon premises controlled by an alien.

381. *Prevention of interference.*—Spurious radiations from an amateur transmitter operating on a frequency below 30,000 kilocycles shall be reduced or eliminated in accordance with good engineering practice and shall not be of sufficient intensity to cause interference on receiving sets of modern design which are tuned outside the frequency band of emission normally required for the type of emission employed. In the case of A-3 emission, the transmitter shall not be modulated in excess of its modulation capability to the extent that interfering spurious radiations occur, and in no case shall the emitted carrier be amplitude-modulated in excess of 100 per cent. Means shall be employed to insure that the transmitter is not modulated in excess of its modulation capability. A spurious radiation is any radiation from a transmitter which is outside the frequency band of emission normal for the type of transmission employed, including any component whose frequency is an integral multiple or sub-multiple of the carrier frequency (harmonics and sub-harmonics) spurious modulation products, key clicks and other transient effects, and parasitic oscillations.

382. *Power supply to transmitter.*—Licensees of amateur stations using frequencies below 30,000 kilocycles shall use adequately filtered direct-current power supply for the transmitting equipment to minimize frequency modulation and to prevent the emission of broad signals.

383. *Authorized power.*—Licensees of amateur stations are authorized to use a maximum power input of 1 kilowatt to the plate circuit of the final amplifier stage of an oscillator-amplifier transmitter or to the plate circuit of an oscillator transmitter.

384. *Transmission of call.—An operator* of an amateur station shall transmit its assigned call at least once during each 15 minutes of operation and at the end of each transmission. In addition, an operator of an amateur portable-mobile radiotelegraph station shall transmit immediately after the call of the station the break sign (BT) followed by the number of the amateur call area in which the portable or portable-mobile amateur station is then operating as for example:

Example 1. Portable or portable-mobile amateur station operating in the third amateur call area calls a fixed amateur station: W1ABC W1ABC W1ABC DE W2DEF BT3 W2DEF BT3 W2DEF BT3 AR.

Example 2. Fixed amateur station answers the portable or portable-mobile amateur station: W2DEF W2DEF W2DEF DE W1ABC W1ABC W1ABC K.

Example 3. Portable or portable-mobile amateur station calls a portable or portable-mobile amateur station: W3GHI W3GHI W3GHI DE W4JKL BT4 W4JKL BT4 W4JKL BT4 AR.

If telephony is used, the call sign of the station shall be followed by an announcement of the amateur call area in which the portable or portable-mobile station is operating.

a. In the case of an amateur licensee whose station is licensed to a regularly commissioned or enlisted member of the United States Naval Reserve, the commandant of the naval district in which such reservist resides may authorize in his discretion the use of the call-letter prefix N in lieu of the prefix W or K, assigned in the license issued by the Commission, provided that such N prefix shall be used only when operating in the frequency bands 1,715-2,000 kilocycles and 3,500-4,000 kilocycles in accordance with instructions to be issued by the Navy Department.

385. *Quiet hours.*—In the event that the operation of an amateur radio station causes general interference to the reception of broadcast programs with receivers of modern design, that amateur station shall not operate during the hours from 8 o'clock p. m. to 10:30 p. m., local time, and on Sunday from 10:30 a. m. until 1 p. m., local time, upon such frequency or frequencies as cause such interference.

386. *Logs.*—Each licensee of an amateur station shall keep an accurate log of station operation to be made available upon request by authorized Government representatives, as follows:

a. The date and time of each transmission. (The date need only be entered once for each day's operation. The expression "time of each transmission" means the time for making a call and need not be repeated during the sequence of communication which immediately follows; however, an entry shall be made in the log when "signing off" so as to show the period during which communication was carried on.)

b. The name of the person manipulating the transmitting key of a radiotelegraph transmitter or the name of the person operating a transmitter of any other type (type A-3 or A-4 emission) with statement as to type of emission. (The name need only be entered once in the log provided the log contains a statement to the effect that all transmissions were made by the person named except where otherwise stated. The name of any other person who operates the station shall be entered in the proper space for his transmissions.)

c. Call letters of the station called. (This entry need not be repeated for calls made to the same station during any sequence of communication, provided the time of "signing off" is given.)

d. The input power to the oscillator, or to the final amplifier stage where an oscillator-amplifier transmitter is employed. (This need be entered only once, provided the input power is not changed.)

e. The frequency band used. (This information need be entered only once in the log for all transmissions until there is a change in frequency to another amateur band.)

f. The location of a portable or portable-mobile station at the time of each transmis-

sion. (This need be entered only once, provided the location of the station is not changed. However, suitable entry shall be made in the log upon changing location, showing the type of vehicle or mobile unit in which the station is operated and the approximate geographical location of the station at the time of operation.)

g. The message traffic handled. (If record communications are handled in regular message form, a copy of each message sent and received shall be entered in the log or retained on file for at least 1 year.)

387. *Portable stations.* — Advance notice of all locations in which portable amateur stations will be operated shall be given by the licensee to the inspector in charge of the district in which the station is to be operated. Such notices shall be made by letter or other means prior to any operation contemplated and shall state the station call, name of licensee, the date of proposed operation, and the approximate locations, as by city, town, or county. An amateur station operating under this rule shall not be operated during any period exceeding 30 days without giving further notice to the inspector in charge of the radio inspection district in which the station will be operated. This rule does not apply to the operation of portable or portable-mobile amateur stations on frequencies above 28,000 kc. authorized to be used by amateur stations (see rule 368).

400. *Only amateur operators may operate amateur stations.*—An amateur station may be operated only by a person holding a valid amateur operator's license, and then only to the extent provided for by the class of privileges for which the operator's license is endorsed.

401. *Validity of operator's license.*—Amateur operators' licenses are valid only for the operation of licensed amateur stations, provided, however, any person holding a valid radio operator's license of any class may operate stations in the experimental service licensed for, and operating on, frequencies above 30,000 kilocycles.

402. *Proof of use.*—Amateur station licenses and/or amateur operator licenses may, upon proper application, be renewed provided: (1) The applicant has used his station to communicate by radio with at least three other amateur stations during the 3-month period prior to the date of submitting the application, or (2) in the case of an applicant possessing only an operator's license, that he has similarly communicated with amateur stations during the same period. Proof of such communication must be included in the application by stating the call letters of the stations with which communication was carried on and the time and date of each communication. Lacking such proof, the applicant will be ineligible for a license for a period of 90 days.

This rule shall not prevent renewal of an amateur station license to an applicant who has recently qualified for license as an amateur operator.

403. *Class of operator and privileges.*—There shall be but one main class of amateur operator's license, to be known as "amateur class," but each such license shall be limited in scope by the signature of the examining officer opposite the particular class or classes of privileges which apply, as follows:

Class A.—Unlimited privileges.

Class B.—Unlimited radiotelegraph privileges. Limited in the operation of radiotelephone amateur stations to the following bands of frequencies: 1,800 to 2,000 kilocycles; 28,000 to 28,500 kilocycles; 56,000 to 60,000 kilocycles; 400,000 to 401,000 kilocycles.

Class C.—Same as class B privileges, except that the Commission may require the licensee to appear at an examining point for a supervisory written examination and practical code test during the license term. Failing to appear for examination when directed to do so, or failing to pass the supervisory examination, the license held will be canceled and the holder thereof will not be issued another license for the class C privileges.

404. *Scope and places of examinations.*—The scope of examinations for amateur operators' licenses shall be based on the class of privileges the applicant desires, as follows:

Class A.—To be eligible for examination for the class A amateur operator's privileges the applicant must have been a licensed amateur operator for at least 1 year and must personally appear at one of the Commission's examining offices, and take the supervisory written examination and code test. Examinations will be conducted at Washington, D. C., on Thursday of each week, and at each radio district office of the Commission on the days designated by the inspector in charge of such office. In addition examinations will be held quarterly in other examining cities on the dates to be designated by the inspector in charge of the radio district in which the examining city is situated. The examination will include the following:

a. Applicant's ability to send and receive in plain language messages in the Continental Morse Code (5 characters to the word) at a speed of not less than 13 words per minute.

b. Technical knowledge of amateur radio apparatus, both telegraph and telephone.

c. Knowledge of the provisions of the Communications Act of 1934, subsequent acts, treaties, and rules and regulations of the Federal Communications Commission, affecting amateur licensees.

Class B.—The requirements for class B amateur operators' privileges are similar to those for the class A, except that no experience is required and the questions on radio-telephone apparatus are not so comprehensive in scope.

Class C.—The requirements for class C amateur operators' privileges shall be the same as for the class B except the examination will be given by mail. Applicants for class C privileges must reside more than 125 miles airline from the nearest examining point for class B privileges, or in a camp of the Civilian Conservation Corps, or be in the regular military or naval service of the United States at a military post or naval station; or be shown by physician's certificate to be unable to appear for examination due to protracted disability.

405. *Recognition of other classes of licenses.*—An applicant for any class of amateur operator's privileges who has held a radiotelephone second-class operator's license or higher, or an equivalent commercial grade license, or who has been accorded unlimited amateur radiotelephone privileges, within 5 years of the date of application may only be required to submit additional proof as to code ability and/or knowledge of the laws, treaties, and regulations affecting amateur licensees.

406. An applicant for the class B or C amateur operator's privileges who has held a radiotelegraph third-class operator's license or higher, or an equivalent commercial grade license, or who has held an amateur extra first-class license within 5 years of the date of application may be accorded a license by passing an examination in laws, treaties, and regulations affecting amateur licensees.

407. *Code ability to be certified by licensed operator.*—An applicant for the class C amateur operator's privileges must have his application signed in the presence of a person authorized to administer oaths by (1) a licensed radiotelegraph operator other than an amateur operator possessing only the class C privileges or former temporary amateur class license, or (2) by a person who can show evidence of employment as a radiotelegraph operator in the Government service of the United States. In either case the radiotelegraph code examiner shall attest to the applicant's ability to send and receive messages in plain language in the continental Morse code (5 characters to the word) at a speed of not less than 13 words per minute. The code certification may be omitted if the applicant can show proof of code ability in accordance with the preceding rule.

408. *Application forms.*—Forms for amateur station and/or operator license shall be obtained by calling or writing to the inspector in charge of the radio inspection district in which the applicant resides. Upon completion of the forms, they shall be sent back to the same office where the final arrangements will be made for the examination: Provided, however, in the case of applicants for the class C amateur operator's privileges, the forms and examination papers when completed shall be mailed direct to the Federal Communications Commission, Washington, D. C.

409. *Grading of examination.* — The percentage that must be obtained as a passing mark in each examination is 75 out of a possible 100. No credit will be given in the grading of papers for experience or knowledge of the code. If an applicant answers only the questions relating to laws, treaties, and regulations, by reason of his right to omit other subjects because of having held a recognized class of license, a percentage of 75 out of a possible 100 must be obtained on the questions answered.

410. *Operator's and station licenses to run concurrently.* — An amateur station license shall be issued so as to run concurrently with the amateur operator's license and both licenses shall run for 3 years from the date of issuance. If either the station license or the operator's license is modified during the license term, both licenses shall be reissued for the full 3-year term: Pro-

vided, however, if an operator's license is modified only with respect to the class of operator's privileges, the old license may be endorsed, in which case the expiration date will not change.

411. *Eligibility for reexamination.*—No applicant who fails to qualify for an operator's license will be reexamined within 90 days from the date of the previous examination.

412. *Penalty.*—Any attempt to obtain an operator's license by fraudulent means, or by attempting to impersonate another, or copying or divulging questions used in examinations, or if found unqualified or unfit will constitute a violation of the regulations for which the licensee may suffer suspension of license or be refused a license and/or debarment from further examination for a period not exceeding 2 years at the discretion of the licensing authority.

413. *Duplicate licenses.* — Any licensee applying for a duplicate license to replace an original which has been lost, mutilated, or destroyed, shall submit an affidavit to the Commission attesting to the facts regarding the manner in which the original was lost. Duplicates will be issued in exact conformity with the original, and will be marked "duplicate" on the face of the license.

414. *Oath of secrecy.*—Licenses are not valid until the oath of secrecy has been executed and the signature of the licensee affixed thereto.

415. *Examination to be written in longhand.*—All examinations, including the code test, must be written in longhand by the applicant.

RMA COLOR CODE

It is not generally known but the color code used by all manufacturers that are members of the Radio Manufacturers Association applies to fixed condensers as well as fixed resistors.

The code is the same for both and the units are ohms in the case of resistors and *micro-micro*-farads in the case of condensers.

Body Color		*End Color*		*Dot Color*	
Black	0	Black	0		
Brown	1	Brown	1	Brown	0
Red	2	Red	2	Red	00
Orange	3	Orange	3	Orange	000
Yellow	4	Yellow	4	Yellow	0000
Green	5	Green	5	Green	00000
Blue	6	Blue	6	Blue	000000
Purple	7	Purple	7	Purple	0000000
Gray	8	Gray	8	Gray	00000000
White	9	White	9	White	000000000

The body color is the first figure of the value. The end color is the second figure of the value. The center dot indicates the number of ciphers following the first two figures.

DATA ON VARIOUS MICROPHONES

Manufacturer	*Model*	*Type*	*Level in DB*	*Manufacturer*	*Model*	*Type*	*Level in DB*
Amperite Corp.	RE-1	Velocity-Ribbon	— 90 db	R. C. A	50A	Inductor	— 67 db
Amperite Corp.	RAE	Velocity-Ribbon	— 90 db	Shure Bro.	3B	Double button	— 45 db
Amperite Corp.	RB	Velocity-Ribbon	— 65 db	Shure Bro.	22B	Double button	— 45 db
Amperite Corp.	RS	Velocity-Ribbon	— 68 db	Shure Bro.	70S	Crystal	— 56 db
Astatic	K-2	Crystal	— 64 db	Shure Bro.	701	Crystal	— 55 db
Astatic	218	Crystal	— 56 db	Thomaston Labs.	MC30	Dynamic	— 86 db
Astatic	D104	Crystal	— 60 db	Universal	A	Single-button	— 40 db
Bruno	RA-2	Velocity-Ribbon	— 90 db	Universal	X	Single-button	— 45 db
Bruno	RA-3	Velocity-Ribbon	— 78 db	Universal	BB	Double-button	— 45 db
Bruno	RV-3	Velocity-Ribbon	— 70 db	Universal	LL	Double-button	— 50 db
Bruno	Vel	Static Velocity	— 53 db	Universal	CB	Double-button	— 45 db
Brush Development	G-2S2P	Crystal	— 70 db	Universal	RL	Velocity-Ribbon	— 63 db
Brush Development	G-4S6P	Crystal	— 60 db	Western Electric	337	Single-button	— 15 db
Brush Development	G-1	Crystal	— 90 db	Western Electric	395	Single-button	— 8 db
Brush Development	G-20	Crystal	— 80 db	Western Electric	615A	Single-button	— 15 db
R. C. A	44A	Velocity-Ribbon	— 78 db	Western Electric	600A	Double-button	— 45 db
R. C. A	4010	Velocity-Ribbon	— 65 db				

BIAS CALCULATIONS

Self-Bias

Self-bias is obtained by inserting a resistor in the cathode or center tap of the filament return and taking the necessary voltage drop across the resistor. To determine the value of grid bias simply divide the grid bias in volts by the plate current to obtain the resistance value in ohms.

$$\text{Ohms} = \frac{\text{grid bias X 1000}}{\text{Plate current in milliamperes}}$$

Thus, for a 76 tube which has a plate current of 5 ma. for which a negative grid bias of 13.5 volts is required:

$$\frac{13.5 \text{ volts X } 1000}{5} = 2700 \text{ ohms}$$

Class "C" Stage Bias

To determine the value of negative bias for a Class "C" stage divide the plate voltage by the mu. or amplification factor of the tube and multiply by two for double cut-off. For higher efficiency and phone operation add 40 per cent to this figure. For example, a 203A tube is to be used Class "C" with 1250 volts on the plate. Amplification of this tube is 25. Therefore

$$\frac{1250}{25} = 50x2 = 100 + 40\ (40\%) = 140 \text{ volts}$$

Bias for Doubler Stage

The bias voltage for doubler stages is calculated similarly to Class "C" bias with the exception that the cut-off value is multiplied by 3. If the R-F excitation is sufficiently high, the bias may be increased with a resultant increase in output and efficiency.

Oscillator Bias

In amateur transmitter oscillator circuits the bias voltage is usually obtained from a grid leak. The bias is developed across the leak and is equal to the product of the d.c. grid current in amperes by the resistance of the grid leak in ohms. For example, if a grid current of 10 ma. is flowing through a 10,000 ohm grid leak the bias will be 0.010 amperes x 10,000 ohms, or 100 volts. In general, grid leak values are not critical. Lowering the ohmic value of the leak will increase the R-F output. Tubes with high mu's operate better with low ohmic values of grid leaks while low mu tubes may require leaks as high as 50,000 ohms.

KEN-O-GRAFS

The following 14 pages of Ken-O-Grafs have been designed to facilitate computing some of the common calculations encountered in amateur radio practice in a most painless modern method. The majority of these graphs are self explanatory with the exception of those described below:

The chart on page 44 permits the instantaneous determination of the frequency corresponding to any wavelength—or the wavelength equivalent of any frequency throughout the entire radio spectrum.

To find the frequency corresponding to any wavelength between 10.1 meters and 100 meters, or the wavelength equivalent of any frequency between 29,690 and 2,998, the chart may be read directly. Outside of this range the reading is made by shifting the decimal points. Thus, if one desires to find the frequency equivalent of 101 meters, for instance, shift the decimal point of the frequency one place to the left. This will show the frequency to be 2969 kc. If the frequency corresponding to 1010 meters is required, shift the wavelength decimal of the first item two places to the right and the frequency decimal two places in the opposite direction, and from this will be found that the required frequency is 296.9 kc.

Conversely, to find the wavelength corresponding to a given frequency, locate the number in the frequency column and read the wavelength in the opposite column. If it is necessary to move the decimal point in the frequency column, always move it in the wavelength column the same number of places, but in the opposite direction.

Where the frequency is shown in terms of megacycles, its equivalent in kilocycles is found by simply adding three ciphers to the megacycle figure.

The Ken-O-Graf on page 45 shows how to find the equivalent of two resistors in parallel and also the capacity of two condensers in series. Place a ruler through the division on arms marked "R1, C1 and R2, C2". The resultant line on RC will be the total resistance or capacity in the circuit.

On the next page will be found a similar chart to be used when the two branches are widely different.

The relation between inductance, capacity and frequency is shown on page 47. With this graph and a ruler any of the above mentioned quantities can be found if the other two are known. For example, what is the highest frequency obtainable when a 200 mmfd. condenser is used with a 13.5 microhenry coil? Lay a straight edge across 20 mmfd. on the capacity scale and 13.5 on the inductance scale; the intersection on the middle scale reads 3 megacycles. This chart can be employed in the same way if any two of three quantities are known.

For Ohms law and power consumed in the circuit the Ken-O-Graf shown on page 48 solves these equations with the aid of the straight edge. If any two quantities are known the other two can be found with the aid of a ruler or straight edge. For example, in a circuit of 2000 ohm resistance and a current of 10 milliamperes; what is the wattage and the voltage? The answer is found where the ruler intersects .2 on the watt scale and 20 on the voltage scale. It is essential when using this scale that all values be read on the A or B scale.

The graph shown on page 49 may be used to find:

(1) The reactance of a given inductance at a given frequency.

(2) The reactance of a given capacity at a given frequency.

(3) The resonant frequency of a given inductance and capacitance.

The sloping lines from lower left to upper right are associated with the inductances indicated along the upper and right hand edges. The lines slanting downward from the left to the right are associated with the capacities indicated along the upper and right hand edges. The reactance in ohms is shown on the left and the frequency at the foot of the chart.

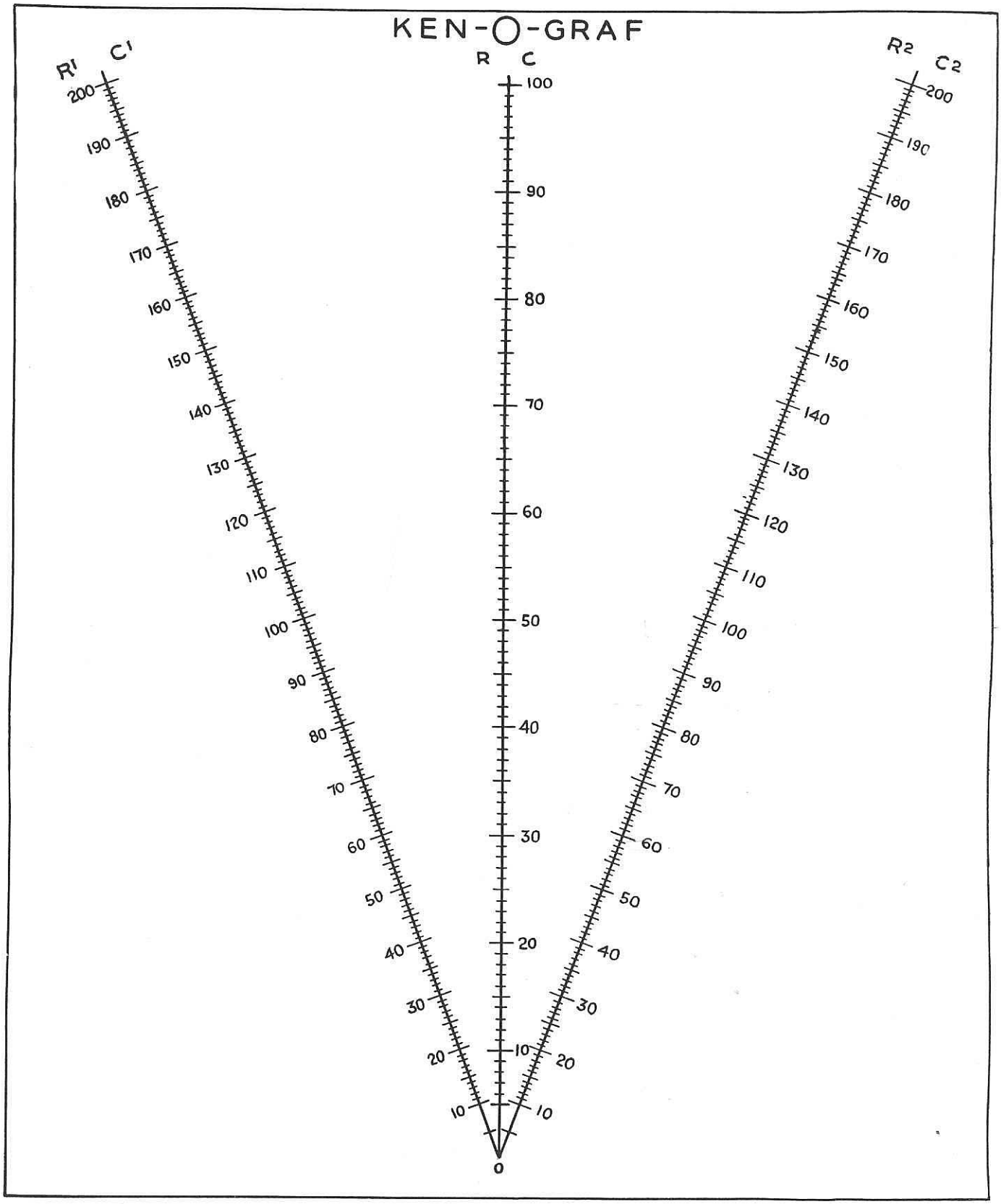
To determine the reactance of a condenser or inductance at a certain frequency, follow along the vertical line corresponding to the proper frequency until it intersects the line corresponding to the specified capacity or inductance. The horizontal line which coincides with this intersection when carried to the left gives the value of reactance in ohms. For example, find the reactance of a coil having an inductance of 1 Henry at 1000 cycles. This value is found by referring to the vertical line corresponding to the 1000 cycles until its intersects the 1 Henry slanting line. The horizonal line at this point of intersection when carried to the left of the graph reads 6,200 ohms. Similarly, the sloping 1 mfd. line can be followed to the point where it intersects with the vertical 1000 cycle frequency line. Projecting from this point of intersection on the horizontal line indicates a reactance of 160 ohms.

To find the resonant frequency of a condenser and inductance, enter the slanting lines for the given inductance and capacity. At the point of intersection project vertically and read the frequency at the foot of the chart. For example, find the resonant frequency of a 1 mfd. condenser and a 1 Henry coil. Follow the sloping 1 mfd. line to the point where it intersects with the 1 Henry line. The vertical line through the point of intersection indicates a frequency of 160 cycles.

The chart shown on page 50 is designed to determine the wattage input to any tube or tubes and the load impedance which any modulated stage presents to the modulator. For example, a 150 T tube operated Class "C" at 1000 volts draws 200 milliamperes. What is the power input and the plate load resistance to be matched by the Class "B" modulator output transformer secondary? Place a ruler on the chart through 200 on the scale marked "Amplifier Plate Current" and 1000 on the scale marked "Amplifier D. C. Plate Voltage". Read 200 watts input on the scale marked "Amplifier Power Input" and 5000 ohms on the scale marked "Amplifier Plate D.C. Load Resistance".

METER-KILOCYCLE CONVERSION

M.	KC.	M.	KC.	M.	KC.	M.	KC.	M.	KC.	M.	KC.	M.	KC.	M.	KC.	M.	KC.
10.1	29,690	20.1	14,920	30.1	9,961	40.1	7,477	50.1	5,984	60.1	4,989	70.1	4,277	80.1	3,743	90.1	3,328
10.2	29,390	20.2	14,840	30.2	9,928	40.2	7,458	50.2	5,973	60.2	4,980	70.2	4,271	80.2	3,738	90.2	3,324
10.3	29,110	20.3	14,770	30.3	9,895	40.3	7,440	50.3	5,961	60.3	4,972	70.3	4,265	80 3	3,734	90.3	3,320
10.4	28,830	20.4	14,700	30.4	9,862	40.4	7,421	50.4	5,949	60.4	4,964	70.4	4,259	80.4	3,729	90.4	3,317
10.5	28,550	20.5	14,630	30.5	9,830	40.5	7,403	50.5	5,937	60.5	4,956	70.5	4,253	80.5	3,724	90.5	3,313
10.6	28,280	20.6	14,550	30.6	9,798	40.6	7,385	50.6	5,925	60.6	4,948	70.6	4,247	80.6	3,720	90.6	3,309
10.7	28,020	20.7	14,480	30.7	9,766	40.7	7,367	50.7	5,913	60.7	4,939	70.7	4,241	80.7	3,715	90.7	3,306
10.8	27,760	20.8	14,410	30.8	9,734	40.8	7,349	50.8	5,902	60.8	4,931	70.8	4,235	80.8	3,711	90.8	3,302
10.9	27,510	20.9	14,350	30.9	9,703	40.9	7,331	50.9	5,890	60.9	4,923	70.9	4,229	80.9	3,706	90.9	3,298
11.0	27,260	21.0	14,280	31.0	9,672	41.0	7,313	51.0	5,879	61.0	4,915	71.0	4,223	81.0	3,701	91.0	3,295
11.1	27,010	21.1	14,210	31.1	9,641	41.1	7,295	51.1	5,867	61.1	4,907	71.1	4,217	81.1	3,697	91.1	3,291
11.2	26,770	21.2	14,140	31.2	9,610	41.2	7,277	51.2	5,856	61.2	4,899	71.2	4,211	81.2	3,692	91.2	3,288
11.3	26,530	21.3	14,080	31.3	9,579	41.3	7,260	51.3	5,844	61.3	4,891	71.3	4,205	81.3	3,688	91.3	3,284
11.4	26,300	21.4	14,010	31.4	9,548	41.4	7,242	51.4	5,833	61.4	4,883	71.4	4,199	81.4	3,683	91.4	3,280
11.5	26,070	21.5	13,950	31.5	9,518	41.5	7,225	51.5	5,822	61.5	4,875	71.5	4,193	81.5	3,679	91.5	3,277
11.6	25,850	21.6	13,880	31.6	9,488	41.6	7,207	51.6	5,810	61.6	4,867	71.6	4,187	81.6	3,674	91.6	3,273
11.7	25,630	21.7	13,810	31.7	9,458	41.7	7,190	51.7	5,799	61.7	4,859	71.7	4,182	81.7	3,670	91.7	3,270
11.8	25,410	21.8	13,750	31.8	9,428	41.8	7,173	51.8	5,788	61.8	4,851	71.8	4,176	81.8	3,665	91.8	3,266
11.9	25,200	21.9	13,690	31.9	9,399	41.9	7,156	51.9	5,777	61.9	4,844	71.9	4,170	81.9	3,661	91.9	3,262
12.0	24,990	22.0	13,630	32.0	9,369	42.0	7,139	52.0	5,766	62.0	4,836	72.0	4,164	82.0	3,656	92.0	3,259
12.1	24,780	22.1	13,570	32.1	9,340	42.1	7,122	52.1	5,755	62.1	4,828	72.1	4,158	82.1	3,652	92.1	3,255
12.2	24,580	22.2	13,510	32.2	9,311	42.2	7,105	52.2	5,744	62.2	4,820	72.2	4,153	82 2	3,647	92.2	3,252
12.3	24,380	22.3	13,440	32.3	9,282	42.3	7,088	52.3	5,733	62.3	4,813	72.3	4,147	82.3	3,643	92.3	3,248
12.4	24,180	22.4	13,380	32.4	9,254	42.4	7,071	52.4	5,722	62.4	4,805	72.4	4,141	82.4	3,639	92.4	3,245
12.5	23,990	22.5	13,330	32.5	9,225	42.5	7,055	52.5	5,711	62.5	4,797	72.5	4,135	82.5	3,634	92.5	3,241
12.6	23,800	22.6	13,270	32.6	9,197	42.6	7,038	52.6	5,700	62.6	4,789	72.6	4,130	82.6	3,630	92.6	3,238
12.7	23,610	22.7	13,210	32.7	9,169	42.7	7,022	52.7	5,689	62.7	4,782	72.7	4,124	82.7	3,625	92.7	3,234
12.8	23,420	22.8	13,150	32.8	9,141	42.8	7,005	52.8	5,678	62.8	4,774	72.8	4,118	82.8	3,621	92.8	3,231
12.9	23,240	22.9	13,090	32.9	9,113	42.9	6,989	52.9	5,668	62.9	4,767	72.9	4,113	82.9	3,617	92.9	3,227
13.0	23,060	23.0	13,040	33.0	9,086	43.0	6,973	53.0	5,657	63.0	4,759	73.0	4,107	83.0	3,612	93.0	3,224
13.1	22,890	23.1	12,980	33.1	9,058	43.1	6,956	53.1	5,646	63.1	4,752	73.1	4,102	83.1	3,608	93.1	3,220
13.2	22,710	23.2	12,920	33.2	9,031	43.2	6,940	53.2	5,636	63.2	4,744	73.2	4,096	83.2	3,604	93.2	3,217
13.3	22,540	23.3	12,870	33.3	9,004	43.3	6,924	53.3	5,625	63.3	4,736	73.3	4,090	83.3	3,599	93.3	3,214
13.4	22,370	23.4	12,810	33.4	8,977	43.4	6,908	53.4	5,615	63.4	4,729	73.4	4,085	83.4	3,595	93.4	3,210
13.5	22,210	23.5	12,760	33.5	8,950	43.5	6,892	53.5	5,604	63.5	4,722	73.5	4,079	83.5	3,591	93.5	3,207
13.6	22,040	23.6	12,700	33.6	8,923	43.6	6,877	53.6	5,594	63.6	4,714	73.6	4,074	83.6	3,586	93.6	3,203
13.7	21,880	23.7	12,650	33.7	8,897	43.7	6,861	53.7	5,583	63.7	4,707	73.7	4,068	83.7	3,582	93.7	3,200
13.8	21,730	23.8	12,600	33.8	8,870	43.8	6,845	53.8	5,573	63.8	4,699	73.8	4,063	83.8	3,578	93.8	3,196
13.9	21,570	23.9	12,540	33.9	8,844	43.9	6,830	53.9	5,563	63.9	4,692	73.9	4,057	83.9	3,574	93.9	3,193
14.0	21,420	24.0	12,490	34.0	8,818	44.0	6,814	54.0	5,552	64.0	4,685	74.0	4,052	84.0	3,569	94.0	3,190
14.1	21,260	24.1	12,440	34.1	8,792	44.1	6,799	54.1	5,542	64.1	4,677	74.1	4,046	84.1	3,565	94.1	3,186
14.2	21,110	24.2	12,390	34.2	8,767	44.2	6,783	54.2	5,532	64.2	4,670	74.2	4,041	84.2	3,561	94.2	3,183
14.3	20,970	24.3	12,340	34.3	8,741	44.3	6,768	54.3	5,522	64.3	4,663	74.3	4,035	84.3	3,557	94.3	3,179
14.4	20,820	24.4	12,290	34.4	8,716	44.4	6,753	54.4	5,511	64.4	4,656	74.4	4,030	84.4	3,552	94.4	3,176
14.5	20,680	24.5	12,240	34.5	8,690	44.5	6,738	54.5	5,501	64.5	4,648	74.5	4,024	84.5	3,548	94.5	3,173
14.6	20,540	24.6	12,190	34.6	8,665	44.6	6,722	54.6	5,491	64.6	4,641	74.6	4,019	84.6	3,544	94.6	3,169
14.7	20,400	24.7	12,140	34.7	8,640	44.7	6,707	54.7	5,481	64.7	4,634	74.7	4,014	84.7	3,540	94.7	3,166
14.8	20,260	24.8	12,090	34.8	8,616	44.8	6,692	54.8	5,471	64.8	4,627	74.8	4,008	84.8	3,536	94.8	3,163
14.9	20,120	24.9	12,040	34.9	8,591	44.9	6,678	54.9	5,461	64.9	4,620	74.9	4,003	84.9	3,531	94.9	3,159
15.0	19,990	25.0	11,990	35.0	8,566	45.0	6,663	55.0	5,451	65.0	4,613	75.0	3,998	85.0	3,527	95.0	3,156
15.1	19,860	25.1	11,950	35.1	8,542	45.1	6,648	55.1	5,441	65.1	4,606	75.1	3,992	85.1	3,523	95.1	3,153
15.2	19,720	25.2	11,900	35.2	8,518	45.2	6,633	55.2	5,432	65.2	4,598	75.2	3,987	85.2	3,519	95.2	3,149
15.3	19,600	25.3	11,850	35.3	8,494	45.3	6,619	55.3	5,422	65.3	4,591	75.3	3,982	85.3	3,515	95.3	3,146
15.4	19,470	25.4	11,800	35.4	8,470	45.4	6,604	55.4	5,412	65.4	4,584	75.4	3,976	85.4	3,511	95.4	3,143
15.5	19,340	25.5	11,760	35.5	8,446	45.5	6,589	55.5	5,402	65.5	4,577	75.5	3,971	85.5	3,507	95.5	3,139
15.6	19,220	25.6	11,710	35.6	8,422	45.6	6,575	55.6	5,392	65.6	4,570	75.6	3,966	85.6	3,503	95.6	3,136
15.7	19,100	25.7	11,670	35.7	8,398	45.7	6,561	55.7	5,383	65.7	4,563	75.7	3,961	85.7	3,498	95.7	3,133
15.8	18,980	25.8	11,620	35.8	8,375	45.8	6,546	55.8	5,373	65.8	4,557	75.8	3,955	85.8	3,494	95.8	3,130
15.9	18,860	25.9	11,580	35.9	8,352	45.9	6,532	55.9	5,364	65.9	4,550	75.9	3,950	85.9	3,490	95.9	3,126
16.0	18,740	26.0	11,530	36.0	8,328	46.0	6,518	56.0	5,354	66.0	4,543	76.0	3,945	86.0	3,486	96.0	3,123
16.1	18,620	26.1	11,490	36.1	8,305	46.1	6,504	56.1	5,344	66.1	4,536	76.1	3,940	86.1	3,482	96.1	3,120
16.2	18,510	26.2	11,440	36.2	8,282	46.2	6,490	56.2	5,335	66.2	4,529	76.2	3,935	86.2	3,478	96.2	3,117
16.3	18,390	26.3	11,400	36.3	8,260	46.3	6,476	56.3	5,325	66.3	4,522	76.3	3,929	86.3	3,474	96.3	3,113
16.4	18,280	26.4	11,360	36.4	8,237	46.4	6,462	56.4	5,316	66.4	4,515	76.4	3,924	86.4	3,470	96.4	3,110
16.5	18,170	26.5	11,310	36.5	8,214	46.5	6,448	56.5	5,307	66.5	4,509	76.5	3,919	86.5	3,466	96.5	3,107
16.6	18,060	26.6	11,270	36.6	8,192	46.6	6,434	56.6	5,297	66.6	4,502	76.6	3,914	86.6	3,462	96.6	3,104
16.7	17,950	26.7	11,230	36.7	8,170	46.7	6,420	56.7	5,288	66.7	4,495	76.7	3,909	86.7	3,458	96.7	3,101
16.8	17,850	26.8	11,190	36.8	8,147	46.8	6,406	56.8	5,279	66.8	4,488	76.8	3,904	86.8	3,454	96.8	3,097
16.9	17,740	26.9	11,150	36.9	8,125	46.9	6,393	56.9	5,269	66.9	4,482	76.9	3,899	86.9	3,450	96.9	3,094
17.0	17,640	27.0	11,100	37.0	8,103	47.0	6,379	57.0	5,260	67.0	4,475	77.0	3,894	87.0	3,446	97.0	3,091
17.1	17,530	27.1	11,060	37.1	8,081	47.1	6,366	57.1	5,251	67.1	4,468	77.1	3,889	87.1	3,442	97.1	3,088
17.2	17,430	27.2	11,020	37.2	8,060	47.2	6,352	57.2	5,242	67.2	4,462	77.2	3,884	87.2	3,438	97.2	3,085
17.3	17,330	27.3	10,980	37.3	8,038	47.3	6,339	57.3	5,232	67.3	4,455	77.3	3,879	87.3	3,434	97.3	3,081
17.4	17,230	27.4	10,940	37.4	8,017	47.4	6,325	57.4	5,223	67.4	4,448	77.4	3,874	87.4	3,430	97.4	3,078
17.5	17,130	27.5	10,900	37.5	7,995	47.5	6,312	57.5	5,214	67.5	4,442	77.5	3,869	87.5	3,427	97.5	3,075
17.6	17,040	27.6	10,860	37.6	7,974	47.6	6,299	57.6	5,205	67.6	4,435	77.6	3,864	87.6	3,423	97.6	3,072
17.7	16,940	27.7	10,820	37.7	7,953	47.7	6,286	57.7	5,196	67.7	4,429	77.7	3,859	87.7	3,419	97.7	3,069
17.8	16,840	27.8	10,780	37.8	7,932	47.8	6,272	57.8	5,187	67.8	4,422	77.8	3,854	87.8	3,415	97.8	3,066
17.9	16,750	27.9	10,750	37.9	7,911	47.9	6,259	57.9	5,178	67.9	4,416	77.9	3,849	87.9	3,411	97.9	3,063
18.0	16,660	28.0	10,710	38.0	7,890	48.0	6,246	58.0	5,169	68.0	4,409	78.0	3,844	88.0	3,407	98.0	3,059
18.1	16,560	28.1	10,670	38.1	7,869	48.1	6,233	58.1	5,160	68.1	4,403	78.1	3,839	88.1	3,403	98.1	3,056
18.2	16,470	28.2	10,630	38.2	7,849	48.2	6,220	58.2	5,152	68.2	4,396	78.2	3,834	88.2	3,399	98.2	3,053
18.3	16,380	28.3	10,590	38.3	7,828	48.3	6,207	58.3	5,143	68.3	4,390	78.3	3,829	88.3	3,395	98.3	3,050
18.4	16,290	28.4	10,560	38.4	7,808	48.4	6,195	58.4	5,134	68.4	4,383	78.4	3,824	88.4	3,392	98.4	3,047
18.5	16,210	28.5	10,520	38.5	7,788	48.5	6,182	58.5	5,125	68.5	4,377	78.5	3,819	88.5	3,388	98.5	3,044
18.6	16,120	28.6	10,480	38.6	7,767	48.6	6,169	58.6	5,116	68.6	4,371	78.6	3,814	88.6	3,384	98.6	3,041
18.7	16,030	28.7	10,450	38.7	7,747	48.7	6,156	58.7	5,108	68.7	4,364	78.7	3,810	88.7	3,380	98.7	3,038
18.8	15,950	28.8	10,410	38.8	7,727	48.8	6,144	58.8	5,099	68.8	4,358	78.8	3,805	88.8	3,376	98.8	3,035
18.9	15,860	28.9	10,370	38.9	7,707	48.9	6,131	58.9	5,090	68.9	4,352	78.9	3,800	88.9	3,373	98.9	3,032
19.0	15,780	29.0	10,340	39.0	7,688	49.0	6,119	59.0	5,082	69.0	4,345	79.0	3,795	89.0	3,369	99.0	3,028
19.1	15,700	29.1	10,300	39.1	7,668	49.1	6,106	59.1	5,073	69.1	4,339	79.1	3,790	89.1	3,365	99.1	3,025
19.2	15,620	29.2	10,270	39.2	7,648	49.2	6,094	59.2	5,065	69.2	4,333	79.2	3,786	89.2	3,361	99.2	3,022
19.3	15,530	29.3	10,230	39.3	7,629	49.3	6,082	59.3	5,056	69.3	4,326	79.3	3,781	89.3	3,357	99.3	3,019
19.4	15,450	29.4	10,200	39.4	7,610	49.4	6,069	59.4	5,047	69.4	4,320	79.4	3,776	89.4	3,354	99.4	3,016
19.5	15,380	29.5	10,160	39.5	7,590	49.5	6,057	59.5	5,039	69.5	4,314	79.5	3,771	89.5	3,350	99.5	3,013
19.6	15,300	29.6	10,130	39.6	7,571	49.6	6,045	59.6	5,031	69.6	4,308	79.6	3,767	89.6	3,346	99.6	3,010
19.7	15,220	29.7	10,090	39.7	7,552	49.7	6,033	59.7	5,022	69.7	4,302	79.7	3,762	89.7	3,342	99.7	3,007
19.8	15,140	29.8	10,060	39.8	7,533	49.8	6,020	59.8	5,014	69.8	4,295	79.8	3,757	89.8	3,339	99.8	3,004
19.9	15,070	29.9	10,030	39.9	7,514	49.9	6,008	59.9	5,005	69.9	4,289	79.9	3,752	89.9	3,335	99.9	3,001
20.0	14,990	30.0	9,994	40.0	7,496	50.0	5,996	60.0	4,997	70.0	4,283	80.0	3,748	90.0	3,331	100.0	2,998


KEN-O-GRAF
R1
C1
R
C
R2
C2
200
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170
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150
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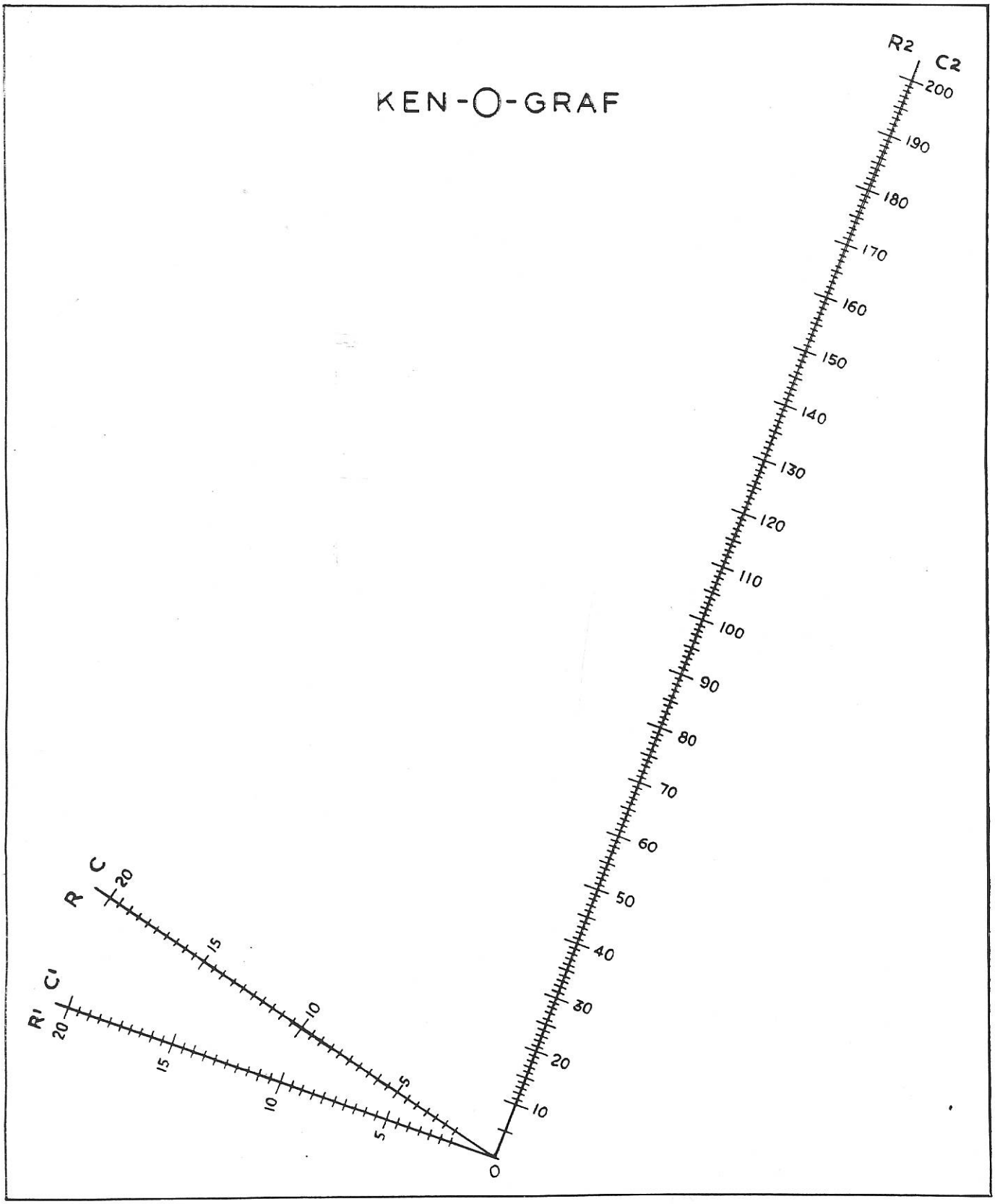
KEN-O-GRAF
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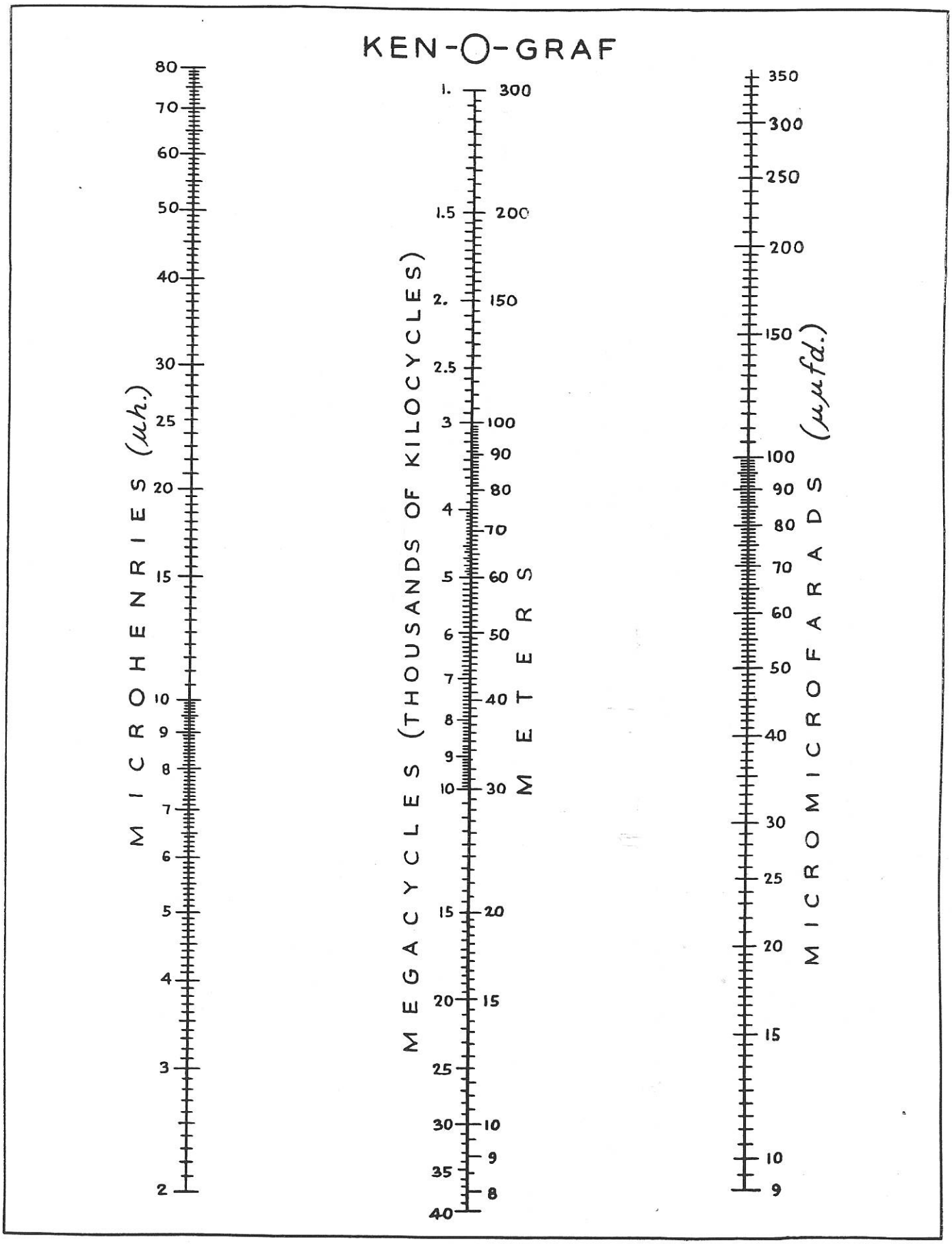
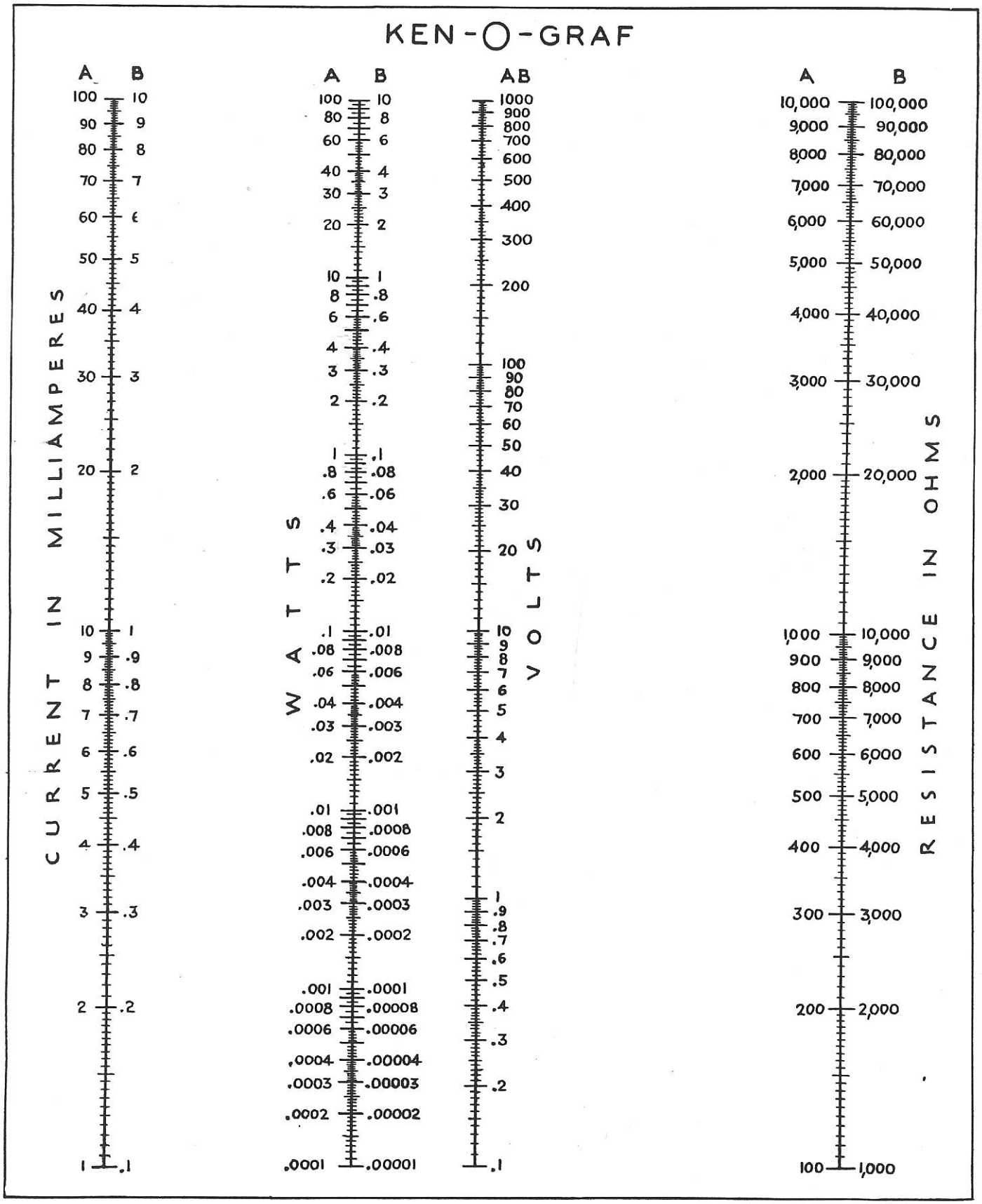

KEN-O-GRAF
MICROHENRIES (μh.)
80 70 60 50 40 30 25 20 15 10 9 8 7 6 5 4 3 2
MEGACYCLES (THOUSANDS OF KILOCYCLES)
1. 1.5 2. 2.5 3 4 5 6 7 8 9 10 15 20 25 30 35 40
METERS
300 200 150 100 90 80 70 60 50 40 30 20 15 10 9 8
MICROMICROFARADS (μμfd.)
350 300 250 200 150 100 90 80 70 60 50 40 30 25 20 15 10 9


KEN-O-GRAF
A B
CURRENT IN MILLIAMPERES
100 10
90 9
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70 7
60 6
50 5
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A B
WATTS
100 10
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VOLTS
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A B
RESISTANCE IN OHMS
10,000 100,000
9,000 90,000
8,000 80,000
7,000 70,000
6,000 60,000
5,000 50,000
4,000 40,000
3,000 30,000
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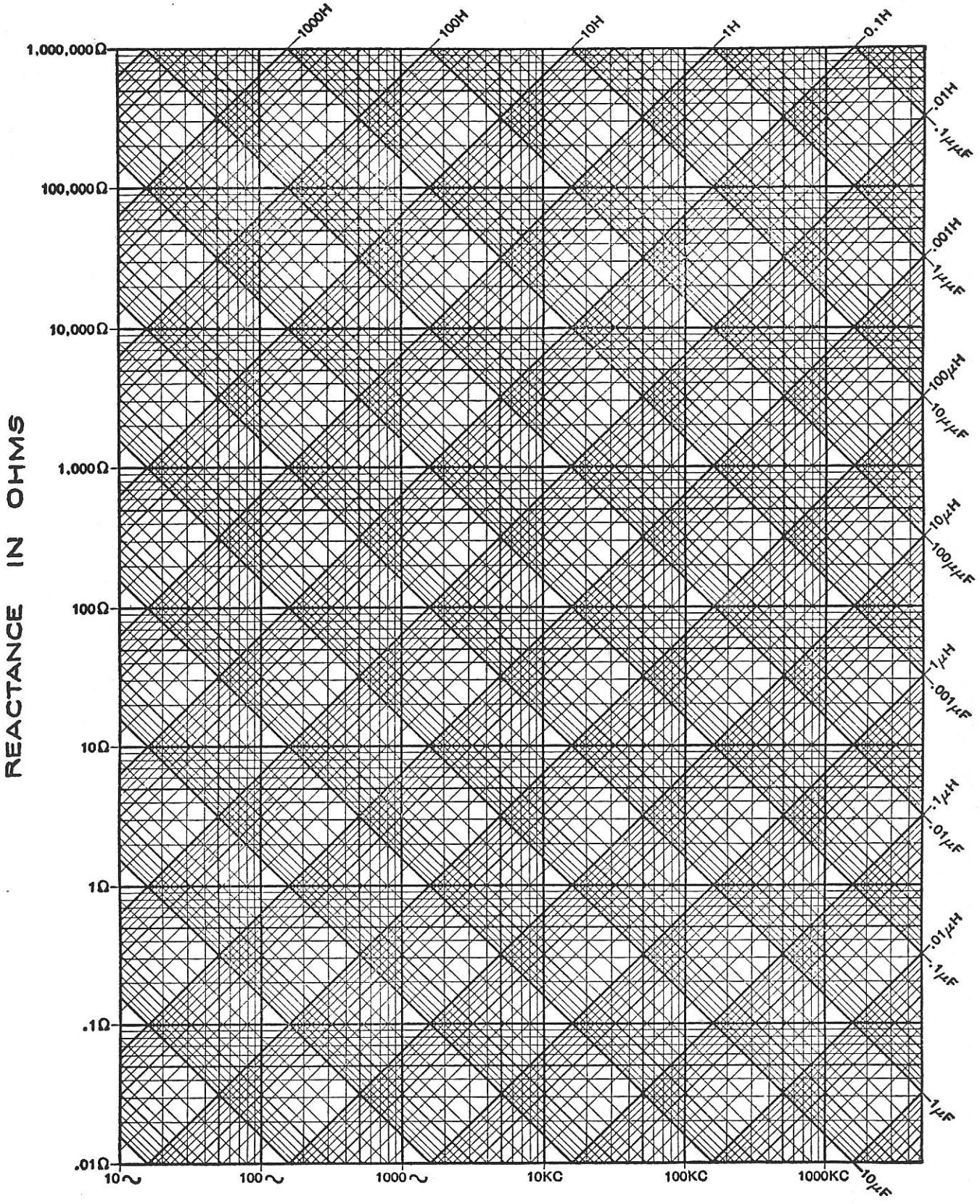
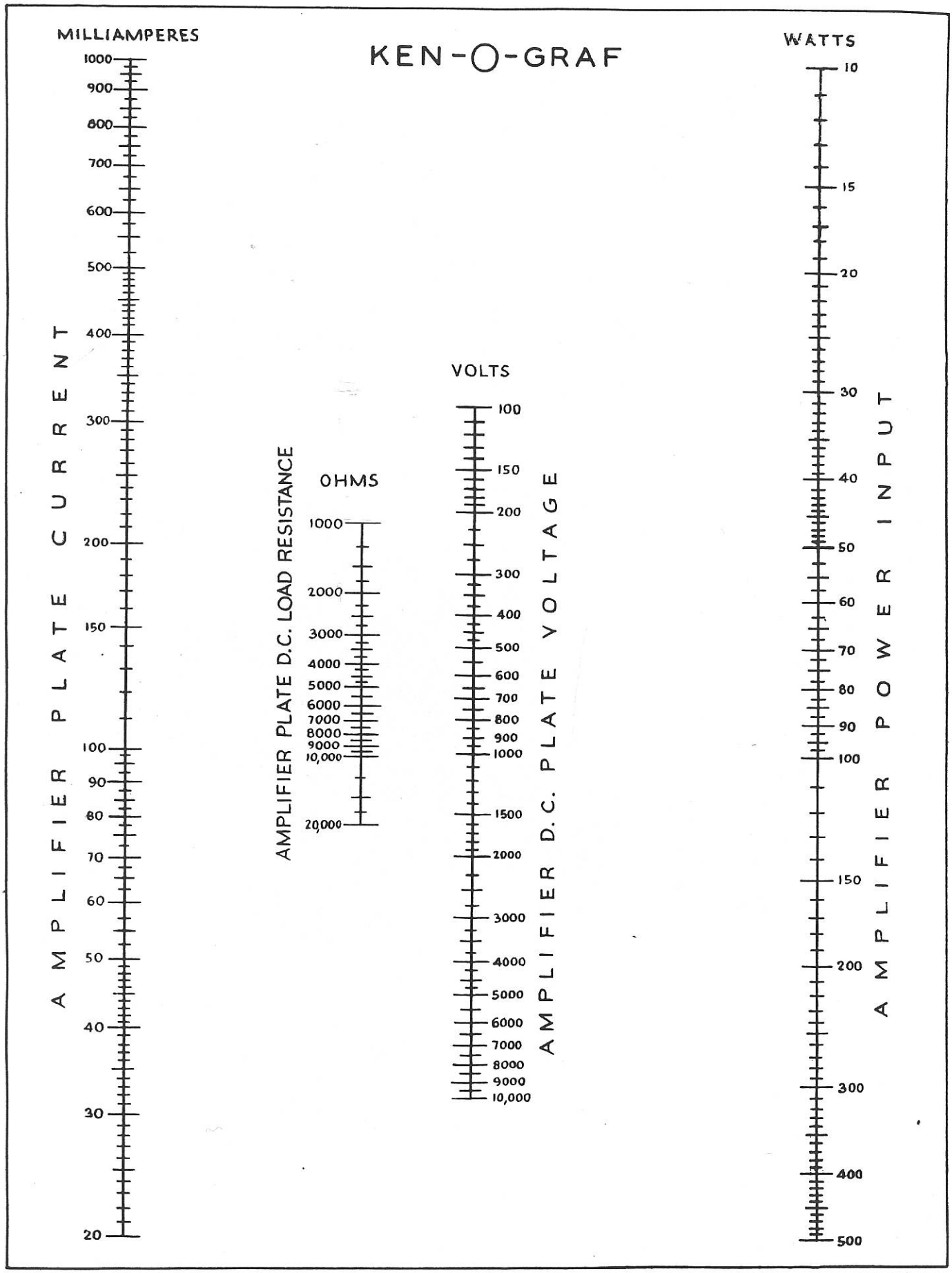
1,000 10,000
900 9,000
800 8,000
700 7,000
600 6,000
500 5,000
400 4,000
300 3,000
200 2,000
100 1,000



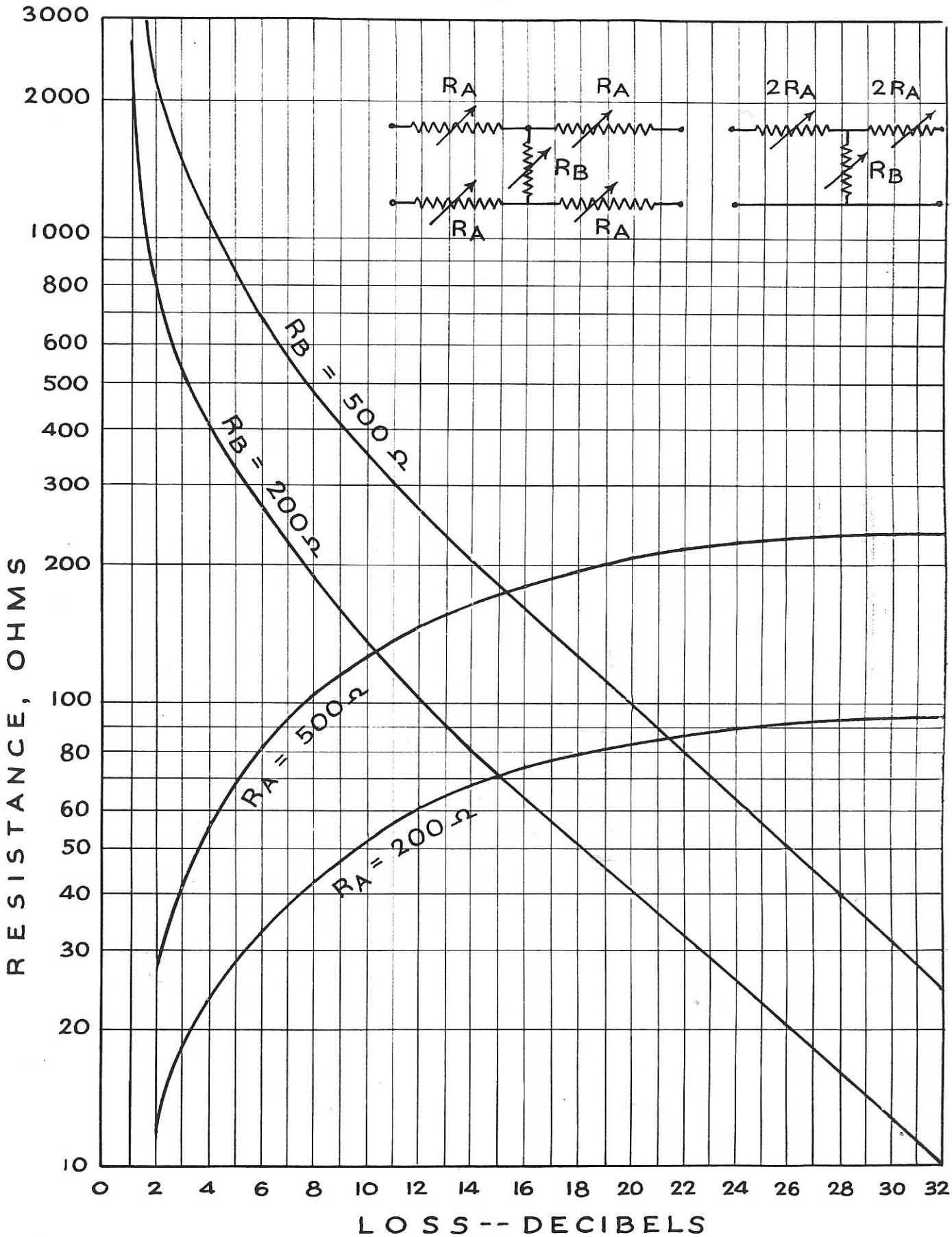
KC = kilocycles
Ω = ohms

μF = microfarads
μμF = micromicrofarads

H = henries
μH = microhenries


KEN-O-GRAF
MILLIAMPERES
1000
900
800
700
600
500
400
300
200
150
100
90
80
70
60
50
40
30
20
AMPLIFIER PLATE CURRENT
OHMS
1000
2000
3000
4000
5000
6000
7000
8000
9000
10,000
20,000
AMPLIFIER PLATE D.C. LOAD RESISTANCE
VOLTS
100
150
200
300
400
500
600
700
800
900
1000
1500
2000
3000
4000
5000
6000
7000
8000
9000
10,000
AMPLIFIER D.C. PLATE VOLTAGE
WATTS
10
15
20
30
40
50
60
70
80
90
100
150
200
300
400
500
AMPLIFIER POWER INPUT

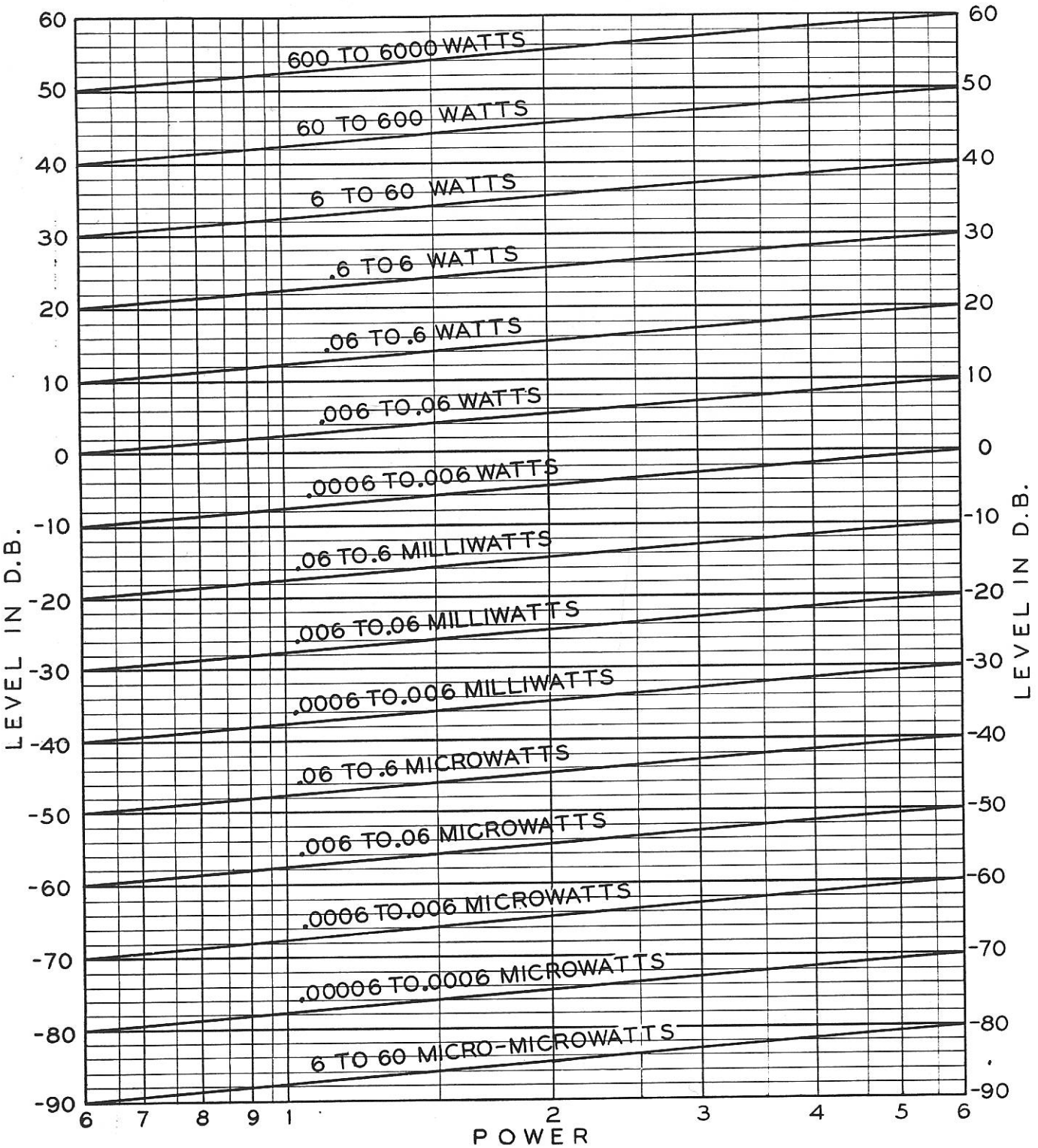
KEN-O-GRAF



Proper attenuation of audio frequencies without introducing distortion is usually accomplished with pads. The Ken-O-Graf shown above gives resistance value of the branches of an "H" or "T" pad for channels having an impedance of 200 or 500 ohms. The range of attenuation is from 2 to 32 db.

KEN-O-GRAF

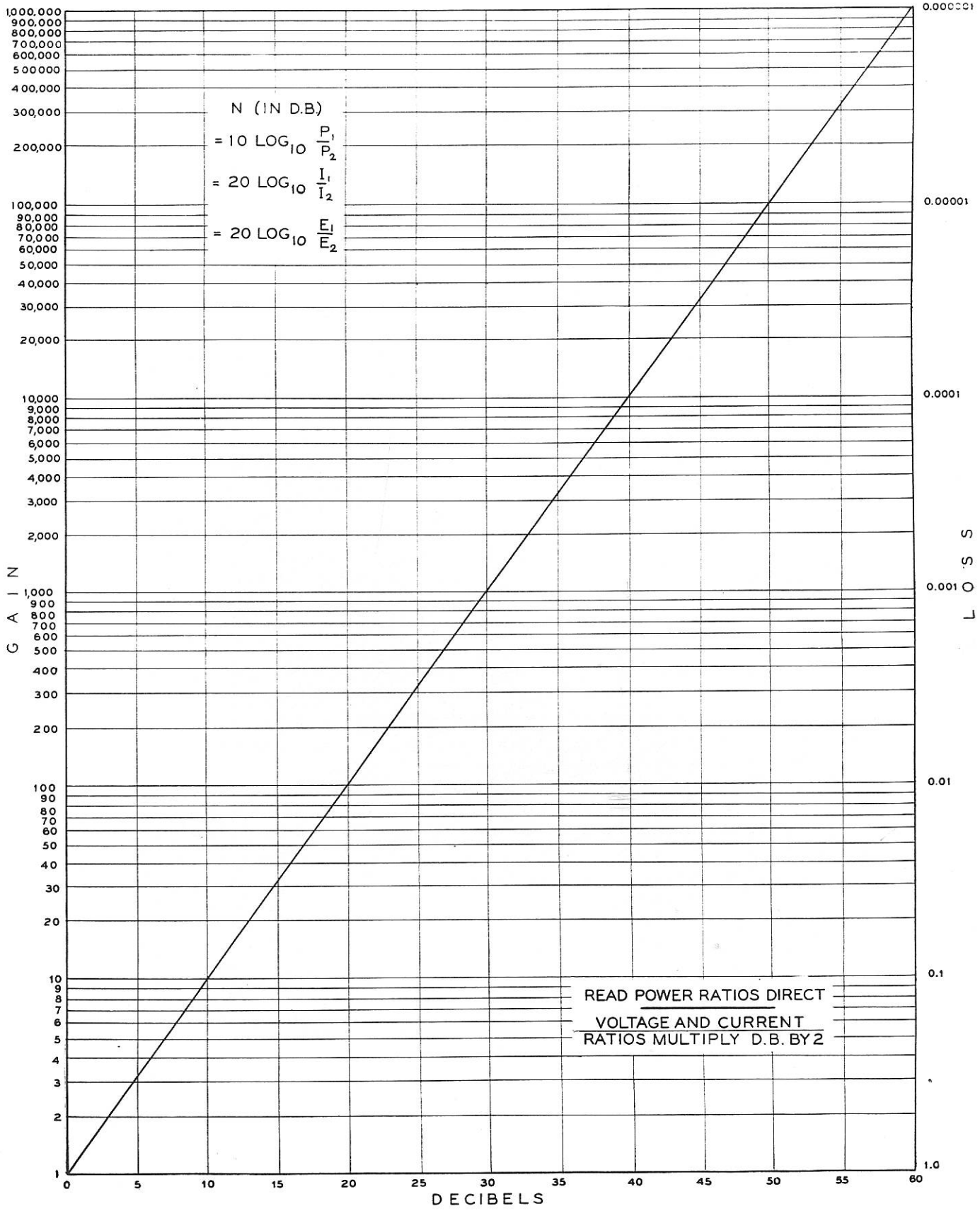
WATTS-VS-DECIBELS



Based on .006 watts at zero level.

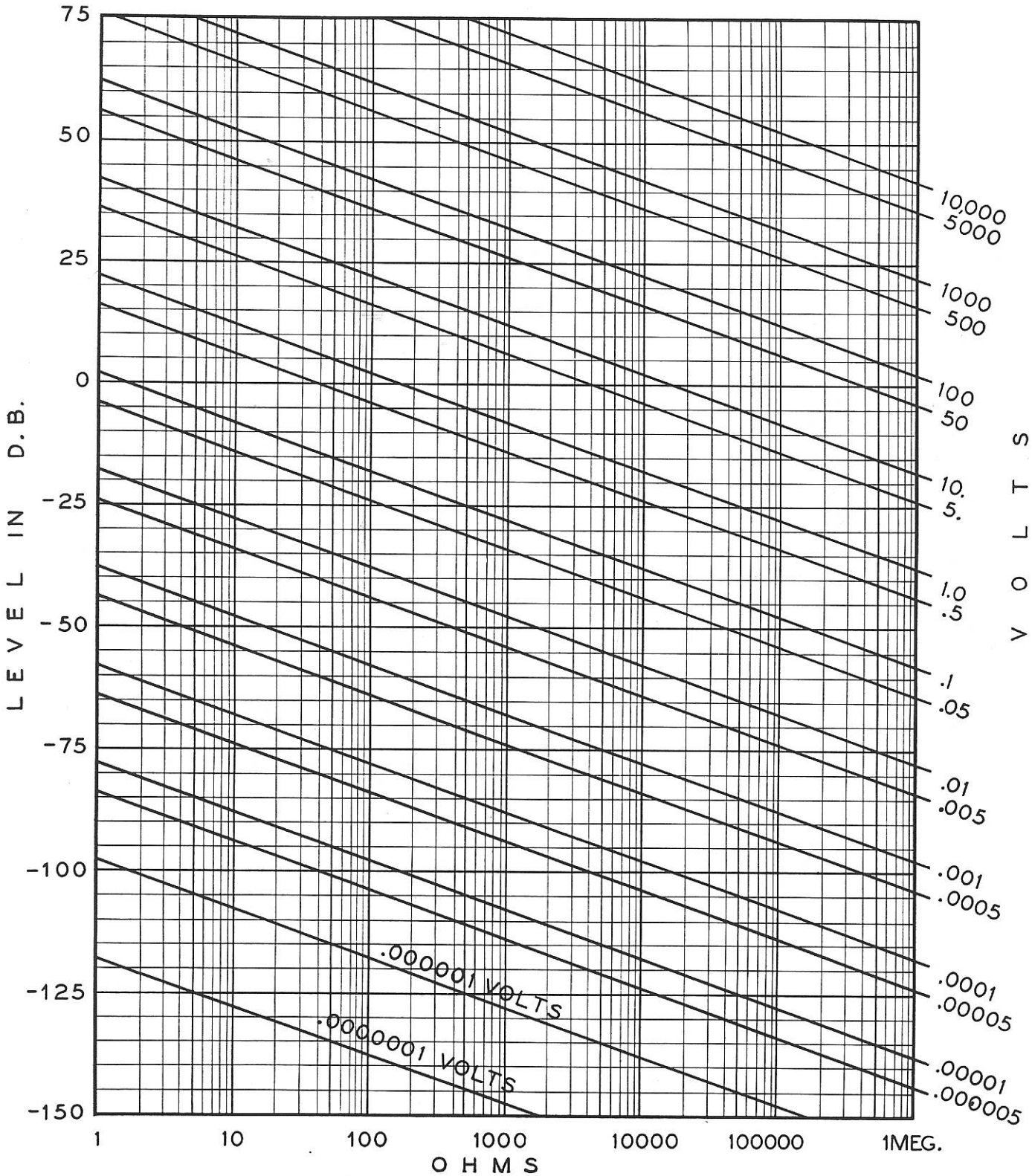
KEN-O-GRAF

CONVERTING LOSS OR GAIN INTO DECIBELS



KEN-O-GRAF

OHMS-VOLTAGE — DECIBELS CONVERSION GRAPH

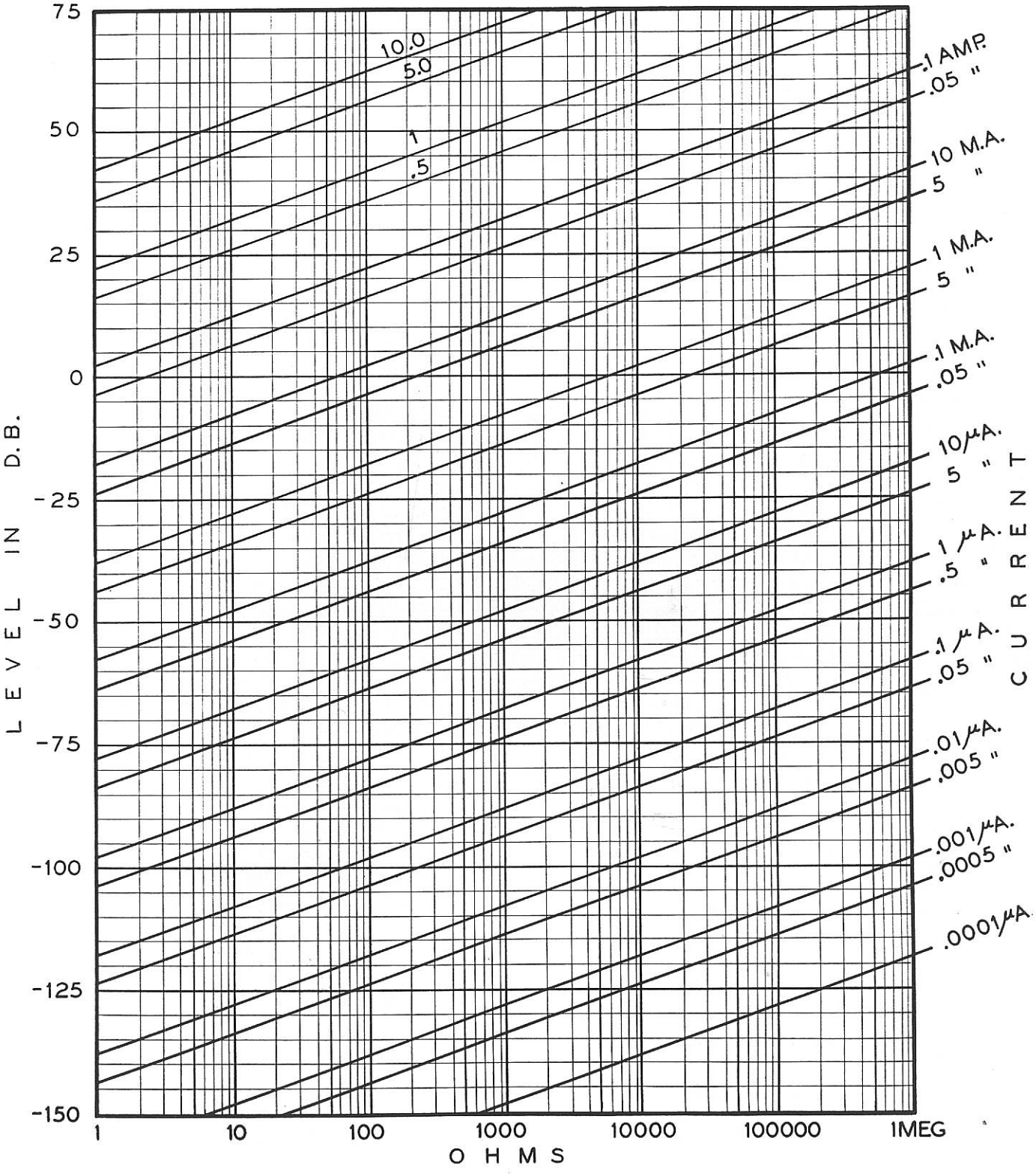


This graph may be used to find ohms, volts and level in decibels. e.g. ***What is the level in decibels*** *at 500 ohms at a voltage of 1 volt? Enter the graph at the bottom (ohms) at 500 ohms and read up to where the slanting 1 volt line intersects. From this point, project horizontally to the left, and read —5 db.*

Based on .006 watts at zero level.

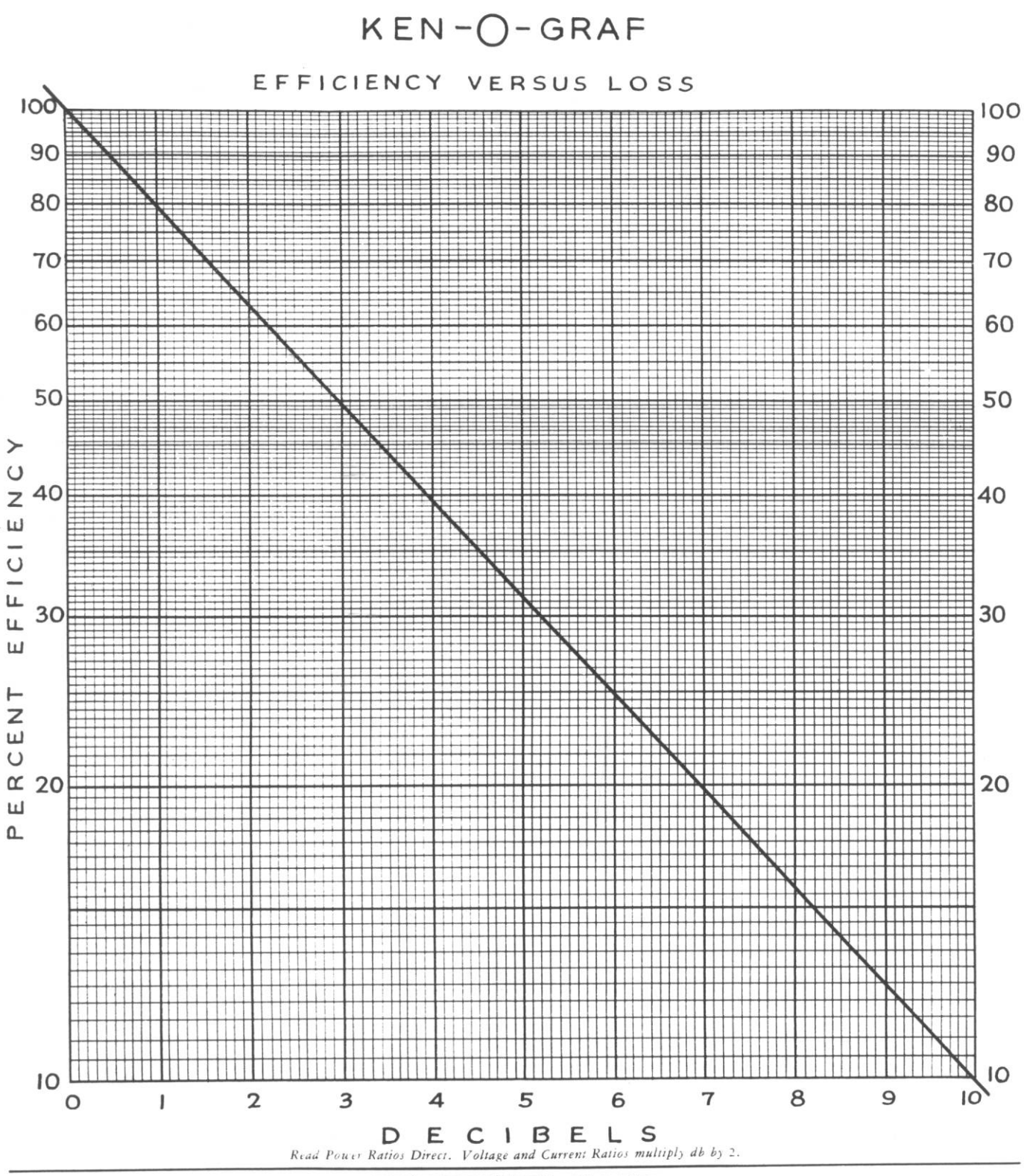
KEN-O-GRAF

OHMS-CURRENT-DECIBELS CONVERSION GRAPH



This graph may be used to find ohms, current and level in decibels, e.g: What is the level in decibels at 600 ohms at a current of 10 M.A. Enter the graph at the bottom (ohms) at 600 ohms and read up to where the slanting 10 M.A. line intersects. From this point, project horizontally to the left, and read +10 db

Based on .006 watts at zero level.



THE DECIBEL OR DB

The decibel is used universally in radio engineering for the measurement of acoustic or electrical power ratios. This unit may be expressed mathematically as

$$db = 10 \log_{10} \frac{P_1}{P_2}$$

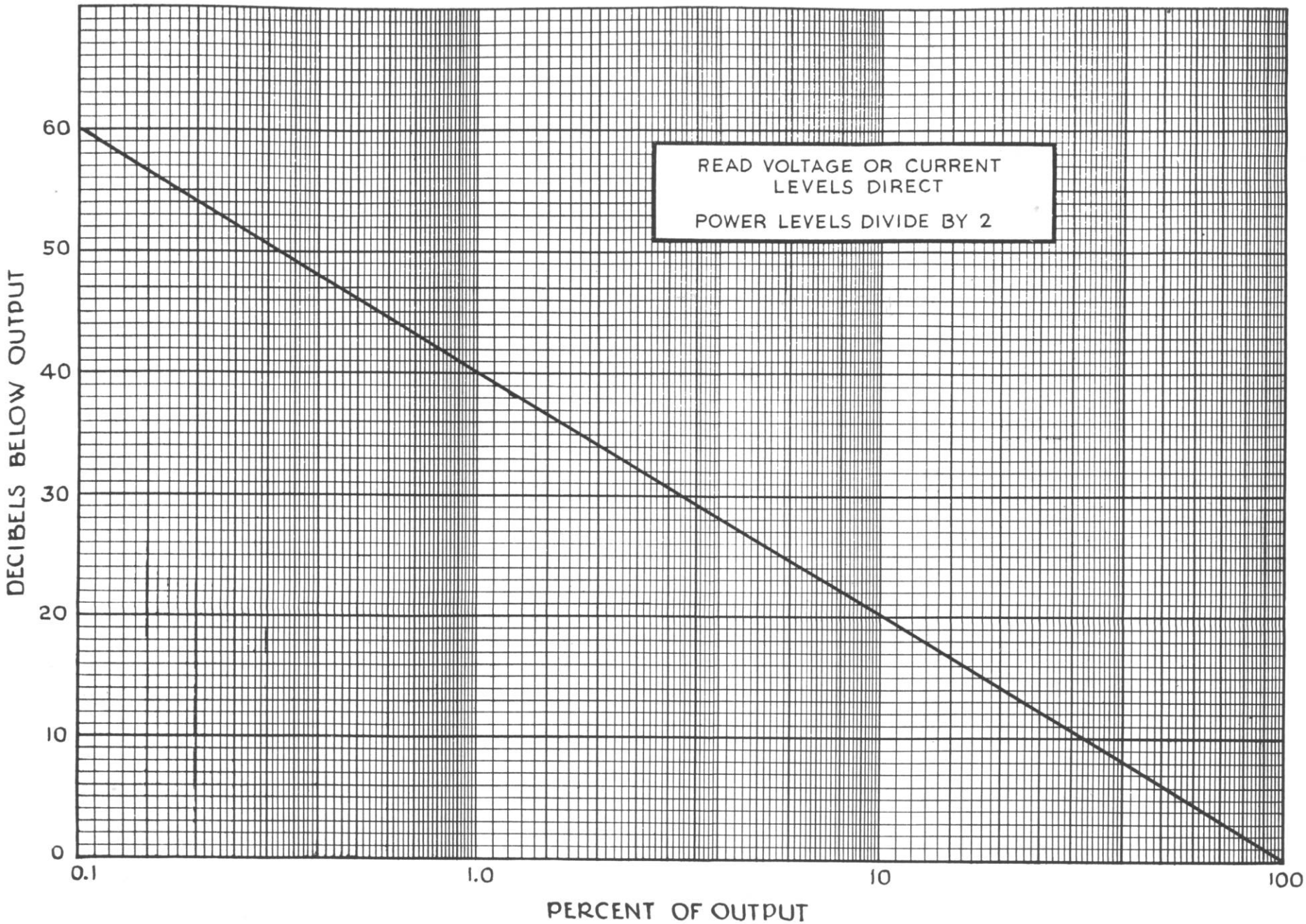
Thus it is seen the decibel so often used in the work of audio amplification, transmission, and reproduction, is simply the ratio between the strengths of any two signals, or the ratio of change in the energy of a signal when it is amplified or attenuated.

As used in amateur radio, the level in decibels is based upon a zero energy level of .006 watts (1.73 volts across a 500 ohm line). Zero levels of 12.5 mw and 1 mw are used in broadcast and telephone technique. All db references contained in this manual are based upon a zero energy level of 6 mw.

All levels above the reference or zero level are designated as plus db and below as minus db. In problems dealing with the conversion of voltage or current ratios the following expression is used.

$$db = 20 \log \frac{E_1}{E_2}$$

KEN-O-GRAF



This Ken-O-Graf is used to determine hum level, harmonic content, etc., in db below maximum output. Example: What is the hum level below output when the hum level is 1%. **Read 40 db** *on the chart.*

COPPER WIRE TABLE

Gauge No. B. & S.	Cross Sectional Area			Turns per Linear Inch				Turns per Square Inch			Feet per Lb.		Ohms per 1000 ft. 25° C.	Carrying Capacity at 1500 C.M. per Amp.
	Diam. in Mils	Circular Mil Area	Diam. in mm.	Enamel	S.S.C.	D.S.C. or S.C.C.	D.C.C.	S.C.C.	Enamel S.C.C.	D.C.C.	Bare	D.C.C.		
1	289.3	83690	7.348	—	—	—	—	—	—	—	3.947	—	.1264	55.7
2	257.6	66370	6.544	—	—	—	—	—	—	—	4.977	—	.1593	44.1
3	229.4	52630	5.827	—	—	—	—	—	—	—	6.276	—	.2009	35.0
4	204.3	41740	5.189	—	—	—	—	—	—	—	7.914	—	.2533	27.7
5	181.9	33100	4.621	—	—	—	—	—	—	—	9.980	—	.3195	22.0
6	162.0	26250	4.115	—	—	—	—	—	—	—	12.58	—	.4028	17.5
7	144.3	20820	3.665	—	—	—	—	—	—	—	15.87	—	.5080	13.8
8	128.5	16510	3.264	7.6	—	7.4	7.1	—	—	—	20.01	19.6	.6405	11.0
9	114.4	13090	2.906	8.6	—	8.2	7.8	—	—	—	25.23	24.6	.8077	8.7
10	101.9	10380	2.588	9.6	—	9.3	8.9	87.5	84.8	80.0	31.82	30.9	1.018	6.9
11	90.74	8234	2.305	10.7	—	10.3	9.8	110	105	97.5	40.12	38.8	1.284	5.5
12	80.81	6530	2.053	12.0	—	11.5	10.9	136	131	121	50.59	48.9	1.619	4.4
13	71.96	5178	1.828	13.5	—	12.8	12.0	170	162	150	63.80	61.5	2.042	3.5
14	64.08	4107	1.628	15.0	—	14.2	13.8	211	198	183	80.44	77.3	2.575	2.7
15	57.07	3257	1.450	16.8	—	15.8	14.7	262	250	223	101.4	97.3	3.247	2.2
16	50.82	2583	1.291	18.9	18.9	17.9	16.4	321	306	271	127.9	119	4.094	1.7
17	45.26	2048	1.150	21.2	21.2	19.9	18.1	397	372	329	161.3	150	5.163	1.3
18	40.30	1624	1.024	23.6	23.6	22.0	19.8	493	454	399	203.4	188	6.510	1.1
19	35.89	1288	.9116	26.4	26.4	24.4	21.8	592	553	479	256.5	237	8.210	.86
20	31.96	1022	.8118	29.4	29.4	27.0	23.8	775	725	625	323.4	298	10.35	.68
21	28.46	810.1	.7230	33.1	32.7	29.8	26.0	940	895	754	407.8	370	13.05	.54
22	25.35	642.4	.6438	37.0	36.5	34.1	30.0	1150	1070	910	514.2	461	16.46	.43
23	22.57	509.5	.5733	41.3	40.6	37.6	31.6	1400	1300	1080	648.4	584	20.76	.34
24	20.10	404.0	.5106	46.3	45.3	41.5	35.6	1700	1570	1260	817.7	745	26.17	.27
25	17.90	320.4	.4547	51.7	50.4	45.6	38.6	2060	1910	1510	1031	903	33.00	.21
26	15.94	254.1	.4049	58.0	55.6	50.2	41.8	2500	2300	1750	1300	1118	41.62	.17
27	14.20	201.5	.3606	64.9	61.5	55.0	45.0	3030	2780	2020	1639	1422	52.48	.13
28	12.64	159.8	.3211	72.7	68.6	60.2	48.5	3670	3350	2310	2067	1759	66.17	.11
29	11.26	126.7	.2859	81.6	74.8	65.4	51.8	4300	3900	2700	2607	2207	83.44	.084
30	10.03	100.5	.2546	90.5	83.3	71.5	55.5	5040	4660	3020	3287	2534	105.2	.067
31	8.928	79.70	.2268	101.	92.0	77.5	59.2	5920	5280	—	4145	2768	132.7	.053
32	7.950	63.21	.2019	113.	101.	83.6	62.6	7060	6250	—	5227	3137	167.3	.042
33	7.080	50.13	.1798	127.	110.	90.3	66.3	8120	7360	—	6591	4697	211.0	.033
34	6.305	39.75	.1601	143.	120.	97.0	70.0	9600	8310	—	8310	6168	266.0	.026
35	5.615	31.52	.1426	158.	132.	104.	73.5	10900	8700	—	10480	6737	335.0	.021
36	5.000	25.00	.1270	175.	143.	111.	77.0	12200	10700	—	13210	7877	423.0	.017
37	4.453	19.83	.1131	198.	154.	118.	80.3	—	—	—	16660	9302	533.4	.013
38	3.965	15.72	.1007	224.	166.	126.	83.6	—	—	—	21010	10666	672.6	.010
39	3.531	12.47	.0897	248.	181.	133.	86.6	—	—	—	26500	11907	848.1	.008
40	3.145	9.88	.0799	282.	194.	140.	89.7	—	—	—	33410	14222	1069	.006

NOTE: Weights and resistances shown were calculated for wires of nominal diameter; hence, variations from these values may be expected. A mil is approximately 1000th part of one inch.

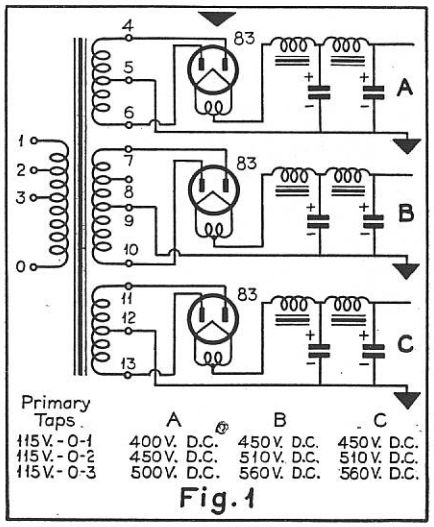
The Practical Solution To The Power Supply Problem

PROBABLY the biggest bug-a-boo in radio is the ever-existing menace of obsolescence. Of course, in such a modern industry new developments are constantly being born, and the older methods are soon discarded to make room for the later developments.

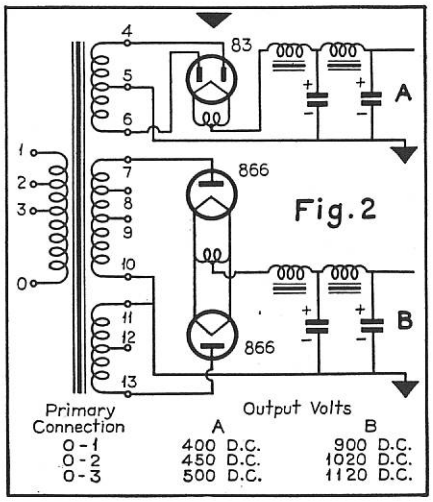
However, from the experimenter's point of view, obsolescence is quite expensive, especially when it involves the discarding of perfectly good equipment. New tubes are superior to existing types, but due to different voltages and circuit applications, changes in associated equipment are often necessary. In many instances the changes in r.f. and audio circuits are inexpensive. Moreover, a change in these circuits usually necessitates a change in the power supply. This is often the most expensive unit in the entire circuit, regardless of the application.

Universal Transformer

In transmitters or high-power public-address systems the low-power tubes require exceptionally good filtering to keep hum level as low as is consistent with good practice. If these low-level stages derive their voltage supply from the high-voltage system it is necessary to thoroughly filter the entire power supply, not only to eliminate hum but also to prevent feedback. Of course, this may be eliminated by filtering a small section that supplies only the lower level tubes. This method, however, jeopardizes condensers and resistors should the load be removed from this section.



Multiple-voltage power-supply circuits using type 83 rectifiers and operating from a single power transformer (filament transformer separate.)



High- and low-voltage power supply using a single 83 and two 866s in full-wave connection, both circuits supplied from a single power transformer (filament supplies separate).

Another method to eliminate this hazard is to use a separate transformer for the input or low-level stages. The drawback to this procedure is the excessive cost and is therefore not usually practical.

The answer lies in the use of a new type of transformer that permits any existing type of rectification in a practical and economical manner.

Voltages Available

The voltages available from this transformer range from 400 volts up to 3000 volts depending upon the type of circuit used. In the schematic (Fig. 1) three separate d.c. supplies ranging from 400 to 560 volts may be obtained. By means of a primary tap these voltages may be varied approximately 12 per cent. This circuit will supply adequate power to three separate audio or r.f. units.

In applications where it is necessary to have a separate low voltage and a high voltage, the circuit shown in Fig. 2, utilizing two 866 tubes and a type 83, is not only economical but very practical for many uses in amateur transmitters and experimental circuits.

Fig. 3 shows a similar application with the exception that the high-voltage supply is obtained from three low cost 83 type tubes in a bridge arrangement. In this application the high voltage supply delivers 140% of full wave rated value. The same voltages are also obtainable in Fig. 4. In this circuit the center tap of one of the high-voltage windings is connected to the filament of a type 83 tube, thereby forming a series connection.

By far the most versatile circuit is shown in Fig. 5. A single 83 is used for low voltage and two 866's connected for full-wave rectification supply the high voltage. Usually when this circuit is used in existing equipment two power transformers are required to accomplish what one will do with this new transformer.

Where higher voltages are desired the circuit of Fig. 6 may be used. This arrangement will supply a d.c. voltage as high as 1020 volts. In a circuit where such high voltages are used it is common practice to supply a lower power stage with a lower voltage. This is obtained from a separate winding using a type 83 full-wave rectifier.

High Voltages

For maximum volts per dollar expended the circuit of Fig. 7 is ideal for those whose pocketbooks are limited. A glance shows two of the high voltage windings connected in series. For rectification two type 83 tubes are connected in tandem. Low voltage is obtained from the other winding with another 83 tube. When it is not desired to utilize the low voltage the three windings may be connected in series. When used as shown in Fig. 8, with two 866 tubes, voltages ranging from 1300 to 1620 volts are procurable.

A still cheaper method of obtaining the same voltages is shown in Fig. 9. Here the outputs of three type 83 tubes are connected in series. In this circuit it is essential that the filament transformer supplying the 83 tubes be adequately insulated to withstand the high voltages.

Perhaps surpassing all circuits shown is the application in Fig. 10. In this circuit 21 different voltages are available. In transmitter use there is sufficient power available to supply anything from a five-watter up to a 500-watt rig. In addition to this a separate low-voltage supply may be taken off of the secondary winding marked 4, 5 and 6, when the high-voltage requirements are not over 2240 volts.

The above application refers to our triple winding power transformers, Type T658 and Type T659. Transformer T658 is rated to supply 175 MA. from each winding. Transformer T659 is similar to the above but designed for heavier current supplies. This unit will supply 350 MA. from each winding.

Another transformer similar to these units is Type T654. This unit is also a triple winding plate transformer which delivers 250 MA. from each winding. However, the voltages available from this unit differ as shown below.

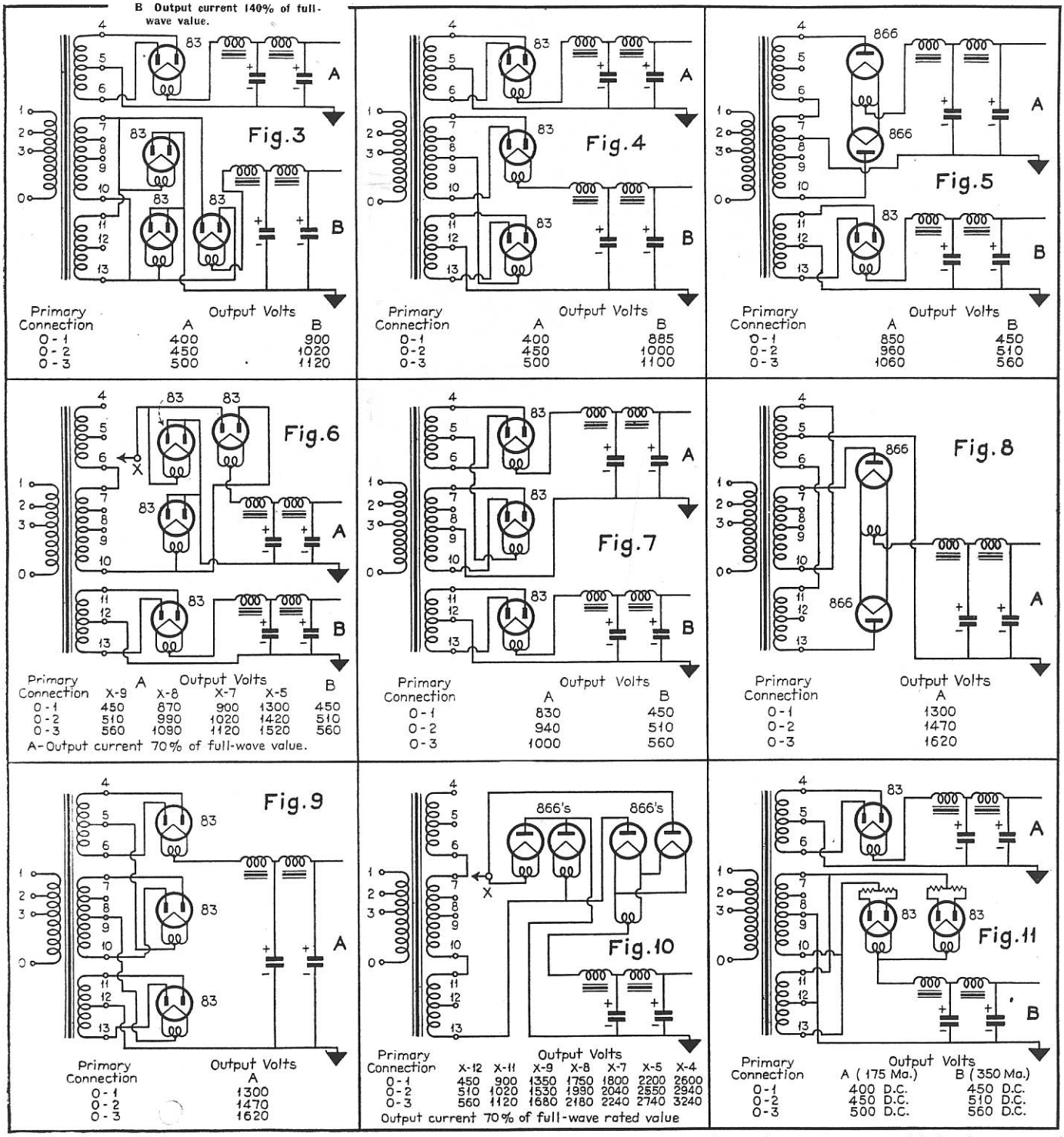
T658-T659	T654
520-0-520	490-0-490
570-0-570	630-0-630
570-0-570	630-0-630

Thus it is seen that the 490 volt winding supplies rectified voltages 7% lower and the 630 volt windings 11% higher than the voltages shown in the 11 schematics.

For circuits requiring exceptionally high current where the voltage requirement does not exceed 560 volts, the circuit shown in Fig. 11 is admirably suited. By connecting two of the windings in parallel the current supply is doubled in the portion of the circuit marked "B." The usual low voltage is available from the third winding and will supply the full current ratings of the transformer.

Bridge Rectification

While this description only covers the more common types of rectification applications the amateur and experimenter will no doubt find other interesting applications. It should be noted in all applications where bridge rectification is used that the maximum output obtainable should never exceed 70 per cent of the rated output of the transformer.



Group of circuits showing the many combinations that may be had with a single universal power transformer (minus filament supply) for the purpose of deriving separate voltages of different values for the various stages of a transmitter or high-power public-address system.

KENYON AMATEUR TRANSMITTER AND PUBLIC ADDRESS COMPONENTS

Kenyon engineers have designed this complete line of audio and power transformers and reactors to make possible a popular priced line particularly suited for amateur transmitter and public address use.

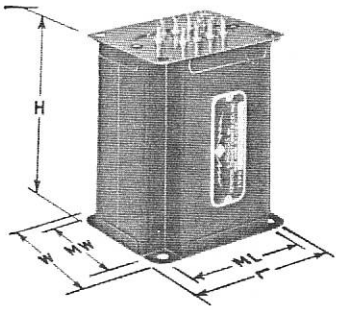
Refinements in design and controlled production result in units which are unapproachable for quality in material of this price range.

Each unit is housed in a metal case finished in a durable black eggshell enamel presenting a pleasing appearance to suit exacting commercial requirements. This case also acts as an electrostatic and electromagnetic shield.

Universal mounting facilities permit all units to be top or bottom mounted to chassis or panels.

With the exception of the high voltage units which are provided with glazed ceramic insulators all units are provided with sturdy solder lug terminals.

T LINE DIMENSIONS



Case	Mounting Dimensions ML	MW	Overall Dimensions Length	Width	Height
1A	2 3/32	1 1/16	2 7/16	2	2 7/8
2A	2 1/8	1 13/16	2 3/4	2 3/8	3 1/16
3A	2 7/16	1 15/16	3 1/16	2 1/16	3 5/8
4A	3 7/8	2 7/16	4 1/2	3	3 7/8
5A	4 1/16	3 1/16	5	3 7/8	5
6A	4 1/2	4 1/16	5	5 1/8	5
7A	5 1/2	4 1/16	6 1/16	5 1/16	6 3/8
8A	5 3/4	4 13/16	6 1/16	5 11/16	7 1/8
9A	6 11/16	5 3/4	7 3/4	6 5/8	7 1/16
10A	8 5/8	7 11/16	9 1/2	8 1/4	10 5/8

Type		Case	List Price
	INPUT TRANSFORMERS		
T-1	Single or double button microphone to one grid Input—400-300-200-100-50 ohms. Hum bucking type	1A	$4.00
T-2	Multiple line to one grid. Input—500-333-250-200-125-50 ohms. Hum bucking type	1A	4.00
T-3	Multiple line to P. P. grids. Input—500-333-250-200-125-50 ohms. Hum bucking type	1A	4.00
T-4	Detector plate, high impedance pickup, or double button microphone to single grid	2A	5.00
	LINE TRANSFORMERS		
T-25	Line to line matching transformer. Primary—500-200-50 ohms Secondary—500-200-50 ohms	2A	5.00
T-27	500 or 200 ohms to 15-8-4 ohms—Level 15 watts	3A	5.00
T-28	500 or 200 ohms to 15-8-4 ohms—Level 30 watts	4A	6.00
T-29	500 or 200 ohms to 15-8-4 ohms—Level 60 watts	5A	9.00
	CLASS "A" INPUT TRANSFORMERS		
T-51	Single Class A Plate 56, 76, 6C5, 77 (triode) 6C6 (triode) etc. to single Class A Grid. Ratio 1:4	1A	3.50
T-52	Single Class A Plate 56, 76, 6C5, 77 (triode) 6C6 (triode) etc. to P. P. Class A Grids. Ratio 1:4 (total pri. to total sec.)	1A	3.50
T-53	Detector plate or single button microphone to single grid	1A	3.50
	For portable applications use open type KA114M. List Price $2.25		
T-54	P. P. Class A Plates 56, 76, 6C5, 77 (triode) 6C6 (triode) etc. to P. P. Class A Grids. Ratio 1:1.8 (total pri. to total sec.)	2A	4.50
T-55	Single Class A Plate 56, 76, 6C5, 77 (triode) 6C6 (triode) etc. to single Class A Grid. Ratio 1:3	2A	4.50
T-56	Single Class A Plate 56, 76, 6C5, 77 (triode) 6C6 (triode) etc. to P. P. Class A Grids. Ratio 1:2 (total pri. to total sec.)	2A	4.00
T-57	Single Class A Plate 56, 76, 6C5, 77 (triode) 6C6 (triode) etc. to single Class A Grid. (Ratio 1:2.) Hum bucking type	2A	5.00
T-58	Single Class A Plate 56, 76, 6C5, 77 (triode) 6C6 (triode) etc. to P. P. Class A Grids. Ratio 1:2 (total pri. to total sec.). Hum bucking type	2A	5.00
	CLASS "AB" AND "B" INPUT TRANSFORMERS		
T-251	Single 53, 6A6, 56, 6C5, etc. to P. P. 53, 6A6, etc. (Single 53, 6A6, etc. in P. P.)	2A	4.50
T-252	Single 30, 49, 89 to P. P. 19, 30, or 49's	1A	3.50
	For portable applications use open type KR19. List Price $1.50		
T-253	Single 46 or 59 to P. P. 46's or 59's, 6F6's, etc.	2A	4.50
T-254	Single 45, 6F6, 2A5, 42, etc. to P. P. 6F6, 45's, 2A5's, 42's, etc.	2A	4.50
T-255	P. P. 56, 76, 6C5, 53, 6A6, 6N7 to P. P. 6L6's	2A	4.50
T-256	P. P. 56, 76, 6C5, to P. P., 45's, 2A3's, 6F6's, etc.	2A	4.50
T-257	P. P. 45's to P. P. Parallel 46's	2A	4.50
T-258	P. P. 45's to P. P. 800's	3A	5.00
T-259	P. P. 2A3's to P. P. 203A's, 838's etc.	4A	6.00
T-260	P. P. parallel 2A3's to P. P. H.D. 203A's, P. P. Parallel 838's etc	4A	8.00
T-271	P. P. 45's, 2A3's, 6F6's (triode) to P. P. Class AB_2 6L6's	3A	5.00
	CLASS "A" OUTPUT TRANSFORMERS		
T-101	Single Class A Plate 56, 76, 6C5, 77 (triode) 6C6 (triode) etc. to 500 or 200 ohms	1A	3.50
T-102	P. P. Class A Plates 56, 76, 6C5, 77 (triode) 6C6 (triode) etc. to 500 or 200 ohms	1A	3.50
T-103	P. P. 45's, or 43's to 500-200 or 15-8-4 ohms	2A	5.00
T-104	Single 2A5, 6F6, 89, 47 etc. to 500-200 or 15-8-4 ohms	2A	4.50
T-105	P. P. 2A5, 6F6, 89, 47 etc. to 500-200 or 15-8-4 ohms	2A	5.00
T-106	P. P. 6B5, 2B6, to 500-200 or 15-8-4 ohms	3A	5.50

CLASS "AB" AND "B" OUTPUT TRANSFORMERS

		Case	List Price
T-301	P. P. 45's, 2A3's (Class AB) 6L6's (Class A) to 500-200 or 15-8-4 ohms. Primary 5000 or 3000 ohms	4A	$6.00
T-302	P. P. 6N7, 53, 49's, 19 to 500-200 or 15-8-4 ohms	3A	5.50
T-303	P. P. 46, 59's, 6F6's (triode or pentode) 2A5's, 42's to 500-200 or 15-8-4 ohms. Primary 6000 or 10,000 ohms	4A	6.00
T-304	P. P. Parallel 45's, 2A3's, to 500-200 or 15-8-4 ohms. Primary 1500 or 2500 ohms	4A	8.00
T-305	P. P. Parallel 46's, 59's, 6F6's (triode or pentode) 2A5's, 42's to 500-200 or 15-8-4 ohms. Primary 3000 or 5000 ohms	4A	8.00
T-317	P. P. 6L6's Class AB_1 (6600 or 3800 ohms—34 watts) to 500-200 or 15-8-4 ohms	4A	8.00
T-319	P. P. 6L6's AB_2 (6000 or 3800 ohms—60 watts) to 500-200 or 15-8-4 ohms	5A	8.50

MODULATION OUTPUT TRANSFORMERS

T-451	Class B 6N7, 53, 6A6, RK34, to 5000 or 3000 ohms. Max. Sec. D. C. 100 M.A.	2A	4.50
T-452	Class B 19, to 5000 or 3000 ohms. Max. Sec. D.C. 50 M.A.	1A	3.50
	For portable application use open type KR19M. List Price $1.50		
T-453	Class AB 2A3's, 45's or Class A, 6L6's to 5000 or 3000 ohms. Max. Sec. D.C. 130 M.A.	4A	8.50
T-454	Class B 46's or 59's, 6F6's (triode or pentode) 2A5's, 42's etc. to 4000-6000-8000 ohms. Max. Sec. D.C. 140-100-75 M.A. Primary 6000 or 10,000 ohms	4A	8.50
T-455	Class B—210's to 5000-7000-9000 ohms. Max. Sec. D.C. 180-150-130 M.A.	5A	10.00
T-456	P. P. Parallel 45's or 2A3's Class AB to 5000-7000-9000 ohms. Max. Sec. D.C. 150-100-75 M.A.	5A	10.00
T-457	P. P. Parallel 46's, 59's, 6F6's, (triode or pentode) 2A5's, 42's etc. to 3000-5000-7000 ohms. Max. Sec. D.C. 220-160-120 M.A. Primary 3000 or 5000 ohms	5A	10.00
T-465	P. P. 838's, 203A's to 4000-6000-8000 ohms. Max. Sec. D.C. 400-320-270 M.A.	7A	25.00
T-470	P. P. H.D. 203A's to 4000-6000-8000 ohms. Max. Sec. D.C. 500-400-350 M.A.	8A	42.00
T-490	Single 2A5, 42 or 6F6 grid modulation transformer to grid modulate 203A's, 211's, etc.	2A	4.50
T-491	Single 45 grid modulation transformer to grid modulate 203A's, 211's, etc.	2A	4.50
T-458	P. P. 801's to 5000-7000-9000 ohms. Max. Sec. D.C. 150-135-110 M.A.	6A	12.50
T-460	P. P. 800's to 6000-8000-10,000 ohms. Max. Sec. D.C. 200-175-150 M.A.	6A	15.00
T-492	Grid or suppressor modulation transformer—P. P. 45's to 10,000 ohm load	3A	5.00
T-459	P. P. 6L6's Class AB_2 to 2500-5000-7000 ohms. Max. Sec. D.C. 300-250-200 M.A.	5A	8.50

FILTER REACTORS

Type No.	Inductance Henries	Max. MA.	D.C. Resistance	Insulation Test	Case No.	List Price
T-155	290	10	4700	1000 V.	2A	$4.00
T-158	*350	10	10000	1000 V.	3A	4.50
T-156	30	25	800	1000 V.	1A	3.00
T-157	20	50	200	1000 V.	1A	3.00
T-153	30	90	350	1000 V.	3A	3.50
T-154	15	165	210	1000 V.	3A	4.00
T-152	10	200	100	1000 V.	3A	4.00
T-164	14	250	135	1500 V.	5A	9.00
T-166	11	300	125	1500 V.	5A	9.00
T-159	12	500	77	1500 V.	6A	12.50
T-165	10	150	275	3000 V.	3A	4.00
T-168	13	250	125	3000 V.	5A	10.00
T-160	11	300	120	3000 V.	5A	10.00
T-167	11	400	80	3000 V.	6A	12.00
T-175	10	200	140	5000 V.	4A	7.00
T-176	10	300	110	5000 V.	5A	11.00
T-178	10	400	90	5000 V.	6A	15.00
T-177	12	500	95	5000 V.	7A	18.00

*Center tapped.

SWINGING REACTORS

Type No.	Inductance Henries	Max. MA.	D.C. Resistance	Insulation Test	Case No.	List Price
T-517	15-45	90-20	350	1000 V.	3A	$3.50
T-515	10-25	165-30	210	1000 V.	3A	4.00
T-506	5-20	200-30	100	1000 V.	3A	4.00
T-507	7-25	250-50	135	1500 V.	5A	9.00
T-510	6-19	300-30	125	1500 V.	5A	9.00
T-511	5-20	170-20	275	3000 V.	3A	4.00
T-508	7-26	250-50	125	3000 V.	5A	10.00
T-514	5-20	300-50	120	3000 V.	5A	10.00
T-516	5-20	400-50	80	3000 V.	6A	12.00
T-509	6-19	200-30	140	5000 V.	4A	7.00
T-512	5-15	300-30	110	5000 V.	5A	11.00
T-513	5-18	400-50	90	5000 V.	6A	15.00
T-521	6-21	500-60	95	5000 V.	7A	18.00

PLATE TRANSFORMERS

Type No.	Primary	A.C. Secondary Volts		D.C. MA.	Case	List Price
T-664		740-0- 740		150	5A	$8.00
T-655	*Tapped	460-0- 460		250	5A	9.00
T-656	*Tapped	740-0- 740		300	6A	12.00
T-657	†Tapped	900-0- 900 900-0- 900	(2 separate secondaries)	200 200	7A	26.00
T-658	‡Tapped	520-0- 520 570-0- 570 570-0- 570	(3 separate secondaries)	175 175 175	7A	21.00
T-654	‡Tapped	490-0- 490 630-0- 630 630-0- 630	(3 separate secondaries)	250 250 250	8A	30.00
T-659	‡Tapped	520-0- 520 570-0- 570 570-0- 570	(3 separate secondaries)	350 350 350	8A	30.00
T-665	*Tapped	1180-0-1180		250	7A	22.00
T-666		1460-0-1460		350	8A	26.00
T-667		1460-0-1460		500	9A	34.00
T-650		1460-0-1460 630-0- 630	(2 separate secondaries)	500 200	9A	38.00
T-661		2080-0-2080		200	7A	22.00
T-662		2080-0-2080		300	8A	30.00
T-663		2360-0-2360		600	10A	70.00

*Primary tapped to increase the above secondary voltages approximately 25%.

†Primary tapped to increase the above secondary voltages approximately 30%.

‡Primary tapped to increase the above secondary voltages approximately 12.5% and 25%.

PLATE AND FILAMENT TRANSFORMERS

Type No.	Sec. Volts	D.C. MA.	F1	F2	F3	F4	Case	List Price
*T-249	235-0-235	20	6.3V.- .6A.CT	6.3V.-.9 A.CT.	.....	.....	2A	$4.50
*T-245	320-0-320	40	5 V.-2 A.	6.3V.-2 A.CT.	.....	.....	3A	5.00
§T-201	0-75	70	5 V.-2 A.	.....	.....	.....	2A	4.50
*T-205	350-0-350	75	5 V.-2 A.	6.3V.-3 A.CT.	.....	.....	4A	6.50
*T-206	325-0-325	100	5 V.-3 A.	6.3V.-3 A.CT.	6.3V.- 2 A.CT.	.....	5A	8.50
T-212	420-0-420	125	5 V.-3 A.	6.3V.-3 A.CT.	2.5V.- 4 A.CT.	.....	5A	9.50
T-214	420-360-125-0-360-420	150	5 V.-3 A.	2.5V.-3 A.CT.	2.5V.- 5 A.CT.	6.3V.-3 A.CT.	5A	10.00
*T-244	425-0-425	165	5 V.-3 A.	6.3V.-3 A.CT.	6.3V.- 3 A.CT.	.....	6A	12.00
*T-248	425-0-425	165	5 V.-3 A.	2.5V.-6 A.CT.	2.5V.- 6 A.CT.	.....	6A	12.00
T-213	520-110-0-520	180	5 V.-3 A.	2.5V.-3 A.	6.3V.- 3 A.CT.	6.3V.-3 A.CT.	5A	11.50
T-215	360-125-0-360	200	5 V.-3 A.	2.5V.-3 A.CT.	2.5V.-10 A.CT.	6.3V.-2.1A.CT.	5A	11.50
T-247	590-0-590	200	5 V.-3 A.	6.3V.-3 A.CT.	6.3V.- 3 A.CT.	.....	5A	12.00
T-216	520-85-0-520	250	5 V.-3 A.	2.5V.-3 A.	6.3V.- 3 A.CT.	6.3V.-3 A.CT.	6A	13.00
†T-207	0-275-375	10	6.3V.- .6A.	6.3V.-1 A.	2.5V.- 1.4A.	.....	3A	4.00
	0-180	6					1A	4.00
‡T-202	0-150	20	6.3V.- .6A.	.....	.....	.....	4A	6.00
§T-220	125-0-125	200	5 V.-3 A.	.....	.....	.....	6A	13.00
T-246	625-0-625	250	5 V.-3 A.	6.3V.-3 A.CT.	6.3V.- 3 A.CT.	.....		

*Indicates unit designed for condenser input to filter. (All other units should be used with choke input.)
†For RCA 913 Midget Cathode Ray Tube.
‡For oscillators, wave meters, etc.
§For bias supplies.

FILAMENT TRANSFORMERS

Single Winding

Type No.	F1	F2	F3	F4	Case No.	List Price
T-352	2.5 V.-10 A. CT. 2000 V. Test	.....	.....	.....	2A	$4.00
T-354	5 V.-3 A. CT. 2000 V. Test	.....	.....	.....	2A	4.00
T-351	6.3 V.-3 A. CT. 2000 V. Test	.....	.....	.....	2A	4.00
T-353	7.5 V.-4 A. CT. 2000 V. Test	.....	.....	.....	2A	4.00
T-357	5.25 V.-12 A. CT. 2000 V. Test	.....	.....	.....	4A	6.00
T-358	5.25 V.-20 A. CT. 2000 V. Test	.....	.....	.....	5A	8.00
T-360	2.5 V.-10 A. CT. 5000 V. Test	.....	.....	.....	3A	6.00
T-365	10 V.-4 A. CT. 5000 V. Test	.....	.....	.....	3A	6.50
T-361	10 V.-8 A. CT. 5000 V. Test	.....	.....	.....	4A	8.00

Two Windings

Type No.	F1	F2	F3	F4	Case No.	List Price
T-366	2.5 V.-10 A. CT. 5000 V. Test	2.5 V.-10 A. CT. 5000 V. Test	.....	.....	4A	8.00
T-363	10 V.-6.5 A. CT. 5000 V. Test	10 V-3.25 A. 5000 V. Test	.....	.....	5A	9.00
T-362	11-12 V.-8 A. CT. 5000 V. Test	10-11 V.-3.5 A. CT. 5000 V. Test	.....	.....	5A	11.00

Three Windings

Type No.	F1	F2	F3	F4	Case No.	List Price
T-364	2.5 V.-8 A. CT. 750 V. Test	2.5 V.-10 A. CT. 750 V. Test	5 V.-6 A. 750 V. Test	.....	4A	7.00
T-356	6.3 V.-3 A. CT. 750 V. Test	5 V.-4 A. CT. 3000 V. Test	5 V.-8 A. CT. 3000 V. Test	.....	4A	9.00
T-355	5 V.-3 A. CT. 4000 V. Test	5 V.-3 A. CT. 4000 V. Test	5 V.-6 A. CT. 4000 V. Test	.....	4A	7.50
T-375	2.5 V.-5 A. CT. 6000 V. Test	2.5 V.-5 A. CT. 6000 V. Test	2.5 V.-10 A. CT. 6000 V. Test	.....	4A	9.00

Four Windings

Type No.	F1	F2	F3	F4	Case No.	List Price
T-373	2.5 V.-5 A. CT. 750 V. Test	5 V.-3 A. 750 V. Test	7.5 V.-3.25 A. CT. 3000 V. Test	7.5 V.-8 A. CT. 3000 V. Test	5A	9.00
T-374	2.5 V.-5 A. CT. 750 V. Test	5 V.-3 A. 750 V. Test	6.3 V.-3 A. CT. 3000 V. Test	7.5 V.-8 A. CT. 3000 V. Test	5A	9.00
T-370	6.3 V.-3 A. CT. 750 V. Test	6.3 V.-3 A. CT. 750 V. Test	2.5 V.-4 A. CT. 750 V. Test	5 V.-3 A. 750 V. Test	4A	7.50
T-371	5 V.-3 A. 750 V. Test	6.3 V.-3 A. CT. 750 V. Test	6.3 V.-3 A. CT. 750 V. Test	7.5 V.-8 A. CT. 2500 V. Test	5A	8.50
T-372	5 V.-3 A. 750 V. Test	5 V.-3 A. CT. 750 V. Test	6.3 V.-3 A. CT. 750 V. Test	7.5 V.-4 A. CT. 2000 V. Test	5A	8.50
T-367	6.3 V.-5 A. CT. 2000 V. Test	6.3 V.-5 A. CT. 2000 V. Test	5 V.-6 A. CT. 2000 V. Test	5 V.-3 A. CT. 2000 V. Test	5A	9.00

Five Windings

Type No.	F1	F2	F3	F4	F5	Case No.	List Price
T-377	5 V.-3 A. 2000 V. Test	5 V.-6 A. 2000 V. Test	6.3 V.-1 A. CT. 2000 V. Test	6.3 V.-5 A. CT. 2000 V. Test	6.3 V.-5 A. CT. 2000 V. Test	5A	9.50

GUARANTY

All Kenyon Transformers are guaranteed against defects in materials and workmanship for a period of ninety days from the time of sale. Inoperative transformers should be returned prepaid to our factory, where they will be inspected and, if found defective from the above mentioned causes, will be replaced without charge.

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

EMERGENCY WORK - QRR

Amateurs have always given an excellent account of themselves in many emergencies of local and national character. In every instance, the amateurs who have considered the possibilities of an emergency arising before the trouble actually came to pass were the ones who must be credited with doing the most important work. They were ready, prepared for the crisis when it came.

Be ready for the emergency call, QRR, when it comes. Jump into the breach with your station, if feasible, or stand by and avoid interference to those handling emergency traffic, if this seems to be the right thing to do. "Standing by" is sometimes the harder, but wiser course if the important communications are being handled satisfactorily by others and your traffic is "public correspondence" for individuals.

Make note of the address of railroads, of Red Cross headquarters, of local military units, police departments, representatives of press associations and the like, if possible putting your station on record with such organizations and other competent authorities so that you will be called upon to assist when emergency communication is necessary. When storms approach or disaster threatens it is best to keep in touch with the situation by radio and again to offer service to these agencies well in advance of the actual emergency. Emergency work reaps big returns in public esteem and personal satisfaction.

After emergency communications are completed, report in detail direct to A.R.R.L.

BEFORE EMERGENCIES

Be ready, with really portable sets, and emergency power supply.

Overhaul and test periodically.

Give local officials and agencies your address; explain the availability of amateur radio facilities through your station in emergencies.

IN EMERGENCY

CHECK station operating facilities; offer your services to all who may be able to use them; inform A.R.R.L. an emergency exists, if possible.

QRR is the official A.R.R.L. "land SOS," a distress call for emergency use *only* . . . for use *only* by station asking assistance.

THE KEY STATION in emergency zone is the first and the supreme authority for priority and traffic routing in the early stages of emergency relief communication.

PRIORITY must be given messages in the general public interest (relief plans, re food, medicine, necessities). Press reports and personal assurance messages can then be handled if practicable.

COÖPERATION is required of all amateurs. Don't clutter the air with useless CQs. The *majority* of amateurs must *listen in;* QRX; avoid QRMing. Be ready to help; operate as intelligently as possible; coöperate by staying off the air while vital first information and relief measures are handled, if stations able to help as well as yours are on the job. (CQ STORM AREA is nothing but "more QRM.")

AFTER EMERGENCIES

Report to A.R.R.L. as soon as possible and as fully as possible so amateur radio can receive full credit. Amateur radio communication in 33 major disasters since 1919 has won glowing public tribute. Maintain this record.