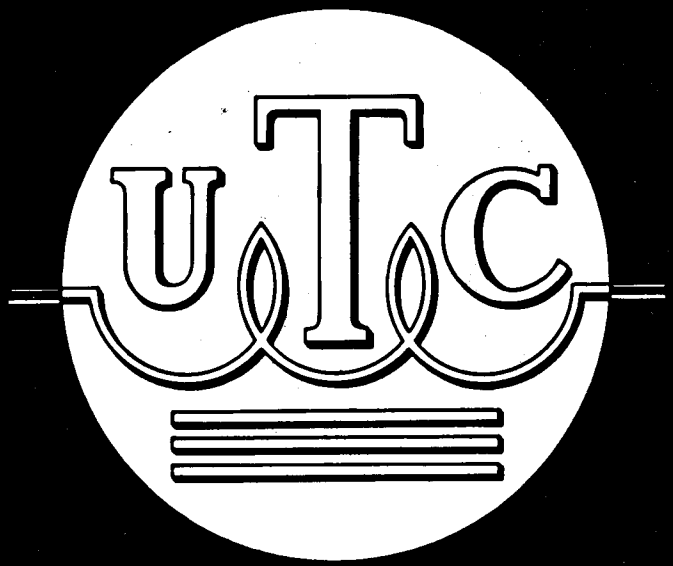
TRANSMITTER AND PUBLIC ADDRESS MANUAL

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FOREWORD

RF CIRCUITS

OSCILLATORS

The amateur transmitter in its simplest form consists of an oscillator with its associated power supply equipment and a key to interrupt the oscillations. The oscillator may be any one of several types, all of which are so familiar that no classification of them is necessary. These oscillators may be divided into two general classes; crystal and self excited. Of the self excited type the electron coupled oscillator far outshines the rest from the standpoint of frequency stability, but the crystal controlled oscillator, except for its inflexibility, leaves little to be desired for the amateur set-up. With the development of new crystals, some of which may be tuned over a limited range, sufficient to get out from under an interfering station, there is relatively little reason for the amateur to run the risk of out of band operation sometimes caused by the use of the self excited type of oscillator.

Of the various circuits which have been developed for crystal oscillators those employing pentodes are as a rule far easier on the crystal and are productive of a higher harmonic output which is very desirable where operation on the higher frequency bands is to be accomplished. Some of the usual crystal oscillator circuits are shown in Figure 1. Screen potential for the pentode oscillator may be obtained through a dropping resistor from the high voltage lead, but somewhat more stable operation will be realized with the voltage divider method, which permits keying of the crystal stage for break-in-operation. Where operation is to be on several bands, for phone or CW, or with high power, it is necessary to add R.F. amplifier stages to the crystal oscillator. The number and design of such stages depends on the purpose of the transmitter.

RF AMPLIFIERS

RF amplifiers may be divided according to their use as class B for linear amplifiers, class BC for C.W. power amplifiers, class C for modulated amplifiers and frequency multipliers. The circuits for these amplifiers are quite familiar and the selection of the circuit to be used is determined mostly by the tube lineup and the method of coupling used. Examples of several of these circuits may be seen in the following pages which illustrate several dependable tube combinations for various types of operation.

Although the design and adjustment of these amplifiers is thoroughly covered in several good handbooks for the amateur, a word or two about the proper operating conditions will not be amiss at this point.

The Class B linear amplifier is biased, not quite to cutoff for efficient operation, and should be heavily loaded to the antenna. The excitation should be adjusted so that grid current barely starts to flow on modulation peaks, and should be operated with the maximum plate voltage consistent with the dissipation ratings of the tubes used. The bias for linear amplifiers should be taken from a low resistance source such as batteries or a bias rectifier of extremely low resistance and good regulation. A good bias supply is, generally speaking, more economical than batteries, especially for high values of bias voltage.

The Class C amplifier must have ample excitation and be so adjusted as to be linear when the plate voltage is varied from zero to twice the operating potential. In other words, the plate current should vary directly as the plate voltage over the entire range. This condition, usually is obtained with bias equal to 2 to 2½ times cut-off and with high excitation. The capacity in the tank circuit of such an amplifier should be somewhat greater than for CW operation, the value depending on the frequency, plate voltage and plate current.

The following formula will give the approximate value of capacity to be used for single ended grid neutralized amplifiers for CW; for phone multiply C by 2, for split-tank coils divide by 4, for plate neutralized amplifiers use ¼ of these values.

$$C = \frac{2{,}600{,}000}{f \times Rb}$$

where C = capacity in mmfd.
f = frequency in mc., and
Rb = plate load resistance (plate voltage divided by current in amperes).

Amplifiers used as frequency multipliers are essentially of the distortion type. In order to produce maximum harmonic output these amplifiers are operated with high bias and plenty of excitation. Usually the pentode is superior to other types for this purpose.

CHECKING RF POWER

Checking the power output of an oscillator or power amplifier is, as a rule, a rather complicated job to do with any degree of accuracy. A simple means of making these measurements is shown in Figure 2.

The operation of this set-up is briefly as follows.

A dummy load is coupled to the tank circuit of the amplifier under test and the values of capacity, coupling, and lamps adjusted to obtain maximum output from the amplifier. The brilliancy of the lamp bank is then either noted by eye or measured with an illumination meter. Now switch the lamp back to the 110V 60 cycle source (or other light socket source) and adjust the voltage to obtain the same brilliancy. Since the lamp is practically non-inductive, the error will be small enough to be neglected for the purposes of this test and the power output of the stage under test may be considered as the 60 cycle power necessary to obtain the same brilliancy from the same bank of lamps on either source.

P = I X E at 60 cycles

RF CIRCUITS

A number of RF circuits are illustrated in the following pages. These circuits are tried and proven and represent good practice in all respects. With proper care and construction these units will involve no difficulty in either setup or operation.

RF CIRCUITS

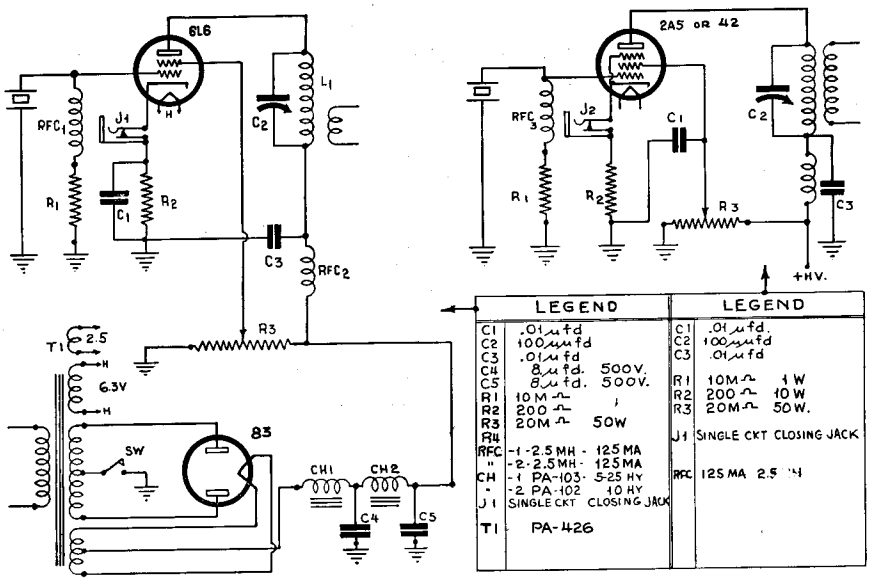


Fig. 1—Typical oscillator circuits

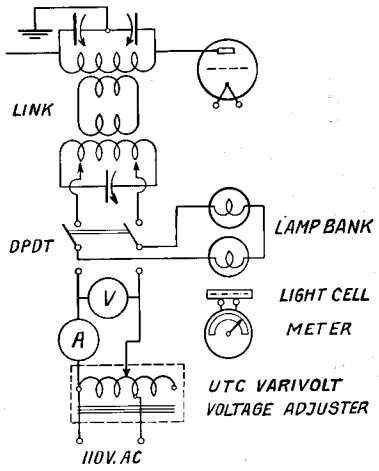


Fig. 2—Method of measuring RF power

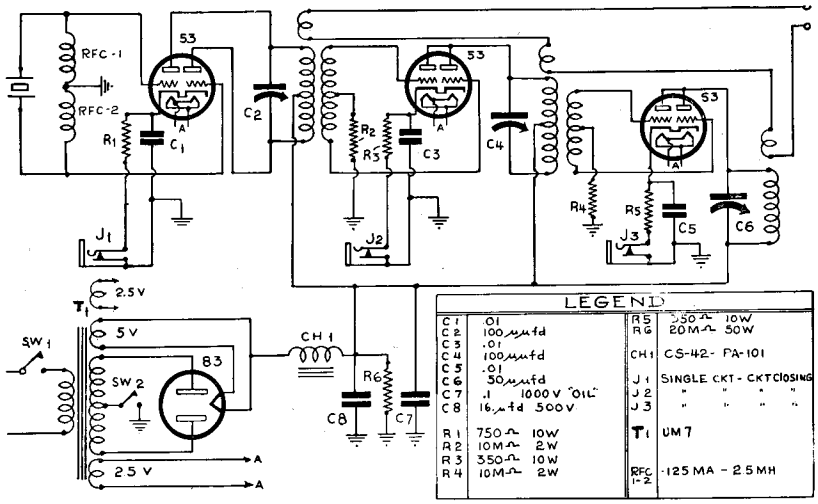


Fig. 3—Multiband Exciter Unit

This unit incorporating three type 53 or 6A6 tubes is an excellent exciter for use with multi-band transmitters. A common link is used and the excited stage is tuned to the desired frequency. Using a 40 meter crystal the exciter will furnish output at 40, 20 and 10 meters. The entire unit including power supply can be built up very easily on a standard 10 x 17 deck.

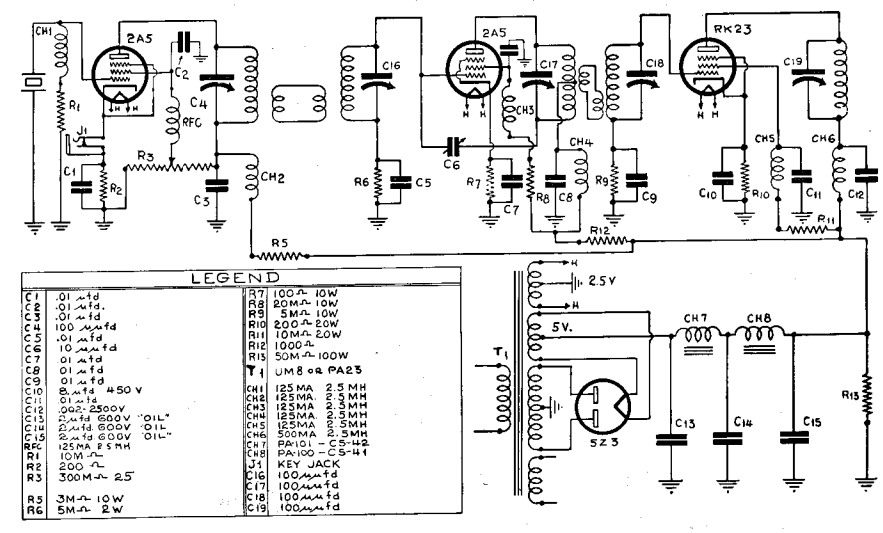


Fig. 4—10-20 Watt simple transmitter

This transmitter uses the 2A5 tube as a pentode buffer-doubler. The neutralization of this tube is not at all critical, the 10 mmfd condenser being set at about one-half capacity and then disregarded.

The RK 23 output stage will deliver a power output of from 10 to 20 watts to the antenna. Link coupling is used throughout to permit flexibility of layout and maximum coupling efficiency. This transmitter is ideal as a low power outfit and will give very satisfactory results even on ten meters if properly constructed. The RK 23 may be modulated by any of the conventional systems including combined plate-screen modulation.

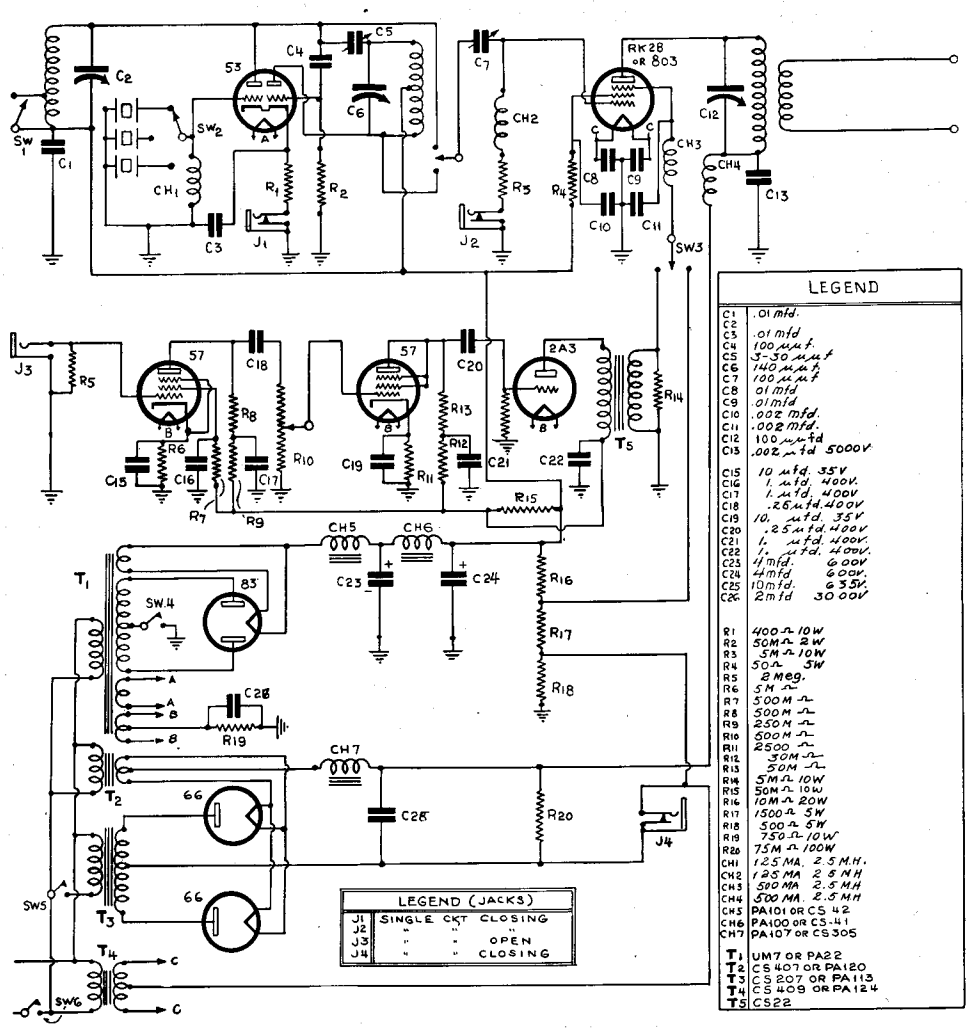


Fig. 5—50 Watt Phone suppressor Modulated Transmitter

This circuit is designed to use the RK-28 or 803 power pentode. The circuit is simple and complete. The audio amplifier is entirely resistance coupled except for the output transformer. The carrier output is 50 watts phone, 150-200 watts CW.

This transmitter makes an ideal setup for the dyed-in-the-wool CW man who likes to use phone occasionally for short-haul work and rag chew sessions but does not want to tie up money in equipment for high level modulation.

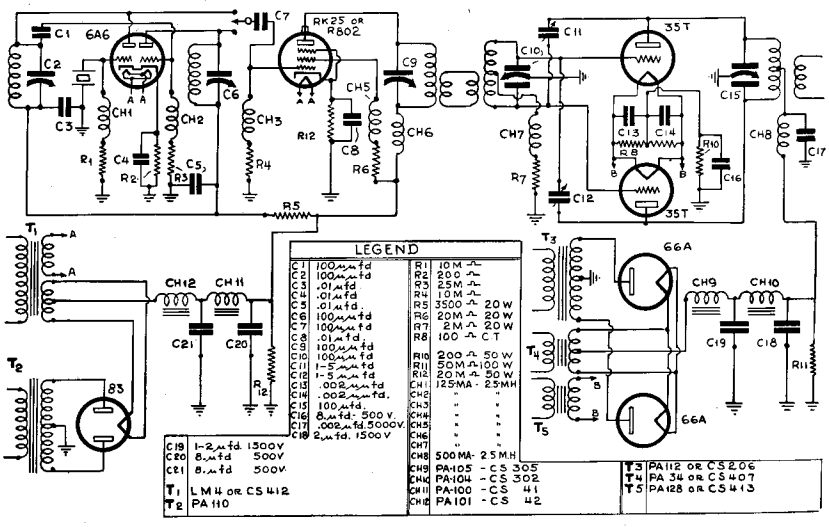
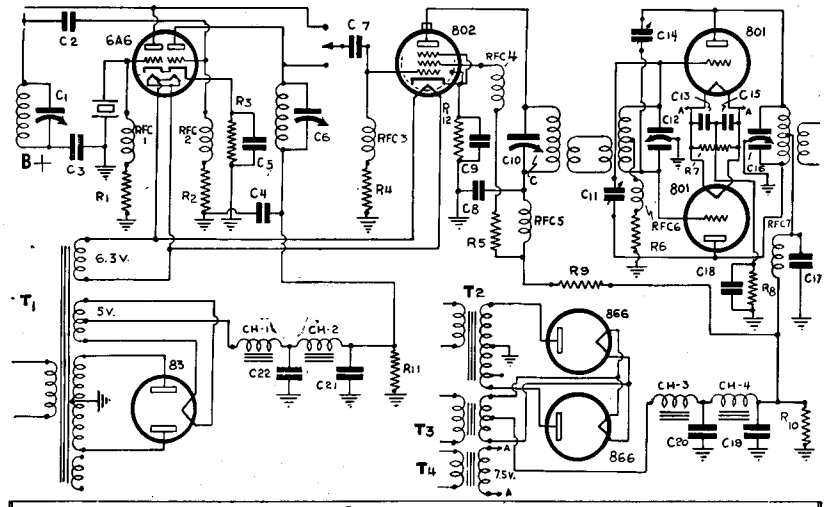


Fig. 6—35T Medium Power Transmitter

The 35T tube lends itself nicely in this design to an inexpensive transmitter capable of an actual power output of 125 watts.

The circuit layout of this transmitter is the same as for the 801 transmitter following except for the 35Ts and slightly higher plate voltage for the final stage. The 35Ts have exceptionally low interelectrode capacities and are very easily driven even at high frequencies. The 35Ts may, due to their low capacities, be used in parallel if so desired. This transmitter is an exceptionally fine performer at 28 megacycles.

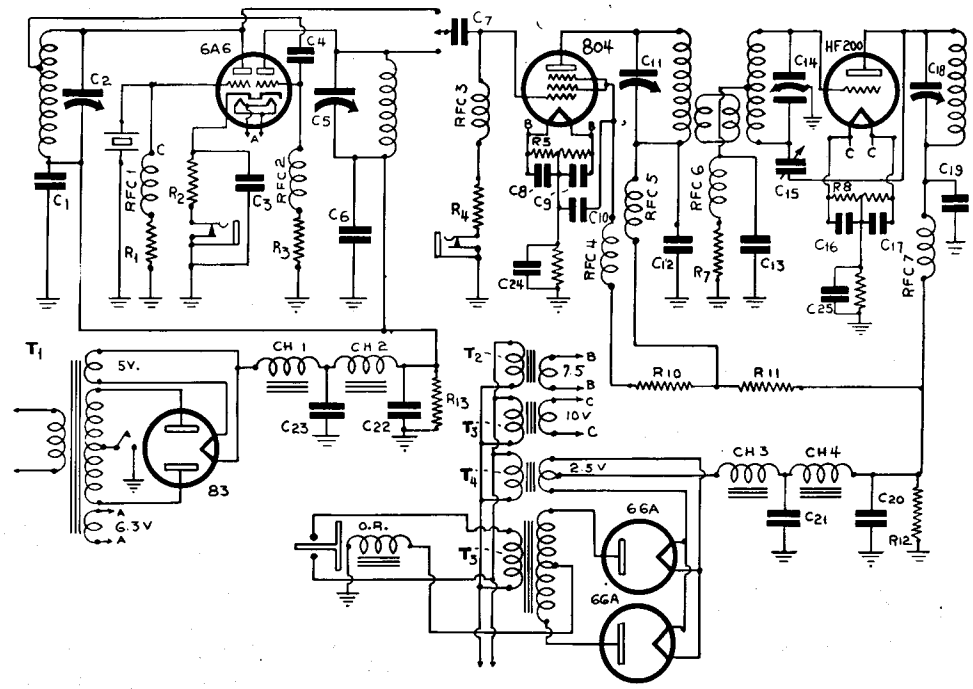


LEGEND

C1	100 μμfd	C12	10 μfd	R1	10 M Ω		T1	PA-426			
C2	.0001 μfd	C13	.01 μfd.	R2	500 M Ω		T2	PA-110 OR PA-111			
C3	.01 μfd.	C14	15 μμfd	R3	400 Ω	10 W.	T3	PA-34			
C4	.01 μfd	C15	.01 μfd	R4	15 M Ω	10 W	T4	PA-28			
C5	.01 μfd.	C16	100 μμfd each Section	R5	5 M Ω	20 W					
C6	100 μμfd	C17	.01 - 200 V	R6	10 M Ω	25 W	RFC	1-2-3-4-5-6-=2.5 MH -125 MA			
C7	50 μμfd	C18	.01 - 200 V	R7	100 Ω	CT	RFC	7 - 500 MA			
C8	.01 μfd	C19	2 μfd 1000 V	R8	200 Ω	50 W	CH-	1- PA103			
C9	.01 μfd	C20	2 μfd 1000 V	R9	2 M Ω	50 W	"	2- PA102			
C10	100 μμfd	C21	8 μfd 600 V	R10	50 M Ω	100 W	"	3- PA-103			
C11	15 μμfd	C22	8 μfd 600 V	R11	20 M Ω	R12- 200 Ω	"	4- PA-102			

Fig. 7—Medium Power Transmitter

This transmitter employs a 6A6 or 53 twin triode as a combined oscillator doubler driving an 802 pentode buffer. Sufficient driving power is available to obtain an output of approximately 60 watts. Link coupling between the buffer and final provides maximum coupling efficiency and permits construction of the final stage on a separate chassis. This transmitter is an exceptionally good performer at ten meters if reasonable care is taken in layout and wiring.



LEGEND

C1	.01 μfd	C9	.01 μfd.	C18	100 μμfd.	R2	200 Ω	R10	20 M Ω 50 W	T1	PA426
C2	100 μμfd	C10	.002 μfd.	C19	002 μfd 5000 V.	R3	50 M Ω	R11	10 M Ω 150 W	T2	PA28
C3	.01 μfd	C11	100 μμfd	C20	2 μfd 3000 V.	R4	5 M Ω	R12	50 M Ω 150 W	T3	PA124
C4	100 μμfd.	C12	.002 μfd.	C21	1. μfd. 3000 V.	R5	100 Ω CT	R13	20 M Ω 25 W	T4	PA120
C5	100 μμfd	C13	002 μfd	C22	8. μfd. 450 V.	R1	10 M Ω	RFC	1-2-3-4-5-	T5	PA114
C6	.01 μfd.	C14	100 μμfd.	C23	8. μfd 450 V.	R7	5 M Ω 50 W	"	500 MA - 2.5 MH		
C7	100 μμfd	C15	25 μμfd	C24	.01 μfd	R8	100 Ω C.T.	CH 1	PA-101	CH2	PA100
C8	.01 μfd	C16	.005 μμfd.	C25	8 Mfd. 400 V.	RFC	1-2-3-4-5-125 MA-25 MH	CH3	PA-107	CH4	PA106

O.R OVERLOAD RELAY

Fig. 8—500 Watt Input Transmitter

This flexible unit incorporates a 6A6 or 53 twin triode in conjunction with an 804 or RK-20 buffer. The circuit is very simple and efficient. The actual power output is approximately 330 watts.

Since high power tubes are rather expensive relay protection for the two power tubes is provided.

The use of a power pentode buffer provides ample excitation for phone work with a minimum number of stages.

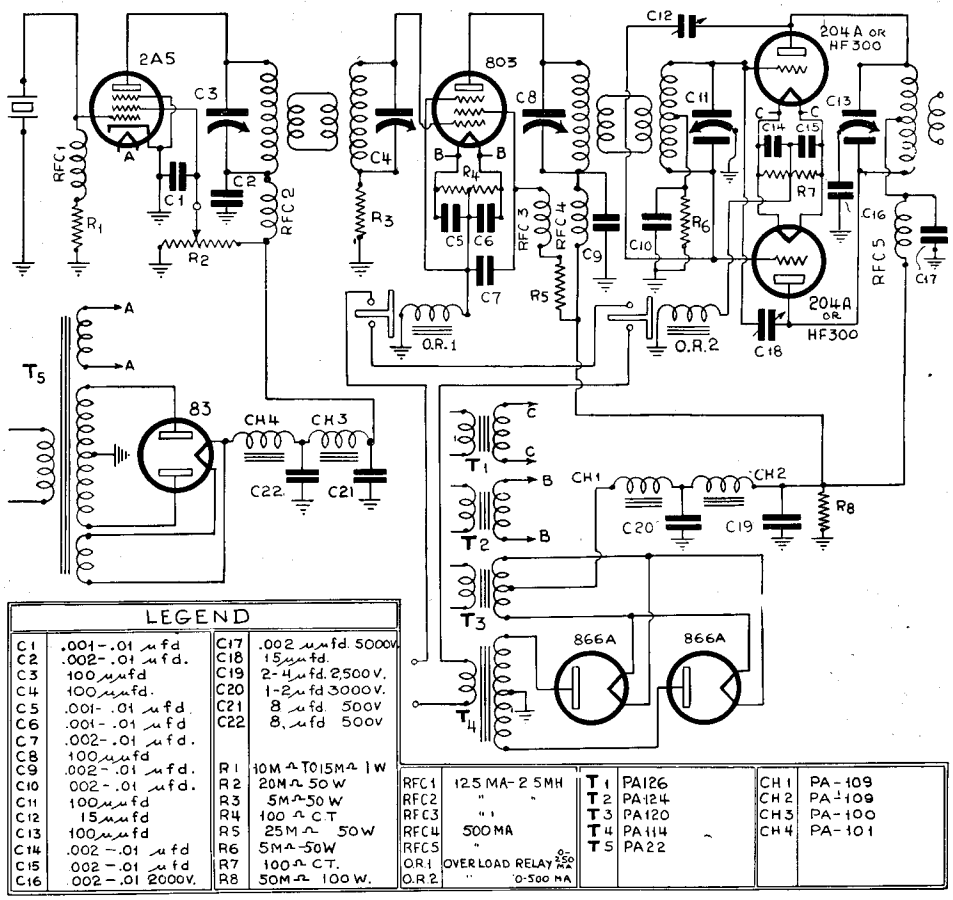


Fig. 9—1 KW Transmitter

This RF design incorporates link coupling throughout to provide maximum efficiency and flexibility. Using either an RK-28 or RCA 803, high power gain is accomplished with a minimum number of stages. The actual power output is 600 to 700 watts.

This transmitter is an excellent job for the high power man who desires reliable communication even under adverse conditions. Modulated by the 500 watt class B Modulator, this rig provides the maximum power allowed under FCC rules. A separate power supply is provided for the oscillator to minimize frequency changes due to load variations. Overload relays are used for the protection of the buffer and final amplifier tubes since with self bias, failure of excitation would result in damage to the tubes.

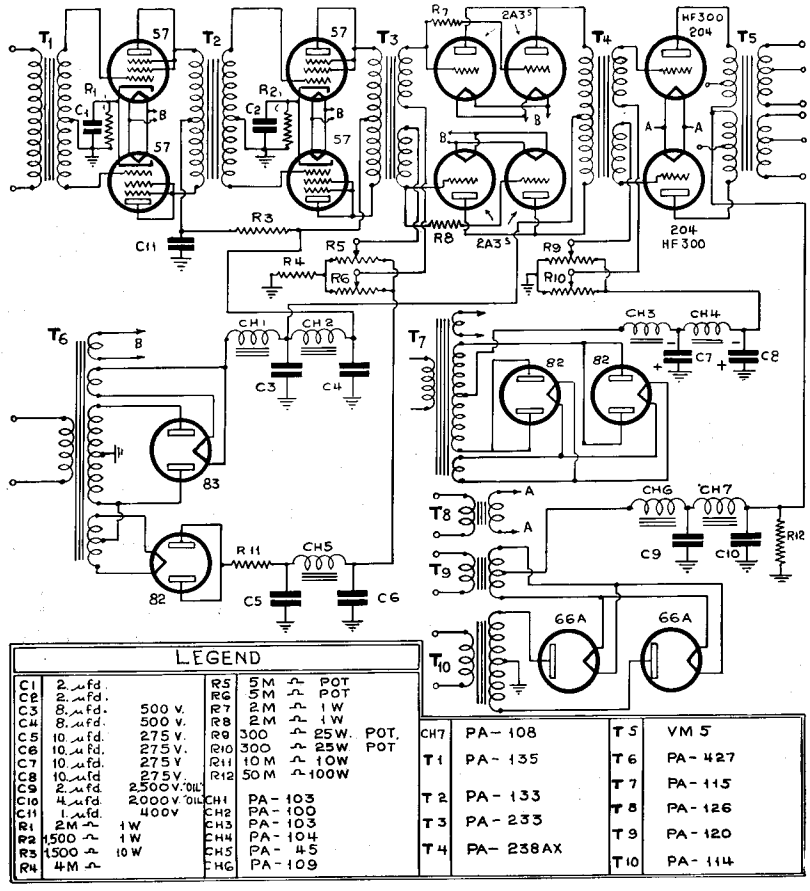


Fig. 10—500 Watt Class B Modulator

This modulator is capable of modulating 100% the 1 KW DC input to a class C RF stage. This modulator is designed to operate with a preamplifier if used with low level microphones. The circuit is very simple and stable. Fixed bias is used on both the driver and output tubes and arranged with adjustable controls so that the plate currents can be balanced. The use of push pull throughout minimizes hum pickup and distortion. The combination of this modulator and the RF unit described above makes an ideal high power phone station. The fidelity of this system is very good from both the frequency range and distortion angles.

AUDIO FOREWORD

AUDIO CIRCUITS

The audio amplifier is the heart of a phone transmitter. Its frequency range and percentage of harmonic distortion will govern the fidelity and naturalness of reproduction of the speaker's voice at the receiving end. Its power output limitation will govern the percentage of modulation obtainable and the consequent distance which can be covered for a given carrier power. The gain of an audio amplifier will limit the type of microphone with which it can be used. It is therefore seen that before constructing an audio amplifier or modulation unit, a number of factors must be considered. These are,

1. Power output
2. Frequency range
3. Harmonic distortion
4. Gain

POWER OUTPUT

The power output required from a modulator unit depends upon the type of modulation used. The most popular type of transmitter design uses high level modulation. In this type of service the audio amplifier should have available a power output equal to at least 50% of the D.C. input to the class C. R.F. stage. In other words, if 250 watts class C input is used an audio amplifier with 125 watts output is necessary to obtain full modulation.

FREQUENCY RANGE

With proper design the frequency range of an amplifier will depend almost entirely on the type of transformers used. UTC manufactures a number of grades of transformers varying appreciably in frequency range. The Chromshield units are very inexpensive but afford the widest possible frequency range for any material in their price class, having uniform response over a wide portion of the audio band. The UTC public address components have a wider frequency range than the Chromshield units, the average uniform response being from 80 to 8000 cycles. This is sufficient for practically all high quality public address and good amateur phone. Where extremely wide frequency range is desired, the UTC linear standard transformers should be used. These units have been specifically designed for broadcast applications and are unequaled for wide range applications. They are linear plus or minus 1 D.B. from 30 to 20,000 cycles. These units are described in the UTC bulletin U1100D.

HARMONIC DISTORTION

There are three major ranges of tube operation in audio amplifiers. The class A amplifier is operated so that the output wave form is substantially the same as the input wave form. The grid is never driven positive with respect to the cathode and the plate current remains steady throughout the entire cycle of operation. Tubes operating in class A amplification are characterized by low power output, low efficiency, and low harmonic content. While output tubes are sometimes used in this manner, class A amplification finds its greatest application in voltage amplifier service.

The class AB amplifier works with more bias than the class A amplifier and the grid is driven positive with respect to the cathode. Two tubes must be used to obtain an output wave form nearly like the input wave form. Some driving power is required and the efficiency lies between that of the class A and the class B amplifier. Class AB tube operation provides considerably greater power output than straight class A, increased plate efficiency, and comparatively low distortion. This method of tube operation finds wide application in low power transmitters. Typical tubes used in this manner are 42's, 45's, 2A3's, 6L6's, 845's and other low mu tubes.

The class B amplifier is biased so that the plate current is almost zero with no signal. For a single tube AC plate current flows for only 180 electrical degrees of the input cycle, two tubes in push pull being required to produce an output wave form similar to the input wave form. Since the grids are driven positive with respect to cathode, power is required to drive the tubes and the regulation of the signal source must have a low impedance in order to obtain satisfactory results.

Class B amplification is very popular in high level modulated transmitters. The tubes are driven up into the grid current region with a resultant high plate efficiency and high power output for a given tube size. Considerable care must be given to the power supply requirements for such service as the plate current of these tubes varies over a wide range. The tubes are also critical as to the load impedance into which they operate. Audio transformers for this service are specially designed and with proper care in the use of these components low harmonic content is obtainable. Tubes suitable for this service have a high mu and include the 46, 203A, 204A, 800, etc.

GAIN

It is common practice in communication work to refer power ratios in terms of decibels. This is convenient in modulator design. If the output of the microphone to be used with an amplifier is known the requisite gain to obtain full power output can be easily computed. This gain should equal the numerical value of the output of the mike in D.B. below zero level added to the numerical value of the power output desired in D.B. with an additional 10 D.B. to permit a control range.

AF CIRCUITS

The following pages illustrate a number of typical modulator circuits as applied in amateur service. It will be seen that in most audio circuits a fixed C bias supply has been provided for the output tubes. This permits large power output without exceeding reasonable limits of distortion. The circuits shown have all been tested and proven and are simple both to construct and to put into operation. The combination of one of these modulator circuits with a corresponding RF circuit, as illustrated in the early part of this bulletin, will form a complete transmitter setup of ideal characteristics.

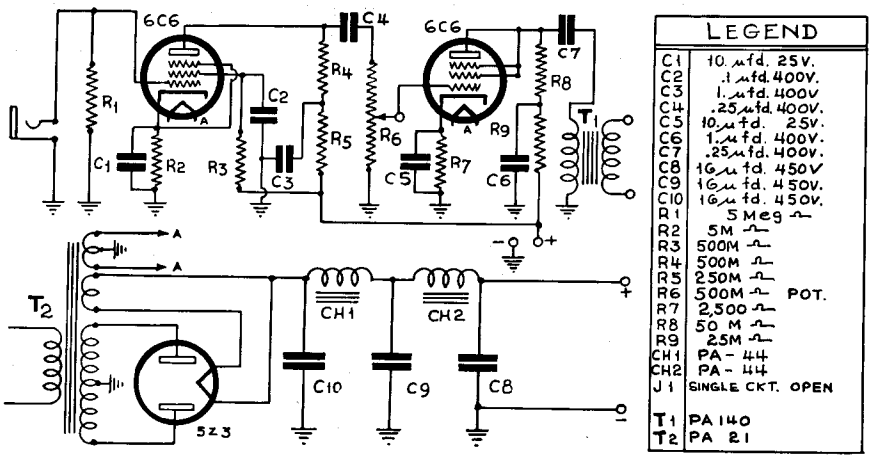


Fig. 11—Pre-Amplifier

This simple resistance coupled pre-amplifier is designed for use with crystal microphones. It may be used with other types of microphones by incorporating the proper type of input transformer. The T-1 output transformer shown has secondary impedances of 200 or 500 ohms.

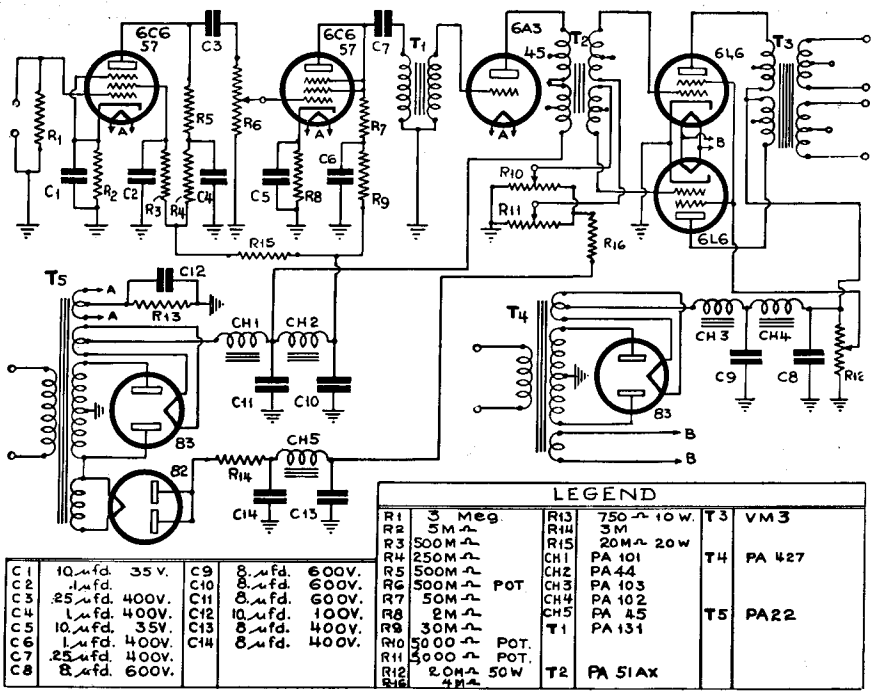


Fig. 12—40-60 Watt Modulator Unit

The simplicity and low cost of this modulator is made possible through the use of the 6L6 beam power tube which has a high power sensitivity and very high power output. The 6A3 or 2A3 driver tube is preferable, as a driving tube having low plate resistance is very important. This amplifier will operate directly from a crystal microphone and is capable of modulating 100% the 120 watts AC input to a class C RF stage. If less power than 60 watts is required, the 6L6's can be operated self bias which eliminates the bias rectifier and also permits the use of a 6C6 triode or similar tube as the driver. Under this operating condition, 40 watts of audio is available. The self bias operating condition is most usual because of the simplicity, reduced cost and stability of operation.

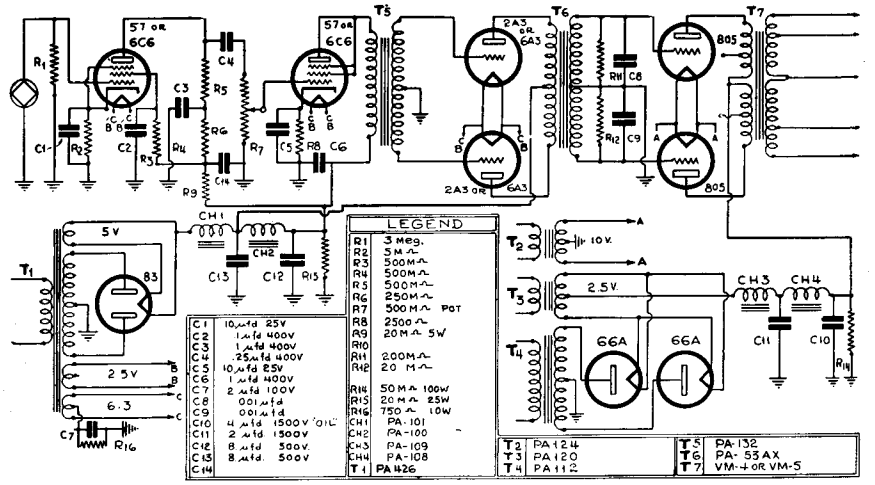
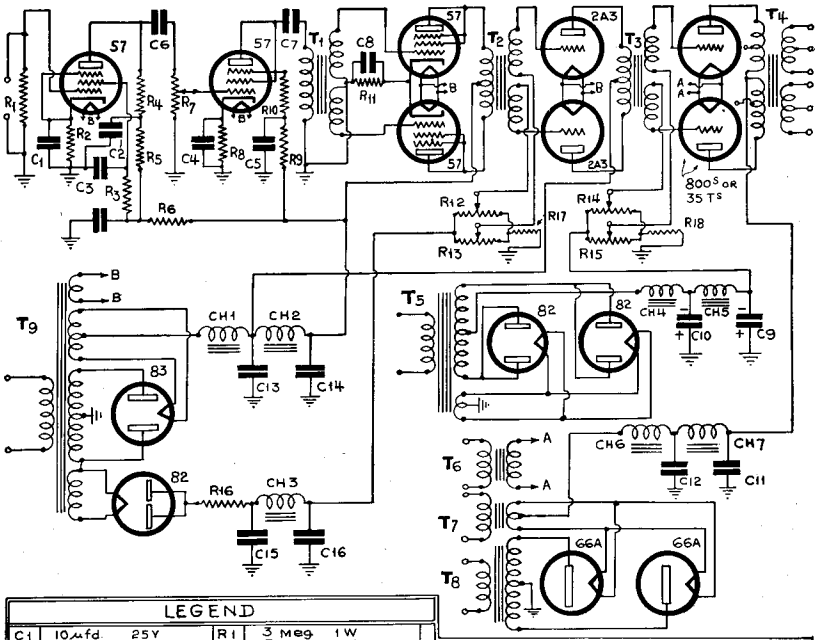


Fig. 13—300 Watt Modulator

This audio amplifier will modulate 100% the 600 watt DC input to a class C RF stage. The four stages of amplification provide sufficent gain for use with high level crystal microphones. The 2A3's are operated self bias as they have sufficient driving power in this method of operation to fully excite the zero bias 805 tubes. Due to elimination of fixed bias on both driver and output stage, this modulator becomes quite simple and inexpensive. The condensers and resistors shown in the grid circuit of the 805's are intended to nullify any tendency for grid oscillation.



LEGEND							
C1	10 μfd 25V	R1	3 Meg 1W	R17	4M	T4	VM3
C2	1. μfd 400V	R2	5 M	CH1	PA-101		
C3	.1 μfd. 400V	R3	500 M 1W	CH2	PA-100	T5	PA-115
C4	10 μfd. 25V	R4	500 M 1W	CH3	PA- 45	T6	PA-122
C5	1. μfd. 400V	R5	250 M 1W	CH4	PA-103	T7	PA-34
C6	.25 μfd 400V	R6	30 M 5W	CH5	PA-102	T8	PA-112
C7	.25 μfd. 400V	R7	500 M POT	CH6	PA-103	T9	PA-425
C8	.5 μfd. 25V.	R8	2 M 1W	CH7	PA-102		
C9	10 μfd. 275V.	R9	25 M 1W	R18	4M		
C10	10 μfd. 275V	R10	50 M 1W	T1	PA-132		
C11	4 μfd 1500 V	R11	1500 2W				
C12	2 μfd 1500 V	R12	5 M POT.	T2	PA-233		
C13	8 μfd 500 V.	R13	5 M POT				
C14	8 μfd. 500 V.	R14	300 25W POT	T3	PA- 53		
C15	10 μfd. 275V	R15	300 25W POT				
C16	10 μfd. 275V.	R16	10 M 10W				

Fig. 14—100 Watt Modulator

This modulator incorporates 800's or 35T's in the output stage driven by 2A3's. Fixed bias with controls for adjusting plate current are provided on both driver and output stages. Sufficient gain is provided in this five stage amplifier to operate directly from a crystal microphone. The output is sufficient to modulate 100% the 200 watt DC input to a Class C RF stage.

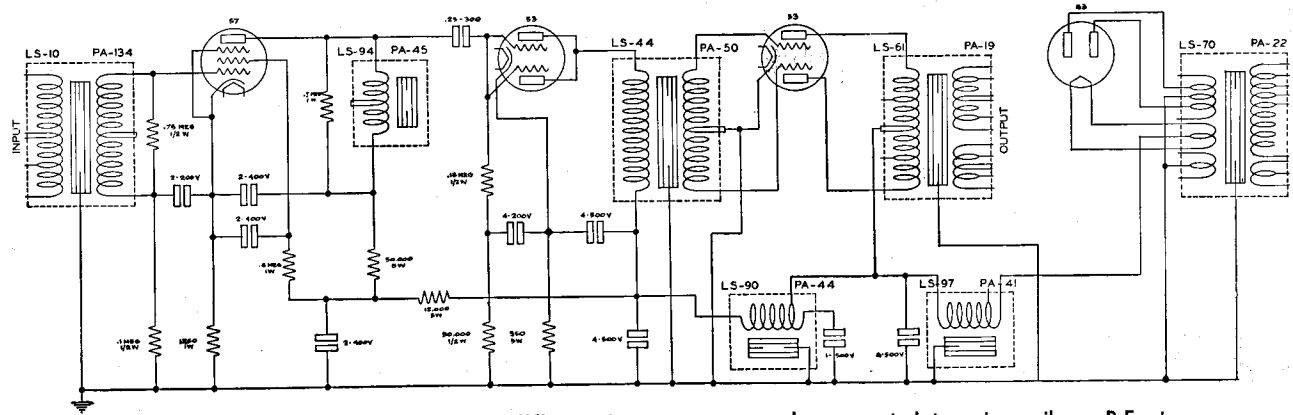


Fig. 15—3 stage 53 Class B power amplifier. Output stage may be connected to voice coils or R.F. stage.

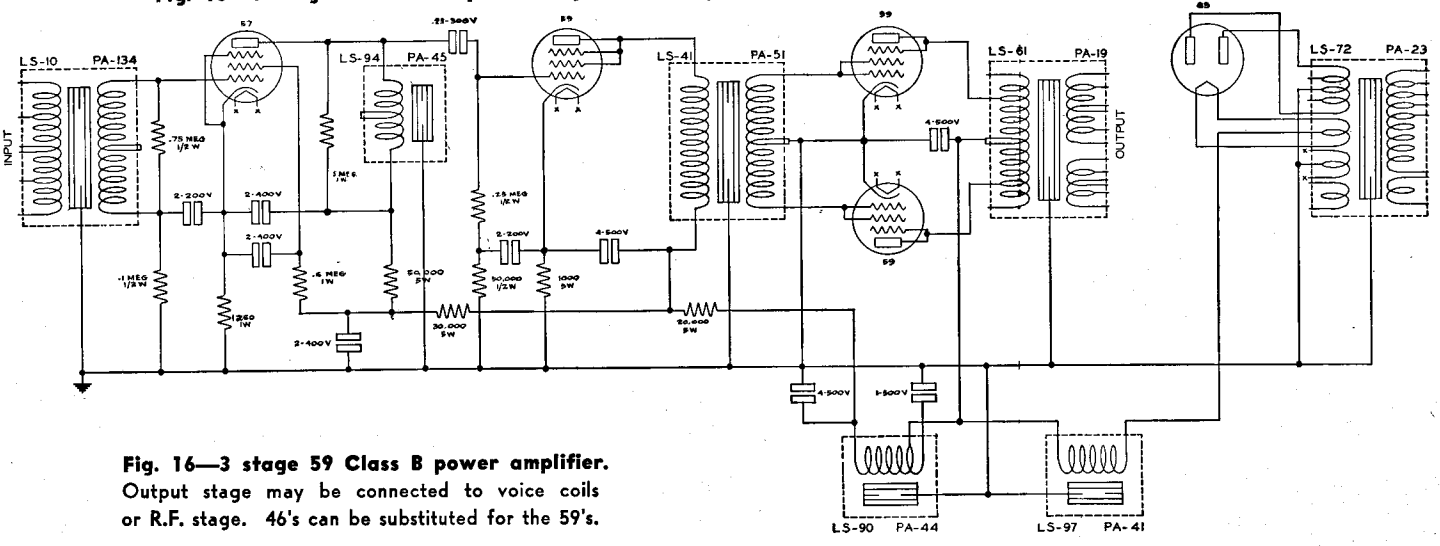


Fig. 16—3 stage 59 Class B power amplifier. Output stage may be connected to voice coils or R.F. stage. 46's can be substituted for the 59's.

HIGH FIDELITY AUDIO CIRCUITS

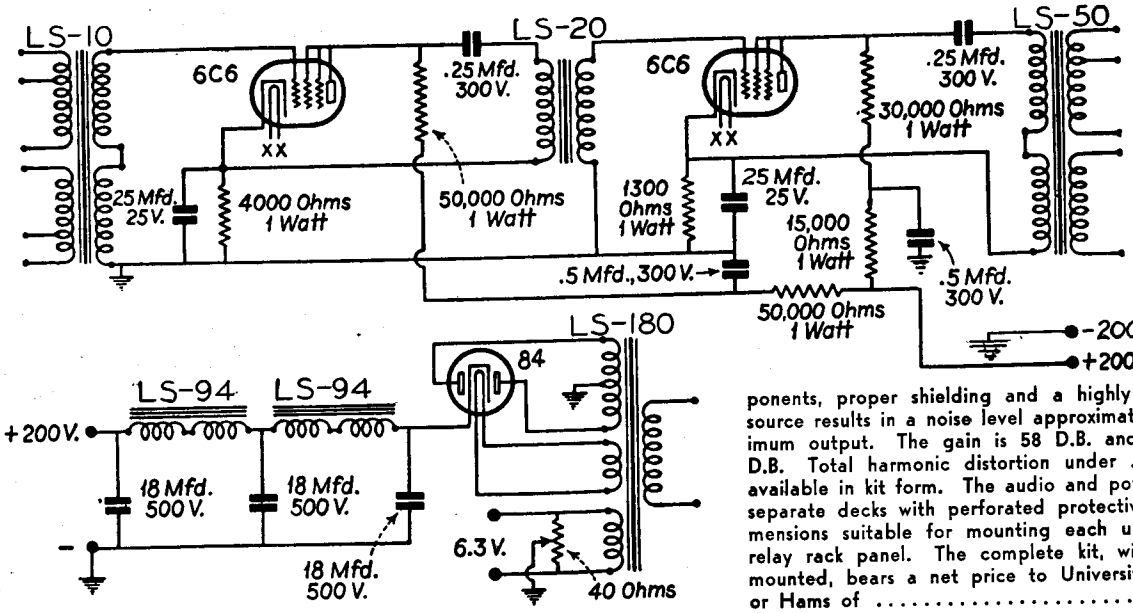


Fig. 17, type LS-P Pre-Amplifier

The 6C6 pre-amplifier shown at left is adapted for use with crystal, ribbon, and voice coil microphones. The circuit and components are ideal for high fidelity, permitting a uniform response from 30 to 15,000 cycles within 2 D.B. The combination of good circuit components, proper shielding and a highly filtered power supply source results in a noise level approximately 80 D.B. below maximum output. The gain is 58 D.B. and power output plus 7 D.B. Total harmonic distortion under .4%. This amplifier is available in kit form. The audio and power supply units are on separate decks with perforated protective covers and have dimensions suitable for mounting each unit on a 3½" by 19" relay rack panel. The complete kit, with all accessories fully mounted, bears a net price to Universities, Broadcast Stations or Hams of **$68.00**

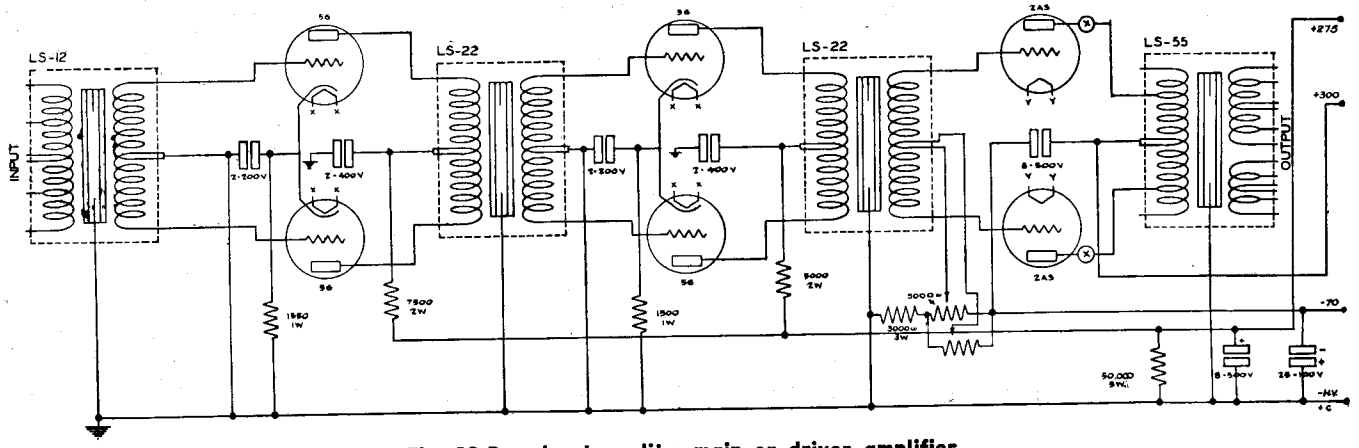
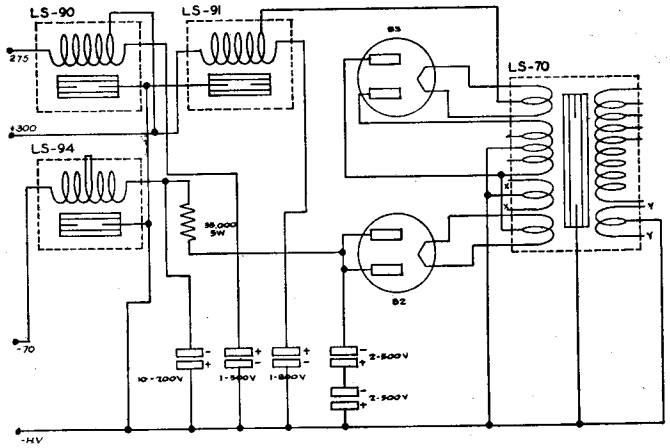
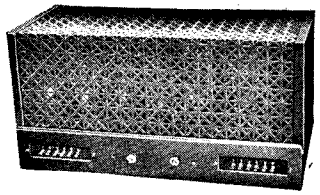


Fig. 18-Broadcast quality, main or driver amplifier

The triple push pull fixed bias 2A3 amplifier circuit shown has extremely low hum level and clean output due to the push pull tube connections. This tends to minimize both plate and filament hum. Adjustable fixed bias is provided to assure balance in the output tubes. The circuit is extremely simple and stable. The undistorted class A output is 15 watts and the gain 80 D.B. The response is uniform from 30 to 15,000 cycles. A trap resonant rectifier filter circuit provides high filter efficiency. This amplifier is available in kit form with audio and power sections mounted on separate drilled metal decks with perforated protective covers. The dimensions of these decks are suitable for mounting on an 8¾" by 19" relay rack panel. Complete LS-2A3 amplifier kit including all accessories fully mounted, net price to Universities, Broadcast Stations or Hams, ... **$118.00**





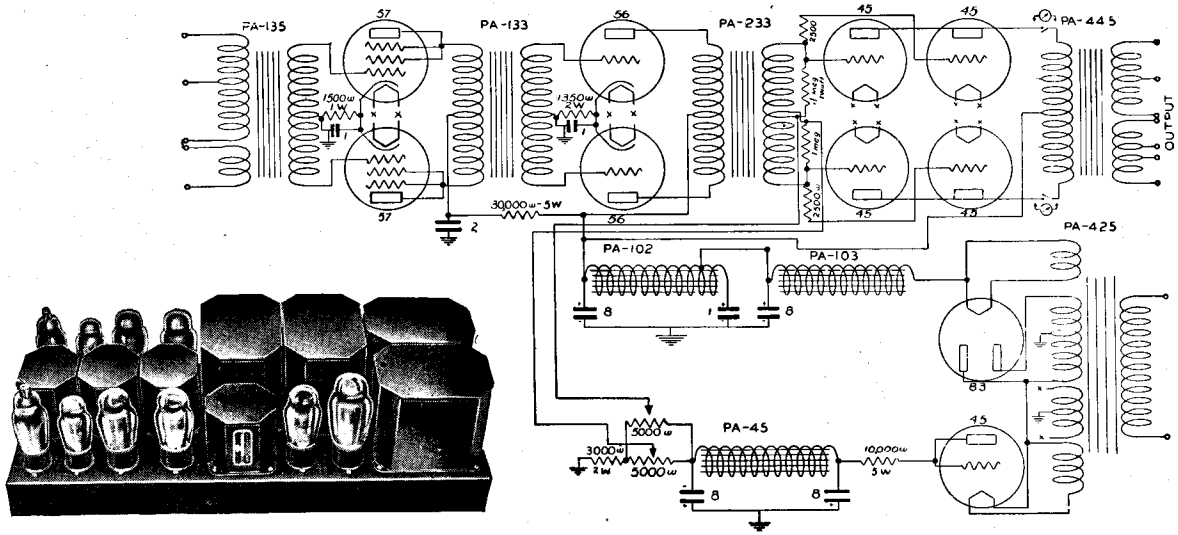
Appearance of each unit of 2A3 amplifier and power supply with perforated protective covers fully mounted. Suitable for attachment to rack panel.

Fig. 19 — PPP-45 AMPLIFIER

The amplifier at the right is a conservative stable unit for public address and modulator work. Through the use of four inexpensive type 45 or 2A3 tubes operated A prime in the output, maximum economy is obtained in both initial cost, tube replacement, and operation. By employing fixed bias and perfectly matched transformers a power output of 38 watts normal is made available. The adjustable bias potentiometers allow perfect matching of the output tube plate currents. This has a considerable bearing on the magnitude of harmonic distortion. The overall gain of this amplfier is 90 DB. The frequency response is uniform from 60 to 10,000 cycles. The overall dimensions including perforated dust cover (not shown) are 22 x 9 x 9 inches high.

This amplifier is available as a kit. Complete kit including all accessories fully mounted, net price to universities, broadcast stations, or hams, ...**$60.00**

If modulator output transformer is desired instead of unit with line and voice coil output impedances, use catalogue designation PPP-45X.



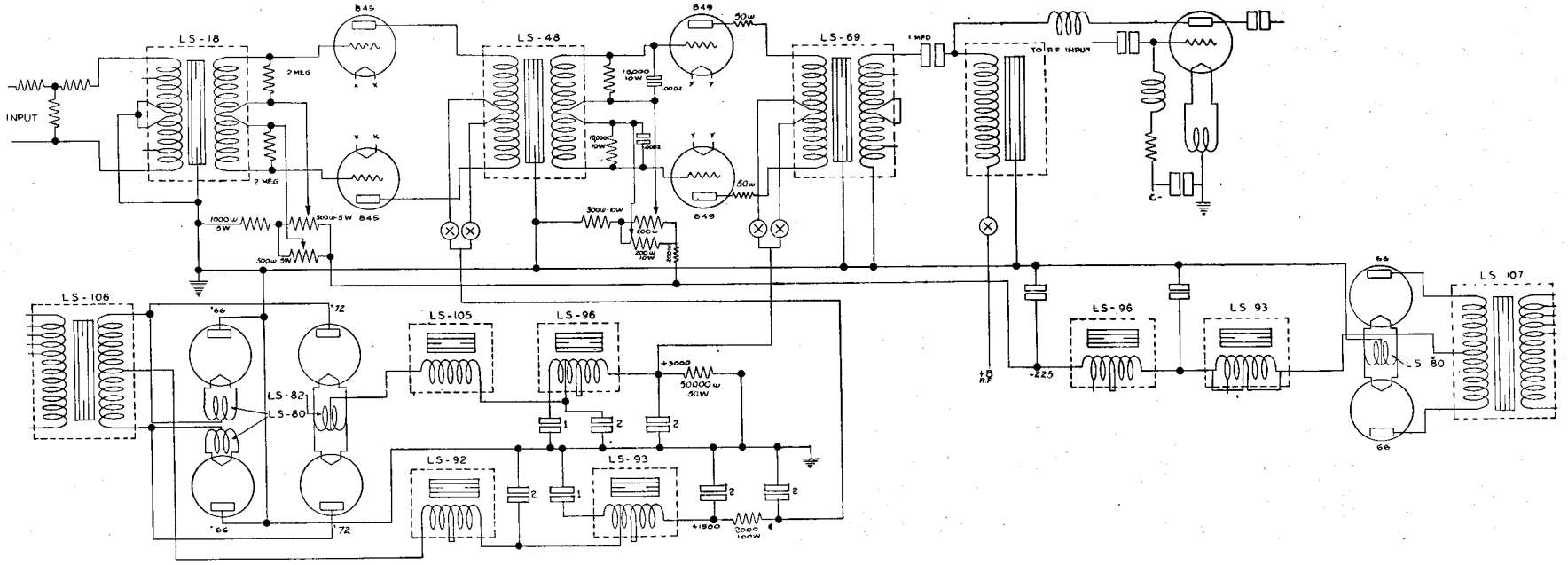


Fig. 20. The above schematic covers the complete circuit of a 1000 watt class B modulator power stage including plate and bias voltage supplies. A duplex bridge rectifier for the 849 plate supply and a full wave rectifier for the 845 plate supply effects maximum economy in cost and operation. It also permits practically complete isolation of the driver and output plate supplies; which is of considerable advantage, as the plate current swing of the 849 tubes is quite high. Potentiometers are incorporated in the bias supply circuit to balance the plate currents of both driver and output tubes. The filter condensers used in the bias supply are 25 mfd. Though not shown, it is also advisable to have a 25 mfd. condenser from each 849 grid return to ground. While the balancing of plate current—the 849 plate and grid resistors—and the 849 grid condensers complicate the circuit somewhat, the final results are well worth the trouble. The power output of 1000 watts is based on 5% harmonic distortion and the frequency discrimination is negligible from 40 to 12,000 cycles. The overall gain of this power stage is 27 DB. The linear standard components used in this broadcast unit are described in the UTC U1100D bulletin. The total list price of all transformer and choke items is **$727.00**

CONTROLLED CARRIER MODULATION

Controlled carrier modulation is to the RF end of a modern transmitter what class B is to the audio end. In addition to the advantages of increased power efficiency, extended tube life and the use of smaller tubes for high power output, controlled carrier modulation reduces interference between stations and increases effective working range of transmission.

The data and explanations which follow will readily substantiate these facts to those who are interested in the theoretical side of transmitter design.

Controlled carrier modulation can be defined as a method of modulation in which the average carrier output varies with the audio level, instead of remaining constant as in conventional modulation systems. Fig. 1 illustrates the relation of RF power to AF power in a typical transmitter using the

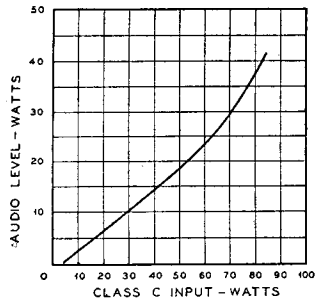


FIG. 1—Class C input vs. Audio level in a Controlled Carrier Transmitter.

first really practical system of controlled carrier modulation. This experimental transmitter used four 59s in class B in the audio modulator and a pair of 801s with controlled class C input in the final. Before going into the technical details of this transmitter, let us examine more closely the various advantages of this controlled carrier modulation and the effects which produce these advantages. They can be enumerated as follows:

1. Reduction in Power Consumption and Operating Costs.

Fig. 2 illustrates the relationship of power measured at the primary of the plate transformer for the final as compared to different audio levels. Every amateur who has watched the wiggling of the plate current meter in a class B amplifier, or by means of an oscillograph used to check percentage modulation, realizes that speech and music are not of continuous level, but consist of a series of valleys and peaks representing different audio levels. Tests by the writer have indicated that if these valleys and peaks are integrated over a period of time, the average audio output is less than 20 per cent of the amplifier peak power handling ability. This is particularly true of the amateur phone station, because silent periods of short duration are extremely frequent. An approximate check taken on three stations indicated that the effective audio power was less than 10 per cent of maximum for 90 per cent of the time.

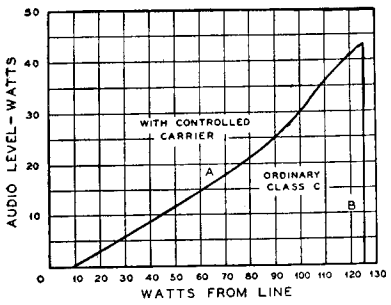


FIG. 2—Comparison Between Ordinary Class C and Controlled Carrier Class C as Referred to the Variation of Power Consumption from the Line vs. Audio Power.

Using this approximate check, the audio power taken 90 per cent of the time on the transmitter described above would be below 4½ watts. In an ordinary transmitter using 801s for the final, Curve B, Fig. 2 would indicate that a constant power of 125 watts would be taken from the line by the final plate transformer. Considering this with respect to Curve A, Fig. 2, this means that for 90 per cent of the time the power taken from the line will be reduced to less than 24 watts. Furthermore, for a very considerable portion of the time the power taken from the line by the final plates will be only 10 watts. This saving in power is tremendous. If duplex operation is used, the operating cost is reduced still further, as negligible plate power is taken by the final during receiving periods.

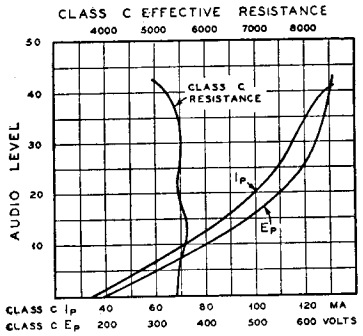


FIG. 3—Relation of Class C Operating Characteristics to Modulator Level in Controlled Carrier Transmitter.

2. Increase in Tube Life.

Referring again to Fig. 1, it is seen that at low audio levels the class C input is very low. This is shown still more clearly in Fig. 3. It is seen from this latter curve that at zero audio input the class C plate current is only 36 milliamperes total, and the corresponding plate voltage 195 volts. The increased tube life at this low plate power is obvious. Using the previous approximation of 10 per cent audio level for 90 per cent of the time, the class C input to this pair of 801s is found to be less than 15 per cent its maximum value for most of the time. The resultant reduction in plate dissipation should increase the tube life many times over. At the moment, the writer does not have facilities to determine this increase and we must consequently wait for further data from the tube companies before an accurate measure of this replacement economy can be determined.

3. Use of Smaller Tubes for High Output.

Most amateurs are familiar with the theory of class B amplification and realize why class B audio amplification made possible greater power from audio tubes. This is easily seen on the curve for plate current vs. power output of a class B system as in Fig. 4. Because the plate current swings through a wide range, the average effective plate current is much less than that at maximum output. An examination of Fig. 3 will show a striking similarity between the class C plate current vs. audio level and the class B plate current vs. audio level of Fig. 4. The effect of the curves is almost identical and consequently it is found that the available power output from a given pair of tubes used with controlled carrier modulation can be increased greatly over the output available from the same tubes in a normal class C amplifier. Tests conducted so far seem to indicate that an increase of almost 100 per cent can be obtained.

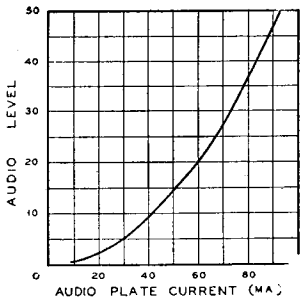


FIG. 4—Relation of Plate Current to Watts in a Typical Class B Amplifier.

4. Reduction of QRM

Because the carrier magnitude is reduced for the greater part of the time, interference between stations is greatly reduced. This is of vital importance in broadcasting as the allocation of stations by the FCC is such that normal interference is comparatively small. The additional aid of reduction in carrier would eliminate this effect practically entirely. To the amateur this is of importance, using controlled carrier modulation the beat note between stations is reduced for a major part of the time.

5. Increased Working Range.

One of the first fundamentals in phone transmission is the formula which states that the carrier power required for a given field coverage varies inversely as the square of the modulation percentage. Assuming for ordinary speech a percentage modulation

of 10 per cent for 90 per cent of the time, we find the following peculiar fact; since

$$\frac{\text{Power A}}{\text{Power B}} = \frac{\%\ B^2}{\%\ A^2}$$

and assuming 50% for "A" (controlled carrier) and 1.58% for "B" (regular class C): (See Fig. 8):

$$\frac{\text{Power A}}{\text{Power B}} = \frac{.25}{.00025} = 1000$$

This means that at 10 per cent audio level the same coverage (distance) could be obtained from a 10 watt transmitter using controlled carrier as from a very much larger transmitter using normal class C. This does not apply to the maximum audio level; at which well-designed transmitters of both types should give 100 per cent modulation. However, as previously stated, the average audio power is far below the maximum audio power. In this respect it might be remembered that broadcast stations have found that the minimum audio power range for good fidelity must be at least 30 DB. This represents a minimum audio power equal to .1% maximum audio power which is a much greater change in percentage modulation in the ordinary transmitter than in any of the examples referred to above.

6. Increased Fidelity.

Broadcast stations have found it necessary to increase the range of audio levels they transmit very appreciably to take care of modern high fidelity requirements. Massa of R.C.A. claims that a range of 70 DB. in audio level is required for real high fidelity. One of the greatest stumbling blocks in the progress of broadcasting in this respect has been the fact that due to the decrease in modulation percentage, the corresponding effective coverage is reduced in accordance with a square law. However, using controlled carrier modulation, the major part of this effect can be eliminated and a much greater range in audio level can be obtained with the same maximum power output and the same coverage. Another important factor in fidelity is the tendency prevalent among broadcast stations and amateurs to overmodulate. If controlled carrier modulation is used, when the audio

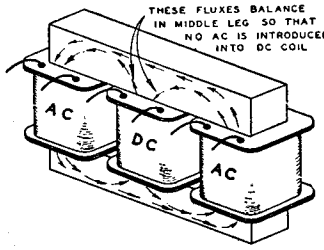


FIG. 5—Appearance of Saturable Reactor

level rises to the point of normal overmodulation, the class C input is automatically increased sufficiently to minimize the effect.

Circuit Details

The basis for control in variactor controlled carrier modulation is the fact that as shown in Fig. 4 the plate current in a Class B audio amplifier varies practically linearly with the power output. The plate current is used to saturate a control reactor which in turn controls the plate supply of the class C final. If a class A modulator is used, other means of obtaining this control current are possible. Fig. 5 illustrates the general nature of a saturable reactor. A shell type laminated core of somewhat different proportions than that in an ordinary transformer is used for the magnetic circuit. Three coils are placed on the respective legs of this core, the outer two being connected in series with the AC line and so related in polarity that their respective magnetic fluxes are in accordance with the arrows shown. It is seen that the MMFs of the two AC magnetic circuits are opposite in direction in the middle leg and tend to neutralize each other. If the coils and magnetic circuit are perfectly balanced, these fluxes will be perfectly balanced and no AC flux will traverse the middle leg of the laminations. The control coil is placed on this middle leg and the plate current of the Class B modulator is passed through it. All radio men are familiar with the fact that as the DC current is increased in a filter choke, its inductance decreases. Exactly the same effect is produced here, except that by proper design a fairly linear relation and a wide range in inductance can be obtained.

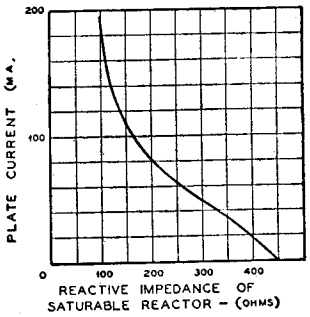


FIG. 6—This Curve Shows the Change in Reactance of AC Coils in a Saturable Reactor as the DC is increased.

Fig. 6 illustrates this relation of saturating DC to AC impedance in the experimental reactor used in the transmitter previously referred to. The linearity of this curve is increased still further in the larger variactors.

The saturable reactor is placed in series with the primary of the final plate transformer. It is seen from Fig. 6 that with no audio signal (minimum DC) the reactance of this reactor is quite high (450 ohms). This effects a great voltage drop to the primary of the plate transformer, as the effective impedance of this primary is quite low. However, as the saturating DC is increased, the reactance is decreased, and the consequent voltage drop is decreased. The primary voltage rises in accordance with this, and with proper design, reaches almost maximum at normal maximum audio output. Even with the reactor practically saturated, a small reactance and consequent voltage drop exists. To compensate for this, an autotransformer is used on the line side of the reactor which increases the total impressed voltage. This autotransformer does not have to be used if the plate transformer primary is wound or tapped for the reduced voltage obtained after the reactor drop. In either case, this voltage drop does not represent a power or efficiency loss, as the drop is almost entirely reactive and results primarily in a change of power factor; i.e., the ratio of VA/watts increases only.

It is apparent, on examining the circuit of Fig. 7, which shows a typical application of this reactor type controlled carrier modulation to an already existing transmitter, that the actual alterations necessary are quite small. Except for the autotransformer-reactor combination and a non-critical condenser, 1 to 8 Mfd., (if it is not already present in the modulator) no additional equipment is necessary. The circuit changes are extremely simple. The DC coil of the reactor is connected in series with the B plus lead of the

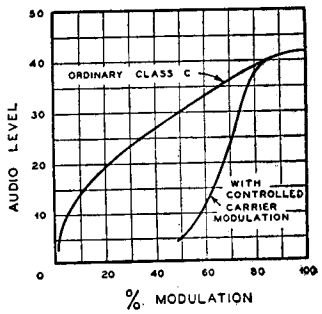


FIG. 8—Percentage of Modulation in Ordinary and Controlled Carrier Transmitters at Various Audio Levels.

modulator. The autotransformer primary is connected to the line and the primary of the class C plate transformer is connected across the output side of the autotransformer with the AC coils of the reactor in series. That is all there is to obtaining controlled carrier modulation from an existing transmitter. A simple switch as indicated in Fig. 7 permits instantaneous changeover from standard to controlled carrier.

We could write pages of superlatives about UTC variactor controlled carrier modulation but we suggest instead that you "ask the man who owns one."

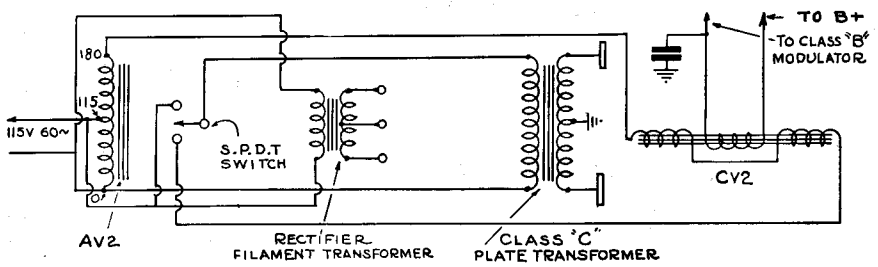


FIG. 7—Circuit of Controlled Carrier Transmitter.

UTC TRANSMITTER KITS

The UTC sectional phone and CW transmitter kits are supplied fully mounted ready to wire. These kits employ the Variactor system of carrier control exclusively.

TYPE 50 CW RF UNIT

This consists of a complete rack mounted 50 watt RF unit incorporating a crystal controlled 2A5 oscillator, a 2A5 buffer-doubler and push pull 46 final amplifier. A choke input mercury vapor rectifier is used having a 5% regulation. This unit is a highly efficient 50 watt CW transmitter. Completely mounted, ready to wire, including dust cover, with one set of coils (specify band desired) net to hams, ... **$ 68.40**

TYPE 30 AF MODULATOR UNIT

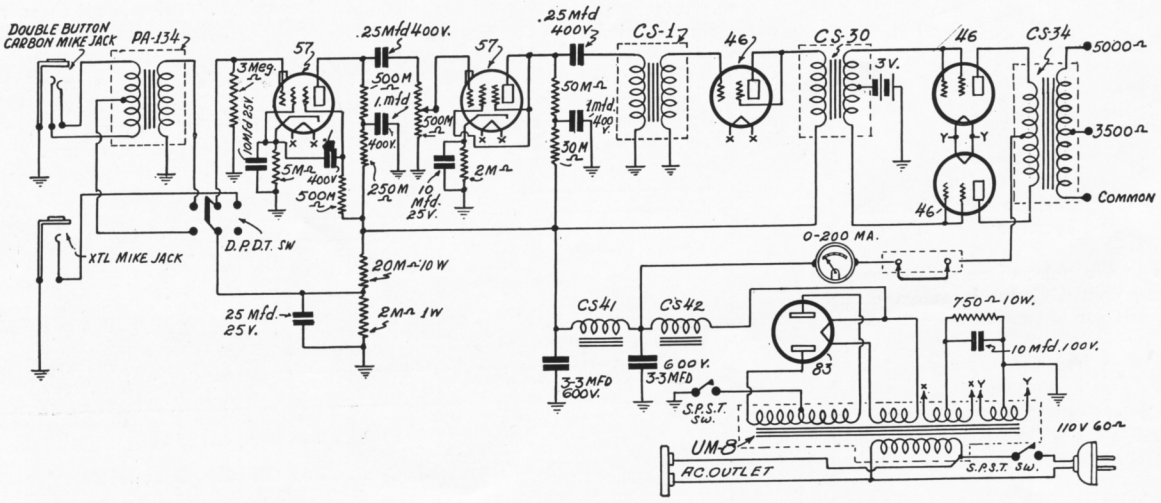
This is a rack mounted high gain speech amplifier using two 57's cascaded into a 46 which drives a pair of 46's in Class B. The power output is 30 watts. Less than 5% distortion is obtained. The amplifier will work with any carbon or high level crystal microphone. Complete kit mounted, ready to wire, including dust cover, net to hams, ... **$ 39.60**

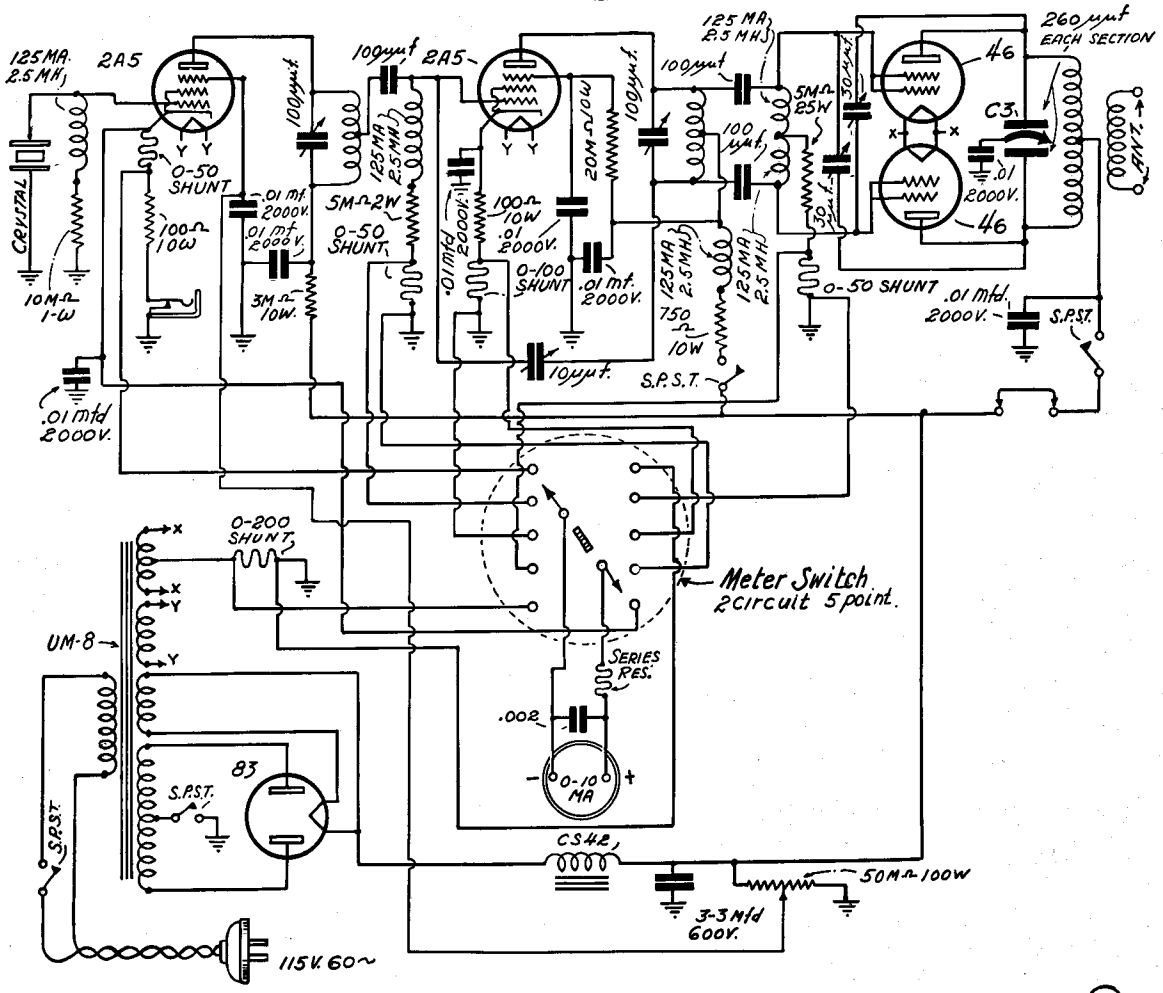
TYPE 50 CC CONTROLLED CARRIER UNIT

This is a Variactor controlled carrier unit which incorporates the control units and a separate power supply to operate the 50 watt class C stage incorporated in the type 50 CW RF unit. Instantaneous switchover is provided from controlled carrier to constant carrier. UTC Variactor controlled carrier increases blanket DX coverage, reduces power consumption and greatly reduces interference between stations. Complete unit mounted, ready to wire, with dust cover, net to hams, ... **$ 33.60**

TYPE 50 TRANSMITTER

Complete kit including units 50 CW, 30 AF and 50 CC mounted in a steel cabinet as illustrated at right. Overall dimensions 29¾ inches high, 19 inches wide, 14 inches deep with rear door. Net to hams, ... **$ 152.40**





ABOVE

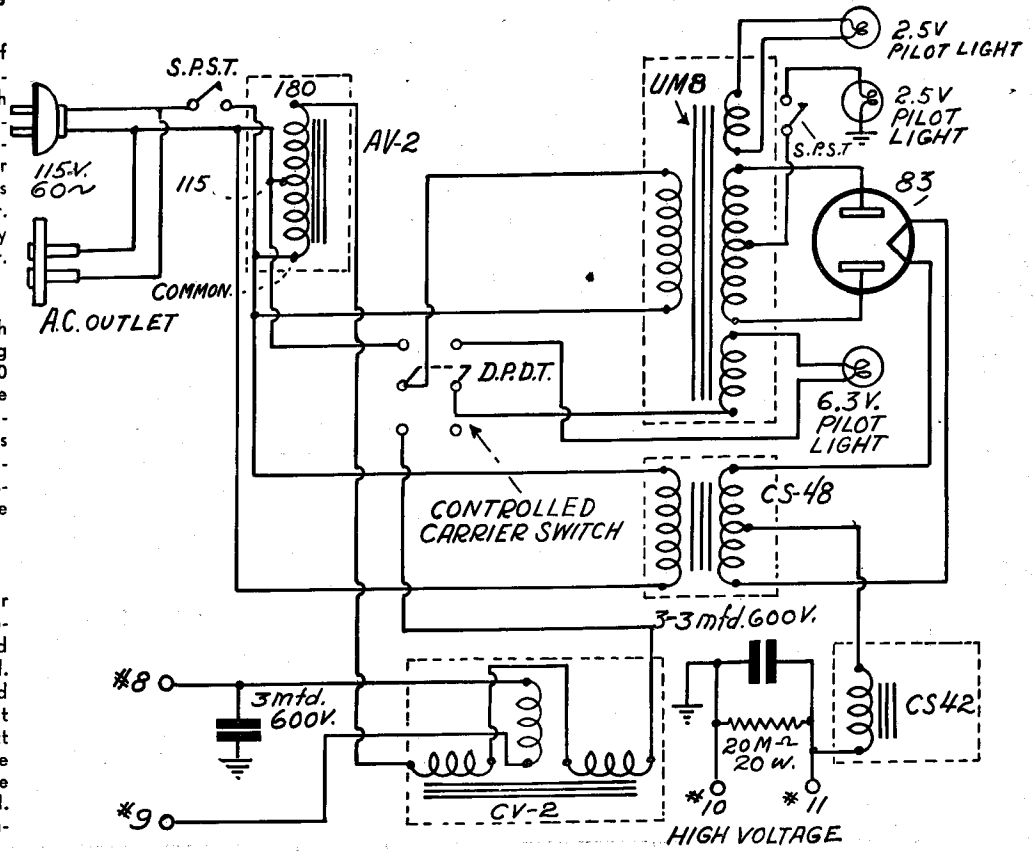
50 watt RF unit. Consists of Crystal-controlled pentode oscillator pentode buffer-doubler, push pull final amplifier, and choke input mercury vapor rectifier system having a regulation better than 5% readings on 5 circuits instantaneously through one meter. Used by itself this unit is a highly efficient 50 watt CW transmitter.

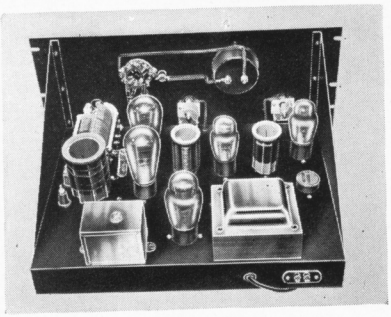
AT LEFT

Consists of a high gain speech amplifier and Class B modulating stage. It has an output of 30 watts, and when used to modulate the RF amplifier at 100% modulation the distortion level is less than 5%. This amplifier is designed for use with high level crystal microphones and will operate with any of the carbon type.

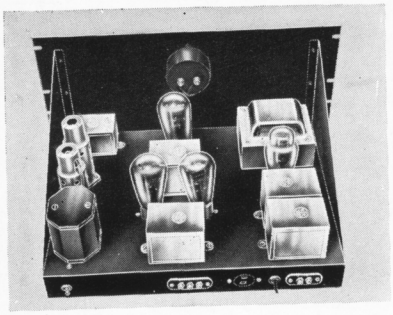
AT RIGHT

VARIACTOR Controlled Carrier unit. Has a separate power supply for 50 watt class C stage and Variactor units for carrier control. Instantaneous switchover provided from carrier control to constant carrier. When used with 500 watt class B Linear stage DX coverage is increased, efficiency of the Linear stage is easily doubled. Reduces interference between stations tremendously.

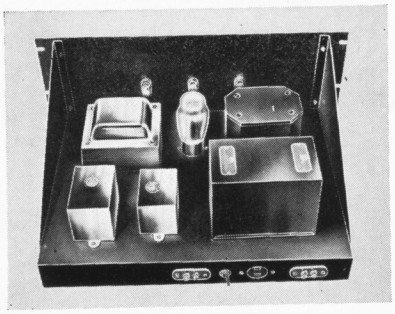




50 CW RF UNIT



30 AF MODULATOR UNIT



50 CC CONTROLLED CARRIER UNIT

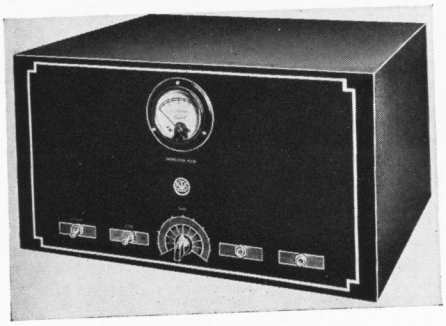
THE 500 WATT INPUT CARRIER CONTROL CLASS B LINEAR STAGE

Consists of a Class B Linear push pull 852 power stage, a high voltage 866A power supply and a C bias supply of exceptionally good regulation. Link coupling provided between the exciter and the 852 Linear Stage. The amplifier is supplied with two cabinets of the type shown above. The 852 Linear Amplifier may be added to the 50 watt Control Carrier rig at a later date. UTC 500W Linear Power Amplifier, completely assembled, ready to wire, with 2 cabinets less antenna unit, less tubes. Net to hams ... **$ 234.00**

Tubes required: 2-852's, 2-866A's, 1-83.

500 AL ANTENNA TUNING UNIT FOR CLASS B LINEAR STAGE

Consists of a low pass antenna matching network made up of two inductors, two capacitors and a sensitive RF thermo couple ammeter, all mounted on a standard 19 inch rack assembly. To be used with 500W Linear Amplifier, fully mounted, ready to wire. Net to hams ..... **$ 36.00**



30 Watt Speech Amplifier and Modulator Section.
Fully Mounted with Removable Dust Cover.

This Amplifier is an ideal attractive unit for PA work. For this service output transformer type CS-36 with secondary impedances of 500, 15, 8, 4 and 2 ohms is used. Complete kit mounted as shown type **30 CAF** net to ham or PA man ..... **$ 39.60**

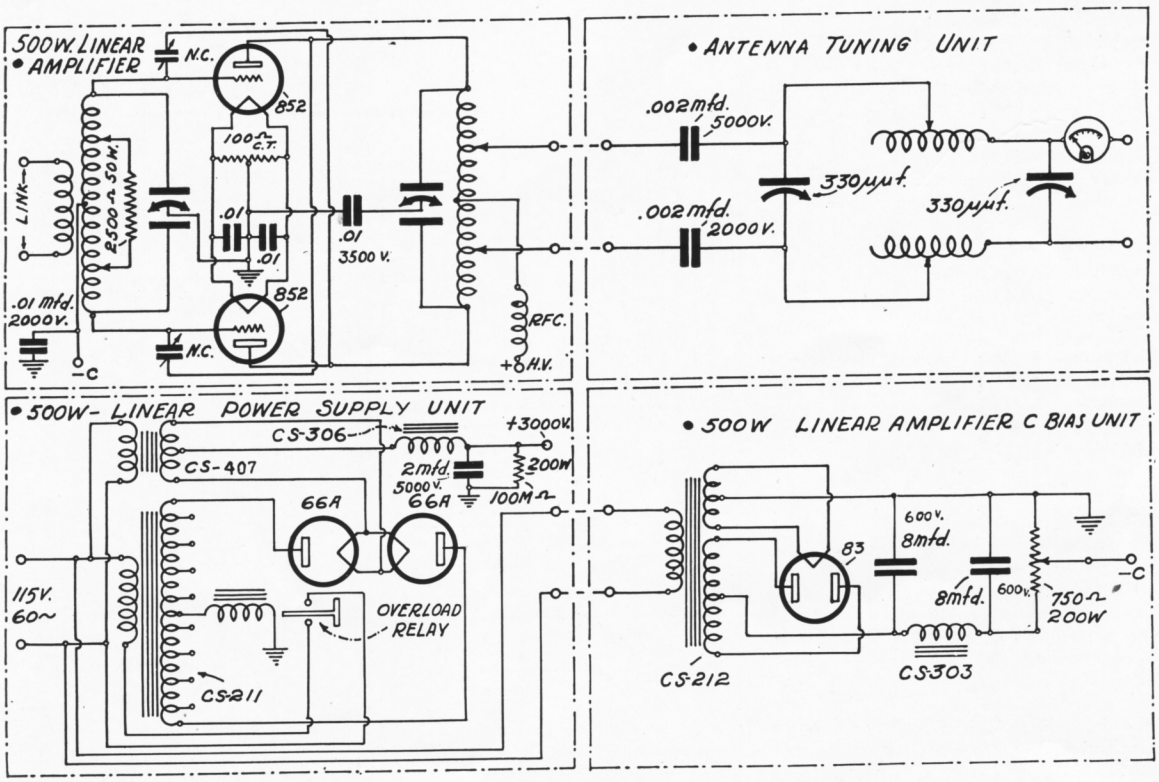


PLATE SUPPLY DESIGN

USE OF TRANSFORMERS

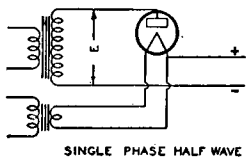
A perfect transformer may be quickly ruined if used improperly. As most power units in communications work are used in conjunction with rectifier circuits, a knowledge of the operation of these circuits will help considerably in assuring proper choice and use of accessory components.

Peak inverse voltage and peak plate current are the important factors to be considered in the choice of rectifier tubes. The values for a number of the standard type tubes are listed below:

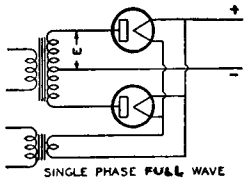
Tube Type	Peak Inverse Volts	Peak Plate Current
82	1,400 volts	.40 A.
83	1,400 volts	.80 A.
66	7,500 volts	.60 A.
66A	10,000 volts	.60 A.
72	7,500 volts	2.5 A.
72A	10,000 volts	2.5 A.
869	20,000 volts	5 A.

The peak inverse voltage can normally be assumed as 1.4x RMS AC voltage from the transformer. The peak plate current is a little more difficult to determine, and is affected very considerably by the form of filter into which the rectifier operates. Most standard circuits use choke input filters, in which case the current available is .66 X the peak plate current.

STANDARD RECTIFIER CIRCUITS

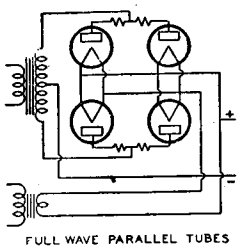


(Figure 4)

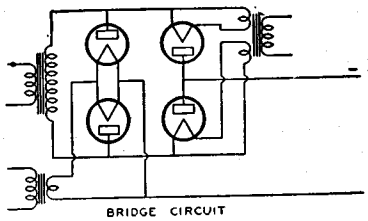


(Figure 5)

Figures 4 to 9 illustrate typical rectifier circuits applicable to communications use. The single phase half wave circuit of figure 4 is not very popular due to the fact that the ripple is of greater magnitude and being of lower frequency than other systems is more difficult to filter. With choke input, the DC voltage will be approximately .45 that of the RMS voltage E. Figure 5 illustrates the full wave single phase circuit which is most commonly used and with which every engineer is familiar. Figure 6

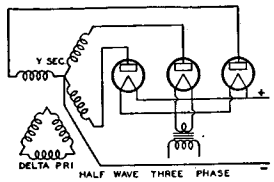


(Figure 6)

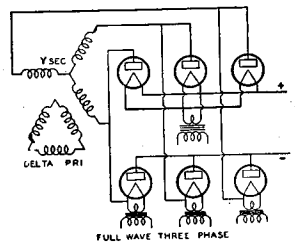


(Figure 7)

is identical in nature with figure 5, except that four tubes (more if desired) are used to obtain higher current output. The resistors shown in the plates of these tubes are highly essential. Otherwise, one tube will generally take most of the load with the natural result that the tube life is greatly decreased. In cases where good regulation is desired a center tapped balancing reactor can be used in place of the resistors. These reactors are simpler and less expensive than the use of resistors. They permit better regulation and less power loss. Figure 7 illustrates a bridge circuit. While this circuit involves four tubes, it has the great advantage that high DC voltages can be obtained without expensive (high peak inverse voltage) tubes and with low voltage transformers. In many cases where full wave rectification has been used and it is desired to increase the DC voltage, it is possible to use the entire secondary output of the plate transformer, and with rectifier tubes in bridge connection, twice the DC voltage will be obtainable. Of course, this reduces the current output due to the transformer current carrying limitations. Figures 8 and 9 are similar in nature to figure 5, except that they are applied to three phase



(Figure 8)



(Figure 9)

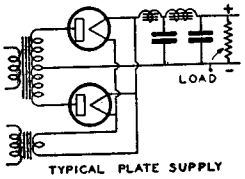
circuits. In the circuit of figure 8, each tube carries current for one-third of a cycle. The circuit of figure 9 is very commonly used for high power transmitters where three phase power supply is available, due to the high DC voltage which is obtainable. This circuit has an added advantage in that the ripple frequency is high, being six times the supply frequency, allowing easy filtering.

Analyzing these rectifier circuits, we obtain the values indicated below as the maximum operating and output values for any of the tubes described above.

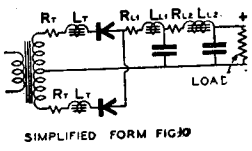
Fig. No.	Transf. Volts E	DC Output Volts at Input to filter	DC Output Current
4	.7 x peak inv. voltage	.45 x E	.33 x peak plate current
5	.35 x peak inv. voltage	.9 x E	.66 x peak plate current
6	.35 x peak inv. voltage	.9 x E	1.32 x peak plate current
7	.7 x peak inv. voltage	.9 x E	.66 x peak plate current
8	.43 x peak inv. voltage	1.12 x E	.83 x peak plate current
9	.43 x peak inv. voltage	2.25 x E	1.0 x peak plate current

As an example, if we apply these figures to the 866 tube, we find that in a full wave circuit, (fig. 5), the maximum transformer voltage E each side of center tap is .35 x 7500 or 2650 volts. This gives us a DC voltage at the input to filter of 2650 x .9 or 2400 volts. The maximum DC output is .66 times the peak plate current of .6 amperes, or 400 MA. Naturally, voltages and currents lower than these values can be used. Where a saiurated input reactor is used, the allowable DC is reduced somewhat. However, as these saturated reactors are normally used in conjunction with a class B amplifier load, the high DC and peak plate currents are generally of short duration reducing the tube life by an amount which is not excessive.

PREDETERMINING DC VOLTAGE

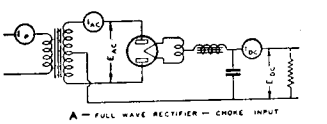


(Figure 10)

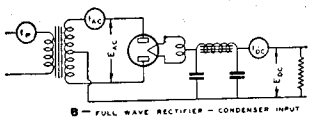


(Figure 11)

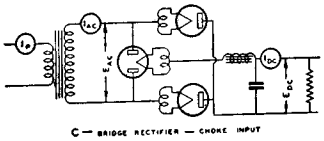
Actually, in practice, the DC voltage in which we are interested is that out of the filter. If we examine our complete circuit closely (fig. 10), we find that it can be reduced to the simpler form of fig. 11. Here we have the ratio of transformation such that E volts are induced in the transformer secondary. From the theoretical DC output which is .9 x E, we must subtract all the voltage drops, which include the drop across Rt (the transformer resistance), across Lt (the transformer leakage reactance), across V (the tube drop), across RL1 and RL2 (the choke resistances). If the transformer regulation is known, a value of E can be obtained which already incorporates the transformer losses. The DC output is then (.9 x E) minus 15 (the normal voltage drop across a mercury vapor tube), (minus IDC x (RL1 plus RL2). This gives us a definite means of predetermining our DC output voltage from a rectifier using a choke input filter.



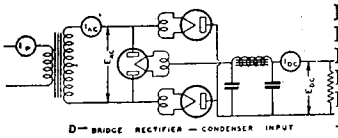
EDC - 435 V
IDC - 100 MA
EAC - 1100 V
IAC - 71 MA
IPRI - .6 MA



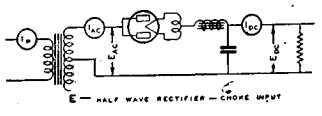
EDC - 675 V
IDC - 100 MA
EAC - 1100 V
IAC - 103 MA
IPRI - .9 MA



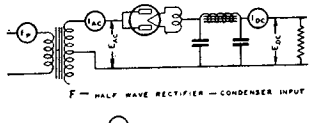
EDC - 860 V
IDC - 100 MA
EAC - 1100 V
IAC - 96 MA
IPRI - 1.1A



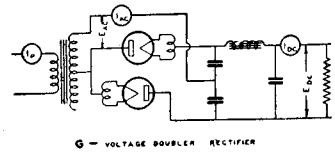
EDC - 1200 V
IDC - 100 MA
EAC - 1100 V
IAC - 148 MA
IPRI - 1.65 A



EDC - 480 V
IDC - 100 MA
EAC - 550
IAC - 120 MA
IPRI - .9 A



EDC - 580 V
IDC - 100 MA
EAC - 550 V
IAC - 190 MA
IPRI - 1.45 A



EDC - 1080 V
IDC - 100 MA
EAC - 550 V
IAC - 310 MA
IPRI - 1.55 A

(Figure 12A to G)

TYPICAL PLATE SUPPLIES

In many cases a particular transformer may be used under different circuit conditions. Figure 12A to G illustrates some of the standard single phase rectifiers more commonly used with typical voltage and current conditions obtained. Comparing A and B, it is soon that when changing the circuit from choke input to condenser input an increase in DC voltage is obtained. However, examination of the primary and secondary transformer currents indicates an increase of almost equal magnitude. If the same power transformer were used, this would mean that while the DC voltage is raised, the DC current will have to be reduced in almost the same amount to keep the power transformer at normal rating. In other words, the DC power will still remain practically the same.
A similar condition applies when a transformer normally used for full wave rectification is changed over for a bridge circuit as C. While the voltage here is practically twice that available in a normally full wave circuit; due to the high increase in primary current the DC load current must be reduced to approximately 60% of the value obtainable in full wave rectification. An examination of the other circuits shown will indicate the method of approach in the use of any of the other circuits with a standard transformer. This can be tabulated as follows, if we take the full wave rectifier with choke input as a standard and let the values of E dc and I dc be one, the same transformer will provide the following values of E dc and I dc in the other circuits shown:

Figure	DC Voltage	DC Amps.
A	1	1
B	1.55	.68
C	2.	.6
D	2.76	.42
E	1.	.62
F	2.4	.39
G	5.	.25

To simplify calculations a number of typical rectifier circuits using standard components are listed on opposite page. Naturally, standard components available will not take care of all requirements which may come up. However, UTC specializes in the construction of transformers to exact specifications, and can give quick delivery on units to the exact requirements of a particular user.

TYPICAL RECTIFIER CIRCUITS

Trans. Type No.	RMS Volts Each Side Center	Full Wave Rectifier					Bridge Rectifier				
		DC Volts	DC Mils	Rectifier Tubes	L_1	L_2	DC Volts	DC Mils	Rectifier Tubes	L_1	L_2
PA-110	515	400	220	83	PA-103	PA-102	860	130	83	PA-101	PA-100
	625	500	200	83	PA-103	PA-102	1060	120	83	PA-101	PA-100
PA-111	750	600	270	66	PA-105	PA-104	1280	160	83	PA-103	PA-102
	900	750	250	66	PA-105	PA-104	1560	150	83	PA-103	PA-102
PA-112	1250	1050	430	66	PA-109	PA-108	2170	260	66	PA-105	PA-104
	1400	1200	400	66	PA-109	PA-108	2400	240	66	PA-105	PA-104
PA-113	1600	1370	430	66	PA-109	PA-108	2800	260	66	PA-105	PA-104
	2000	1730	400	66	PA-109	PA-108	3500	240	66	PA-105	PA-104
PA-114	2500	2160	540	66	PA-109	PA-108	4300	325	66	PA-109	PA-108
	3000	2620	500	66	PA-109	PA-108	5300	300	66A	PA-109	PA-108
PA-116	1250	1070	220	66	PA-105	PA-104	2190	130	66	PA-101	PA-100
	1400	1200	200	66	PA-105	PA-104	2440	120	66	PA-101	PA-100
PA-117	3000	2575	1100	72	PA-1C	PA-1S	5300	650	66A	PA-1C	PA-1S
	3500	3035	1000	72	PA-1C	PA-1S	6200	600	66A	PA-1C	PA-1S
PA-154	3500	3070	540	72	PA-109	PA-108	5300	325	66A	PA-109	PA-108
	4000	3525	500	72	PA-109	PA-108	7100	300	66A	PA-109	PA-108
CS-203	800	660	150	83	CS-304	CS-301	1380	100	83	CS-304	CS-301
CS-204	800	650	250	83	CS-305	CS-302	1365	150	83	CS-304	CS-301
CS-205	750	600	380	66	CS-306	CS-303	1270	230	83	CS-305	CS-302
	900	745	350	66	CS-306	CS-303	1550	210	83	CS-305	CS-302
CS-206	1250	1030	540	66	CS-306	CS-303	2150	325	66	PA-105	PA-104
	1400	1190	500	66	CS-306	CS-303	2400	300	66	PA-105	PA-104
CS-207	1600	1360	430	66	CS-306	CS-303	2800	260	66	PA-105	PA-104
	2000	1725	400	66	CS-306	CS-303	3500	240	66	PA-105	PA-104
CS-208	2500	2150	540	66	CS-306	CS-303	4300	325	66	PA-109	PA-108
	3000	2610	500	66	CS-306	CS-303	5300	300	66A	PA-109	PA-108
CS-209	1250	1050	220	66	CS-304	CS-301	2190	130	66	PA-101	PA-100
	1400	1200	200	66	CS-304	CS-301	2440	120	66	PA-101	PA-100
CS-210	2300	2000	250	66	CS-306	CS-302	4070	150	66	PA-101	PA-100

NOTE: **(a)** The difference between the PA and CS transformers consists of approximately 15° C difference in temperature rise, a large insulation safety factor on the PA units, and a difference in the primary winding.

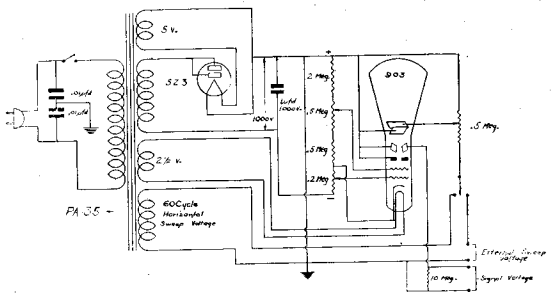
(b) The PA plate transformers have taps on the primary for operation on 105, 115, 210, 230 volts. The minor taps are suitable for adjustment for exact line voltage or exact DC voltage desired. **Reduced power operation is obtainable with these transformers when operating with 110V line by switching to the 220V Primary tap. This results in 50% reduction in the DC output.**

(c) Due to the high voltages in bridge rectifier circuits it is suggested that where convenient the filter chokes be used in the negative leg, or that they be insulated from ground.

CATHODE RAY OSCILLOSCOPE

At the right is shown the complete circuit of a cathode ray oscilloscope for transmitter work. Details as to the operation of an oscilloscope-modulation indicator of this type have appeared a number of times in radio publications.

PA-35 Power transformer for cathode ray oscilloscope, list price 18.00



POWER SUPPLY FILTERS

Power supplies for modern radio equipment are generally obtained by rectifying an AC supply. This process is carried out in two steps. In the first step, the AC voltage is converted to a pulsating DC. In the second step this pulsating DC is passed through a filter which smoothes out the pulsations to a point approaching the smoothness of direct current. The filter unit serves the function of supplying electrical inertia to the change in magnitude of the pulsating current. The pulsations in the rectified DC are multiples of the power supply frequency if a half wave rectifier is used and are multiples of twice the power supply frequency if a full wave rectifier is used. Similarly in a three phase half wave rectifier the pulsation frequency is three times the power supply frequency and in a three phase full wave rectifier six times the power supply frequency. The function of the filter circuit is to attenuate both the fundamental frequency and the corresponding harmonics to a point that is not objectionable. Economic considerations generally determine the extent of this attenuation.

REGULATION

Another factor which must be considered in connection with filter circuits is the question of power supply regulation. In addition to the regulation or change between no load and full load caused by the resistance drop in the filter chokes, the regulation of the rectifying circuit or unit itself must also be considered.

As an example, a typical half wave rectifier may have a 50% regulation from no load to full load as compared to a typical full wave rectifier having 10% regulation. In some filters a condenser is placed immediately after the rectifying unit to assist filtering. Under no load conditions this condenser tends to store the electrical energy so that a peak voltage equal to 1.4 times the RMS voltage applied to the plates is obtained. As a load is applied, the charge built up on this first condenser is drained and the peak voltage can no longer be maintained, the DC voltage dropping to a point approaching the average value. It is rather difficult to pre-determine in a simple manner the exact DC voltage using this type of filter. As the ratio of load current to capacity is increased, the voltage will tend to drop down.

On the other hand, if a condenser having infinite value could be used, the peak voltage would be maintained regardless of load current. A typical instance where the ratio of capacity to load current is high may be found in the anode supply of a cathode ray tube. In this type of filter a condenser of 1 Mfd is generally used and a current of approximately 1 MA is drained. Under this condition, a half wave rectifier with 710 volts on the plate will effect a DC output voltage of 1000.

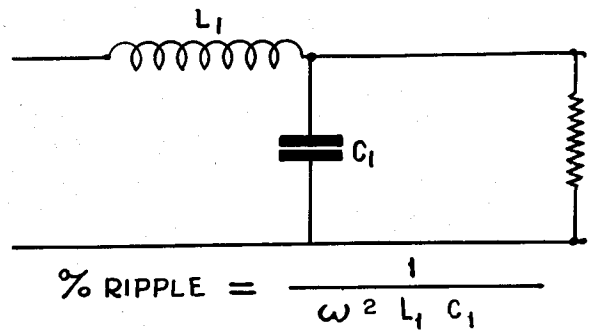
To improve regulation, a bleeder is generally used. This consists of a resistance shunted across the DC output and in most cases drains approximately 10% of the full load current. Another device frequently used to maintain good regulation, where the current changes through a wide range, is a swinging choke preceding the first condenser. With proper design, increasing load will lower the impedance of this choke sufficiently to allow the voltage to build up across the condenser following. In computing regulation, the IR drop in the chokes must always be considered.

VARIACTORS

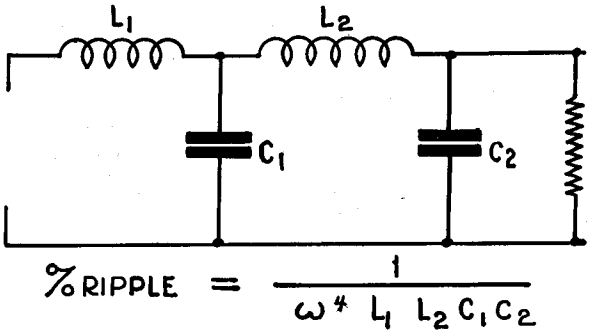
Certain applications such as class B audio amplifiers produce wide changes in DC current with a corresponding tendency for poor power supply regulation. In many of these applications, distortion or non-linear modulation may be produced by the voltage fluctuation of the power supply. To offset this condition, the UTC engineering staff have developed a form of saturable choke which is inserted in series with the primary of the plate transformer. A DC winding is coupled to this choke and inserted in series with the DC load. As the load is increased, the series choke is saturated and more AC voltage is impressed across the plate transformer primary which consequently compensates for the additional drop in rectifier and filter circuit. This form of UTC control unit is termed a Variactor. In most cases these variactors are made on special order only. However, a few are maintained as stock items. As a typical instance of the application of the UTC Variactor we can take the case of a class B-46 amplifier. A typical ordinary plate supply for this purpose deliveries 400 volts on the plate at no signal and 350 volts on the plate at maximum audio output. Using a Variactor, the voltage can be actually made to start at 400 and end up with 405 volts and at full load.

HUM

After analyzing the filter requirements with reference to regulation, the next point is the analysis of the actual hum suppression desired. Since in a rectifying system the attenuation of all frequencies is desired, a low pass filter is used which theoretically should have a cut off point at zero frequency. However, this theoretical condition would entail Inductance and capacitance elements of infinite value. For practical purposes, the magnitude of these elements are controlled by economical considerations but in any case must be sufficiently large to attenuate the lowest frequency present. To exactly determine the ripple at the output of a filter, is a rather complex proposition. Fortunately in all commercial applications the reactance of each condenser is small compared with the reactance of the preceding inductor and the reactance of the final condenser is small compared with the resistance of the load. Under this condition, the analysis of ripple may be simplified and can be evaluated as indicated in figures 1 and 2. To simplify this calculation, the chart of figure 3 has been prepared, from which the attenuation of hum in typical, practical circuits can be readily obtained. In most cases, the higher harmonics can be practically neglected as the attenuation of this type of filter varies as the 4th power of the frequency.



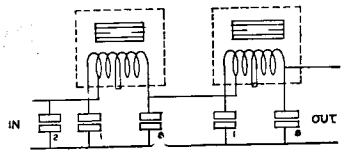
(Figure 1)



(Figure 2)

RESONANT CIRCUITS

To improve the filtering efficiency, resonant or hum-bucking circuits are sometimes used. The most practical device of this



(Figure 4)

nature is the UTC hum-bucking choke which is available in a number of standard ratings. In typical rectifiers, the use of hum-bucking chokes will increase the filter efficiency 4 times as compared to an equivalent amount of inductance and capacity in a standard filter. Figure 4 illustrates a typical hum-bucking circuit.

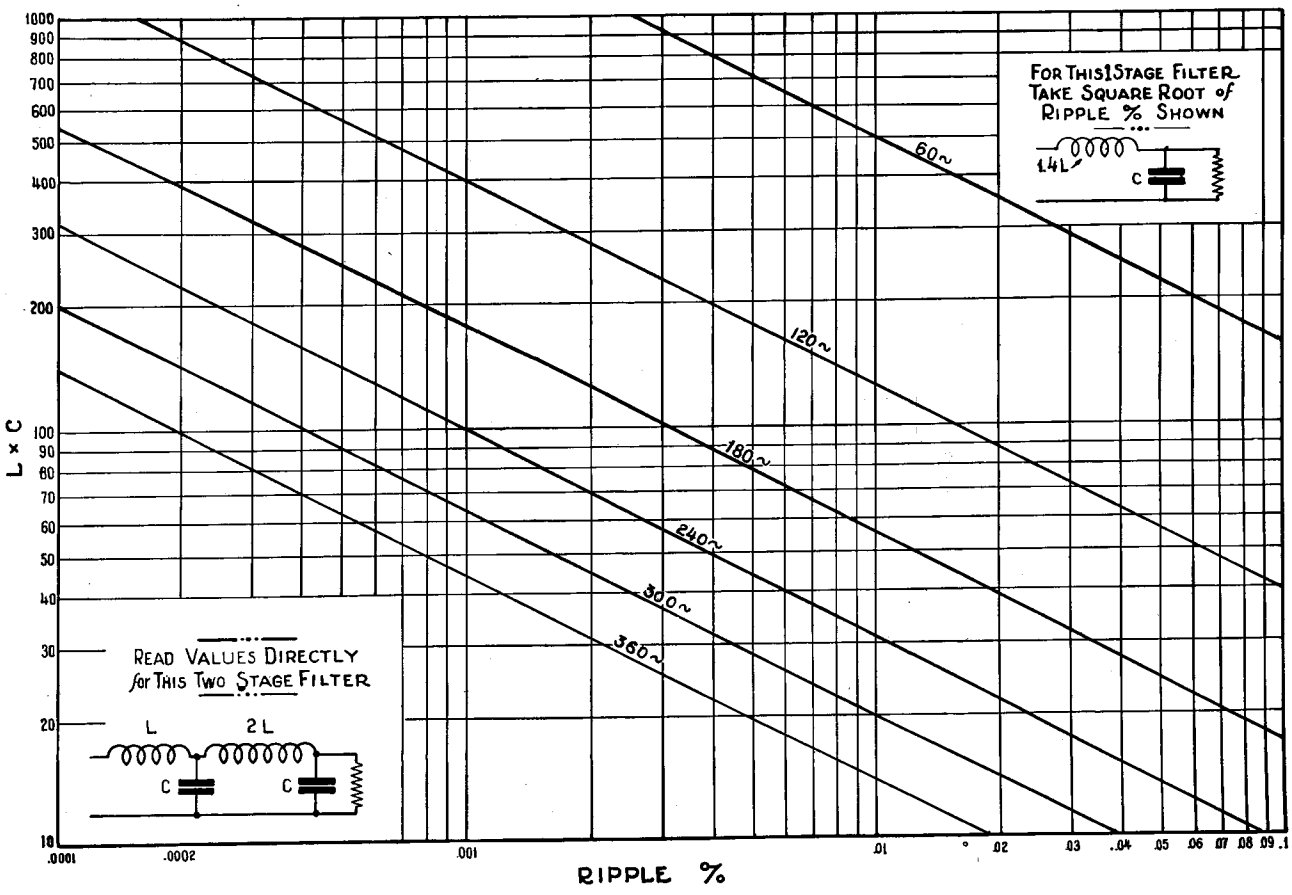
CAUTIONS

A number of important point must be watched in the use of filter circuits. One important fact is that at least one of the filter inductances should always be placed in the positive leg. If all inductors are used in the negative leg, the distributed capacitance of the transformer winding will by-pass the rectifier and allow a non-filterable residual voltage to appear across the load.

Another important point is the fact that there should be a negligable coupling between the filter inductors. If a co-efficient of coupling of even 1% occurs between the first and later filter chokes, the amplitude of the higher harmonics across the load becomes very appreciable. To prevent this UTC Linear Standard chokes for use in high attenuation filters are housed in high permeability cast cases.

Choke input circuits are always used in polyphase rectifiers and should also be used with high power single phase rectifiers because of the high ratio of average to peak current that is obtainable with choke input.

The first condenser in a filter circuit should be capable of operating continuously with a DC voltage equal to the peak AC voltage applied to the rectifier. This also applies to the first filter choke. It is important in the use of the chart of figure 3 and the formulas of figures 1 and 2 that a knowledge of the actual inductance and capacity values be had. Many condensers have been found to be far poorer than their rated capacity, particularly in the electrolytic type. The inductance of filter chokes varies appreciably with DC and many units are not rated with inductance at the actual value of DC used.



The above curve provides a simple means of calculating ripple percentage. The figures on the curve are self-explanatory.

UTC Manufactures

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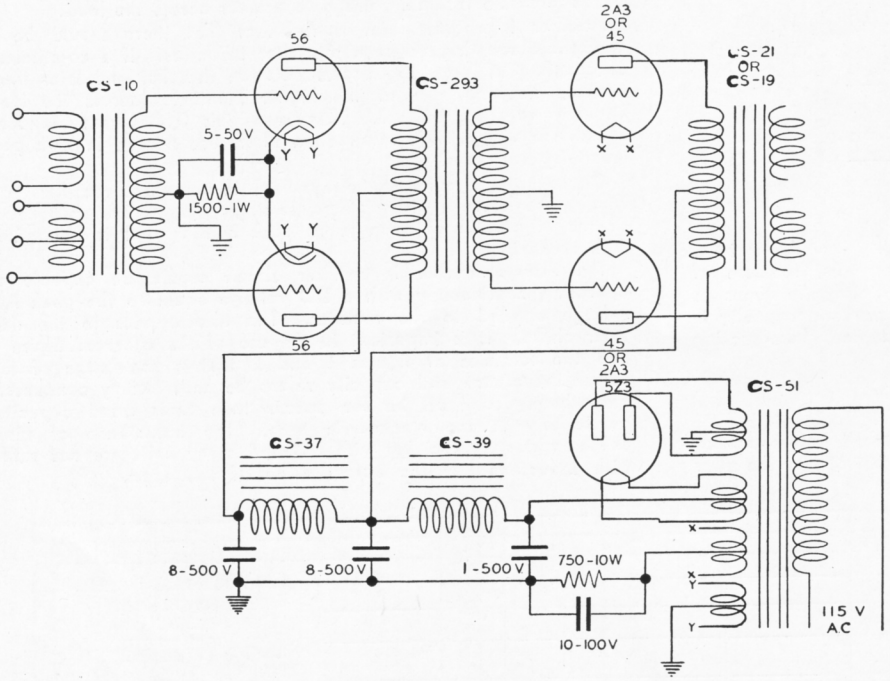
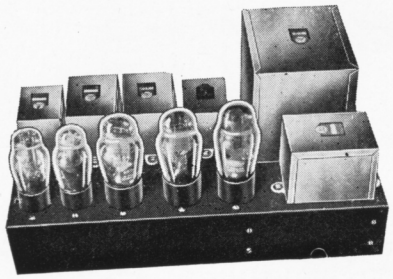
CHROMSHIELD AMPLIFIER KITS

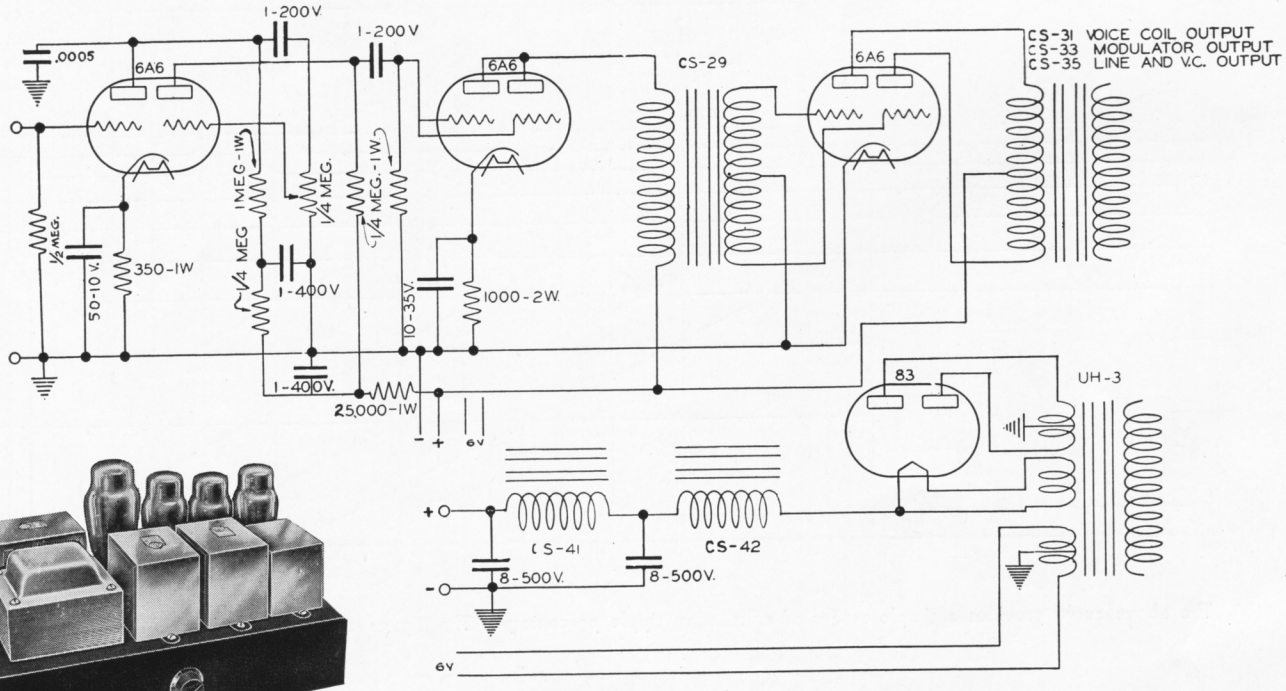




Overall dimensions, 14 x 7½ x 7¼

CAK-1 AMPLIFIER KIT

This kit consists of a two-stage amplifier using push pull 56 tubes into push pull 2A3 or 45 tubes. The input transformer type CS-10, accommodates either a high impedance plate such as the detector tube of a radio receiver, or a pick up, or a single button mike, double button mike or lines. The output transformer, type CS-21, has secondary impedances of 500, 15, 8, 4 and 2 ohms. The overall gain is approximately 48 DB. The power output is 14 watts peak, 10 watts normal. The frequency response is unusually good for PA and general broadcast programs. This amplifier can be used with metal tubes using 6C5's in place of the 56's and 6F6's triode connected in place of the 45 or 2A3 tubes. The list price of complete kit including all accessories ..... **$ 32.75**



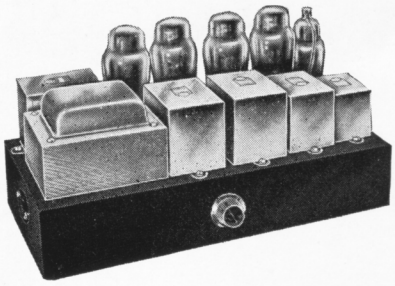
Overall dimensions, 12 x 6½ x 7¼

CAK-2 AMPLIFIER KIT

The CAK-2 amplifier is very popular for transmitter and PA work, as it provides a stable high gain amplifier that is light in weight and reasonable in cost. The input is arranged to match the new crystal microphones, or other high impedance input.

This unit incorporates a 6A6 tube cascaded feeding 6A6 tube parallel connected. The second 6A6 drives an output 6A6 tube in class B using a special driver transformer. The type CS-35 output transformer has secondary impedances of 500, 15, 8, 4 and 2 ohms. The list price of complete kit including all accessories ..... **$ 30.00**

If type CS-33 modulator output transformer having secondary impedances of 5000 and 3500 ohms is desired, use designation CAK-2X.

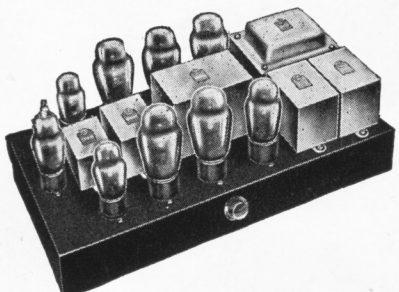


Overall dimensions 14 x 7 x 7¼

CAK-3 AMPLIFIER KIT

The CAK-3 kit is a simply constructed unit very popular in the PA and transmitter fields. It has a high impedance input and consists of a 57 tube transformer coupled to a 46 tube which in turn drives a pair of 46 tubes in class B. The tonal quality and overall fidelity are excellent. The power output is 40 watts peak, 28 watts normal, and the overall gain 75 DB. The CS-36 output transformer has impedances of 500, 15, 8, 4 and 2 ohms. The list price of complete kit including all accessories,..... **$ 35.00**

If this kit is desired with CS-34 modulator transformer having secondary impedances of 3500 and 5000 ohms, use designation CAK-3X.

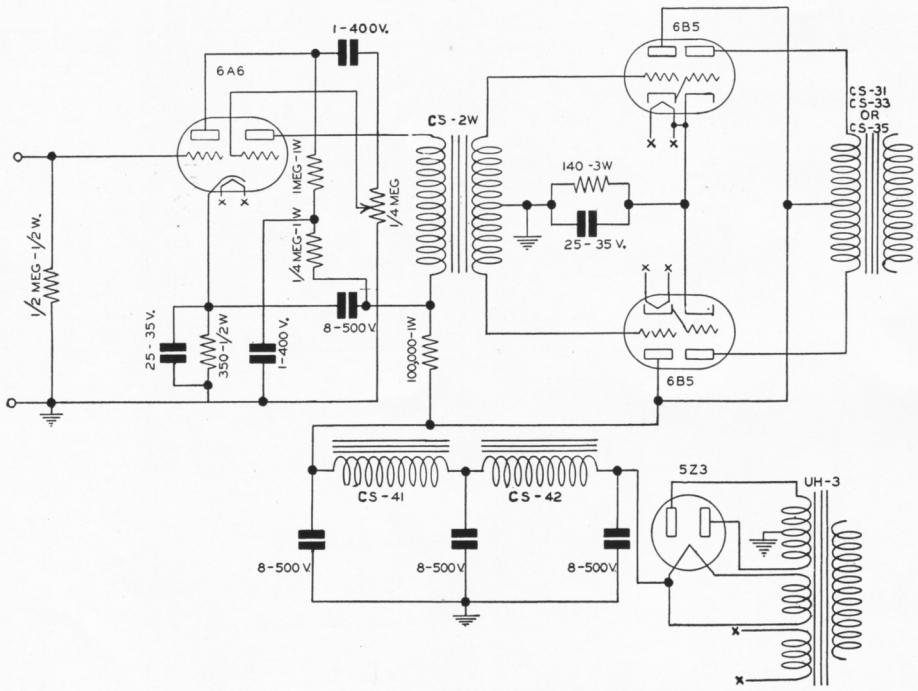


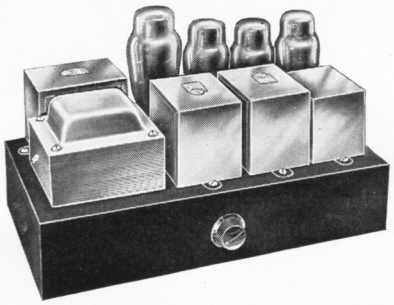
Overall dimensions, 16⅝ x 8½ x 7¼

CAK-4 AMPLIFIER KIT

This kit is unusually popular because of its high power output and its simplicity of construction. The circuit consists of a high impedance input, a 57 tube transformer coupled to push pull 56 tubes driving four type 2A3 or 45 tubes in A prime. A separate bias rectifier is provided to permit maximum power from the output stage with low distortion. A peak power of 40 watts and normal power of 30 watts is available. Harmonic distortion up to 10 watts is under 3%, up to 30 watts under 7%. The overall gain is more than 80 DB. The CS-452 output transformer has secondary impedances of 500, 15, 8, 4 and 2 ohms. The list price of complete kit including all accessories, ... **$ 44.50**

If type CS-455 modulator output transformer having secondary impedances of 10,000, 7500 or 5000 ohms is desired, use designation CAK-4X.



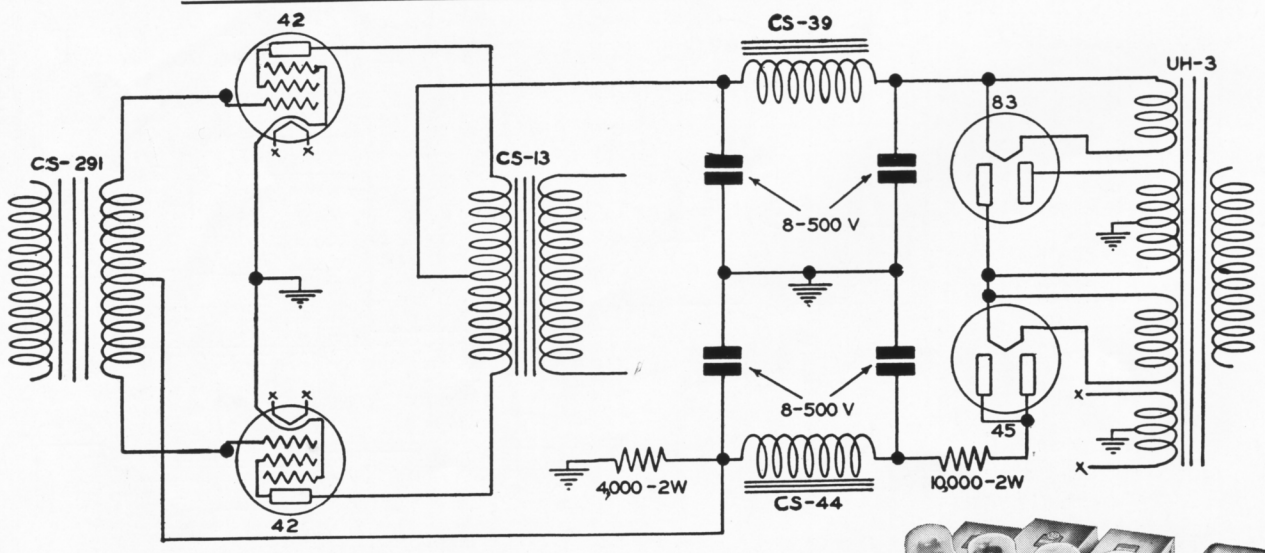


Overall dimensions, 12 x 6½ x 7¼

CAK-5 AMPLIFIER KIT

The CAK-5 kit is unusually popular because of its simple construction involving a minimum number of tubes. The new 6B5 power tubes are used in the output stage providing a peak power output of 22 watts and a normal output of 15 watts. The input to this amplifier is high impedance and is fed into a 6A6 tube cascaded which in turn is transformer coupled to 6B5's. The overall gain is approximately 100 DB. The CS-35 output transformer has secondary impedances of 500, 15, 8, 4 and 2 ohms. The list price of complete kit including accessories, ... **$ 31.25**

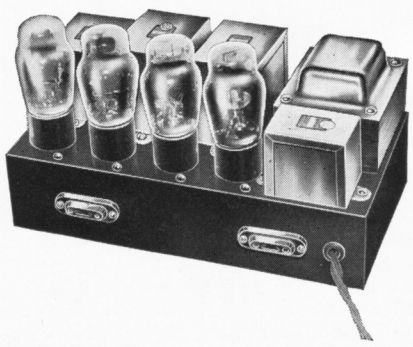
If type CS-33 modulator output transformer having secondary impedance of 5000 and 3500 ohms is desired, use designation CAK-5X.



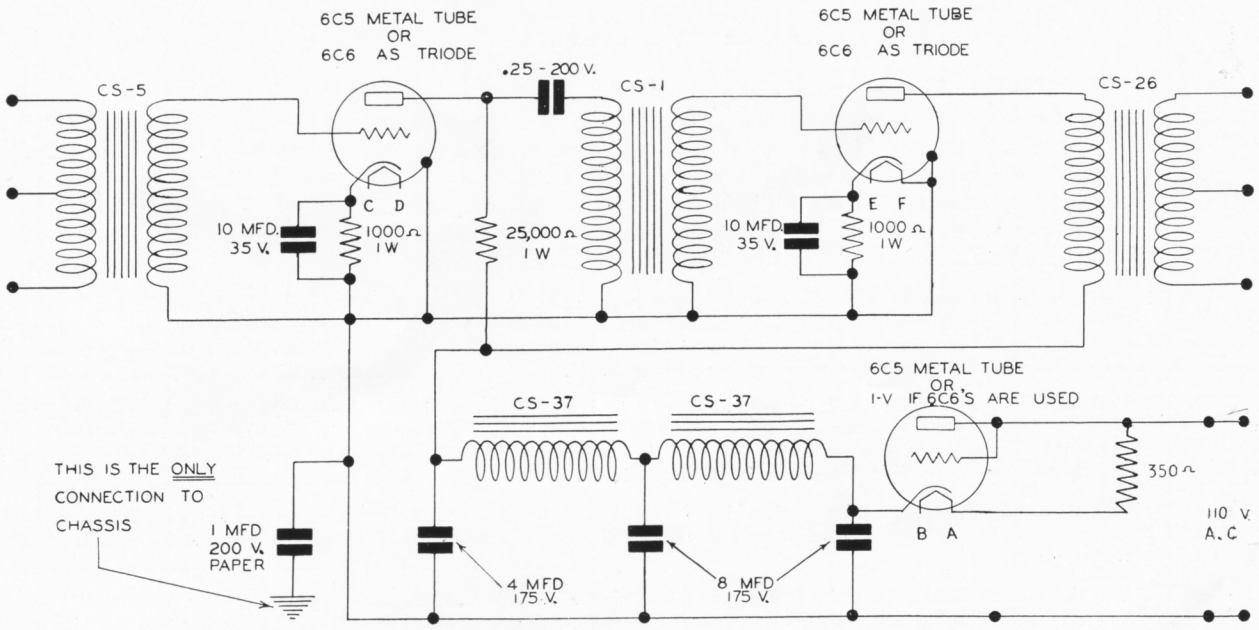
CAK-6 AMPLIFIER KIT

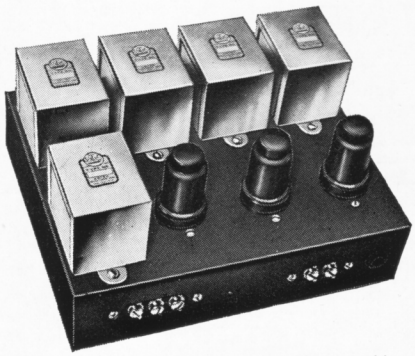
This amplifier is a single stage high power A prime unit designed to convert standard receivers using a single output tube to a high power, high fidelity unit. The input transformer is designed to work directly from any standard output tube in a radio receiver, which if a pentode must be reconnected for triode operation. A separate bias rectifier is provided to effect ideal, fixed bias, A prime operation. The harmonic content is less than 1% up to 5 watts, less than 5% up to 18 watts. The CS-19 output transformer has impedances of 500. 15, 8, 4 and 2 ohms. The list price of complete kit including all accessories, ... **$ 26.00**

If it is desired to use type CS-24 modulator output transformer having 4000 and 2000 ohm secondary impedance, use designation CAK-6X.



Mounting Dimensions, 11 x 5¾ x 7¼

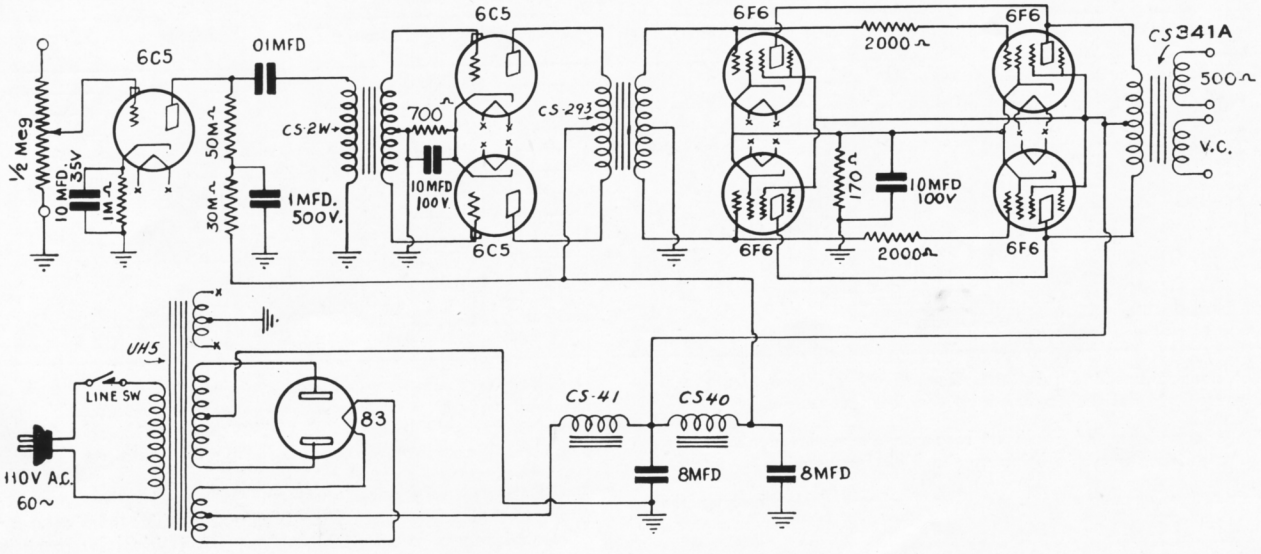


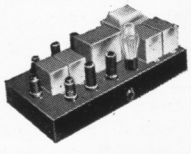


Overall Amplifier Dimensions, 8 3/8 x 7 x 4 1/8

CAK-7 AMPLIFIER KIT

The CAK-7 pre-amplifier kit has been designed to take advantage of the ideal characteristics of the new metal tubes when applied to pre-amplifier service. These tubes have low harmonic content and low hum level. This amplifier will work on any 110 Volts 25 to 60 cycle AC or DC line. Three identical 6C5 tubes are used. One is a rectifier, the other two are used as transformer coupled amplifiers. The overall gain is 55 DB. The input transformer is designed to work from any standard microphone or line. The output transformer is tapped for a 500 or 200 ohm line. The list price of complete kit including all accessories, ... **$ 22.00**



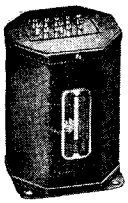


Overall dimensions, 16 5/8 x 8 1/2 x 7 1/4

CAK-8 AMPLIFIER KIT

The CAK-8 super power amplifier kit employs the new metal tubes in all audio stages resulting in reduced tube noise, positive shielding and increased strength and compactness. A gain of 95 DB and a power output of 35 watts is available The output transformer type CS-341A has secondary impedances of 500, 15, 8, 4 and 2 ohms. The list price of complete kit including all accessories, ... **$42.75**

UTC VARITONE



VT-1

The UTC Varitone is a revolutionary audio device which permits full control of the frequency response of any audio amplifier or receiver. Using this device, tone correction can be effected for defects in acoustic conditions or overall audio response. It is also possible to produce new tonal effects from phonograph recordings or radio reception and to bring back notes which would otherwise be lost completely. Due to the high equalization obtainable with the Varitone, some loss in gain is effected. If the amplifier or receiver does not have gain to spare, it may be necessary to add an additional stage of audio frequency amplification. The Varitone is made in five types, as follows:

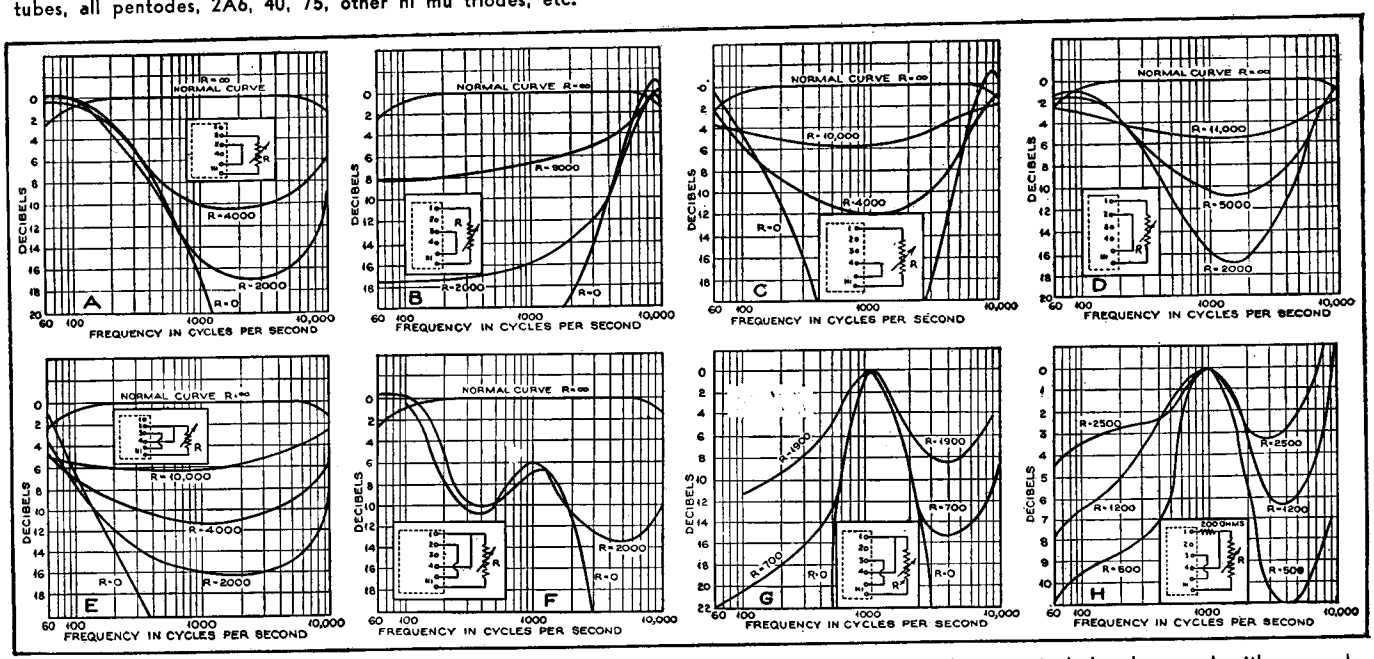
VT-1 This Varitone is incorporated with a universal audio transformer. Two primaries are provided. One is suitable for working from a single or double button microphone a low impedance pickup, or a line; the other primary is designed to work out of the plate of a tube or from a high impedance pickup. The secondary winding is centertapped and is equally suitable for working into one or two grids. The types of response curves possible are shown in curves A to H. List Price $8.50

VT-2 The VT-2 is a varitone control unit, incorporated with an impedance matching device so that it can be connected directly across a 200 or 500 ohm line, or low impedance pickup or mike, or in shunt with the plate circuit of any triode or a high impedance pickup. The circuit is not changed in any other way. The VT-2 is solely an addition for tone correction. The original audio circuits are not disturbed. The response curves possible are shown in curves A to H. List Price $6.00

VT-3 The VT-3 is a complete self-contained unit which does not use external control. The components are adjusted so that 10 db. equalization is effected at 80 and 7000 cycles. This unit is connected directly from plate to B plus of first audio triode. No other alteration is made. List Price $5.00

VT-4 The VT-4 is a complete self contained wired unit including a variable control so arranged that with the control at one end high fidelity performance is effected by the increase of low and high frequencies, and with the control at the other end the high response is reduced to diminish static, line noises, and heterodyne whistles. The unit is connected directly from plate to B plus of first audio triode. This unit is designed to work in the plate circuit of low impedance tubes such as 01A, 12A, 30, 31, 26, 27, 37, 55, 56, 85, 262A, 864, 57 triode, 6C6 triode, 77 triode, etc. List Price $6.00

VT-5 The VT-5 is similar to the VT-4 except that it is designed to work out of high impedance tubes such as all screen grid tubes, all pentodes, 2A6, 40, 75, other hi mu triodes, etc. List Price $6.00



A—The connections and resultant response curve shown above are used where it is desired to bring up the low frequencies.

B—The connections and resultant response curve shown above are used where it is desired to bring up the high frequencies.

C—This system of connections brings up the low and high frequencies simultaneously.

D—This system of connections brings up the low and high frequencies simultaneously. The equalization is appreciably sharper than in C, the slope of the curve being almost linear on both sides. This circuit is recommended only with an amplifier or receiver whose frequency response is unusually bad, such as a cheap midget radio.

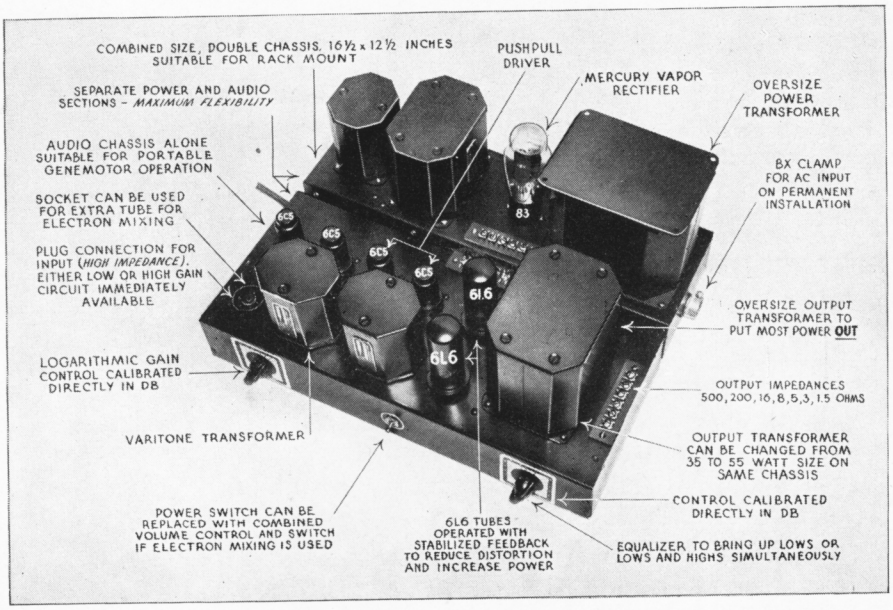
E—This arrangement of connections brings up both highs and lows to a minor extent until almost all resistance is cut out, at which time the low frequencies are brought up sharply.

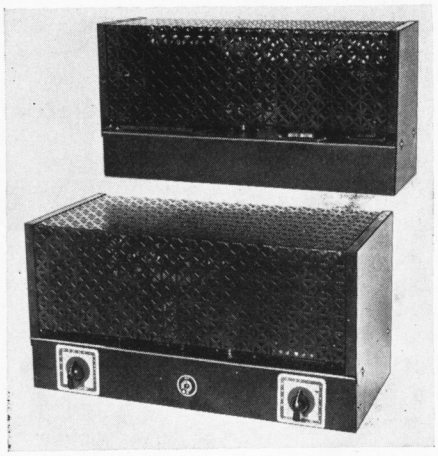
F—Many dynamic speakers, particularly when used with a poorly designed cabinet, have marked resonance at the low and high frequencies, generally in the vicinity of 400 and 4000 cycles. The system of connections above will absorb these resonances, as shown in the response curves.

G—This system of connections is generally used with zero resistance. A sharp single frequency filter is effected which eliminates practically all frequencies but 1000 cycles. This is ideal for reception of C W, as static, heterodyne and other QRM are eliminated, affording greater intelligibility and accuracy. This sharp 1000 cycle circuit is also excellent for use with A C bridges. All harmonics, etc., are completely eliminated.

H—This circuit is ideal for the amateur, or short wave DX fan. The audio frequency range can be reduced to just the essential frequencies for intelligible speech. All extraneous static, whistles, etc., are eliminated. This arrangement of connections is also used frequently where it is desired to demonstrate poor frequency response.

THE UTC BEAM POWER AMPLIFIER





The UTC beam power amplifier kits are designed to take full advantage of the unusual characteristics of the new 6L6 tubes. Some of the unique features of this amplifier are:

HIGH POWER . . . . . 35 watts self bias, 55 watts fixed bias.
HIGH GAIN . . . . . 118 DB with provision for immediate change-over to 95 DB.
SEPARATE CHASSIS for power supply and audio sections permitting maximum flexibility and minimum hum pickup.
STABILIZED FEEDBACK . . . . . effects increase in output power and reduction in overall distortion.
EQUALIZER with calibrated control to bring up the low frequency end or to bring up both low and high frequencies simultaneously.
MOBILE OPERATION can be obtained using the audio chassis alone and genemotor. 20 watts available.
RACK PANEL MOUNTING or rack cabinet mounting permissible. Combined overall dimensions 16½ x 12½ x 8 inches.
ELECTRON MIXING can be added to this kit with very little change.

CIRCUIT DETAILS

The high power sensitivity of the 6L6 lends itself very well to a simple high gain amplifier using a minimum number of tubes. A total of four stages are used in this amplifier to give an overall gain of 118 DB. The circuit consists of a single 6C5 resistance coupled to a second 6C5, Varitone transformer coupled to push pull 6C5's, which in turn drive the 6L6's. The use of a special driver transformer and stabilized feedback in the output transformer permits maximum efficiency to be obtained from the output stage. Under some conditions, it is desirable to couple a high level source into an audio amplifier of this type. For this service, a low gain terminal from the grid of the second tube is brought out. This permits a reduction in hum level and a more uniform operation of the gain control. The input circuit of this amplifier is high impedance, suitable for crystal microphones, etc. Where a low impedance input is desired, a UTC ultra compact unit can be mounted on the chassis. Due to their small size, the ultra compact units have a minimum of hum pickup.

Self bias operation of the 6L6 tubes with the corresponding 35 watt power output will take care of practically all PA, home or low power transmitter applications. If higher power is desired, fixed bias should be used. A bracket is provided under the audio section of this amplifier for mounting a 22½ volt C battery which is used to provide the fixed bias. A larger output transformer must also be used for this service.

For mobile service, the audio section alone is used. A 22½ volt C battery is used for bias in this application also so that the full plate voltage obtainable from a filtered genemotor can be used. A 350 volt 100 ma genemotor will provide 20 watts of output power.

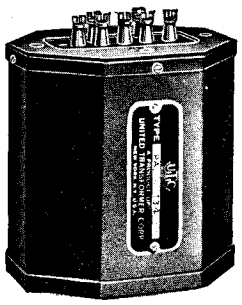
MECHANICAL CHARACTERISTICS

The combined overall dimensions of the two decks with perforated covers is 16½ x 12½ x 8. These dimensions permit this amplifier to be readily mounted on a rack or in a cabinet. In addition, the separate chassis construction permits the units to be mounted individually in a radio set cabinet or in a portable amplifier cabinet with loudspeakers. The terminal strips which connect the power supply and audio amplifier are placed adjacent to each other on the chassis so that there is no possibility of improper connection. The terminal strip for the output of the amplifier is arranged so that the leads can be brought directly out from the strip through the perforated protective cover.

PAK-1 Self bias amplifier kit. 35 watt operation. Output transformer impedances 500, 200, 16, 8, 5, 3, 1.5 ohms. Includes all accessories except tubes. Fully mounted. List price **$75.00**
PAK-1X Same as PAK-1, but with Varimatch modulation output transformer. List price **75.00**
PAK-2 Fixed bias amplifier kit. 55 watts operating condition. Output transformer with impedances of 500, 200, 16, 8, 5, 3, 1.5 ohms. Includes all accessories except tubes. Fully mounted. List price..... **80.00**
PAK-2X Same as PAK-2, but with Varimatch modulation output transformer. List price **80.00**

PUBLIC ADDRESS COMPONENTS

The Public Address series of audio, filter and power units described below are designed to satisfy the demand for a popular priced quality line having the many exclusive and Universal features associated with UTC products. All cases are finished in a black eggshell enamel to suit exacting commercial requirements as to appearance. Each transformer may be fastened to chassis or rack panel with lugs either at top or bottom. The housings are physically symmetrical and similar in construction and when grouped in finished equipment present a thoroughly professional appearance. Transformers PA-134, 135 and 136, are now manufactured in the hum-bucking type of construction. In consequence they have an extremely low hum pickup and are excellent for low level work.



MOUNTING DIMENSIONS
(With Flange)

PA-1	1-15/16 x 2-7/16
PA-2	2-7/16 x 3-7/8
PA-3	3-1/16 x 4-5/16

(Without Flange)

PA-1	1-13/16
PA-2	1-5/8 x 3-1/16
PA-3	1-13/16 x 3-7/8

OVERALL DIMENSIONS

	L	W	H
PA-1	2 1/2	3	3
PA-2	3-1/6	4 1/2	3 1/2
PA-3	3 5/8	4 7/8	4 1/4

INPUT TRANSFORMERS, CLASS A

PA-131 Transformer from 1 plate to 1 grid. 3:1 ratio. PA-1 ..... **$4.50**
PA-132 From 1 plate to 2 grids. 2:1 ratio each side. Split sec. PA-1 ..... **5.00**
PA-133 From 2 plates to 2 grids. 1.75 ratio each side. Primary and secondary each in two sections. PA-1 ..... **6.00**
PA-233 From two 56, 6C6 triode, 6C5, or similar tubes to push pull 45's, 2A3's or 6L6's self or fixed bias. PA-1 **6.00**
PA-134 500, 200, or 50 ohm line to single grid. PA-1 ..... **6.50**
PA-135 500, 200, or 50 ohm line to push pull grids. PA-1 ..... **7.50**
PA-136 Single plate or pickup and carbon mike or low impedance pickup to one or two grids. PA-1 ..... **7.50**

MIXING, MATCHING TRANSFORMERS

PA-137 Mixing 500, 200, or 50 ohm line to 500, 200 or 50 ohm line. PA-1 ..... **$5.50**
PA-138 Audio line matching. Will handle 20 watts audio power. Input 500 or 200 ohm line, Output 16, 8, 5, 3 and 1.5 ohms. PA-2 ..... **7.50**
PA-139 Audio line matching. Will handle 30 watts audio power. Input 500 or 200 ohm line. Output 16, 8, 5, 3, 1.5 ohms. PA-3 ..... **12.50**

CLASS A OUTPUT TRANSFORMERS

PA-140 From a triode plate like 864, 27, 112A, 55, 30 to 500, 200 or 50 ohms. **$6.50**
PA-141 From push pull triode plates like 864's, 27's, 112A's 30's to 500, 200 or 50 ohms. **7.50**

REACTORS

PA-40 Filter choke. 12 henrys. Max. D.C. 200 MA. Resistance 110 ohms. PA-2 ..... **$4.50**
PA-41 Class B input filter choke for 46, 53, and 59 tubes. Max. D.C. 200 MA. Resistance 100 ohms. PA-2 **4.50**
PA-43 Filter choke. 15 henrys. Max. D.C. 165 MA. Resistance 375 ohms. PA-2 ..... **4.50**
PA-44 Filter choke. 30 henrys. Max. D.C. 100 MA. Resistance 375 ohms. PA-2 ..... **4.00**
PA-45 Parallel feed audio choke, 250 henrys. Max. D.C. 15MA. Resistance 4500 ohms. PA-1 ..... **4.50**
PA-46 Center tapped audio choke for P.P. 245, 59, 2A3 and 250 tubes. Over all inductance 50 henrys. Max. D.C. 125 MA. Resistance 725 ohms. PA-2 ..... **5.50**
PA-47 Center tapped audio choke for P.P. connection. Overall inductance 300 henrys. Max. D.C. 10 MA. Resistance 4750 ohms. PA-1 ..... **5.50**
PA-48C High inductance filter choke 100 hys, maximum DC 50 MA, resistance 2500 ohms. PA-1 ..... **4.50**

POWER AND FILAMENT TRANSFORMERS

PA-21 Plate transformer for single 45, 47, 59 or class B 79 tubes. Primary 115 V. A.C. 60 cycles. Secondaries: 300-0-300 at 75 MA; 2 1/2 V.C.T. 3 A., 6.3 V.C.T. 2.5 A., 2 1/2 V.C.T. 6 A. PA-3 ..... **$ 8.00**
PA-22 Plate transformer for push pull 45, 59, 47, 2A3 tubes, or class B 53's. Pri. 115 V. A.C. 60 cycles. Secondaries: 400-0-400 at 125 MA; 2 1/2 V.C.T. 5 A., 2 1/2 V.C.T. 10 A., 5 V.C.T. 3 A. PA-3 ..... **10.00**
PA-23 Plate transformer for class B 46 or 59 tubes. Primary 115 V. A. C. 60 cycles. Secondaries: 570-0-570 at 150 MA; 2 1/2 V.C.T. 5 A., 2 1/2 V.C.T. 10 A., 5 V. 3 A. PA-3 ..... **12.00**
PA-24 Plate transformer for push pull 250 tubes and tuner. Primary 115 V. A.C. 60 cycles. Secondaries: 600-0-600 150 MA; 2 1/2 V.C.T. 10 A., 7 1/2 V.C.T. 2.5 A., 7 1/2 tapped at 5 V. 3 A., 5 V.C.T. 3 A. PA-3 **13.50**
PA-425 Plate transformer for parallel push pull 45 A prime tubes. Pri. 115 V. A.C. 60 cycles. Secondaries 400-0-400 at 200 MA; 2 1/2 V.C.T. 6 A.; 2 1/2 V.C.T: 10 A., 5 V.C.T. 3 A., 6.3 V.C.T. 3 A., PA-3 ..... **12.50**
PA-426 Plate transformer for class B 6A6 and A prime 42 tubes. Pri. 115 V.A.C. 60 cycles. Secondaries 400-0-400 at 125MA; 2 1/2 V.C.T. 6 A. 6.3 V.C.T. 4 A. 5 V.C.T. 3 A. PA-3 ..... **10.00**
PA-428 Power transformer for push pull 6L6 tubes self or fixed bias primary 115 V. AC, 60 cycles. Secondaries 450-0-450 at 250 ma; 6.3 VCT-4 A, 2 1/2 VCT-3A; 2 1/2 VCT-3A; 5 VCT-3A. Taps on high voltage winding for bias supply rectifier. PA-4 ..... **14.00**
PA-25 Secondary. 2 1/2 V.C.T. 10 amps. PA-1 ..... **4.50**
PA-26 Secondary. 5 V.C.T. 3 amps. PA-1 ..... **4.50**
PA-27 Secondary. 6.3 V.C.T. 2.5 amps. PA-1 ..... **4.50**
PA-28 Secondary. 7 1/2 V.C.T. 3 amps. PA-1 ..... **4.50**

PA SERIES OF CLASS A AND CLASS B OUTPUT TRANSFORMERS

Type	Primary Impedance	Will Match	Secondary Impedance	Case & Price
PA-15	8000 ohms plate to plate.	Class A, in push pull: 250's, 245's, 43's. Single: 211, 843, 842, 205D, 48.	500, 200, 16, 8, 5, 3, 1.5 ohms.	PA-2 **7.00**
PA-16	5000 ohms plate to plate or 3000 ohms plate to plate.	**For 5000 ohms** In push pull: self bias 2A3's, W.E. 275A's. Single: 59 triode or 71A. **For 3000 ohms** In push pull: Fixed bias 2A3's, single W.E. 52A.	500, 200, 16, 8, 5, 3, 1.5 ohms.	PA-2 **7.00**
PA-17	2500 ohms plate to plate or 1500 ohms plate to plate.	**For 2500 ohms** Four 2A3's in push pull parallel self bias. **For 1500 ohms** Four 2A3's in push pull parallel fixed bias.	500, 200, 16, 8, 5, 3, 1.5 ohms.	PA-3 **10.00**
PA-18	4000 ohms plate to plate.	Four 250's in push pull parallel.	500, 200, 16, 8, 5, 3, 1.5 ohms.	PA-3 **10.00**
PA-19	10,000 ohms plate to plate or 6000 ohms plate to plate.	**For 10000 ohms** **Class A** push pull 59 triodes, 71A's, 6B5's, **single** 210, 41, 268A, 2A3. **Class B** push pull 49's, 53's, 79's, 89's. **For 6000 ohms** **Class A** push pull 52A's, **single** 31, 46, 59 pentode. **Class B** push pull 46's, 59's.	500, 200, 16, 8, 5, 3, 1.5 ohms.	PA-2 **7.00**
PA-710	20,000 ohms plate to plate or 14,000 ohms plate to plate.	**For 20,000 ohms** Push pull 210's. **For 14,000 ohms** Push pull 47's, 2A5's, 42's used as pentodes.	500, 200, 16, 8, 5, 3, 1.5 ohms.	PA-2 **7.00**
PA-245	6000 ohms plate to plate and 3500 ohms plate to plate.	**For 6000 ohms** Class A prime 45's self bias. Class B 46's and 59's. Class A WE 252 A's. **For 3500 ohms** Class A prime 45's fixed bias.	500, 200, 16, 8, 5, 3, 1.5 ohms	PA-2 **7.00**
PA-445	3000 ohms plate to plate and 1750 ohms plate to plate.	**For 3000 ohms** Four 45's in push pull parallel A prime self bias. Four WE 252A's in push pull parallel class A. Four 46's or 59's in push pull parallel class B. **For 1750 ohms** Four 45's in push pull parallel A prime fixed bias.	500, 200, 16, 8, 5, 3, 1.5 ohms	PA-3 **12.50**
PA-2L6	6600 ohms plate to plate.	Push pull 6L6's self bias. 35-40 watts output.	500, 200, 16, 8, 5, 3, 1.5 ohms	PA-3 **10.00**
PA-4L6	3800 and 3300 ohms plate to plate.	**For 3800 ohms.** Two 6L6's fixed bias, 60 watts output. **For 3300 ohms.** Four 6L6's self bias, 60-80 watts output.	500, 200, 16, 8, 5, 3, 1.5 ohms	PA-4 **15.00**

BALANCE COILS

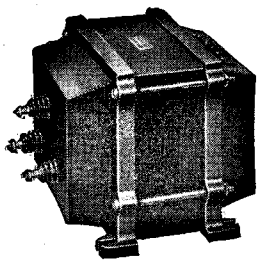
The new UTC development which permits paralleling mercury vapor rectifier tubes with equal current distribution.

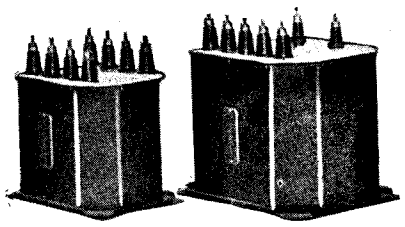
PA-10B Center tapped choke to equalize the load between two 80's, 81's, 82's, 5Z3's, 83's, etc. PA-2 case **$5.00**
PA-11B Center tapped choke to equalize the load between two 866's, 866A's. PA-3 case **10.00**
PA-12B Center tapped choke to equalize the load between two 872's, 872A's. PA-5 case **25.00**

UTC TRANSMITTING COMPONENTS

Mounting Dimensions

PA-1	1-15/16 x 2-7/16
PA-2	2-7/16 x 3-7/8
PA-3	3-1/16 x 4-5/16
PA-4	3-3/4 x 5-7/32
PA-5	4-3/4 x 6-3/8
PA-6	7 x 7





OVERALL DIMENSIONS

	L	W	H
PA-1	2 1/2	3	3
PA-2	3-1/16	4 1/2	3
PA-3	3 5/8	4 7/8	4 1/4
PA-4	6	4 1/2	4 3/4
PA-5	7	5 3/8	5 1/2
PA-6	7 3/4	7 3/4	7 1/2

The transmitting type of UTC Class B audio, filter and power components have been developed for and are now widely used by Commercial Telephone, Telegraph, Communication and Broadcast systems. They are particularly well adapted for use in AMATEUR TRANSMITTER applications.

All audio, filter and power units are fully shielded in symmetrically housed cases and present a thoroughly professional appearance when grouped in finished equipment. PA type cases may be mounted with terminals on top or below the chassis. All units are fully impregnated and then sealed in their cases with a special heat dissipating compound.

INPUT TRANSFORMERS CLASS B, A PRIME

PA-49 Push pull 45, 59 or 6L6 plates to push pull 845A prime grids. PA-2 ..... **$7.50**

PA-50AX Single 53, 56, 6C5, 6C6 triode, 6A6 to Class B 53, 6A6 or 6E6 grids or single 89 to Class B 89 grids. PA-1 ..... **5.50**

PA-51AX Single 46 or 6L6 to Class B 46 or 59 grids.
Single 45, 59, 2A3 or 6L6 to Class B 46 or 59 grids
Single 49 to Class B 49 grids.
Single 37, 76, 6C6 or 6C5 triode to Class B 19 or 79 grids.
Single 30 to Class B 19 or 79 grids.
Single 89 to Class B 19 or 79 grids.
Single 2A5, 42, 45 triode plate to A prime 45's 2A5's or 42's, PA-1 ..... **5.50**

PA-52AX Push pull, 45, 59, 2A3 or 6L6 plates to 2-46 Class B grids.
Push pull 45, 59, 2A3 or 6L6 plates to 4-46 or 59 Class B grids.
Push pull 2A3's to 2-841 Class B grids. PA-2 ..... **6.50**

PA-53AX Push pull 42, 45, 50, 59, 2A3 or 6L6 plates to two 210, 801, RK-18, 35T or 800 Class B grids.
Push pull 2A3 plates to two 838, 203A, 50T, 35T, 211A, 242A, 830B, 800, RK-18, 801 or 210 Class B grids. PA-2 ..... **7.50**

PA-59AX 500, 200 or 50 ohm line to two 805, 838, 203A, 830B, 800, RK-18, 801 or 210 Class B grids **7.50**

PA-238AX Push pull parallel 2A3, 45, 50, 59 or 6L6 to four 805, 838, or 203A Class B grids.
Push pull parallel 2A3, 45, 50, 59, 6L6 or two 211A, 845 plates to Class B 204A, HF-300 or 849 grids.
Push pull parallel 2A3, 45, 50 or two 50T, 211A, 845 plates to Class B 150T or HF-200 Class B grids. PA-3 ..... **17.50**

PA-512 500, 200 or 50 ohm line to two 150T, HF-300, HF-200, 204A or 849 Class B grids. PA-3 ..... **20.00**

FILAMENT TRANSFORMERS

Types PA-34 to PA-127 tapped at 105-115, 220, 230 Volts A.C., 50/60 cycles

PA-34 2 1/2 V.C.T. 10 amps for 2-866's—5000 V. insulation—PA2 ..... **$7.50**

PA-120 2 1/2 V.C.T. 10 amps for 2-866's—10,000 V. insulation—PA-3 ..... **9.00**

PA-121 5 V.C.T. 20 amps for 2-872's—10,000 V. insulation—PA-3 ..... **14.00**

PA-122 7 1/2 V.C.T. at 6.5 amps for 2-800's, RK-18's, 825's, 210's. 5000 Volt insulation—PA-3 ..... **11.00**

PA-123 2-7 1/2 V.C.T. 6.5 amp windings for 800's, RK-18's, 825's, 210's—5000 V. insulation—PA-3 ..... **14.50**

PA-124 10 V.C.T. 7 amps for 2-203 A's, 242 A's, 211's, 845's, 852's, 860's, 217 C's. 10,000 V. insulation—PA-3 ..... **12.00**

PA-126 2-14 V.C.T. 12.5 amp windings tapped at 11 or 10 volts. 5000 V. insulation—for 04 A's, 49's, HF-200's, HF-300's or F100 A's—PA-4 ..... **20.00**

PA-127 2 1/2 V.C.T. at 10 amps 10,000 volt insulation, 2-10 V.C.T. 3.5 amp windings. 5000 V. insulation—PA-3 ..... **15.00**

PA-128 5 V.C.T. 12 amps for 3-35T's, 2-50T's or 1-150 T. 7000 V. insulation. PA-3 ..... **10.00**

PA-129 7 1/2 V.C.T. 23 amps for 2-300T's or other 7 1/2 volt tubes. PA-3 ..... **12.50**

PA-29 Secondaries. 2 1/2 V.C.T. 5 A., 2 1/2 V.C.T. 5 A., 5 V.C.T. 3 A. PA-2 ..... **6.25**

PA-30 Secondaries. 2 1/2 V.C.T. 5 A., 7 1/2 V.C.T. 2.5 A., 7 1/2 V.C.T. 2.5 A. PA-2 ..... **6.75**

PA-31 Secondaries. 2 1/2 V.C.T. 5 A., 5 V.C.T. 3 A., 7 1/2 V.C.T. 2 1/2 A. PA-2 ..... **6.75**

PA-32 Secondaries. 5 V.C.T. 3 A., 5 V.C.T. 3 A., 5 V.C.T. 3 A. PA-2 ..... **6.75**

PA-33 Secondaries. 5 V.C.T. 3 A., 7 1/2 V.C.T. 2 1/2 A., 7 1/2 V.C.T. 2 1/2 A. PA-2 ..... **6.75**

NOTE: Types PA-29, 30, 31, 32, 33 are insulated for 2000 volts. Primaries designed only for 115 volts A.C., 50/60 cycles.

Universal Modulation Chokes and Varimatch Transformers

Several factors must be remembered in coupling the modulator and final stages in a transmitter employing high level modulation. These may be enumerated as:

1. The audio output should be approximately 50% of the Class C input of the RF stage.
2. The actual audio output available for modulation is equal to the audio output of the modulator tubes minus the losses in the coupling unit.
3. The impedance ratio of any two windings on the same core is equal to the square of the turns ratio.
4. The primary impedance of a transformer depends upon the secondary load.

While the first factor mentioned above is commonly known and applied, the second factor is one which is frequently overlooked. A highly efficient coupling device involves considerable design and care. Some contemporary transformers recently tested in the UTC audio labs have shown as much as 3 DB loss. While this seems to be an insignificant amount in terms of DB, it actually means a transfer efficiency of 50%. In other words, if 100 watts were available from the modulator tubes, only 50 watts would be delivered as actual power to the Class C stage. Naturally, 100% modulation could not be obtained. To reduce these losses, UTC transformer core materials are operated at conservative flux densities, the resistance of the windings is kept at a small value as compared to the matched impedance, and low leakage reactance is effected by proper interleaving of windings.

Where a common power supply is used for the Class B and Class C stages, an additional increase in efficiency can sometimes be obtained through the use of a tapped modulation choke in place of a double winding transformer.

Analyzing factors 3 and 4 mentioned above, it is seen that the turns ratio of a transformer definitely limits its application. This is an important factor in modulator work as the number of combinations of modulator tubes and operating conditions available, and Class C combinations possible, is almost unlimited. Standard transformers as made in the past will generally take care of only one combination of modulator and final stage, and since only a limited number of these transformers have been available, the amateur frequently found it necessary to use a transformer which was "the nearest thing" to the actual transformer required for the particular application. While a 20% mismatch caused by such an occurrence does not represent a serious loss in actual power, it does reduce the undistorted power available from a Class B modulator because optimum plate load is not reflected to the tubes. To overcome this difficulty, UTC has brought out two types of units which have universal characteristics. The UTC Varimatch transformer is a new development which through a combination of tapped windings permits an extremely wide range in impedance matching combinations. The combinations available are indicated on pages 32 and 33.

In many cases the specified plate to plate load impedance for the modulator tubes does not coincide with the values listed in the left hand column of the impedance chart. If such is the case, select the value nearest the specified plate to plate impedance for the tubes to be used in the modulator; then the available secondary load impedances are calculated by multiplying the values listed under secondary impedances by the ratio of the plate to plate impedance of the modulator to the value selected from the left hand column, that is

$$R_L = \frac{\text{P to P load impedance of modulator tubes}}{\text{primary impedance in left hand column}}$$ multiplied by secondary impedance listed in right hand columns.

FOR EXAMPLE: The modulator is to use 2 838's operating at 1250V. The plate to plate load impedances of the 838's under these conditions is 11200 ohms. The power output is 260 watts. With this AF output the DC input to the Class C stage should be 520 watts. If the Class C plate voltage is 2500V the plate current will be 208 MA; giving an RF load impedance of 12000 ohms.

Choose primary taps to give 12000 ohms plate to plate and secondary taps to give 12500 ohms.
Substituting in the formula

$$\text{Secondary } R_L = \frac{11200}{12000} \times 12500 = 11700 \text{ (secondary impedance)}$$

The difference between the required 12000 RF load impedance and the calculated available load impedance of 11,700, gives a match within 2½%.

Some typical modulator operating conditions and impedances for use with these Varimatch units are noted on the following page.

As previously stated, where a common plate supply is used, a tapped modulation choke will have slightly higher efficiency than a double winding transformer. The UTC universal chokes have been designed for this service. Below are noted some of the available impedance combinations possible with these chokes.

Secondary Impedances for Single Modulator Plate Loads of

B	P	Sec.	Impedance Ratios	750 Ohms	1,250 Ohms	2,000 Ohms	2,500 Ohms	3,000 Ohms	3,500 Ohms	4,500 Ohms	5,000 Ohms	6,000 Ohms	10,000 Ohms
2	3	1	.11	....	....	....	....	...	....	....	....	....	1,100
4	2	6	.16	....	....	....	....	....	....	....	....	960	1,600
4	8	3	.25	....	....	....	....	....	875	1,578	1,750	2,100	2,500
3	2	4	.45	....	....	900	1,124	1,350	1,575	2,022	2,250	2,700	4,500
3	6	2	.56	....	....	1,120	1,400	1,680	1,960	2,520	2,800	3,360	5,600
4	2	8	.64	....	800	1,280	1,600	1,920	2,240	2,880	3,200	3,840	6,400
8	10	6	1	....	1,250	2,000	2,500	3,000	3,500	4,500	5,000	6,000	10,000
4	8	2	1.56	1,170	1,950	3,120	3,900	4,680	5,460	7,025	7,800	9,360	15,600
3	2	6	1.78	1,335	2,225	3,560	4,450	5,350	6,230	8,100	8,900	10,680	17,800
2	4	6	1.96	1,470	2,450	3,920	4,900	5,875	6,860	8,820	9,700	11,750	19,600
4	8	1	2.25	1,690	2,815	4,500	5,625	6,750	7,875	10 130	11,250	13,500	....
2	3	4	2.8	2,100	3,500	5,600	7,000	8,400	9,800	12,600	14,000	16,800	....
6	10	2	3.06	2,293	3,830	6,130	7,650	9,180	10,700	13,770	15,300	18,370	....
2	4	8	3.24	2,430	4,050	6,480	8,100	9,720	11,340	14,590	16,200	19,450	....
3	1	10	4.00	3,000	5,000	8,000	10,000	12,000	14,000	18,000	20,000	....	....
2	4	10	4.84	3,627	6,050	9,690	12,100	14,500	16,950	....	....	....	....
6	10	1	5.08	3,810	6,360	10,160	12,700	15,250	17,800	....	....	....	....
2	3	6	5.43	4,075	6,800	10,860	13,590	16,300	19,000	....	....	....	....
4	6	2	6.25	4,690	7,820	12,500	15,630	18,750	....	....	....	....	....
3	2	10	7.1	5,320	8,870	14,200	17,750	....	....	....	....	....	....
10	6	2	7.59	5,690	9,500	15,200	19,000	....	....	....	....	....	....
4	6	1	9	6,750	11,250	18,000	....	....	....	....	....	....	....
2	3	10	13.43	10,100	16,800	....	....	....	....	....	....	....	....
6	8	2	15.4	11,550	19,250	....	....	....	....	....	....	....	....
10	8	3	16	12,000	20,000	....	....	....	....	....	....	....	....

EXAMPLE—A Class C tube, with 1300 volts on the plate, draws a current of 130 mills. Its Class C load is therefore $\frac{1,300}{.130}$, or 10,000 ohms. The modulator tube with 1300 volts on the plate has a plate LOAD of 6,000 ohms.

Referring to the chart, select that value which is closest to 10,000 and which appears in the column headed by 6,000 ohms. This is 10,680. The terminal connections to be used will then be found in the first three columns at the left end of the line in which the 10,680 appears. These are:

Terminal	P	B	Sec.
Tap..No.	2	3	6

One common power supply must be used for the modulator and the Class C amplifier.

Secondary Impedances for Plate to Plate Loads of

P	B	P	Sec.	Impedance Ratios	1,750 Ohms	3,000 Ohms	3,500 Ohms	5,000 Ohms	6,000 Ohms	7,000 Ohms	8,000 Ohms	10,000 Ohms
6	3	1	6	.25	....	....	....	....	1,500	1,750	2,000	2,500
6	3	1	7	.39	....	1,180	1,360	2,000	2,350	2,750	3,120	3,900
5	3	2	1	.44	....	1,320	1,550	2,200	2,650	3,100	3,500	4,400
6	3	1	8	.56	....	1,700	1,950	2,800	3,500	3,900	4,500	5,600
5	3	2	7	.695	....	2,100	2,450	3,500	4,200	4,900	5,500	6,950
6	3	1	9	.76	1,350	2,300	2,650	3,800	4,550	5,300	6,100	7,600
6	3	1	10	1	1,750	3,000	3,500	5,000	6,000	7,000	8,000	10,000
5	3	2	9	1.35	2,350	4,050	4,720	6,750	8,100	9,500	10,800	13,500
6	4	3	2	1.55	2,700	4,650	5,400	7,700	9,300	11,000	12,400	15,500
5	3	2	10	1.8	3,150	5,400	6,300	9,000	10,800	12,600	14,500	18,000
6	4	3	10	2.25	3,950	6,800	8,000	11,200	13,500	16,000	18,000	22,500
8	6	4	2	3.06	5,350	9,200	10,700	15,000	18,036	....	....	....
8	6	4	1	4	7,000	12,000	14,000	20,000	....	....	....	....
10	8	6	1	6.25	11,000	19,000	...	....	....	....	....	....
18	8	6	1	6.25	11,000	19,000	....	....	....	....	....	....

EXAMPLE—A Class C tube, with 1,300 volts on the plate, draws a current of 235 mills. Its Class C load is therefore $\frac{1,300}{.235}$, or 5,500 ohms. The modulator tubes have a plate-to-plate load of 10,000 ohms.

Referring to the chart, select that value which is closest to 5,500 and which appears in the column headed by 10,000 ohms. This is 5600. The terminal connections to be used will then be found in the first four columns at the left end of the line in which the 5,600 appears. These are:

Terminal	P	B	P	Sec.
Tap. No.	6	3	1	8

One common power supply must be used for the modulator and class C amplifier.

A detailed application sheet is supplied with each Varimatch and HUC Universal Choke showing the methods of application and connections. These units, in addition to the advantage of universal application, have another great advantage in the fact that they never become obsolete. New tubes and new circuits are continuously coming up, but due to the wide application of these units, they can always be used for practically any condition as long as it is within their power rating.

VM-1

Modulator Tubes	Modulator Plate To Plate Load Impedance	Plate Volts	Bias Volts	AF Power Output	Class C DC Watts Input
2A3's AB	3000 ohms	300 V.	— 62 V.	15 W.	30 W.
2-45's AB	3200 ohms	275 V.	— 68 V.	12 W.	24 W.
1602's, 210's	8000 ohms	425 V.	— 50 V.	25 W.	50 W.
53 or 6A6	10000 ohms	300 V.	0	10 W.	20 W.
2-53's or 6A6's	5000 ohms	300 V.	0	20 W.	40 W.
46's	6000 ohms	450 V.	0	25 W.	50 W.
2-6L6's Class AB_1	6600 ohms	400 V.	— 23 V.	30 W.	60 W.

VM-2

Modulator Tubes	Modulator Plate To Plate Load Impedance	Plate Volts	Bias Volts	AF Power Output	Class C DC Watts Input
2 53's or 6A6's	5000 ohms	300 V.	0	20 W.	40 W.
2-46's	6000 ohms	450 V.	0	25 W.	50 W.
4-46's	3000 ohms	450 V.	0	50 W.	100 W.
2-6L6's Class AB_1	6600 ohms	400 V.	— 23 V.	30 W.	60 W.
1602's or 210's	8000 ohms	425 V.	— 50 V.	25 W.	50 W.
801's	10000 ohms	600 V.	— 75 V.	45 W.	90 W.
2-6L6's AB_2	3800 ohms	400 V.	— 25 V.	60 W.	120 W.

VM-3

Modulator Tubes	Modulator Plate To Plate Load Impedance	Plate Volts	Bias Volts	AF Power Output	Class C DC Watts Input
4-46's	3000 ohms	450 V.	— 20 V.	50 W.	100 W.
2-6L6's AB_2	3800 ohms	400 V.	— 25 V.	60 W.	120 W.
RK 30's or 800's	12500 ohms	1000 V.	— 55 V.	100 W.	200 W.
	6400 ohms	750 V.	— 40 V.	90 W.	180 W.
35 T's	10000 ohms	1000 V.	— 25 V.	125 W.	250 W.
	6600 ohms	750 V.	— 35 V.	90 W.	180 W.
RK 18's	10000 ohms	750 V.	— 40 V.	65 W.	130 W.
	12000 ohms	1000 V.	— 50 V.	100 W.	200 W.
RK 31's	13600 ohms	1000 V.	0	110 W.	220 W.
845's AB	4600 ohms	1000 V.	—175 V.	75 W.	150 W.
	8800 ohms	1250 V.	—225 V.	105 W.	210 W.

VM-4

Modulator Tubes	Modulator Plate To Plate Load Impedance	Plate Volts	Bias Volts	AF Power Output	Class C DC Watts Input
RK 30's or 800's	12500 ohms	1000 V.	— 55 V.	100 W.	200 W.
35 T's	10000 ohms	1000 V.	— 35 V.	115 W.	230 W.
	12800 ohms	1250 V.	— 45 V.	130 W.	260 W.
	16000 ohms	1500 V.	— 60 V.	140 W.	280 W.
RK 31's	13600 ohms	1000 V.	0	110 W.	220 W.
	17000 ohms	1250 V.	0	140 W.	280 W.
203 H's, 203A's or 211's	6900 ohms	1000 V.	— 35 V.	200 W.	400 W.
	9000 ohms	1250 V.	— 45 V.	260 W.	520 W.
838's	7600 ohms	1000 V.	0	200 W.	400 W.
	11200 ohms	1250 V.	— 16 V.	260 W.	520 W.
830 B's	6000 ohms	800 V.	— 27 V.	135 W.	270 W.
	7600 ohms	1000 V.	— 35 V.	175 W.	350 W.
805's	6700 ohms	1250 V.	0	300 W.	600 W.
50 T's	20000 ohms	2000 V.	—180 V.	250 W.	500 W.
	15000 ohms	1500 V.	—135 V.	175 W.	350 W.
	10000 ohms	1250 V.	—125 V.	135 W.	270 W.
HK 354's	10000 ohms	1500 V.	—125 V.	280 W.	560 W.

VM-5

Modulator Tubes	Modulator Plate To Plate Load Impedance	Plate Volts	Bias Volts	AF Power Output	Class C DC Watts Input
203 H's, 203A's or 211's	9000 ohms	1250 V.	— 45 V.	260 W.	520 W.
838's	11200 ohms	1250 V.	— 16 V.	260 W.	520 W.
805's	6700 ohms	1250 V.	0	300 W.	600 W.
	8200 ohms	1500 V.	— 16 V.	370 W.	740 W.
203H	10000 ohms	1750 V.	— 65 V.	370 W.	740 W.
	15000 ohms	2000 V.	— 75 V.	450 W.	900 W.
204A or HF 300	7800 ohms	1500 V.	— 40 V.	400 W.	800 W.
	8200 ohms	1750 V.	— 50 V.	500 W.	1 KW.
	8800 ohms	2000 V.	— 60 V.	600 W.	1200 W.
	13120 ohms	2500 V.	— 85 V.	650 W.	1300 W.
150 T's	5000 ohms	1250 V.	—100 V.	260 W.	520 W.
	8000 ohms	1500 V.	—125 V.	350 W.	700 W.
	10400 ohms	2000 V.	—175 V.	500 W.	1 KW.
	14000 ohms	2500 V.	—225 V.	650 W.	1300 W.
50 T's	20000 ohms	2000 V.	—175 V.	250 W.	500 W.
4-203A's	4500 ohms	1250 V.	— 45 V.	500 W.	1 KW.
4-838's	5600 ohms	1250 V.	— 16 V.	500 W.	1 KW.
4-805's	3350 ohms	1250 V.	0	600 W.	1200 W.
HK 354's	15000 ohms	2000 V.	—175 V.	370 W.	740 W.
	17500 ohms	2500 V.	—225 V.	460 W.	920 W.

Type HUC Universal Modulation Chokes

HUC-20 Will handle 20 watts audio power. It can be used with Class B 46's, 59's, 53, 6A6, 79 etc.; or class A 2A3's, 250's, 210's, Class A prime 42's, 45's etc. PA-2 ..... **$7.00**

HUC-50 Will handle 50 watts audio power. Suitable for use with class B 210's, 801's, 830's, 841's, push pull parallel 46's, 59's, 6A6's, push pull parallel 45's A prime, push pull parallel 250's, 2A3's etc. PA-3 ..... **12.50**

HUC-100 Will handle 100 watts audio power. Suitable for use with class B 800's, 211E's, A prime 845's, 284A's, etc. PA-4 ..... **20.00**

HUC-200 Will handle 200 watts audio power. Suitable for use with class B203's, 830B's HK354's, single Eimac 150T, push pull parallel A prime 845's, 284A's push pull parallel 800's etc. PA-5 ..... **32.50**

HUC-500 Will handle 500 watts audio power. Suitable for class B204's, A prime 849's, Eimac 150T's, push pull 212D's in A prime, etc. UTS Case **80.00**

VARIMATCH MODULATION TRANSFORMERS

The UTC Varimatch transformer is a new type of modulation transformer so designed that a very wide range of impedance matching combinations is obtainable (See chart). In addition to taking care of practically every modulator problem, the value of these units cannot be overemphasized from the angle of universal applications when tube types or operating conditions are changed. Secondaries are designed to carry class C plate current.

The Varimatch Transformer Never Becomes Obsolete

Pri. Ohms P to P	SECONDARY RF LOAD IMPEDANCES AVAILABLE											‡AUDIO LOAD IMPEDANCE	
2000	1070	1950	2150	3620	3920	4300	6350	6550	7900	8600	11400	200	350
3000	1620	2950	3240	5500	5900	6500	9400	10000	11800	13000	17000	300	520
4000	1380	1850	2160	2850	3450	4300	5500	7300	8650	12500	17400	250	400
5000	1730	2300	2700	3500	4300	5400	7000	9150	10800	15700	21600	300	500
6000	1070	2140	2180	2750	3620	4250	4300	5150	6350	8300	8600	200	370
7000	1250	2400	2500	3200	4280	5000	5050	6000	7300	9700	10000	230	430
8000	1440	2760	2900	3700	4900	5650	5800	6900	8400	10000	12000	270	500
9000	1620	2050	3100	3240	3900	4150	6200	6500	7750	9400	12500	300	550
10000	1800	2300	3500	4300	4600	6100	6900	7100	8600	10500	14000	330	600
12000	2070	2150	2750	4250	4320	5150	7250	8300	8700	12500	17400	370	400
14000	2440	3200	4900	6000	9700							430	
16000	2780	3700	5600	6900	11000							500	
18000	3140	4150	6300	7750	12500							550	
500*	1070	1950	2150	3620	3920	4300	6350	6550	7900	8600	11400		

* In some cases it is desired to match an RF load to the 500 Ohm output of a PA amplifier. The terminal arrangement noted will take care of this application.

‡ These impedances are suitable for PA applications. If a monitor speaker is desired, proper distribution of power is obtained by operating this low impedance into the high impedance primary of the speaker transformer.

Intermediate P.P. primary impedance values available in addition to those shown.

VM-1 Will handle any power tubes to modulate a 20 to 60 watt Class C input stage..... **$ 8.00**

VM-2 Will handle any power tubes to modulate a 40 to 120 watt Class C input stage..... **12.50**

VM-3 Will handle any power tubes to modulate a 100 to 250 watt Class C input stage..... **20.00**

VM-4 Will handle any power tubes to modulate a 200 to 600 watt Class C input stage..... **32.50**

VM-5 Will handle any power tubes to modulate a 450 watt to 1 KW plus, Class C input stage..... **70.00**

CLASS B OUTPUT TRANSFORMERS FOR R.F. SERVICE

PA-801 Primary tapped 10,000 ohms or 8,000 ohms for 801's, 210's, 1602's, RK-18's. Secondary 7500, 6250, 4500, 3250 ohms. PA-3 ..... **$12.50**

PA-800 Primary 12,500 ohms for 800's, RK-18's, 35T's, Secondary 10,000, 7500, 5000, 3500 ohms. PA-4..... **18.00**

PA-830 Primary 7600 ohms for 838's or 830B's with plate voltage of 1000 V. Secondary 10,000, 2500 ohms. PA-5 ..... **22.50**

PA-838 Primary tapped 11,200 ohms or 9000 ohms for 838's, 203A's, 242A's, 211's, 845's A.B. Impedance based on 1250 V. Plate Voltage. Secondary 10,000, 2,500 ohms. PA-5. ..... **25.00**

PA-805 Primary 8200 ohms for 204A's or HF-300's with 1750 V. plate voltage or 805's with plate voltage 1500 V. Secondary 6250, 4000, 3000. PA-6..... **50.00**

PA-850 Primary 11,000 ohms for 150 T's or HF-200's operating with 2000 V. plate voltage. Secondary 9000 6000, 4500 ohms. PA-6 ..... **50.00**

PA-438 Primary tapped 5600 ohms or 4500 ohms for push pull parallel tubes with 1250 V. plate voltage. 838's, 203A's, 242A's, 211A's, 845's AB., Secondary 6000, 4000, 3000 ohms. PA-6 ..... **50.00**

OUTPUT TRANSFORMERS FOR SEPARATE PLATE AND SCREEN MODULATION OF PENTODES

These new modulation transformers are designed for maximum efficiency with the new RF pentodes. Separate secondary windings are provided thus allowing full audio output and obviating the wasteful losses of a screen dropping resistor.

PA-503 Class B 6A6 or 53 plates to a single RK-23 or 25 for separate plate and screen modulation. PA-2..... **$7.00**

PA-504 Class B 801's or 210's to a single 804 or RK-20 for separate plate and screen modulation. PA-3..... **12.50**

PA-505 Class B 800's or 35T's to a single 803 or RK-28 for separate plate and screen modulation. PA-4..... **18.00**

UTC TRANSMITTING POWER SUPPLY COMPONENTS

PLATE TRANSFORMERS

Primary 105, 115, 220, 230 volts A.C. 50/60 cycles

PA-110	515 or 625 each side of center at 200 MA 400 VDC or 500 VDC. PA-3	**$10.00**
PA-111	750 or 900 each side of center at 250 MA 600 VDC or 730 VDC. PA-4	**18.00**
PA-112	1250 or 1400 each side of center at 400 MA 1050 VDC or 1190 VDC. PA-6	**35.00**
PA-113	1600 or 2000 each side of center at 400 MA 1370 VDC or 1720 VDC. PA-6	**57.50**
PA-114	2500 or 3000 each side of center at 500 MA 2160 VDC or 2620 VDC. UTS case	**76.00**
PA-154	3500, 4000 each side of center at 500 MA 3050 VDC or 3500 VDC. UTS case	**100.00**
PA-115	C bias plate transformer for class B 203A's, 830B's, 800's, or 210's using one or two 82 rectifiers. PA-3	**10.00**
PA-116	1250 or 1400 each side of center at 200 MA 1050 VDC or 1190 VDC. PA-5	**25.00**
PA-117	3500 or 3000 each side of center at 1 ampere. 2620 VDC or 3050 VDC. UTS case	**115.00**

NOTE: Operating the above transformers on 115 volt line the DC output voltage can be reduced to half of normal value, for reduced power operation, by switching to the 220 volt tap.

CLASS B INPUT SWINGING CHOKES*

Type	Swinging Action	Current Range	Maximum DC Oper. Voltage	Ohmic Resistance	List Price	Case
PA-101	5 to 25 henrys.	15 to 150 MA	450	115	**$5.00**	PA-2
PA-103	5 to 25 henrys.	20 to 200 MA	600	110	**8.00**	PA-3
PA-105	6 to 30 henrys	25 to 250 MA	1300	90	**12.00**	PA-4
PA-107	20 to 100 henrys	25 MA to 250 MA	2600	240	**20.00**	PA-5
PA-109	5 to 25 henrys	75 to 500 MA	1300	60	**20.00**	PA-5
PA-IC	5 to 25 henrys	100 to 1000 MA	4000	50	**35.00**	UTS

TRAP RESONANT SMOOTHING CHOKES*

Smoothing Chokes have an off center tap for hum bucking arrangements.

Type	Inductance	DC Output	Ohmic Resistance	List Price	Case
PA-100	8 henrys	150 MA	115	$5.00	PA-2
PA-102	10 henrys	200 MA	110	8.00	PA-3
PA-104	12 henrys	250 MA	90	12.00	PA-4
PA-106	35 henrys	250 MA	240	20.00	PA-5
PA-108	10 henrys	500 MA	60	20.00	PA-5
PA-IS	10 henrys	1000 MA	50	35.00	UTS

* Test voltage is twice maximum peak voltage plus 1000 volts.

MODULATION CHOKES

Type	Inductance	D.C. Output	Ohmic Resistance	List Price	Case
150	30 Henrys	125 MA	550	12.50	PA-3
151	30 Henrys	200 MA	425	20.00	PA-5
152	30 Henrys	400 MA	300	32.50	PA-5

UTC CONTROLLED CARRIER COMPONENTS

The **UTC Variactor** controlled carrier modulation system:

- Increases blanket DX coverage many times.
- Almost doubles Class C tube ratings and will double to quadruple Class B linear tube ratings.
- Allows power consumption saving of 50% or over.
- Reduces interference between stations tremendously.
- Increases Fidelity.

UTC bulletin 11CC gives full details on this new system of transmission.

The Essential Variactor Unit Required for Controlled Carrier Modulation Is Now Available in Six Types to Take Care of Transmitters From 25 to 800 Watts Input.

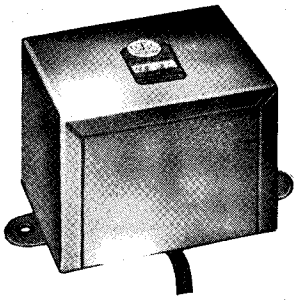
CV VARIACTORS FOR CONTROLLED CARRIER CLASS C

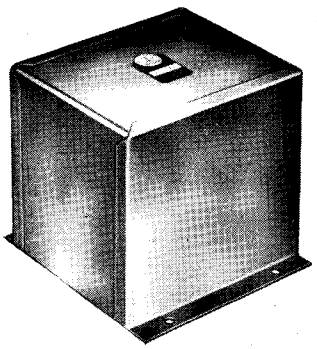
		List Price
CV-1	25 to 50 watts maximum input controlled class C	$ 7.50
CV-2	50 to 100 watts maximum input controlled class C	10.00
CV-3	100 to 170 watts maximum input controlled class C	15.00
CV-4	170 to 300 watts maximum input controlled class C	20.00
CV-5	300 to 500 watts maximum input controlled class C	25.00
CV-6	500 to 800 watts maximum input controlled class C	33.00

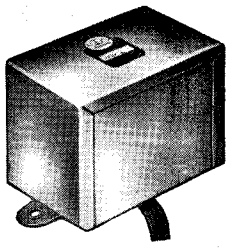
AV AUTOTRANSFORMERS FOR CV VARIACTORS—115/170 VOLTS AC

	List
AV-1 for use with CV-1	$ 5.00
AV-2 for use with CV-2	6.00
AV-3 for use with CV-3	7.00
AV-4 for use with CV-4	9.00
AV-5 for use with CV-5	12.00
AV-6 for use with CV-6	15.00

UTC CHROMSHIELD Audio Filter and Power Components







OVERALL DIMENSIONS

L	W	H
3	1 1/2	1-11/16
3 3/8	1 3/4	2-1/16
3 3/4	2	2 1/4
4 1/8	2 1/8	2 3/4
5	2 3/4	3 3/8
6	3 3/4	4 1/4
4 3/4	4 5/8	4 1/2

Mounting Dimensions

C-1 2-7/16
C-2 2-7/8
C-3 3-1/4
C-4 3-5/8
C-5 1-15/16 x 4-1/2
C-6 1 1/2 x 5 3/4
C-7 3-7/16 x 4-3/16

CLASS A INPUT TRANSFORMERS

CS-1	1 plate to 1 grid. 3 1/2:1 ratio: C-2 mtg.	$2.35
CS-2	1 plate to 2 grids, split secondary. 2:1 ratio. C-2 mtg.	2.50
CS-3	Push pull plates to push pull grids. 1.8:1 ratio. C-3 mtg.	2.75
CS-4	Low or high impedance pickup to grid. Pri. 500, 1000, 2000, 4000 ohms. C-2 mtg.	3.00
CS-5	Single or double button mike to 1 grid. C-2 mtg.	2.50
CS-6	Single or double button mike to 2 grids. C-2 mtg.	3.00
CS-7	Ribbon velocity mike to grid. C-2 mtg.	3.50
CS-10	Single plate and carbon mike to one or two grids. C-2 mtg.	3.50
CS-1P	Single power detector plate to single grid. 3:1 ratio. C-4 mtg.	3.50
CS-2P	Single power detector plate to push pull grids. 1 1/2:1 ratio. C-4 mtg.	3.75
CS-2W	Single plate to push pull grids. Wide range response, 1:1 ratio. C-3 mtg.	3.50

MATCHING TRANSFORMERS

CS-8	Ribbon velocity mike to 500 or 200 ohms. C-2 mtg.	3.50
CS-9	Mixing carbon mike, 500 or 200 ohm line to 500 or 200 ohm line. C-3 mtg.	3.50
CS-26	Single 26, 56, 27, 55, 77, 6C5 triode or 864 plate to 500 or 200 ohms. C-2 mtg.	3.00
CS-27	Push pull 26, 56, 27, 55, 77, 6C5 triodes or 864 plates to 500 or 200 ohms. C-3 mtg.	3.50
CS-28	Line to speaker audio matching transformer. Input 4000 ohms and 500 ohms. Output 15, 8, 4, and 2 ohms. Will handle up to 15 watts. C-4 mtg.	4.50
CS-282	Line to speaker audio matching transformer. Input 2000, 500 or 200 ohms; output 15, 8, 4, 2 ohms. Will handle 30 watts. C-5 mtg.	7.00

A PRIME AND CLASS B INPUT TRANSFORMERS

CS-29	Driver plate to 53, 6A6, 49, 79 or 89 grids C-4 mtg.	$2.75
CS-30	Driver 46 or 59 plate to 46 or 59 grids. C-4 mtg.	2.75
CS-291	Single 2A3, 45, 42, 2A5, 6F6, 6D5 triode plate to push pull A prime 2A3, 45, 42, 2A5, 6F6, 6D5 grids. C-3 mtg.	3.75
CS-292	Push pull 53 or 6A6 triode plates to two or four class B 53 or 6A6 grids. C-3 mtg.	3.25
CS-293	Push pull triode 56, 37, 57, 77, 6C6, 6C5 plates to two or four A prime 45, 2A3, 42, 2A5, 6F6, 6D5 6L6 grids. C-3 mtg.	3.50
CS-294	Push pull 2A3 or 45 plates to two class B 210 or 801 grids. C-4 mtg.	5.00
CS-295	Push pull 2A3 or 59 plates to four 46 or 59 class B grids. C-4 mtg.	5.00

OUTPUT TO VOICE COIL

CS-11	Single 250, 245, 59, 6F6 triode, 71A to 15, 8, 4, or 2 ohm voice coil. C-3 mtg.	$2.50
CS-12	Single 18, 20, 33, 41, 42, 47, 2A5, 59, or 6F6 metal pentode, and 89 or 6D5 triode plate to 15, 8, 4, or 2 ohm voice coil. C-3 mtg.	2.50
CS-13	Push pull 250, 245, 59, 6F6 triode or 71A plates to 15, 8, 4, or 2 ohm voice coil. C-4 mtg.	3.00
CS-14	Push pull 18, 20, 33, 41, 42, 47, 2A5, 59, 6F6 metal pentode, 89, or 6D5 triode plates, to 15, 8, 4, or 2 ohm voice coil. C-4 mtg.	3.00
CS-15	Push pull 2A3 or 6D5 plates to 15, 8, 4, or 2 ohm voice coil. C-4 mtg.	3.00
CS-16	Push pull 48 plates to 15, 8, 4, or 2 ohm voice coil. C-4 mtg.	3.00
CS-31	Push pull 6B5, 6A6, 53, 49, 79, 89 plates or 6F6 metal pentodes or triodes self bias to 15, 8, 4, or 2 ohms. C-4 mtg.	3.25
CS-32	Push pull 46, 59, 6F6 triode fixed bias plates to 15, 8, 4, or 2 ohms. C-4 mtg.	3.25

OUTPUT TO LINE AND VOICE COIL

CS-17	Single 250, 245, 59, 6F6 triode, 71A to 500, 15, 8, 4, or 2 ohms. C-3 mtg.	3.00
CS-18	Single 18, 20, 41, 47, 2A5, 59, 6F6 pentode, or 89 6D5 triode plate to 500, 15, 8, 4, or 2 ohms. C-3 mtg.	3.00
CS-19	Push pull 250, 245, 59, 6F6 triode or 71A plates to 500, 15, 8, 4, or 2 ohms. C-4 mtg.	3.50
CS-20	Push pull 18, 20, 33, 41, 42, 2A5, 59, 6F6 pentode, 89 triode plates to 500, 15, 8, 4, or 2 ohms. C-4 mtg.	3.50
CS-21	Push pull 2A3, 6D5 plates to 500, 15, 8, 4, or 2 ohms. C-4 mtg.	3.50
CS-35	Push pull 6A6, 6B5, 53, 49, 79, 89 plates or 6F6 metal pentodes or triodes self bias to 500, 15, 8, 4, or 2 ohms. C-4 mtg.	3.75
CS-36	Push pull 46, 59, 6F6 triode fixed bias plates to 500, 15, 8, 4, or 2ohms. C-4 mtg.	3.75
CS-341A	Push pull parallel class B 53, 6A6, 6B5, 6F6 metal pentodes or triodes self bias to 500, 15, 8, 4, 2 ohms. C-5 mtg.	7.50
CS-452	Push pull parallel 2A3 or 45 A prime plates to 500, 15, 8, 4, 2 ohms. C-5 mtg.	7.50
CS-456	Push pull self bias 6L6's AB to 500, 15, 8, 4, 2, ohms. C-5 mtg.	7.50
CS-457	Push pull fixed bias or four self biased 6L6's, AB to 500, 15, 8, 4, 2 ohms.	10.00

OUTPUT TO RF LOADS

CS-22	Single 250, 245, 59, 6F6 triode, 71A to 4000 or 2000 ohms. C-4 mtg.	2.75
CS-23	Single 18, 20, 33, 41, 42, 2A5, 59, 6F6 pentode or 89 triode plate to 4000 or 2000 ohms. C-3 mtg.	2.75
CS-24	Push pull 250, 245, 59, 6F6 triode, 71A to 4000 or 2000 ohms. C-4 mtg.	3.25
CS-25	Push pull 18, 20, 33, 41, 42, 47, 2A5, 59, 6F6 pentode or 89 triode plates to 4000 or 2000 ohms. C-4 mtg.	3.25
CS-33	Push pull 6A6, 6B5, 53, 49, 79, 89 plates or 6F6 metal pentodes or triodes self bias to 5000 or 3500 ohms. C-4 mtg.	3.50
CS-34	Push pull 46, 59, 6F6 triode fixed bias plates to 5000 or 3500 ohms. C-4 mtg.	3.50
CS-453	Push pull 2A3 or 45 A prime plates to 5000, 7500, 10000 ohms. C-5 mtg.	5.00
CS-454	Class B 210 plates to 5000, 7500, 10,000 ohms. C-6 mtg.	8.50
CS-455	Push pull parallel 2A3 or 45 A prime plates to 5000, 7500, 10,000 ohms. C-5 mtg.	7.50

Humidity proof Chromshield Transceiver audio transformers. All Chromshield transceiver units fit in the C1 case.

CS-101	Interstage audio 4:1 ratio	$1.95
CS-102	Single plate to 2 grids, 2½:1 ratio	2.00
CS-103	Single or double button mike to 1 grid.	2.00
CS-104	Single plate and carbon mike to 1 grid.	2.25
CS-105	Velocity mike to 500 or 200 ohms	2.25
CS-106	Single 56, 6C6, 6C5, 864 plate to 500 or 200 ohms	2.25
CS-107	Driver plate to 19, 49, 79, 89 grids	2.25
CS-108	Class B 19, 49, 79, 89 plates to 5000 or 3500 ohms.	2.75

FILTER AND AUDIO CHOKES, FILAMENT TRANSFORMERS

CS-37	Filter choke. 25 henrys 30 MA; resistance 900 ohms. C-2 mtg.	$2.00
CS-38	Filter choke. 15 henrys 60 MA; resistance 240 ohms. C-2 mtg.	2.00
CS-39	Filter choke. 20 henrys 90 MA; resistance 400 ohms. C-4 mtg.	2.50
CS-40	Filter choke. 30 henrys 75 MA; resistance 350 ohms. C-4 mtg.	3.00
CS-41	Filter choke. 10 henrys 150 MA; 95 ohms. C-4 mtg.	3.00
CS-42	Class B input choke. Max. D.C. 175 MA. C-4 mtg.	3.00
CS-43	Center tapped audio for push pull triode plates. Resistance 12,000 ohms. C-3 mtg.	3.50
CS-44	Detector plate shunt choke. Max. D.C. 3 MA. C-2 mtg.	2.25
CS-45	Pri. 115 A.C. Sec. 2½ V.C.T. 6 A. C-2 mtg.	1.75
CS-46	Pri. 115 A.C. Sec. 6.3 V.C.T. 3 A. C-2 mtg.	2.25
CS-47	Pri. 115 A.C. Sec. 2½ V.C.T. 12A. C-3 mtg.	2.25
CS-48	Pri. 115 A.C. Sec. 5 V. 4 A. C-3 mtg.	2.25
CS-49	Pri. 115 A.C. Sec. 7½ V.C.T. 3A. C-3 mtg.	2.25
CS-50	Plate Transformer for small power tubes, Class A and B. Pri. 115 V.A.C. 60 cycles. Secondaries: 300-0-300 at 75 MA; 5 V.C.T. 3 A., 6.3 V.C.T. 2½ A., 2½ V.C.T. 6 A. C-7 mtg.	7.00
CS-51	Plate transformer for push pull power tubes Class A and B. Pri. 115 V.A.C. 60 cycles. Secondaries: 400-0-400 at 125 MA; 2½ V.C.T. 5 A., 2½ V.C.T. 10 A., 5 V.C.T. 3 A. C-7 mtg.	9.00
CS-52	Plate transformer for push pull 6 volt power tubes class A and B. Pri. 115 V.A.C. 50/60 cycles. Secondaries: 400-0-400 at 125 MA; 6.3 V.C.T. 5A. 2½ V.C.T. 6A. 5 V.C.T. 3A. C-7 mtg.	8.50
UH-3	For eight to ten tube sets. Overall dimensions 3¾ x 3⅛. Mounting dimensions 3⅛ x 2½. Secondaries: 750 V.C.T. 100 MA, 6.3 V.C.T. 4 amps, 2½ V.C.T. 4 amps, 5 volts 3 amps.	5.00
UM-7	For receivers and power amplifiers using 2A3, 46, or 6L6 power tubes. Overall dimensions 4⅝ x 3¾ Mounting dimensions 3¾ x 3. Secondaries: 850 V.C.T. 175 MA, 5 volts 3 amps. 2½ V.C.T. 5 amps, 2½ V.C.T. 14 amps.	7.50
UM-8	For high power receivers and amplifiers using class B 46 and 59 power tubes. Overall dimensions 4⅝ x 3¾. Mounting dimensions 3¾ x 3. Secondaries: 1100 V.C.T. 175 MA, 5 volts 3 amps, 2½ V.C.T. 5 amps, 2½ V.C.T. 10 amps.	8.75

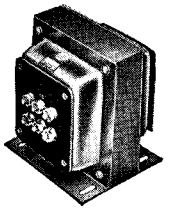
CHROMSHIELD POWER SUPPLY COMPONENTS

UTC CHROMSHIELD transmitting line . . . outstanding in performance . . . smartly professional in appearance . . . all units are fully enclosed in cases having a symmetrical appearance when grouped in finished equipment.

PLATE TRANSFORMERS, PRIMARY 115 VOLTS A.C. 50/60 CYCLES

CS-200	450 each side of center at 150 MA; 5V-3A; 2½ V-10A. CV mtg.	$ 6.50
CS-201	500 each side of center at 200 MA; 2½ V.C.T. 14 A; 5 V.C.T. 3 A; CD mtg.	8.00
CS-202	600 each side of center at 200 MA; 2½V-10A; 7½ V-3A; 5V-3A. CD mtg.	10.00
CS-203	800 each side of center at 150 MA; 660 V. P.S. CD mtg.	7.50
CS-204	800 each side of center at 250 MA; 650 V. DC. CD. mtg	11.00
CS-205	750 or 900 each side of center at 350 MA; 590 V. DC. or 725 V. DC. CPA mtg.	17.00
CS-206	1250 or 1400 each side of center at 500 MA; 1035 V. DC. or 1170 V. DC. CPA mtg.	32.00
CS-207	1600 or 2000 each side of center at 400 MA; 1370 V. DC. or 1730 V. DC. CPA mtg.	43.50
CS-208	2500 or 3000 each side of center at 500 MA; 2135 V. DC. or 2585 V. DC. UTS mtg.	65.00
CS-209	1250 or 1400 each side of center at 200 MA; 1050 V. DC. or 1185 V. DC. CPA mtg.	20.00
CS-210	2300 each side of center at 250 MA; 2000 V. DC. CPA mtg.	35.00

Note: Using a bridge type rectifier DC. voltages indicated above are doubled but permissable current drain is reduced one-third.



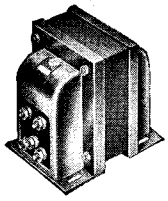
CD mtg.

SMOOTHING CHOKES

CS-301	12 Henry, 200 MA; D.C. resistance 140 ohms. CV mtg.	$5.00
CS-302	12 Henry, 300 MA; D.C. resistance 105 ohms. CD mtg.	7.50
CS-303	12 Henry, 500 MA; D.C. resistance 70 ohms. CD mtg.	13.00

INPUT SWINGING CHOKES

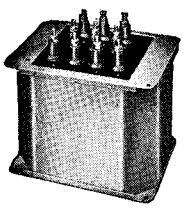
CS-304	5/25 Henry, 200 MA; D.C. resistance 140 ohms. CV mtg.	$5.00
CS-305	5/25 Henry, 300 MA; D.C. resistance 105 ohms. CD mtg.	7.50
CS-306	5/25 Henry, 500 MA; D.C. resistance 70 ohms. CD mtg.	13.00



CV mtg.

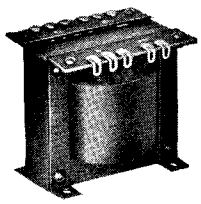
FILAMENT TRANSFORMERS, PRIMARY 115 VOLTS A.C. 50/60 CYCLES

CS-401	2½ V.C.T. 20 A; 5 V.C.T. 3 A; 7½ V.C.T. 6½ A. 2500 V. insulation CD mtg.	$8.50
CS-402	10 V.C.T. 6½ A; 10 V.C.T. 6½ A; 7½ V.C.T. 2½ A; 2½ V.C.T. 5 A; 2500 V. insulation. CD mtg.	11.50
CS-403	11 V.C.T. tapped at 12 and 14 volts at 10 A. 5000 V. insulation. CD mtg.	8.50
CS-404	2½ V.C.T. 12 A; 5000 V. insulation; 10 V.C.T. 6½ A. CD mtg.	8.00
CS-405	5 V.C.T. 20 A; 7000 V. insulation. CD mtg.	7.50
CS-406	5 V.C.T. 20 A; 10,000 V. insulation. CD mtg.	10.00
CS-407	2½ V.C.T. 12 A; 7000 V. insulation. CV mtg.	4.50
CS-408	7½ V.C.T. 6½ A; 5000 V. insulation. CV mtg.	4.50
CS-409	10 V.C.T. 6½ A; 5000 V. insulation. CV mtg.	5.00
CS-410	5 V.C.T. 3 A; 5 V.C.T. 3 A; 5 V.C.T. 6 A; 5000 V. insulation. CV mtg.	5.00
CS-411	2½ V.C.T. 6 A; 2½ V.C.T. 6 A; 2½ V.C.T. 12 A; 10,000 V. insulation. CD mtg.	10.00
CS-412	6.3 V.C.T. 5 A; 5 V.C.T. 8A. CV mtg.	5.00
CS-413	5 V.C.T. 12 Amps. for 3-35 T's, 2-50 T's or 1-150 T. CV mtg.	5.00
CS-414	7½ V.C.T. 20 Amps. for 2-300 T's. CD mtg.	8.50
CS-130	Chromshield Exciter lamp transformer primary tapped for 105, 115, 125 volts, 50-60 cycles, Secondary 8½ and 10 volts at from 4 to 8 amps	5.00



CPA mtg

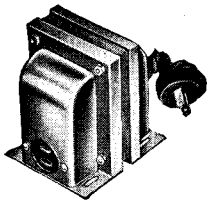
LM-1	2½ V.C.T. 20 A; 2500 V. insulation. OT mtg.	3.00
LM-2	7½ V.C.T. 6.5 A; 2500 V. insulation. OT mtg.	3.50
LM-3	10 V.C.T. 6½ A; 2500 V. insulation. OT mtg.	4.00
LM-4	6.3 V.C.T. 5 A; 5 V.C.T. 6 A; 2500 V. insulation. OT mtg.	4.00
LM-5	2½ V.C.T. 12 A; 5000 V. insulation. OT mtg.	3.50
LM-6	5 V.C.T. 3 A; 5 V.C.T. 3 A; 5 V.C.T. 6 A; 2500 V. insulation. OT mtg.	4.00
LM-7	Three 7½ V.C.T. 2½ Amp. windings; 2500 V. insulation. OT mtg.	4.00
LM-8	2½ V.C.T. 5 A; 2½ V.C.T. 5 A; 5 V.C.T. 3 A; 2500 V. insulation. OT mtg.	3.50
LM-9	2½ V.C.T. 5 A; 5 V.C.T. 3 A; 7½ V.C.T. 3 A; 2500 V. insulation. OT mtg.	4.00
LM-10	2½ V.C.T. 5 A; 7½ V.C.T. 3 A; 7½ V.C.T. 3 A; 2500 V. insulation. OT mtg.	4.00
LM-11	5 V.C.T. 3 A; 7½ V.C.T. 3 A; 7½ V.C.T. 3 A; 2500 V. insulation. OT mtg.	4.00
LM-12	2½ V.C.T. 5 A; 5 V.C.T. 3 A; 6.3 V.C.T. 3 A; 2500 V. insulation. OT mtg.	4.00



OT mtg.

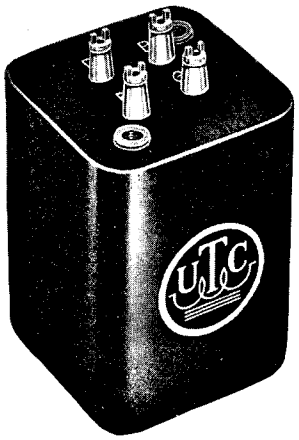
CHROMSHIELD STEP DOWN TRANSFORMERS 220-240 TO 110-120 VOLTS, 50/60 CYCLES

CS-120	85 Watt capacity	$ 4.50
CS-121	125 Watt capacity	5.50
CS-122	175 Watt capacity	6.50
CS-123	250 Watt capacity	7.50



ULTRA COMPACT HIGH FIDELITY audio units for portable preamplifiers in remote pickup, aircraft and noise meter applications.

The **UTC ULTRA COMPACT** audio units, designed as companion units for acorn and small metal type amplifier tubes, measure up to high quality broadcast standards. These units are the smallest wide range audios in their class and their development was made possible through the use of the most permeable of the new UTC core materials HIPERM ALLOY No. 4.



Actual Size

Technical data on the ULTRA COMPACT audio units:

Frequency response + or — 2 db from 30 cycles to 20,000 cycles.
Weight: approximately 5 1/2 ounces.

Size:

Overall dimensions
height 1-15/16" (including clearance for lugs 2 1/4")
width 1-7/16".
depth 1-7/16".

Mounting dimensions

1-1/8 between centers across the base and top diagonals. The use of tapped metallic inserts permits mounting with lugs either on top or bottom and eliminates waste chassis space normally taken by mounting flanges.

Shielding: The **UTC ULTRA COMPACT** series of audio units employ a true hum balancing coil structure which combined with a special magnetic structure afford a maximum of inductive shielding. Separate electrostatic shields grounded to the core are brought out to a separate lug on the bakelite terminal strip.

Coil Design: The multiple tap windings used on input to grid, plate to line, mixing, and output transformers, make possible a wide combination of impedance connections without impairing the efficiency or audio range of each unit, thus increasing their versatility of application.

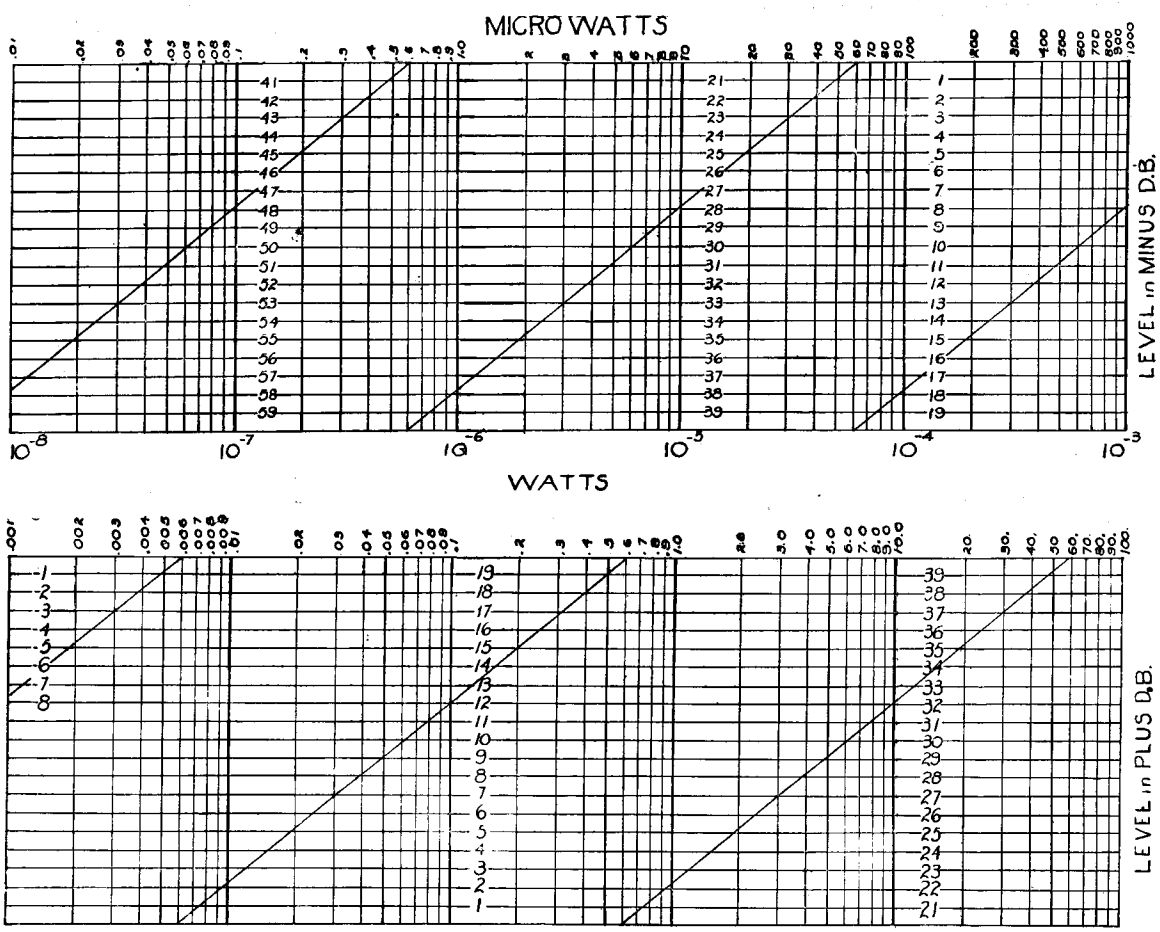
Type	Application	Primary Impedance	Secondary Impedance	List Price
A-10	Multiple line or microphone to single grid	500, 333, 250, 200, 125 or 50 ohms	50,000 ohms	$10.00
A-12	Multiple line or microphone to 2 grids	500, 333, 250, 200, 125 or 50 ohms	80,000 or 20,000 ohms	10.00
A-14	Dynamic microphone to 1 or 2 grids	30 ohms	50,000 or 12,500 ohms	9.00
A-16	Single plate (6C6, 955, 262A etc.) to single grid	15,000 ohms	60,000 ohms	8.00
A-18	Single plate (6C6, 955, 262A etc.) to 2 grids	15,000 ohms	80,000 or 20,000 ohms	9.00
A-20	Multiple line or microphone to multiple line	500, 333, 250, 200, 125 or 50 ohms	500, 333, 250, 200, 125 or 50 ohms	10.00
A-22	Dynamic microphone to Multiple line	30 ohms	500, 333, 250, 200, 125 or 50 ohms	9.00
A-24	Single plate 6C6, 955, 262A etc. to multiple line	15,000 or 3,750 ohms	500, 333, 250, 200, 125 or 50 ohms	10.00
A-26	Push pull plates (6C6, 955, 262A etc.) to multiple line	30,000 or 7,500 ohms	500, 333, 250, 200, 125 or 50 ohms	10.00
A-28	Bridging transformer	4000 ohms	500, 333, 250, 200, 125 or 50 ohms	10.00

AUDIO CHOKE

A-30 Parallel feed choke. May also be used as a push pull audio choke.
300 Henrys @ 2 MA 6000 ohms D.C.
75 Henrys @ 4 MA 1500 ohms D.C.
Inductance with no unbalanced DC 450 Henrys..... **$7.00**

UTC now manufacturers special **ULTRA COMPACT** units to customers' specific requirements. Rapid delivery of special units can be made as required. Consult our engineering staff.

DECIBEL DATA



CONVERSION OF POWER TO DB

To set up a standard of electrical energy comparison, the use of the decibel has been based on a reference level of 0DB at a power level of .006 watts. In other words, energy levels greater than .006 watts are + DB compared to reference level and energy levels less than .006 watts are — DB compared to reference level.

The chart above indicates power level in watts against DB as compared to .006 watts reference level. The DB equivalent of any specific value of audio power can be immediately determined. This chart can also be used for determining DB gain or loss if the two powers are known. The DB equivalent of these powers can immediately be located on the chart. Subtracting these DB equivalents (algebraically) we obtain the gain or loss in DB. For example, let us consider an amplifier which requires 1 volt at 500 ohms input to drive the output to 12 watts. The power input equals $\frac{E^2}{R}$ or $\frac{1}{500} = .002$ watts.

The DB equivalents for input and output powers are then seen to be approximately — 5 DB and + 33 DB respectively. The overall gain is then 33 — (5) or a total of 38 DB.

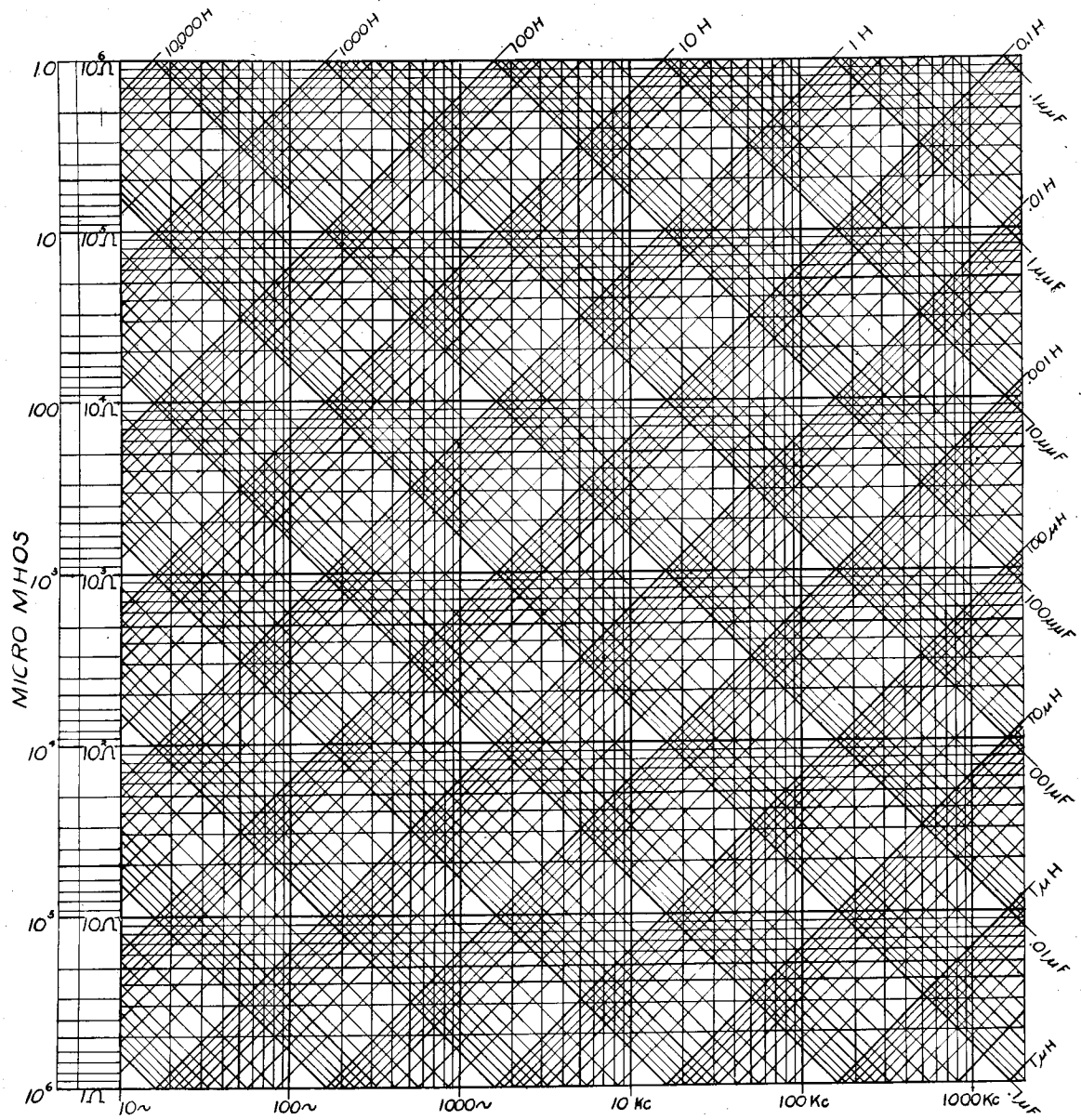
DB vs. RATIO OF POWER, VOLTAGE, OR CURRENT

The table below is intended for the conversion of power or voltage ratios to DB. If voltage ratios are used, it is necessary that the same impedance apply to both voltage measurements. The lesser value of power or voltage should be taken as the numerator of the ratio so that the ratio itself will be less than unity. Whether the DB value obtained is a gain or loss is naturally governed by whether the output power or voltage is greater than the input or less. Current ratios are naturally the same as voltage ratios. If the loss or gain is greater than 20 DB, the following additional step must be taken:

For voltage ratios, move the decimal point one point right for each 20 DB; in other words, if we have a ratio of .00041, move point 3 figures to the right, making .41 and add 60 DB to the DB equivalent of .41 (7.74 DB). This gives us a total of 67.74 DB.

For power ratios, the same method applies, except that the decimal point is moved one figure to the right for each 10 DB.

DB	$\frac{I_2}{I_1}$	$\frac{P_2}{P_1}$	DB	$\frac{I_2}{I_1}$	$\frac{P_2}{P_1}$	DB	$\frac{I_2}{I_1}$	$\frac{P_2}{P_1}$
0	1.00	1.00	2.36	.76	.578	5.35	.54	.292
.18	.98	.96	2.62	.74	.548	5.68	.52	.27
.35	.96	.922	2.85	.72	.518	6.02	.50	.25
.54	.94	.884	3.10	.70	.49	6.94	.45	.203
.72	.92	.846	3.35	.68	.462	7.96	.40	.16
.92	.90	.81	3.61	.66	.435	9.12	.35	.123
1.11	.88	.774	3.88	.64	.41	10.5	.30	.09
1.31	.86	.74	4.15	.62	.384	12.0	.25	.063
1.51	.84	.706	4.44	.60	.36	14.0	.20	.04
1.72	.82	.672	4.73	.58	.336	16.5	.15	.023
1.94	.80	.64	5.04	.56	.314	20.0	.10	.01
2.16	.78	.608						



KC = KILOCYCLES μF = MICROFARADS H = HENRYS

Ω = OHMS μμF = MICROMICROFARADS μH = MICROHENRYS

The construction and use of this chart is as follows:

The sloping lines from lower left to upper right represent inductances and those from lower right to upper left, capacitances. The main divisions are subdivided on a logarithmic scale, each line being an even multiple of the first. For example, the light line immediately following the dark 1 Henry line represents two times 1 Henry; the next line represents 3 Henrys; etc. It should be noted that when interpolating between minor divisions, the same logarithmic gradation should be used as in the major divisions. To obtain the reactance or admittance of a capacitance or inductance, the sloping line should be followed to the point where it intersects with the vertical line corresponding to the frequency at which the value is desired. The horizontal line which corresponds with this intersection when carried to the left gives the value of reactance or admittance. In a similar manner, if reactance and frequency are known, the inductance or capacitance can be determined by a reverse process.

EXAMPLE TO DETERMINE REACTANCES.

To find the reactance of a coil having an inductance of 1 Henry at a frequency of 1000 cycles, we follow the slanting 1 Henry line until it meets the vertical 1000 cycle line. At the point of intersection, a horizontal line to the left edge of the chart indicates a reactance of 6200 ohms. Similarly, the sloping .1 mfd. line can be followed to the point where it intersects with the vertical 1000 cycle line and a horizontal line from the point of intersection to the left side of the chart indicates a reactance of 1600 ohms.

EXAMPLE TO DETERMINE RESONANCE.

To determine the point of resonance, let us consider the values of inductance and capacitance chosen in the previous example. We follow the sloping 1 Henry line to the point where it intersects with the .1 mfd. line. The vertical line through the point of intersection indicates a resonance frequency of 500 cycles.

EXAMPLE OF PARALLEL CIRCUIT CALCULATIONS.

The mho scale is primarily useful in the solution of parallel circuits. Consider an inductance of 1 Henry in parallel with .1 mfd. at 1000 cycles. The admittance of 1 Henry is found by the chart to be 161 micromhos at 1000 cycles, and the admittance of a .1 mfd. condenser 625 micromhos at the same frequency. In adding admittances of inductances in parallel or condensers in parallel, the admittances are simply added without regard to sign. However, the sign of capacitance and inductance are opposite when used in parallel. Therefore, in this example, the total admittance is 161 minus 625, or minus 464 micromhos. Glancing at the left side of the chart, this is found to correspond to 2160 ohms, which is the total reactance of the combination.

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TECHNICAL DATA

UTC COMPONENTS

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