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APRIL 1952
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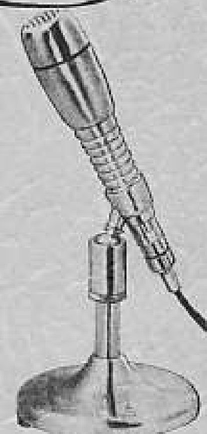

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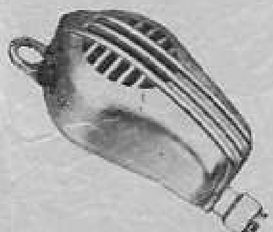

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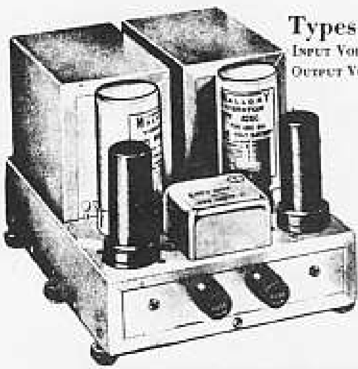

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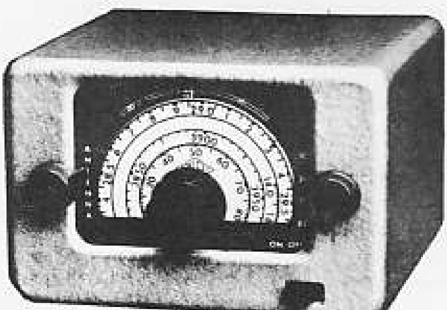

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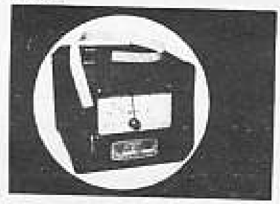

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Editor - Fenwick Job, VE3WO

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APRIL, 1952

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SIDEBANDS

This column for April is being written for amateurs interested in getting into Single Sideband Suppressed Carrier but who have felt the construction of such a rig was a little too difficult without access to a laboratory full of check instruments.

Biggest bugaboo of building a unit like the now famous G.E. SSB Jr. which is one of the best of the various types of Single Sideband generators, was the accurate alignment of the phase shift network, to obtain the suppression possible. Very few hams in this country have had the instruments needed for the job. This now is no longer the case.

You, if you're really sincere, have at your disposal, the complete fzcilities needed, through the courtesy of Ted Pfeiffer of the Erie Resistor Company of Canada. This means that the tough phase shift network problem has been solved for you.

Precision resistors of high stability are a requisite of this rig and for a nominal and more than fair cost, the six resistors will be checked for dead accuracy on a precision bridge at the Erie plant. They will be then shipped out to you, so that you can do the actual construction of the network yourself. The five percent and ten percent capacitors are stocked in the values needed by A and A Radio, Adelaide St. West, Toronto and are worth about 85 cents each. The variable air and mica condensers needed (El Mencos) - used as padders to hit the frequencies, are shown in the latest flyer from Universal Electric on St. Lawrence St., Montreal in close enough values to do the job. The cost is small, and if you haven't this flyer, you can write them for it.

You can order the resistors needed through myself (the set of six in high stability type costs $3.75) and the other parts as shown above direct from the suppliers. You can then construct the network as shown in the G.E. Ham News, leaving off the dotted line connections. When finished, ship it in a carefully protected package either to me, or to Erie, and the unit will be carefully aligned and returned to you for the very nominal charge of $3.50. Total cost for the network thus runs about $11.00 as against the $59.00 tariff for the only commercial job available.

The transformers shown are of a type not made in Canada. There is a source of supply in Detroit for these however, willing to co-operate with us and each unit costs just $1.80 (three needed) plus small duty cost. Write me direct for full information on this jobber - or write to Reno Radio on Broadway Avenue, Detroit Michigan.

If you object to spot frequency operation on the SSB Jr., do as many have, myself included to get around this feature. If you set it up on 5200 kilocycles, with a 9.0 megacycle VFO working into a mixer you can take off either 75 or 20 meter output quite readily. Follow this with a linear driver and a good linear final with an MB-150 Multi-band tank, by National, and you have the ultimate in band hopping with no effort at all. Complete design data on the modified coils for 5200 kc operation will be given to any ham interested enough to write me for it.

In case you were wondering, the SSB Jr. has a number of advantages over the other types of SSSC rigs. One of these is the ease of tuning the signal in on almost any receiver. Another is the fine quality, sideband suppression on the unwanted side. A third is low cost of construction. Xtals for the W4OLL rig can be obtained from Washington SunRadio but are relatively more expensive to use. And when the phase shift is all aligned for you, nothing could be simpler than to do the rest of the alignment of the rig yourself.

Who could ask for more - the equivalent of a kw AM on a 12 by 17 chassis ?????????????

de VE3WO

Let's Look to Linears

By Ray L. Dawley.

With the increasing amount of plate dissipation available per tube dollar, it seems a shame that more phone amateurs do not realize how to make the best use of it in their own transmitters. With this inexpensive plate dissipation available, efficiency modulated amplifiers, i.e. class B linears and grid bias modulated final stages, are capable of giving considerably more antenna watts per dollar than many high-level plate-modulated systems. Especially is this true with the amateur who at present has a medium or low power phone rig and wishes to increase its power output. In such a case, if the old rig operates well, has good quality, good frequency stability, and is capable of operating on all the desired bands, by far the least expensive and most satisfactory procedure is to add a modern linear amplifier.

If, however, the old rig was not so satisfactory as far as the r.f. portion was concerned but the speech amplifier and modulator were satisfactory, grid bias modulation of a couple of fairly high power tubes would be best.

At any rate with plate dissipation available in the medium wattage class at about 10 watts per dollar, it is questionable as to whether one should invest in a high level modulator system with its attendant extra power supplies, modulation transformer, etc., for the power range from 100 to 300 watts in the antenna.

Of course it must be admitted there are arguments against efficiency modulated finals as well as for them. One of these is that they are difficult to adjust. This is not true if the proper tuning procedure is followed. As a matter of fact it is at least as difficult a problem to adjust *properly* a class C amplifier, especially at higher power levels (so that it is strictly linear over its operating range). Another argument is that they draw a lot of useless power from the line only to radiate it as heat. This most certainly is not true. If the additional power drawn by the modulator filaments and plates, the modulator supply rectifiers and bleeder, and the power lost due to the inefficiencies of the additional transformers is considered, the class B linear will almost always be found to be at least as efficient as the plate modulated system. In other words, if the total drain of the entire transmitter from the line is compared as a ratio to the power output in first a transmitter with high level plate modulation and then one with low level or grid modulation, the overall efficiency of the low level modulated job usually will be as good and sometimes better. Consider the case of the broadcasters. How many of them with powers over 100 watts or so use high level plate modulation? An unusually small percentage will be found.

More Advantages

A few other advantages of class B linears will be cited. Despite the low cost per watt of antenna power, efficiency modulated amplifiers have the advantage that they require a much smaller number of small parts. This of course is offset by the fact that a few more expensive large parts are needed. But since in almost every case a better grade of materials will be purchased, their life will be proportionately longer.

Another thing is the fact that the power drain of a rig using either the bias or excitation systems of modulation remains constant under modulation. This eliminates the ducking lights and grunting and groaning power supplies so commonly associated with high level class B modulation. And, to mention one more point that may interest the amateur interested in high quality transmission, it is very much simpler and less expensive to obtain *good* audio quality with low audio-level modulation.

Power Output

The amount of power available from a properly operating linear amplifier is primarily determined by the plate dissipation available in that stage. The secondary consideration is the amount of distortion that can be tolerated. Under ordinary conditions (with reasonable distortion) and assuming an average efficiency of 33% and modulation capability of 100%, the power output of a linear amplifier stage is equal to 50% of the maximum power the tubes are capable of dissipating. This value can be increased, but the distortion goes up rapidly. For example, a pair of "fifty watters" (203-A's, 211's, etc.) with a total plate dissipation of 200 watts would be capable of putting out a carrier of approximately 100 watts under rated operating conditions.

The same tubes when modulated class C would take care of an input of about 350 watts, which would result in a carrier of about 225 watts (assuming 65% fundamental efficiency and rated operating conditions). Thus we have a power ratio of 2.25/1 or a db ratio of 3.5. Since an increase of one R (or S) generally is taken to be a ratio of 6 db, we see that by plate modulating the final instead of running it as a linear we have gained only slightly more than ½ R in signal strength. This increase of course is negligible.

Tubes

The best type of tube for use in a class B linear stage should have the following characteristics: high plate dissipation and a clear bulb to help in getting rid of this heat, low or medium amplification factor, low plate impedance, and high transconductance. The reasons for these requisites are obvious. The plate dissipation should be high because the power output of the stage is dependent primarily upon this factor. The μ should be low so that the cut-off bias will be as high as possible. When this bias is high, the grid voltage excursions can be higher without drawing excessive grid current. For the same reason the plate voltage on the tubes should be as high as they will comfortably stand to reduce the danger of running into the so-called "diode-bend" in the tube's characteristic. This bend occurs when the instantaneous positive grid voltage approaches the minimum plate voltage. The high transconductance enables the tubes to operate on a minimum of excitation and at highest efficiency.

Other considerations in the design of an efficient class B linear or grid modulated final are: proper design of the grid and plate tank circuits, good grid bias supply regulation, proper loading on the modulated stage when using a linear and on the exciting stage when using grid bias modulation, and lastly, proper loading of the plate circuit of the final stage. All these are important and must be given proper consideration.

Tank Condensers

The plate tank capacity must be somewhat larger than that commonly used for plate modulation because the tubes must work into quite a low value of load impedance. The circulating current will not be materially increased by this large tank capacity because there is necessarily such a large amount of external inductance coupled into the circuit. Similarly, the r.f. voltage appearing across the tank is very much less than with plate modulation, even though the plate voltage on the linear may be much higher to begin with. As a matter of fact the voltage rating of the tank condenser need be only about half that required for the same carrier power with high level modulation of the same tubes.

The grid tank also should be quite high-C in design. Due to the variations in grid current drawn by the tubes under modulation, this circuit must be designed to have good regulation with a varying load. This is accomplished by the use of high-C and through the use of a so-called "swamping resistor". The actual capacity across the tank coil should be about 2 $\mu\mu$fd. per meter at the operating frequency. The swamping resistor will be of the order of 2000 to 10,000 ohms and is best connected from grid to grid on the tubes. It can be made up conveniently from a bank of series paralleled 3 or 5 watt carbon resistors. The total number of resistors should be capable of dissipating about 50% or 60% of the input to the modulated stage. Thus, if the modulated amplifier has 30 watts input, the resistors should be able to dissipate about 18 watts and should have a total resistance that will cause the aforementioned 18 watts to be dissipated.

Bias

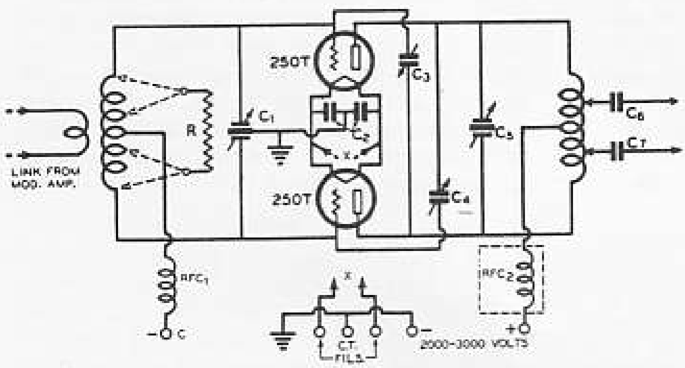
The source of bias used should have good negative-current regulation. Batteries (when new) and m.g.'s really make the best supply, but as they are too bulky for ordinary use some sort of a stabilized power supply is most commonly applied to the job.

Loading of the preceding stage must be done carefully. In this operation three conditions must be met. First, the modulated amplifier must be loaded to its proper operating conditions;' second, the coupling between the two circuits concerned must be fairly tight; and third, the amount of voltage appearing at the grids of the linear must be held within fairly close limits.

To bear out further the fact that linears are very economical for the power range of from 100 to 300 watts, the practical example to be described was built and checked.

The results obtained were very satisfactory. Using a pair of Eimac 150T's, 250TL's or 250TH's in a conventional circuit, 200 watts actual output was obtained at 2000 volts with the tubes running below maximum rating. With the plate voltage increased to 2500 and then 3000 volts, 250 watts of carrier power was obtained with the tubes running at maximum plate dissipation. The tubes were biased to the theoretical cut-off point in each case (plate voltage divided by amplification factor). There seemed to be no point in increasing the plate voltage above 2500 volts as far as economical output was concerned. However, at the higher plate voltage the excitation power required was reduced slightly by the fact that less swamping resistor dissipation was needed to obtain linearity.

A similar advantage was gained through the use of the "low" (medium) μ 150T or 250TL tubes in place of the higher μ 250TH's. One



A 10-20 Meter Linear. For Lower Frequencies, Increase C_1 and C_5.

C_1—75 μμfd. per section, 3000 volt spacing
C_2—.005 μfd. mica, 1000 volt
C_3,C_4—"800 Type" neutralizing condensers
C_5—50 μμfd. per section, 6000 volt spacing
C_6,C_7—.002 μfd., 5000 volt
R—Swamping resistor, see text
RFC_1 — 2½ mh., 125 ma. choke
RFC_2 — Optional 500 ma. choke, see text

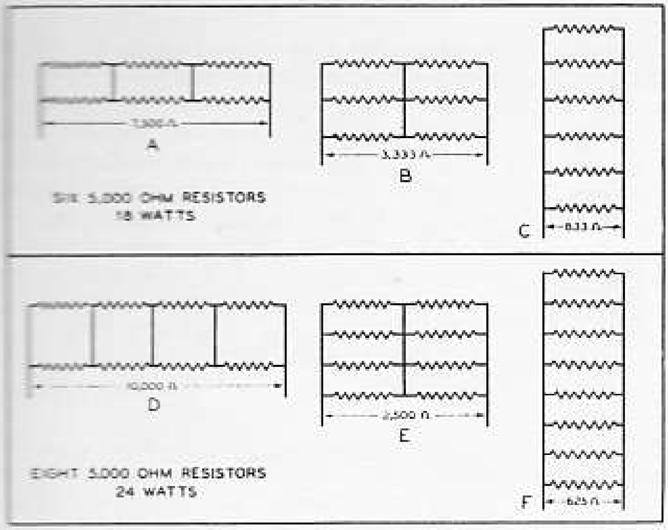
reason is obvious: the grid *current* excursions will necessarily be higher with high μ tubes. This means that a lower value (ohms) and higher wattage swamping resistor will have to be used to insure linearity in the grid circuit of the high μ tubes.

Another reason for using low μ tubes is that the low μ tubes almost always have a better dynamic grid characteristic.. So we see that while the higher μ tubes will work satisfactorily and put out approximately the same amount of power as the lower μ ones, they are less desirable for use as a linear. The same reasoning applies, though to a more limited extent, to a comparison of the two tubes as grid bias modulated amplifiers. So, for these particular tests, the 150T and 250TL tubes were used in preference to the 250TH.

Forced Draft

With conventional tubes operating at normal ratings as a class C amplifier the limiting factors to the power output are primarily the peak filament emission and the peak plate voltage that the tubes will stand. For class B linear operation, however, the limiting factor is (as was mentioned in the previous article) primarily the plate dissipation allowable on the tubes. Now there are many things that limit the allowable plate dissipation: the temperature at which the plate may be operated before it will release occluded gas, the maximum temperature at which the glass bulb may be operated before it tends to release occluded gas or to soften, to name the more important ones. Obviously we cannot exert any control over the first two of the factors. However in the last few years a great many forward strides have been made to minimize the limitations imposed by these first two. So we see that if we keep the glass temperature down below the maximum safe value we can utilize a great deal more of the tubes' useful characteristic.

This method of glass cooling is quite simple and involves nothing more than the proper placing of an inexpensive 8" fan. At any rate the fan should be placed so that its stream plays directly upon the envelopes of both tubes. The resultant blank cooling will allow the normal plate dissipation rating *without* forced draft to be exceeded by 25-60%, pro-



viding one of the other factors (mentioned before) does not come into play. Also the life of the tube at the normal rating can be somewhat prolonged by this cooling.

The Modulated Amplifier

The modulated amplifier that precedes the linear stage can, of course, be modulated in any of the conventional ways. Grid, suppressor, or plate modulation may be used. Also the linear stage may follow another linear or a single sideband amplifier as the case may be. In any case the peak output or the carrier output (peak output in a single sideband stage and carrier output in a constant carrier system as is more commonly used), whichever is considered, should be roughly one tenth that to be expected from the linear.

Since a linear amplifier may be adjusted to have a *slight* modulation-gaining characteristic with a negligible increase in distortion by *slightly* overbiasing it, they are well suited to follow a modulated amplifier that is not capable of modulating quite 100% without distortion. Both grid and suppressor modulated amplifiers fall into this class. They are easily capable of modulating 90% with very little distortion. Thus we may adjust our linear so that when the preceeding stage is modulating a maximum of 90%, the linear is modulating the carrier 100%. In this way the overall distortion of the system is reduced.

Mechanical Construction

The particular linear shown and described herein was built primarily to illustrate the principles described in the previous article. Consequently it was built upon a wooden baseboard and is not necessarily meant for exact reproduction. Much attention, however, was given to obtain short leads and a balanced circuit layout. The layout itself, therefore, does lend itself well as a suggestion when using similar-type double-ended tubes.

The plate tank (both coil and condenser) is mounted upon a small flat piece supported by a vertical upright. This upright is of such a length as to bring the plate tank to the approximate level of the plate connections of the tubes. Then the neutralizing condensers are mounted vertically upon this upright. In this way we have short plate leads, short plate tank to neutralizing condenser leads, and quite short leads from these condensers to the grids of the tubes. Aside from this the layout is perfectly conventional.

Tuning Up

Without a doubt the first thing to do when tuning up a linear is to forget it entirely and concentrate all your efforts upon the modulated amplifier. If this stage is not operating properly and stably with good linearity and no bugs or parasitics, it is a hopeless task to try to get a linear to work. So we see that we must first get the modulated amplifier so adjusted that it will operate perfectly and modulate 100% with ease. Then the plate current which gives proper operation of the modulated stage should be noted, as this value will be needed later. Then we can leave this stage and turn our efforts to the linear.

The first thing to do is to neutralize accurately the linear stage. It is quite important that it neutralize to the proverbial "gnat's eyebrow" If there is any trace of r.f. that cannot be elim-

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The lowest note anyone can whistle, says Cal Hadlock, W1CTW, is 500 cycles. If you need a thousand-cycle note for test purposes, whistle your lowest possible note, and then, according to Hadlock, you need only to hit an octave higher and presto, there is your test signal.

inated from the tank circuit, in other words, if there is any reaction between the input and output circuits, it will be nigh impossible to keep the amplifier from oscillating when it is standing with cutoff bias and full plate voltage.

The next test is to set the linear up with full plate voltage and slightly less than cut-off grid bias. If it will stand there while the plate condenser is tuned some distance each side of resonance without breaking into some kind of oscillation on its first try, it is truly a remarkable amplifier. In most cases there will be some one or more kind of oscillation take place: either a low frequency as determined by the r.f. chokes in the circuit, a high frequency determined by lead length and stray capacities, or a frequency near the carrier frequency and caused by regeneration in the amplifier.

In the amplifier shown there was no trouble experienced from neutralization difficulties or high frequency parasitics. The stage did, however, oscillate quite strongly at some frequency below 500 k.c. as determined by the r.f. chokes. At cut-off bias with about 2500 volts on their plates, the tubes drew about 450 ma. and put out great flames of this low frequency r.f. Tuning of either the plate or grid condensers had little or no effect on the parasitic. The trouble was quite definitely and very effectively cured by removing the plate choke RFC_2. However, it was still shown in the diagram because it may be needed in some cases if a slightly different layout is used. In any case it is a poor idea to use chokes with similar characteristics in both the plate and grid circuits.

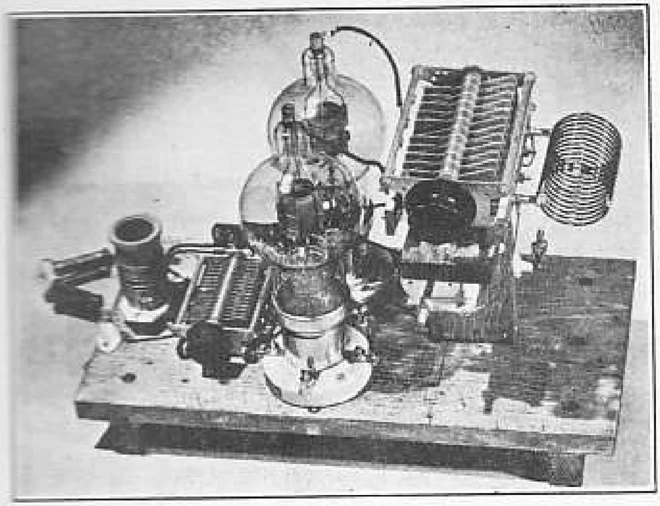
High frequency parasitics can be eliminated by a different layout, or, if they persist, can be stopped by the use of small parasitic chokes. The carrier frequency oscillations can in most cases be stopped by proper neutralization and layout. One thing that will greatly reduce the tendency toward any kind of parasitic and also help the general operation of the linear amplifier is to use quite a large value of split-stator grid tuning condenser. The capacity from grid to ground on each side of the tuning condenser (this, of course, is twice the total tank capacity) acts as a very effective by-pass to any other than the carrier frequency.

Now, if all the parasitics have been eliminated with the amplifier standing without any excitation, the next test is to apply the excitation (without the swamping resistor across the tank) and vary it (by means of the coupling link or any other convenient method) from zero to the maximum amount available. This maximum value of excitation will of course be considerably more than ever used under operating conditions. The amplifier should be loaded up to the antenna or a dummy for this test. It should be possible to vary the excitation between these wide limits without any parasitics or irregularities taking place. If it is possible, the amplifier is then ready for operation as a linear.

Now comes the grid loading operation, which is accredited the most difficult part of tuning up a linear. The swamping resistor should be non-inductive and capable of dissipating about 60% of the input to the modulated stage. This modulated stage should, as mentioned before, have a carrier power output of about 10% of the output to be expected from the linear. A single 801 with 35 watts input was used to excite the linear stage in the laboratory tests.

A convenient way of making the swamping resistor is to take a number of three watt 5000 ohm carbon resistors and series-parallel them in such a manner that the load is equally divided between them. There are in most cases (with six or eight resistors in all) three to six different resultant resistances that can be obtained while still dividing the load equally between them. A few of the possible combinations that would be of the order of resistance required by an ordinary type linear are shown in the diagram. Tubes similar to those mentioned before will ordinarily require a value of from 2500 to 5000 ohms directly from grid to grid. Lower μ tubes require a somewhat higher resistance and higher μ tubes a lower value. The arrangement used in this particular linear is that shown at B of this figure and the resistors were connected from grid to grid on the two tubes.

The proper procedure is to try, first the resistors connected directly to the grids in this manner. Apply cut-off bias to the linear, normal plate voltage to the modulated amplifier, and turn off the plate supply to the final stage. Then increase the coupling between the modulated stage and the grids of the



linear until normal plate current (as was noted before) is obtained on the modulated amplifier. The grid current should be of the order of 3 to 10 ma. If it isn't, try a different value of swamping resistor; if too low, a higher value; if too high, try a lower value. If a satisfactory point cannot be found in this way, try a value of resistor that was too low from grid to grid and tap it down the coil a small distance.*

After a satisfactory point has been found, apply the plate voltage to the linear and couple up the dummy antenna until the stage draws an input of about 1½ times the total plate dissipation in the stage (750 watts input for this particular linear).

Now we need an audio oscillator , a buzzer in front of the microphone, or some other source of constant tone as an input to the speech amplifier. Place a thermo-galvanometer, oscilloscope, or other modulation indicating device on the output of the modulated stage and find the point to which the gain control must be advanced to obtain 100% modulation of this stage. Now place the indicating device on the output of the linear and run the gain control back and forth between zero and the pre-determined point of 100% modulation of the exciting stage. If the modulation follows up with no irregularities or flattening-off points and the tubes do not operate too hot under no modulation, the adjustments that have been made are satisfactory. However, the possibility that the first adjustment will be satisfactory in all respects is rather remote.

In a majority of cases the first try will not be satisfactory. Here are a few difficulties that may be encountered and their remedies.*

Amplifier modulates down—Reduce excitation by lowering resistance of swamping resistor and increase coupling to antenna.

Amplifier modulates up but less than 100%—Same as above.

Modulates properly but tubes run too hot—Decrease antenna coupling and excitation.

Tubes run too cool, not enough output—Decrease antenna coupling and excitation.

Amplifier modulates more than preceding stage—Increase excitation, vary antenna coupling if necessary, reduce bias slightly.

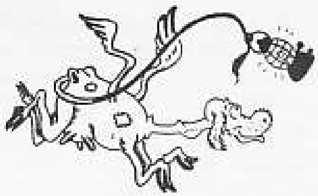
If the preceding steps were taken properly and in the order given, no difficulties other than those given should be encountered. The actual adjustment is really much more simple than these many lengthy paragraphs would indicate and each adjustment made has a very definite bearing on the emitted signal.

When the final adjustment has been made and the quality sounds "broadcast", remove the dummy, connect the antenna and adjust it until the linear draws the same plate current as with the dummy. She is now all set to go.

*It is preferable, when possible, to use a slightly higher value of resistance and connect directly from grid to grid. This provides a better regulating effect and also has a very beneficial effect upon parasitic oscillations.

*The whole procedure will be more simple if one will realize that the maximum amount of excitation that can be used while preserving 95-100% modulation capability is dependent upon antenna loading. The heavier the loading, the more excitation can be used. If the loading is too light or the excitation too heavy, the stage cannot be fully modulated. The simplest method is to increase the excitation in easy jumps and increase the loading each time just enough to preserve "100% modulation capability"; when the tubes are drawing 1.5 times their rated plate dissipation in plate input, stop.

In actual practice no attempt is made to get full 100% modulation capability. "100%" means in the vicinity of 95% modulation. Above 95% modulation, the distortion rises very fast in any transmitter, regardless of the type modulation used. Few broadcast stations attempt to modulate over 95% on peaks for this reason.



Tracking Down The Decibel

H. BURGESS

Tells You All About It

As one progresses from the "how-to-build-it" hobby side of radio to the engineering end of the art, more and more use is made of the decibel. This is another one of the many terms the radio engineer has borrowed from other branches of physics, one that has proved to be quite puzzling and awe inspiring to the laymen. It is one of those terms that, when the opportunity presents itself, we can spring on the uninitiated, terrifying them with the wonders of science.

All too often those who use the term daily are not quite sure what it is all about; and the poor unsuspecting beginner is frightened away from an understanding of it without even a struggle.

Definition of the Decibel

The purpose of this article is to try and make a little clearer what a decibel is and why it acts the way it does. The average person seems to encounter difficulty when studying the subject. It is sometimes difficult for some to grasp the decibel because of its "nothingness." It has no weight, cannot be seen, and its taste and smell are negligible. Before going further it might be well to state that the decibel is a *ratio,* nothing more and nothing less. It merely represents the relationship between two quantities of energy. Unlike the meter, pound, or quart, it has no counterpart in wood or metal in the bureau of standards. It is an arbitrary standard set up by telephone engineers for their convenience in making measurements or calculations.

The decibel is similar to the old "transmission unit" which was used for measuring the efficiency of telephone and associated circuits. The original unit was equal to the loss in a mile of standard telephone cable. This mile of cable was used to compare the losses or gains in a circuit.

The mile of standard cable is too bulky to keep hanging around for measuring purposes; so it was replaced by its electrical equivalent, which is an artificial line with a resistance of 88 ohms and a capacity of .054 microfarads.

For measuring purposes the combination of these units was equal to a mile of standard cable. If the input to a circuit was increased, the amount of increase could be measured by the number of mile units which had to be inserted to bring the output back to the original level.

Now the greatest defect of the mile of standard cable is that the cable, having a certain amount of inductance and capacity, does not have a flat frequency response and the transmission efficiency depends upon frequency as well as power. In working with new types of circuits there was a great need for a new unit of transmission which was *independent of frequency*. One was needed which was based on power alone, since the gain or loss in power is the true index of efficiency.

Another measurement scale was devised and the basic unit of transmission, by agreement of the engineers, was made the bel. It was given this name in honor of Alexander Graham Bell, the inventor of the telephone. In common practice one tenth of this fundamental unit is used; it is called the decibel and goes by the abbreviation db.

The decibel is a natural unit based upon the way our ears respond to various sound levels. We rate the efficiency and power output of apparatus in watts, but our ears do not respond to sound energy the same as a meter. Instead of responding in direct proportion to the wattage, our ears respond *logarithmically* with respect to the power.

For those who may have become a little doubtful about their algebra, a little review may be in order before continuing with the discussion.

Use of Logarithms

The common system of logarithms uses ten as a base. The logarithm of a number is the power to which ten, the base, must be raised to equal the number. Example: ten squared or raised to the second power equals 100. Thus the logarithm of 100 is 2. If we raise 10 to the third power we have 1000 and so the logarithm of 1000 is 3. The number which we have just found is called the characteristic of the logarithm and always has a value of one less than the number of digits in the given number. 1000 has four digits and so the characteristic of its logarithm is 3, or 10 raised to the third power is 1000. Unless the given number is a direct power of 10, its logarithm consists of the characteristic followed by a decimal known as the mantissa, which must be found from a table of logarithms. If we want to find the logarithm of 775 we know that the characteristic is one less than the number of digits so that makes it 2. By referring to a logarithm table we find the mantissa to be .8893 and so the logarithm of 775 is 2.8893. This means that if 10 is raised to the 2.8893 power, it will equal 775. Numbers may be multiplied by adding their logarithms or they may be divided by subtracting their logarithms.

Returning to the discussion of the decibel, suppose we had an amplifier with an even 1000 milliwatts output. If the output were reduced the least amount detectable by a sensitive ear and the output then measured, we would find that it had been reduced to about 794 milliwatts, or to 0.794 of the original power. If once again the power were reduced the slightest amount detectable to the ear (a *good* ear) and the output again measured, we would find that the power had been reduced to 0.794 of 794 milliwatts or to 0.630 of the original. If we go so far as to reduce power another step we find that the power has been reduced to 500 milliwatts, or to one-half of the original amount in three steps.

The decibel, which is the new unit of transmission or power ratio, is supposed to be the smallest change in power that is audible to a trained ear. The formula for finding the decibel of a ratio between two power levels is given as:

$$\text{db} = 10 \log_{10} \frac{\text{power}_1}{\text{power}_2}$$

Power 1 and 2 represent the power before and after it has been reduced or increased. When substituting, if the larger of the two is always placed on top it will simplify the solution. If we substitute 1000 milliwats for p_1 and 794 milliwatts for p_2, we will have the following:

$$\text{db} = 10 \log_{10} \frac{1000}{794} = 10 \log_{10} 1.259,$$

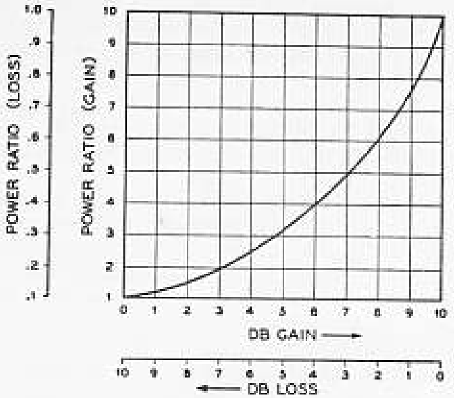
and the logarithm of the power ratio, 1.259, is 0.100 so

$$\text{db} = 10 \times 0.1,$$
$$\text{db} = 1.0$$

In substituting for the second and third reductions we find that we have reductions of 2 and 3 db respectively. This then gives us an approximate scale that is easy to remember: one db reduces the power to 4/5 of the original, two db reduces it to 2/3 and a reduction of three db brings the power down to ½.

Practical Examples

If these three power ratios are memorized, almost any db loss or gain can be quickly



figured. For example, what power ratio would be represented by a loss of 9 db? A 9 db loss would be the same as three 3 db losses. Remembering that a 3 db loss equals a power ratio of ½ and also remembering that when the logarithms of a number are added the numbers are multiplied, we find the following:

$$3db + 3db + 3db = \tfrac{1}{2} \times \tfrac{1}{2} \times \tfrac{1}{2}$$
$$9db = \text{power ratio of } \tfrac{1}{8}.$$

To find the ratio of a 7 db loss we have the same as a 3 db, 3 db and 1 db loss so:

$$3db + 3db + 1db = \tfrac{1}{2} \times \tfrac{1}{2} \times 4/5$$
$$7db = \text{power ratio of } 1/5.$$

When solving for a gain, the problem is figured for an equivalent loss and the resulting power ratio inverted. For example, to find the power ratio of a gain of ten db, we have a change of 3 db, 3 db, 3 db and 1 db so it follows that:

$$3db + 3db + 3db + 1db = \tfrac{1}{2} \times \tfrac{1}{2} \times \tfrac{1}{2} \times 4/5$$
$$10db = 1/10.$$

Inverting: 10 db gain = power ratio of 10.

This is another common ratio that should be committed to memory, and is easy to remember: 10 db equals a power ratio of 10.

Voltage or Current Ratios

The formula so far has been for finding the decibel direct from the power measurements. When voltage or current readings are to be used in place of power, the formula must be changed to read:

$$db = 20 \log_{10} \frac{V_1}{V_2}$$

The power in a circuit is proportional to the square of the voltage or current. As stated before, adding of the logarithm of a number to that of another multiplies the numbers, so two times the logarithm of the voltage or current ratio squares it and gives us the power ratio. Current values may also be substituted for V_1 and V_2. When using voltage or current values in the formula it is considered that the *input and output impedances are the same.*

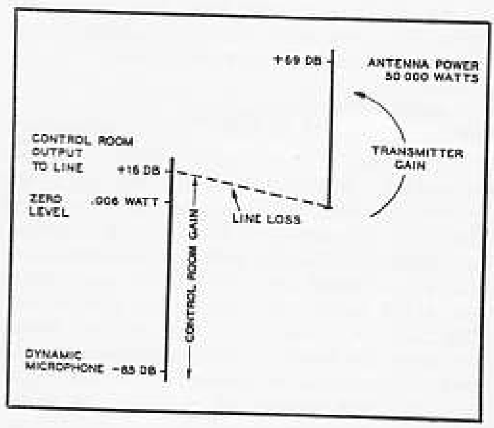
By substituting in the formula for power we can work out the following table.

Decibels gain	Power ratio
0	1
1	1.25
10	10
20	100
30	1000
40	10,000

By this we find that each time the level in decibels is increased by ten, the power is multiplied by ten. To increase the audio output of any apparatus by 40 audible steps or 40 db, the power output must be increased 10,000 times.

Practical Application

Any knowledge of the decibel is useless unless we can apply it to everyday work, so let us see if it can be of any benefit on a very



common problem. Suppose that the spirit has moved us to replace the type 45 audio tube in the old super-what's-it with a nice new 6L6. We wonder how much more volume we will have. The old 45 has an output of 2 watts and the 6L6 has an output of 6.5 watts. With an increase in power like this, the old blooper should have a new lease on life; but suppose we substitute in the formula and see just what will happen:

$$\text{db gain} = 10 \log_{10} \frac{6.5}{2}$$
$$= 10 \log_{10} 3.25 = 10 \times .511$$
$$= 5.1$$

By this we find that we will have an increase of only 5 db and unless we compared the two volume levels directly we would not notice any great difference. The change certainly would not justify going to very much expense.

Reference Level

In the true sense, the decibel is a *ratio* and has *no set value*. But by agreement of engineers a power value of 0.006 watts has been set arbitrarily as *zero level*. This means that 0 db is equal to 6 milliwatts and this is used as a reference level from which to work. Any power less than the 0.006-watt zero level is rated in terms of *minus numbers* or "db down." Power levels *above* the zero mark are measured in terms of *positive values* or "db up."

By using a reference level such as this, microphones and other types of generators may be given a comparative rating. A carbon mike may be rated at —45 db and a certain dynamic mike may carry a rating of —85 db level. The output of an amplifier also may be rated in db, which means that the maximum output is that many db above the zero level of 0.006 watts.

The range of hearing of the human ear extends from the *threshold of audibility* to the threshold of feeling, which is the point at which the vibrations can be felt by the nerves as well as heard by the ears. This covers a range of about 80 db or a power ratio of 100,000,000 times. It is possible to increase the sound intensity to the point where the pressure of the waves becomes so great that the sensation becomes one of pain. At this point the range has been extended to about 120 db above the threshold of audibility.

In common speech the sound level ranges from a whisper, which is about 20 db, to common speech at about 40 db. With a maximum of lung power and a minimum of brain power, a level of 50 db above the threshold of audibility can be reached vocally.

NATIONAL CALLING AND EMERGENCY FREQUENCIES

C.W.	'PHONE
7100 kc. (day)	3875 kc.
3550 kc. (night)	14,225 kc.
14,050 kc.	29,640 kc.
28,100 kc.	

During periods of communications emergency these channels will be monitored by stations of the National Emergency Net for personal-inquiry traffic. At other times, these frequencies can be used as general calling frequencies to expedite general traffic movement between amateur stations. Emergency traffic has precedence. After contact has been made the frequency should be *vacated immediately* to accommodate other callers.

The following are the National Calling and Emergency Frequencies for Canada: *c.w.* — 3535, 7050, 14,060; *'phone* — 3815, 14,160 kc., 28,250 kc.

The Canadian Amateur Radio Operators' Association has received inquiries concerning the continued issuance of the "Worked All VE" award. WAVE certificates are still being issued and cards, together with the 25-cent fee, should be sent to Mr. Elton Culp, VE3AUQ, Club Secretary, C.A.R.O.A., 67 Sherwood Ave., St. Catherines, Ontario.

WAVE (*Worked All "VE"*). Submit proof of QSO with two different stations on two different bands in each of the Canadian provinces (Yukon Territory and Northwest Territories considered as part of British Columbia). Thus, a total of 18 confirmations is required. All QSOs shall have been made on or after January 1, 1939. In U. S. and Canada all QSOs shall have been made from one state or province. Fee is 25c.

A Sunday in the Life of a Ham

(Dedicated with Vy 73 to the Ham Down the Street.)

9:00 a.m.—Folks leave for the day and Ham is alone. Aimlessly paces floor in his room. Stops and views visage in mirror. Makes weekly mental note to get hair cut sure next Saturday. Resumes walking, watching b.c.l. set out of corner of eye. After great mental wrestling, says, "Aw, well, guess I'll go out'na shack."

Unlocks door of shack noting key turns very hard as usual. Makes mental note to oil sometime. Shoves master switch which turns on all lights, filaments in transmitter and receiver, soldering iron and much miscellaneous equipment scattered along and under work bench. Clicks switch putting plate voltage on receiver. Indulges in idle cogitation anent desire for broadcast coils. Aimlessly opens various well-filled drawers in operating desk. Spies very battered coil which gets careful investigation. Receives brilliant idea and rummages around until he finds ancient variable condenser that might be 250 μμfd. Emits joyful grunt, and opens top of receiver. With the aid of tattered test leads, makes "b.c.l. set" by clipping coil and condenser onto grid of first detector and onto b.f.o. switch on front panel. Tunes condenser avidly. B.c.l. set operates very unstably and with high distortion. Stations seem infrequent and play no Benny Goodman records.

Decides to heck with b.c.l. and in process of experimentation discovers that by putting 40-meter coil in oscillator and 80 coil in detector can tune 30-meter commercials. For best reception 80-meter coil must be mounted with judicious use of rubber bands to exert starboard pressure. Resurrects battered mill from under bench and copies a Mex commercial. Success—50%.

10:00 a.m.—Turns off receiver deciding that all Mex commercials stand on their heads and send left handed. Leans back too heavily in chair, breaking back out. Fixes chair with hammer, shingle nails and muttered imprecations. In melee unknowingly knocks soldering iron from tin can rest.

Decides to tune up rig as W9 last night only gave him 5 and 8. Emphatically decides for umpteenth time to buy some 6-watt car lights as Xmas tree lights, especially blue ones, highly unsatisfactory. Pulls ½-inch arc from final tank. Fire comes through pet r.f. pencil and burns finger. Sucks finger and smells something else burning. Dives madly into rig thinking transformer he traded pair of anemic 210's for had finally given up ghost. Transformer sings merrily and only red hot. Finds soldering iron, which is sending up fair sized smudge, and replaces on tin can. Decides he was going to tear up flooring anyway to put in new switching system. Turns off rig.

11:00 a.m.—Ham discovers that action picture of World's Greatest Risqué Dancer has slipped down behind operating desk. Rescues picture and retacks to wall. Scratches out title and substitutes call of Ham Down the Street. Fills out five QSL's, depositing them with twenty-five more in desk drawer to await financial opulence.

Finds old European recording of Ray Noble and places upon turn table. Winds crank industriously amid great groaning and thumping of spring. Finds amplifier and plugs output into bench panel after deciphering maze of wiring. Plugs pickup into input of amplifier, and clicks switch. Panel light on amplifier fails to glow; remembers burning it out when tuning up buffer stage last week. Notes dandy hum in speaker; puts pickup on record and spins turn table with finger. Record gives off faint squeaks and scratches, while speaker emits loud hum as before. Manipulates gain control frantically with no effect. Remembers removing various resistors to experiment with 6L6 oscillator, and hunts feverishly for resistors. Decides Ham Down the Street swiped them yesterday. Gets down bottle of resistors and RMA color chart.

12:00 noon—Starts putting resistors back in bottle, deciding he didn't want to hear Ray

Noble anyway. Departs for house to eat lunch and QSO YL on land line. YL very touchy about being stood up last night when the dx was rolling in. Ham explains at length to no avail, mentally deciding to give up radio for umpteenth time. YL hangs up with loud bang. Ham decides to stick to radio and replaces receiver. Rubs ear and sits moodily by phone.

1:00 p.m. — Revives drooping spirits with can of beer and retires to shack. Takes pencil and, standing on chair, marks, "What are you looking up here for?" on ceiling. Admires ingenuity and handicraft for five minutes from various angles. Decides he's gone the Ham Down the Street one better. Finds old copper tubing tank coil and decides to go on 20 c.w. by doubling in final. After much calculation discovers frequency will land in fone band. Makes mental note to write to RADIO's Open Forum anent outrageous width of 20-meter fone band.

Cuts coil down and haywires it in final. Tube develops definite sunset glow, while r.f. has gone down until flame hardly burns finger. Ham decides it's self-excited, but what the heck? Calls CQ till he's black in the face, then decides the QRM situation on 20 is terrific. Puts rig back on 40.

2:00 p.m.—Ham finds license manual and makes up mind for umpteenth time to pass class A and go on 75 fone. Fills in all the O's with pencil for three pages and then decides the dx situation on 75 is terrible, and anyway he'd better stick to c.w. Pulls open desk drawer to replace manual and finds resistors from amplifier. Solders resistors back in after filing residue from soldering iron and retinning it. Soldering tip is now so short it's easier to use shank. Amplifier again plays with former brilliance. Remembers Ham Down the Street has two new Benny Goodman recordings, and departs with formidable 2000-volt 1-μfd. filter, and trading gleam in eye.

3:00 p.m.—Reappears at shack with two new B. G. recordings, minus 2000-v. 1-μfd. filter and trading gleam. Seems fairly exhausted. Cranks up gain on amplifier until QSL's on wall begin to vibrate, and plays B. G. recordings incessantly.

4:00 p.m.—Puts amplifier back under work bench making mental note to trade B. G.'s for two Ambrose. Resurrects dusty dim doorbell ringer from under bench and mounts on wall with display caption reading, "Ring Only In Case Of Fire." Gets brilliant idea and upsets shack hunting for Ford spark coil. Finds coil in obscure corner under two tanned cat skins, the remains of an ancient b.c.l. set, and a very defunct "B" battery. Hooks up coil, running wires with great cunning. Touches ringer with some trepidation. Jolt seems very satisfactory. Shakes arm vigorously and hears folks arriving. Greets family and asks when supper will be ready. Folks have stopped at drive-in on way home. Rereads funny papers in bad frame of mind.

5:00 p.m.—Eats dinner and evolves scheme for making records sound European by putting extra pickup on record and making synthetic room echo. Starts for shack with vague idea of going on air. Folks take firm stand about wanting air for Charlie McCarthy and Jack Benny. Decides to QSY to YL's house and affect reconciliation. Departs whistling, "Sweet Someone," interspersed with CQ's.

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THE SEASON
EXPLORE VHF
HERE'S THE SET
the national HFS
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27 mcs to 250 mcs in 6 bands.
● AM-FM-CW!
Operation assures optimum signal-to-noise ratio.
● MOBILE-PORTABLE-FIXED!
National 686S vibrator supply — 5886 power supply— or "A" and "B" batteries.
● RECEIVER OR CONVERTER!
Makes features of connected receiver usable on VHF!
Two-gang Main Tuning Capacitor, panel-controlled Antenna Trimmer Capacitor and 6 sets of plug-in coils tune the receiver in six bands. Power furnished by separate unit. Power supply listed below is excellent where 115-230 V, 50-60 cycle AC is available. Also operates with combination of "B," and storage batteries or 6 volt vibrator-type supply.
SEE IT AT YOUR LOCAL JOBBERS
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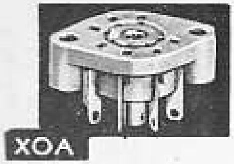
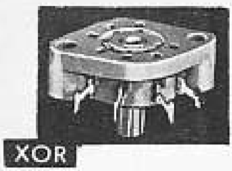
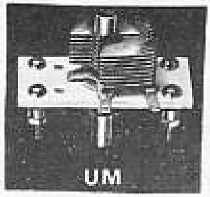
National



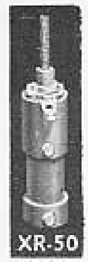
The XOA Socket is a socket for the Miniature Button 7 Pin base tubes. Low loss mica filled bakelite insulation. Mounts with two 4-40 screws. Socket contacts extend axially from base of socket.



The XOR Socket is the same as the XOA Socket except that the contacts extend radially from base of socket.



The UM condensers are low-loss, aluminum plate staked construction miniature variables designed for UHF converters, VFOs and the like — minimum capacity is exceptionally low. The UMs can be mounted in PB-10 or RO shield cans and have ¼" dia. shafts front and rear for ganging (see pages 21, 23 and 24 for shield cans and couplings). Plates: straight-line-cap., 180° rotation. Dimensions: Base 1" x 2¼", mtg. holes on ⅝" x 1-23/32" centers, 2-5/16" max. length.



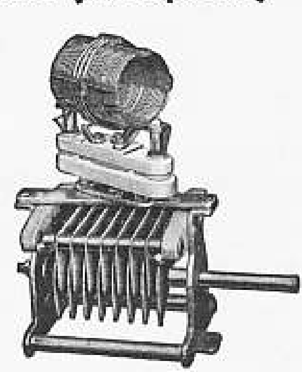
The AR-2 and AR-5 coils are high Q permeability tuned RF coils. The AR-2 coil tunes from 75 Mc. to 220 Mc. with capacities from 100 to 10 micro-micro-farads. The AR-5 coil tunes from 37 Mc. to 110 Mc. with capacities from 100 to 10 micro-micro-farads. The inductive windings supplied may be replaced by other windings as desired to modify the tuning range.

The XR-50 coil forms may be wound as desired to provide a permeability tuned coil. The form winding length is 11/16" and the form winding diameter is ⅜ inch. The iron slug is ⅝" dia. by ½" long.

EXCITER COILS AND FORMS — TYPE AR-16 (Air Spaced)

These air-spaced coils are suitable for use in stages where the plate input does not exceed 50 watts and are available in the sizes tabulated below. Capacities listed will resonate the coils at the low frequency end of the band and include all stray circuit capacities. All have separate link coupling coils and all fit the PB-16 Plug and XB-16 Socket.

The XR-16 Coil Form also fits the PB-16 Plug and XB-16 Socket. It has a winding diameter of 1¼" and a winding length of 1¾".



Band	End Link	Cap Mmf	Center Link	Cap Mmf	Swinging Link	Cap Mmf
6 meter	AR16-6E	25	AR16-6C	25		
10 meter	AR16-10E	20	AR16-10C	20	AR16-10S	25
20 meter	AR16-20E	26	AR16-20C	26	AR16-20S	40
40 meter	AR16-40E	33	AR16-40C	33	AR16-40S	55
80 meter	AR16-80E	37	AR16-80C	37	AR16-80S	60
160 meter	AR16-160E	65	AR16-160C	65		

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DX PREDICTIONS

Prepared by C.B. McKee, Engineering
Division, CBC International Service

Skywire frequency predictions are for amateur communications on various circuits to almost any part of the world. These tables are for five major areas in Canada, and amateurs who are operating reasonably close to the cities indicated will find these predictions quite adequate.

Figures shown are in megacycles and indicate the band to be used. They are for normal F layer transmission and don't consider Sporadic E which may provide unusual DX openings!

Toronto to: EST	00	02	04	06	08	10	12	14	16	18	20	22
Europe	7	7	7	14	14	14	14	14	14	14	7	7
Africa	7	-	-	-	-	-	-	14	28	14	14	7
Caribbean	7	7	7	14	14	14	14	14	14	14	14	7
S. America	7	7	7	14	14	-	-	14	14	14	14	7
Australia	7	7	7	7	7	-	-	-	-	-	-	-
U.S. - West	14	14	14	7	14	14	14	14	14	14	14	14
U.S. - Central	7	7	7	7	14	14	14	14	14	14	14	14
U.S. - South	14	14	7	14	14	14	14	14	14	14	14	14
Vancouver	7	7	7	7	7	14	14	14	14	14	14	14
Watrous	7	7	7	7	14	14	14	14	14	14	14	14
Montreal	4	4	4	4	7	7	7	7	7	7	7	7
Sackville	7	7	4	7	7	7	7	7	7	7	7	7

Sackville to: AST	01	03	05	07	09	11	13	15	17	19	21	23
Europe	7	7	7	14	14	14	14	14	14	14	7	7
Africa	7	-	-	-	-	-	-	14	14	14	14	7
Caribbean	7	7	7	14	14	14	14	14	14	14	14	7
S. America	7	7	7	14	14	-	-	14	14	14	14	7
Australia	7	7	7	7	7	-	-	-	-	-	-	-
U.S. - West	14	14	7	7	14	14	14	14	14	14	14	14
U.S. - Central	14	14	7	14	14	14	14	14	14	14	14	14
U.S. - South	14	14	7	14	14	14	14	28	14	14	14	14
Vancouver	14	7	7	7	14	14	14	14	14	14	14	14
Watrous	14	7	7	14	14	14	14	14	14	14	14	14
Toronto	7	7	4	7	7	7	7	7	7	7	7	7
Montreal	4	4	4	7	7	7	7	7	7	7	7	7

Watrous to: MST	22	00	02	04	06	08	10	12	14	16	18	20
Europe	7	7	7	7	-	14	14	14	14	14	7	7
Africa	14	7	7	14	14	14	14	14	14	14	14	14
Caribbean	14	14	14	14	14	-	-	14	14	14	14	14
S. America	14	14	14	14	14	28	28	28	28	28	14	14
Australia	14	14	7	7	7	7	7	-	-	-	-	14
U.S. - West	14	7	7	7	7	14	14	14	14	14	14	14
U.S. - Central	7	7	7	7	7	7	14	14	14	14	14	14
U.S. - South	7	7	14	14	14	14	14	14	14	14	14	7
Vancouver	14	7	7	7	7	14	14	14	14	14	14	14
Toronto	7	7	7	7	14	14	14	14	14	14	14	14
Montreal	7	7	7	7	14	14	14	14	14	14	14	14
Sackville	14	7	7	14	14	14	14	14	14	14	14	14

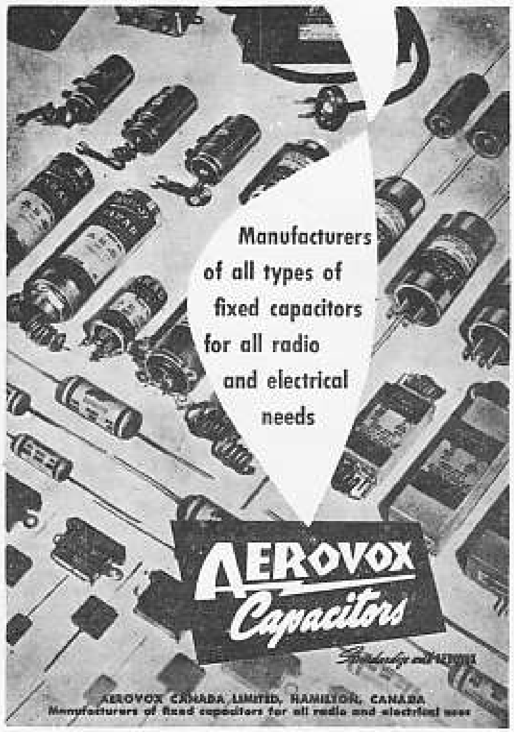
Montreal to: EST	00	02	04	06	08	10	12	14	16	18	20	22
Europe	7	7	7	14	14	14	14	14	14	14	7	7
Africa	7	-	-	-	-	-	-	14	28	14	14	7
Caribbean	7	7	7	14	14	14	14	14	14	14	14	7
S. America	7	7	7	14	14	-	-	14	14	14	14	7
Australia	7	7	7	7	7	-	-	-	-	-	-	-
U.S. - West	14	14	14	14	14	14	14	14	14	14	14	14
U.S. - Central	7	7	7	7	14	14	/14	14	14	14	14	14
U.S. - South	14	14	7	14	14	14	14	14	14	14	14	14
Vancouver	14	7	7	7	14	14	14	14	14	14	14	14
Watrous	7	7	7	7	14	14	14	14	14	14	14	14
Toronto	4	4	4	4	7	7	7	7	7	7	7	7
Sackville	4	4	4	7	7	7	7	7	7	7	7	7

Vancouver to: PST	21	23	01	03	05	07	09	11	13	15	17	19
Europe	7	7	7	7	14	14	14	14	14	14	7	7
Africa	14	14	7	7	14	14	14	14	14	14	14	14
Caribbean	14	14	14	14	14	-	-	14	14	14	14	14
S. America	7	7	14	14	14	14	14	14	14	14	14	7
Australia	14	14	7	7	7	7	7	-	-	-	-	14
U.S. - West	7	7	7	4	4	7	7	7	7	7	7	7
U.S. - Central	14	7	7	7	14	14	14	14	14	14	14	14
U.S. - South	7	7	14	14	14	14	14	14	14	14	14	7
Watrous	14	7	7	7	7	14	14	14	14	14	14	14
Toronto	7	7	7	7	7	14	14	14	14	14	14	14
Montreal	14	7	7	7	14	14	14	14	14	14	14	14
Sackville	14	7	7	7	14	14	14	14	14	14	14	14

HAMADS

Skywire Hamads must pertain to amateur radio. Rates are 20 cents per word, per insertion for commercial advertisements for profit, and 4 cents per word for all non commercial, non-profit advertisements by experimenters or licensed radio amateurs. Full remittance MUST accompany copy. Print plainly and count address in the total. Do NOT send personal checks unless exchange is included. Mail to Skywire, Toronto.

HOWARD 438 RECEIVER - 8 tubes, xtal filter, built in speaker, covers from 520 kc to 42 mc. Provision for vibrapack and S meter. Instruction manual and the parts list included - just overhauled and aligned. $75.00 or nearest offer! C-2 Frequency Meter, perfect shape, with shockmount and transit case, $25.00 RME-69 receiver and matching speaker, operating manual, nearly new condition, $125.00 or nearest offer. Want Trimm Featherweight fones, high resistance. Write VE7DY, 1610 Pinewood Avenue, Victoria, B.C.



WANTED - AN HRO RECEIVER type M or later model with a full set of bandspread and broadcast coils too, if possible. A 60 cycle power supply would be desirable, as would the matching speaker, but not essential. Quote your best price in the first letter and I won't quibble. Write W.H. Galpin, 74 Princess St., Winnipeg.

FOR SALE - NATIONAL NC-173 RECEIVER. The condition is excellent and the best offer over $225.00 will be accepted. Write VE1PA, G.H. McKenzie, Lakeburn, New Brunswick.

BRAND NEW FACTORY CARTONED TROPICALLY treated National NC-2-40-D receiver for sale. This was bought to take south and has never been touched since it left the factory. The set is one of the worlds finest for performance and I can't use it now. Best offer of more than $300.00 taken it - saves you a lot of money. A letter to E. Boyden, 10 Barclay Rd., in Wilson Heights P.O., Ontario will get a prompt reply.

WANTED - BACK ISSUES OF THE ENGLISH Short Wave Magazine, from the latest of the 1952 copies back to September, 1950. Will pay fifty cents per copy for these. VE3BTL, 38 Stamford Square N., Toronto.

WANTED IN OTTAWA - Room and board from May to September by student working in Ottawa. Permission would be required to run small transmitter. R.J. Kavanagh, VE1YW, Beaverbrook Residence, Fredericton, New Brunswick.

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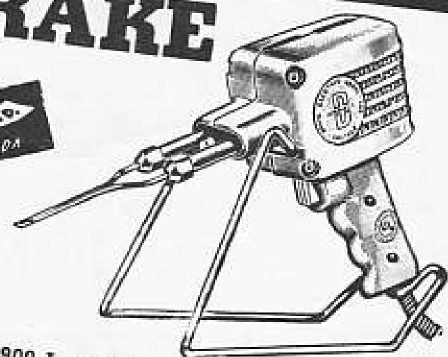

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HOW'S UR OBS IQ?

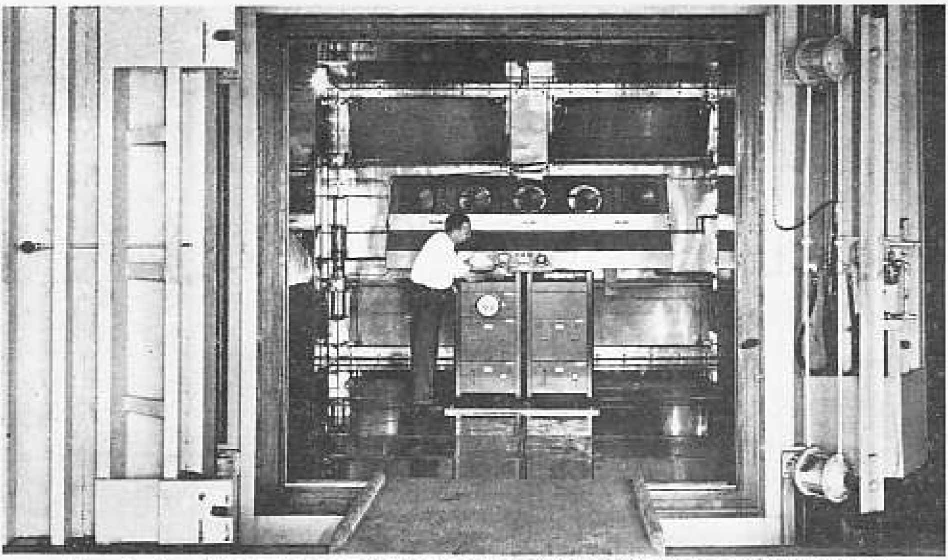
Official Bulletin Nr 226, March 26th, 1952. The Canadian Department of Transport announces that effective April 1st, the frequencies 14,350 to 14,400 kilocycles will be deleted from Canadian amateur radio assignments. Effective May 1st the frequencies of 21,000 to 21,450 kilocycles will be made available for CW emission only.

Official Bulletin Nr 338, March 12th, 1952. Effective March 11th, F.C.C. announces that the prohibition of contacts with amateur stations in certain foreign countries as was announced in its public notice of December 21st, 1950 no longer applies to the Netherland Antilles. Basis of removal of PJ from the prohibited list, is the recent action of the Netherlands Antilles government in authorising amateur operation in that country. QSL cards confirming contact with licensed amateur PJ stations will be accepted for DX Century Club credits. Contacts made during the March 15th and 16th period of ARRL DX Contest with Netherlands Antilles may be counted for score credit.

Official Bulletin Nr 339, March 18th, 1952. To conform with Atlantic City regulations, the F.C.C. proposes to delete from amateur assignments, the frequencies 14,350 to 14,400 kilocycles effective April 1st and to make available the frequencies 21,000 to 21,450 kilocycles effective May 1st. Respective dates for filing comment are March 28 and April 17th. The present 21 megacycle proposal is for CW emission only. A later rule making will take up phone or other sub-allocation. See March QST for 15 meter equipment suggestions. Coils made by B & W are available in Canada. See page 2 this issue.

Official Bulletin Nr 340, March 31st, 1952. Effective from 3.01 AM EST April first, the F.C.C. by action today withdraws the upper fifty kilocycles 14,350 to 14,400 kc of the twenty meter amateur band. This action in conformity to Atlantic City is to pave the way for opening a 21 megacycle amateur band in May. The Canadian Department of Transport takes similar action with respect to Canadian amateurs, deleting 14,350 to 14,400 kc effective April first. Please notify any amateurs heard in these frequencies after the first of April to protect them from F.C.C. monitoring notification.

Official Bulletin Nr 341, April 10th, 1952. A.R.R.L. invites applications for its Official Observer appointment. League members who are residing in any U.S. or Canadian sections are eligible. The various classes of Observer appointments include categories for phone and CW checking which require only receiver equipment and individual skill. All interested amateurs are requested to write to A.R.R.L Headquarters for application blanks.



A standards engineer prepares electronic equipment for test in RCA's new "stratosphere chamber", which can simulate any climatic or atmospheric condition.

Weather Made to Order

ALL the world's weather is now available in a single room 14 feet square and 10 feet high in the testing laboratory of the RCA Engineering Products Department in Camden, N. J.

With this 50-ton chamber, recently installed for the testing of all kinds of electronic equipment under conditions to which it may be exposed in use, laboratory personnel can simulate all temperatures, humidity levels, and other climatic and atmospheric conditions found on or above the earth, to an altitude of 70,000 feet above sea level.

Here, every device made by RCA for military or civilian use in far-away places, from airplane transmitters to walkie-talkies, can be proved under conditions prevailing in the Sahara or Siberia, in the jungles of the South Pacific or atop the Himalayas.

Known as a "stratosphere chamber", it can reduce atmospheric pressure to the level encountered at an altitude of 70,000 feet, which is higher than the accepted altitude record for heavier-than-air craft and almost as high as man has ascended in a balloon. The partial vacuum produced is sufficient to reduce a 29-inch column of mercury to one inch.

Heating and refrigeration equipment within the chamber can create temperatures from 185° F. — more than 50 degrees higher than the highest natural temperature ever recorded on the earth's surface — to minus 85° F. — within a few degrees of the lowest natural temperature earth-bound instruments have recorded. To provide refrigeration for the unit requires 180 horsepower, enough to run 720 average size domestic refrigerators simultaneously.

Humidity within the chamber can range from a heavy fog to almost complete lack of moisture.

Because of its size and weight, the chamber, which cost $150,000, posed a number of installation problems. It was built in three sections and transported from Newark, N. J. to Camden by trailer-truck. Because the chamber overhung the trailer three feet on each side, creating a traffic hazard, special approval from the State Highway Department was necessary, and the trip was made in the early hours of the morning, when traffic was light. The three sections weighed 11, 17, and 21 tons, respectively. In order to get them into the laboratory, a wall area measuring 18 by 20 feet had to be removed from the building.

The door of the chamber weighs about two tons, and is moved into place on rollers fixed at the top of the chamber. To obtain a perfect seal, an air cylinder is fixed on each corner of the door to exert the required pressure. An inner wall of 9-inch-thick insulation is used to maintain temperatures.

TELEVISION

CHECKING TELEVISION WAVEFORMS WITH A C R O

By SAMUEL MARSHALL*

This month we are interrupting our Television series to bring you an outstanding article on the use of an Oscilloscope for servicing Television receivers. This article is reprinted from "Radio Service Dealer" for January by permission of the author.

In making these tests it is best to tune in a station broadcasting a test pattern, as this lends itself to easy interpretation. Set the receiver on its side or back so that all the test points may be conveniently reached. No tests are recommended on the high voltage section and care should be taken to avoid contact with that circuit.

Initial Test Point

The most convenient initial point of measurement is the output of the second detector. The reason for this choice is that the signal voltage at this point is 1 or 2 volts, and lends itself to good observations on an oscilloscope. Remember that we are primarily concerned with measuring and observing the video picture signal and the synch pulses, and that these are first observable in their demodulated forms at the output of the second detector.

Figure 1 at the top right illustrates a combined video signal and vertical synch pulse obtained at the detector output. The sweep frequency of the CRO has been set at 30 cycles in order to permit two of these pulses to appear on the screen. The partial circuit diagram on the left illustrates the test points for this test. This corresponds to point E on the block diagram. The complete front view of the cathode ray oscilloscope with all its settings, and the waveform appearing on the screen is at the right of Figure 1.

To make this test a connection is made between the detector output and the vertical input connection on the CRO. Another connection is then made between the ground connections of the receiver and the oscilloscope. The detector output connection may be taken off at either side of the coupling condenser, C, whichever is most convenient. The receiver output is adjusted to its optimum level, thereby requiring a minimum setting of the vertical gain control on the scope. This will result in more accurate and satisfactory patterns.

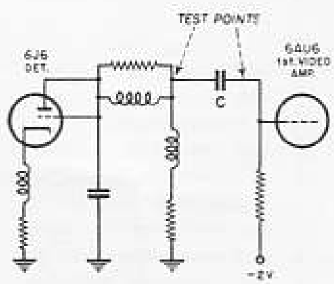
Notice the amplitude A of the combined synch pulse and signal as compared with the signal amplitude itself shown as B. The middle line at B, represents the blanking level, and the height above this level—(in the slide this occurs below the blanking level because of the reversed phase of the pattern)—is the region called "blacker-than-black."

The blanking level should be 75% of the total height, A, according to FCC standards.

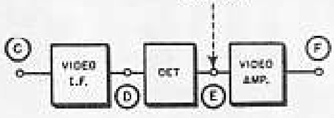
Shown in the lower right hand side of this illustration are the horizontal synch pulses and the associated picture signal. The same test point is used. However, the sweep frequency of the CRO is now adjusted to one-half the incoming horizontal synch pulse frequency. This is 15,750 divided by 2, or 7,875 cycles

Figure 2 shows the vertical and horizontal pulses at the output of the first video amplifier. Notice that the phase has been reversed 180° which is characteristic of vacuum tube action. The amplitude of the signal at this point is about 16 volts. Varying the gain of the receiver by means of the contrast control will produce corresponding variations in the height of the pattern.

(Continued on next page)

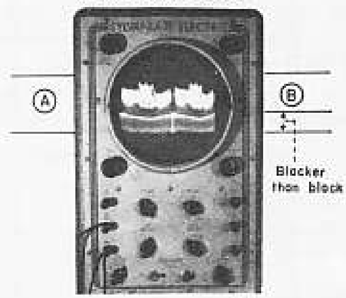


PARTIAL SCHEMATIC
OF CIRCUIT UNDER TEST



PARTIAL BLOCK DIAGRAM

VERT. SYNCH PULSE



HOR. SYNCH PULSE

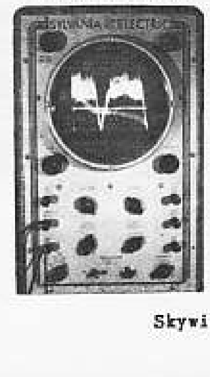


Figure 1
Waveforms horizontal and vertical obtained at detector output.

*Samuel L. Marshall, Managing Editor of Radio Service Dealer, has taken courses in Electrical Engineering at Brooklyn Polytechnic Institute and New York University. He has been a radio service technician since 1923. In 1937 Mr. Marshall joined the George Westinghouse Vocational High School in Brooklyn, New York, where he is engaged as a TV instructor. In 1943 he wrote "Elements of Practical Radio Mechanics", a book which is used as a standard text in many schools throughout the country. First and foremost is his interest in advancing the cause and status of the radio serviceman. At present he is Chairman of the Board of Directors of the Associated Radio-Television Servicemen of New York, and is currently arranging a TV Lecture Course for the New York Empire State Federation of Electronic Technicians Associations.

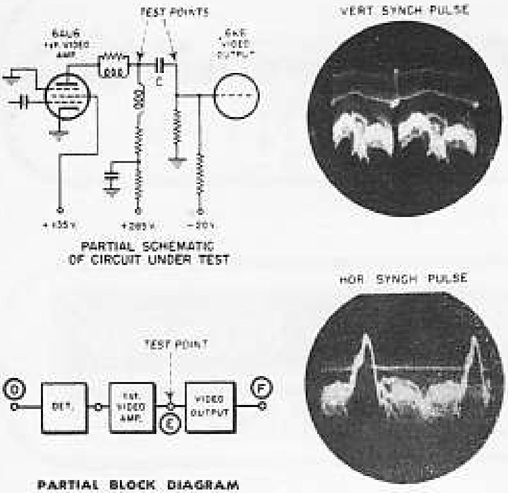


Figure 2
Horizontal and vertical pulses obtained at 1st video amplifier

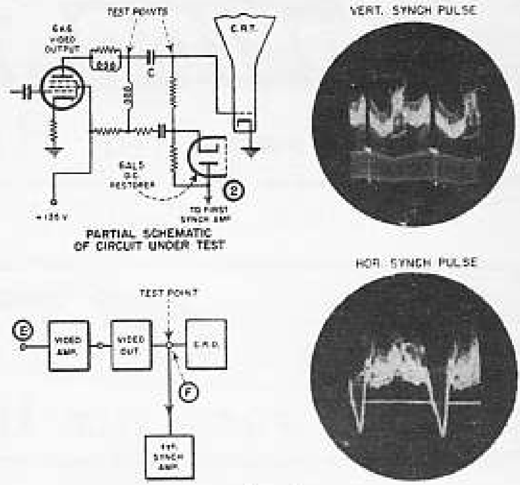


Figure 3
Horizontal and vertical pulses obtained at video output tube.

As in the previous test, the sweep of the CRO is adjusted to portray two pulses. The test point may be made on either side of the coupling condenser, C, shown in the partial schematic at the left of the slide. The probe connection of the scope may be brought to the plate side of the coupling condenser if an isolating condenser is located in series with the vertical input terminal; and it usually is.

Proceeding now to the output of the final video stage, as shown in Figure 3, we notice that the phase for both horizontal and vertical plates is again reversed, and that the amplitudes of the signal are considerably increased. In this case it is 45 volts. This output is fed directly into the grid of the CRT, and as previously pointed out, represents a positive picture phase.

Synch Circuit Section

A portion of the video signal is taken off the d-c restorer at the 6AL5 plate connection No. 2. The signal at this point, containing both video and synch components, with the video somewhat reduced, is fed into the first synch amplifier at a negative synch phase, or what amounts to the same thing, a positive picture phase.

This is shown in Figure 4. The operating characteristics of this circuit result in a reduction of pulses due to noise and other interfering signals. The amplitude of the signal at the grid of the first synch amplifier is about one-fourth that of the output at the plate of the final video amplifier. This is due to the signal being taken off a point on a voltage divider connected across this circuit.

Figure 5 shows the horizontal and vertical pulses as they appear at the grid of the synch clipper or separator. Notice that the amplitude at this point is 60 volts, and that the signal still contains considerable picture components. Also, the signal now has a negative picture phase, or a positive synch phase.

We now shift our take-off point to the output circuit of this tube, as shown in Figure 6. Observe that the picture signal has now been completely eliminated, and that only the synch pulses remain. The amplitude of these pulses at this point is 80 volts, and the synch phase is now negative.

The action in this circuit that produces this clipping of the picture signal results from the following:

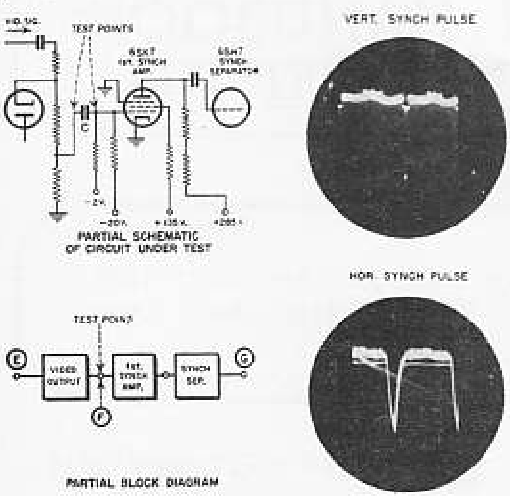


Figure 4
Pulses obtained at 1st synch amplifier on either side of C.

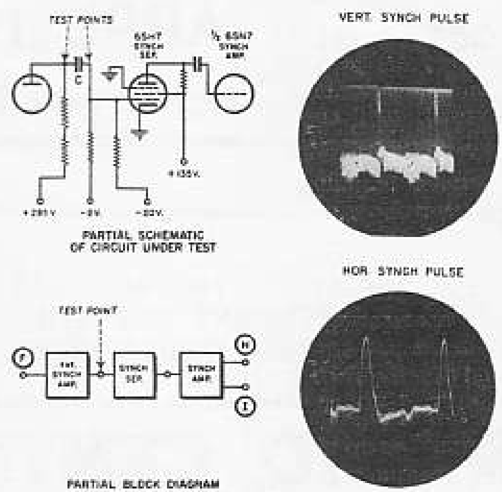


Figure 5
Pulses obtained at input of 6SH7 synch separator. Note waveforms.

DX QTH'S

C8KY	Box 73, Lanchow, Kansu, China.
CN8EF	C/o US Naval Air Station, Casablanca.
D5AA	Gabriel Migeon, SP 76422, BPM 451, French Zone, Germany.
EL3A	Box 98, Monrovia, Liberia.
ET3AH	Frank Frost, PO Box 858, Addis Ababa, Ethiopia.
FU8AA	Rene Thevenin, Ile-de-Pentecote, New Hebrides.
G2FDF/YI	W. F. Limehouse, Vickers' Armstrongs Rep., Iraqi Airways, Baghdad Airport, Iraq.
HC1CF	Box 2850, Quito, Ecuador.
HH2ME	PO Box 153, Port-au-Prince, Haiti.
I1AHK	Aldo Ravenna, Via Principa Amadeo 8, Cagliari, Sardinia.
J5HS	Box 515, Tokio 4.
J9ABX	W. C. Baxter, APO 331-3, c/o PM, San Francisco.
KG6AAF	HQ 20th Air Force, APO 234, c/o PM, San Fransicso.
KM6AA	C.A.A., Midway Island, Central Pacific.
KW6AC	C.A.A., Wake Island, Central Pacific.
M1A	Dr. Corrado Francini, Republica di San Marino.
PK6TO	Box 76, Macassar, Celebes.
PX1C	Box 66, Andorra.
VO2AT	APO 863, PM, New York.
VO6Y	Pan-Canada Air Lines, Goose Bay, Labrador.
VP5AS	APO 861, c/o PM, Miami, Fla.
VP8AI	Pebble Island, Falkland Islands.
VS2BU	Sgt. Morgan, RAF Butterworth, Penang, Malaya.
VS2CB	c/o Telecoms Dept., Kuala Lumpur, Malaya.
VS6BA	109 Austin Road, Hong Kong.
VS7PS	No. 1 A.W.B.S., c/o GPO, Colombo, Ceylon.
VS9AF	c/o A. Besse & Co., Aden.
W2WMV/C9	Box 10, Navy 3930, Fleet PO, San Francisco *(Station at Mukden, Manchukuo).*
W6WCN/KG6	NAS Kobler, Navy No. 957, US Naval Air Station, Saipan, c/o Fleet PO, San Francisco.
XAFG	Radio Officer, VG Police, Trieste.
XAFQ	US Army, Free Territory of Trieste.
ZC6MF	c/o X Branch, HQ Palestine.
ZC6SX	B. P. Knight, Belmore, Seagrave Road, Sileby, Loughborough.
ZA3B	Radio Marine Station, Durazzo, Albania.
ZD2P	D. C. Piccirillo, Radio Officer, Posts and Telegraphs, Port Harcourt, Nigeria.
ZD2S	G. Sherwood, c/o W.A.A.C., Ikeja Airport, Lagos.

1. The picture signal at the grid of the tube has a negative polarity.

2. The operating voltages on the tube are such that all negative portions of the signal are cut off.

Since the polarity of the video or picture portion of the signal is negative, and since all negative portions of the signal are clipped off, only the synch pulses remain.

The next test point is the plate of the third synch amplifier. The polarity of the synch signal at the grid of this tube is now negative. At the plate it becomes positive. The complete change taking place in the synch signal polarity in the three stages of the synch amplifiers is shown in Figure 7. Here we see a negative synch pulse entering the grid of the first synch amplifier, and, after going through three complete 180° phase reversals, emerging from the last stage with a positive polarity.

This last synch tube, which is one half of a duo-triode, operates at low enough potentials so that an 80 volt signal applied to the grid drives the tube beyond cut-off passing only the peaks of the signal. This results in an additional clipping action, thereby further reducing noise and other interfering pulses.

Integrating Circuit

The amplitude at the output of this tube, which is shown as point 1 in Figure 8 is 80 volts. The synch pulse phase is positive, and we are now in a position to inject this signal into the horizontal and vertical blocking oscillators for purposes of triggering them to the exact frequency of the incoming station pulses.

The signal at the output of the final synch amplifier contains both the horizontal and vertical pulses which we must separate from each other. This is done by the integrating and differentiating networks. These are shown in Figure 8 as combination R-C filter circuits. The integrating circuit shown at the top left consists of a number of resistors and capacitors connected in such a manner as to short out the horizontal pulses and build up the amplitude of the vertical pulses. Notice the shunt capacitors, C_1, C_2, and C_3. These condensers in addition to building up the amplitude of the vertical synch signal during successive pulses of the serrated vertical synch pulse, short out the higher frequency horizontal pulses, leaving only the vertical pulse to reach the grid of the 6J5 vertical oscillator.

Proceeding now to the differentiating circuit, the 100 uuf condenser connecting the output of the third synch amplifier to the input of the horizontal oscillator presents a high reactance to the low frequency vertical pulses as compared to high frequency horizontal pulses, so that the signal permitted to pass thru this condenser contains only the horizontal pulses.

If we apply the test probe of the CRO to point 1, both the vertical and the horizontal pulses appear. At point 2 only the vertical pulses appear, and at point 3 only the horizontal pulses appear.

We are now ready to trace the vertical pulses as they proceed from the output of the 6J5 oscillator to the input of the vertical deflecting coils. The lower left-hand portion of Figure 9 is devoted to the block diagram of this portion of the circuit.

The upper left-hand portion of the figure is confined to a simplified partial schematic of this circuit. The four test points shown in the block diagram are indicated in the partial schematic by identical numbers. Thus:

No. 1 is the input of the vertical oscillator.

No. 2 is the output of the vertical oscillator, the amplitude of which is about 120 volts. The signal is acted upon by the discharge or peaking circuit. The object of this circuit is to obtain a wave at the output of the oscillator which insures the presence of a sawtooth current wave in the vertical deflecting coils. But, more on that shortly.

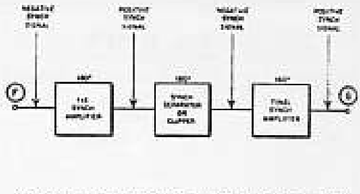


Figure 7
Signal phase is reversed 180° as it passes through each tube.

No. 3 is the output of the vertical deflecting coils. The potential at this point is about 65 volts.

No. 4 is the input to the vertical output tube, which is about 450 volts.

The corresponding waveforms for test points 1, 2, 3, and 4 are shown at the right of the screen.

No. 1 proceeding from top to bottom indicates the sharp steep discharge, and slow saw-tooth charge portions of the wave which are characteristic of the blocking oscillator.

No. 2 indicates the effect of the peaking, or discharge circuit on this waveform. Variations of this waveform may be produced by varying the vertical amplitude control. This is an excellent check on the operation of this circuit.

No. 3 indicates the waveform of the pulse at the plate of the vertical output tube, or the 6K6. Notice how high the pulse voltage is for the retrace portion. This is necessary to insure a high retrace current rate on the vertical deflecting coils during the retrace period.

Peaking

The formula relating to voltage, inductance, and the rate of change of current in coil can be given in two forms:

e = L x Rate of change of current

Rate of change of current = e/L

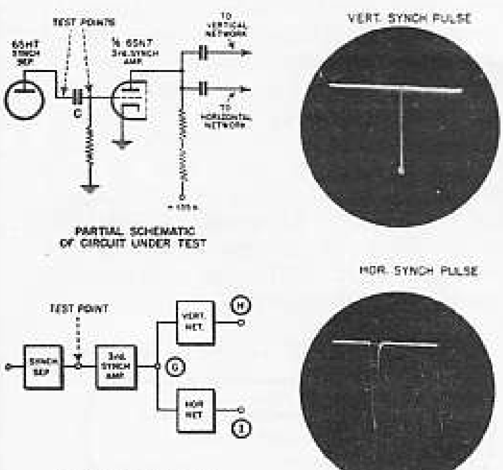


Figure 6
Horizontal and vertical pulses obtained at 3rd synch amp. input.

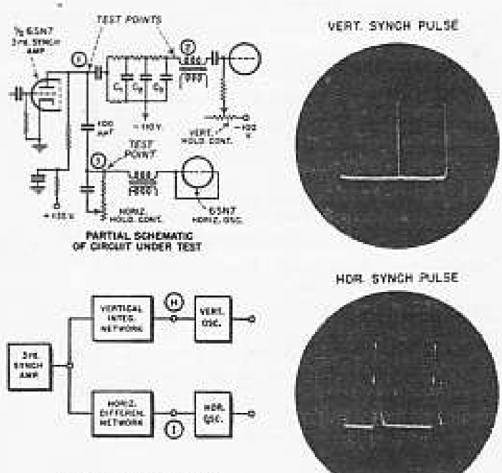


Figure 8
Waveforms obtained at horizontal and vertical separation points.

During the retrace period the frequency is much higher than the 60 cycle frequency of the trace period. As a result, the reactance set up by the inductance in the coil is much higher than before. This affects the current considerably. From the formula shown above, in order to get a high and fast discharge of current during the retrace period the voltage amplitude must be high and its waveform steep.

Returning again to Figure 9, and examining waveform No. 4 once again, we notice that the trace portion of the voltage curve is somewhat of a sawtooth. This is due to the fact that during the trace period, the inductance of the vertical deflecting coil is negligible as compared to its resistance. In a resistance, if we want a saw-tooth current we must have a saw-tooth voltage. This explains why, in the composite wave, the waveform of the retrace is a sharp high amplitude pulse, and the waveform of the trace is a low amplitude saw-tooth.

Horizontal Circuit

We can now proceed to the horizontal oscillator and the circuits devoted to the development of the horizontal sweep. Figure 10 illustrates the partial schematic of this portion of the circuit in the upper left portion of the screen. Below it is the block diagram showing the test points numbered to correspond to the same points in the schematic above. These test points are as follows:

No. 1 is the input of the horizontal oscillator.

No. 2 is the output of the horizontal oscillator, at about 120 volts.

No. 3 is the output of the horizontal discharge circuit, at about 45 volts.

No. 4 is the output of the horizontal output tube, at about 4,000 volts. The utmost caution should be used when measuring high voltages of this nature.

No. 5 is the output of the horizontal output transformer, which is about 800 volts, and represents the voltage waveform appearing across the horizontal deflecting coils. Notice the flattop characteristic of this waveform. It will be recalled that in order to obtain a saw-tooth current wave in a circuit which is predominantly inductive, a flattop voltage wave is required. When measuring these high voltages a high voltage test probe should be used, and a capacitance voltage divider should be employed for the CRO to prevent damage to its input circuit.

Space does not permit further analysis of the many fine points each of the circuits abound in. Television technicians have a powerful tool in this waveform analysis, for in reality it is dynamic analysis applied to the video and synch portions of the television receiver. Acquainting himself with its techniques the TV technician will add to his stock-in-trade a very powerful ally in helping him lick those "difficult" TV service problems.

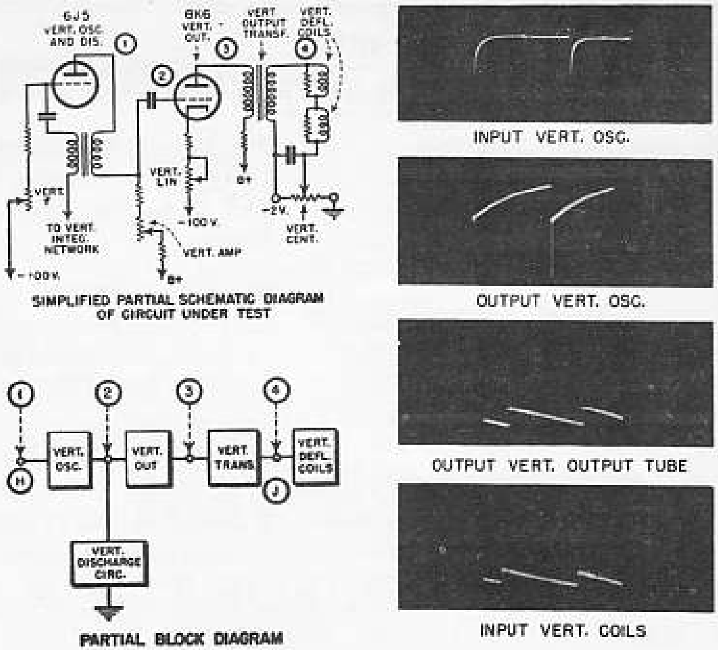


Figure 9—Waveforms obtained at various test points in vertical circuit.

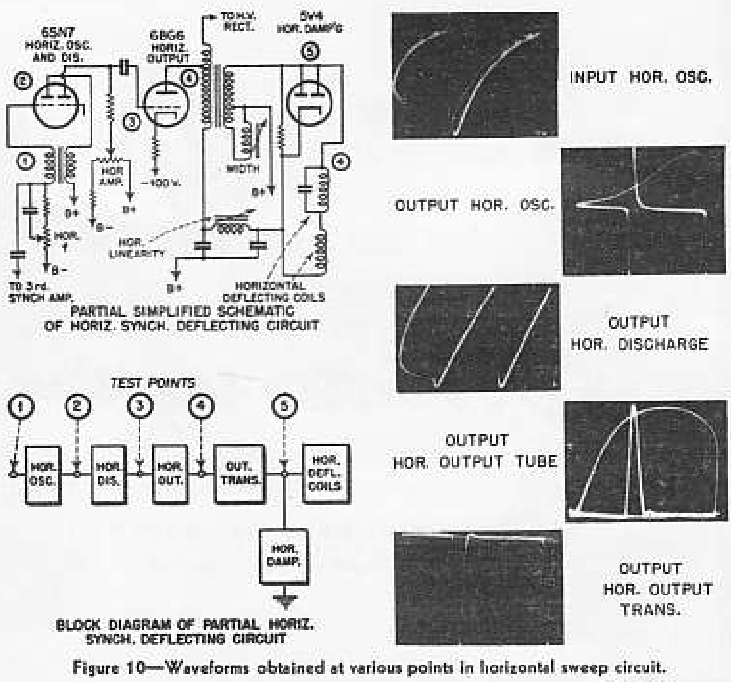


Figure 10—Waveforms obtained at various points in horizontal sweep circuit.

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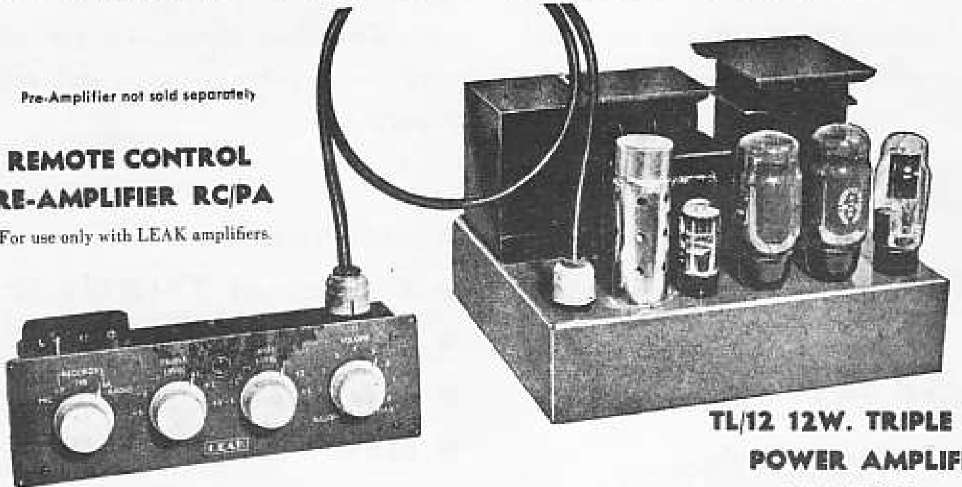

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The unit will mount on motor-board through a cutout of 10⅛ x 3⅛ in., or it can be bolted to the power amplifier, when, with a top cover, the whole assembly becomes portable.

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- No H.T. electrolytic smoothing or decoupling condensers.
- Impregnated transformers; tropically finished components.
- H.T. and L.T. supplies for pre-amp. and radio units.
- Distortion: at 1,000 c/s and 10 W. output, 0.1%: at 60 c/s and 10 W. output, 0.19%; at 40 c/s and 10 W. output 0.21%.
- Hum and Noise: −72 to −80 db on 10 W.
- Frequency response: ±0.1 db, 20 c/s-20 kc/s.
- Sensitivity: 160 mV.
- Damping Factor: 20. Input impedance: 1 Meg.
  Output impedances: 2ω; 7-9ω; 15-20ω; 28-36ω.
  Phase margin 20° ± 10°: Gain margin 10 db + 6 db.

25 W. model available.

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In the TL/12 amplifier the hum and noise levels fall within −80 db and −72 db relative to 10 watts. This amount of power, as hum and noise, is inaudible from the most efficient loudspeakers. Notice particularly that feedback is taken from the low side of the output transformer. Many circuits show it as taken from the anode side, which will result in higher hum levels than without feedback.

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