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NUVISTOR TWO-METRE CONVERTER

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Nuvistor receiving valves—designed, engineered, and constructed for vhf operation—have opened an entirely new field of amateur radio activity.

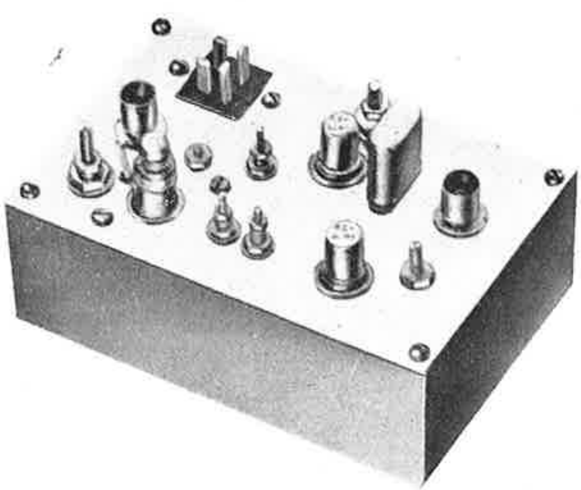
Consider the 6CW4, for example. Its wide acceptance as an rf amplifier for television fringe areas has proven its superiority over conventional triodes for weak-signal amplification. When used with the latest thimble-size nuvistor, the 7587 tetrode mixer, the overall performance of the 6CW4 as a front-end vhf converter is considerably enhanced.

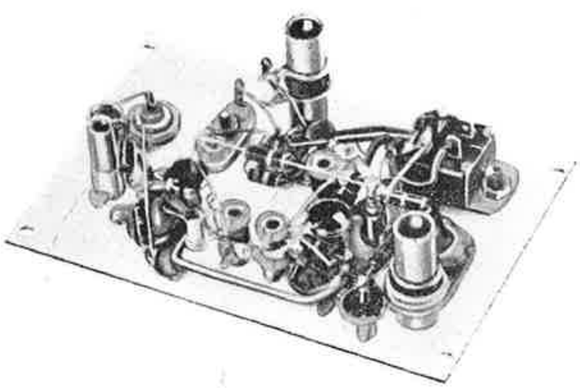
The 7587 has many advantages over its older glass-valve counterparts. In addition to small size, low heater power, rugged construction, and low lead inductance, the nuvistor tetrode has a high transconductance (almost twice that of the nearest glass valve) at a low plate voltage and plate current. It also has reduced input loading because it needs low local-oscillator drive. Because the valve has a high conversion gain, it provides a good output-signal voltage.

As shown in the schematic for a vhf mixer (Figure 1), the 6CW4 is used as a low-noise rf amplifier followed by a 7587 tetrode mixer. Another 6CW4 is used in a one-stage overtone crystal oscillator. The rf amplifier, an inductance-neutralized stage, is similar to one described in the September, 1960, issue of QST. The mixer and oscillator stages make optimum use of the unique nuvistor characteristics. Power required for the heaters is 410 milliamperes at 6.3 volts; for the B+voltage, approximately 25 milliamperes at 110 volts.

Construction

All coils except the rf-amplifier input coil have been wound on slug-tuned forms to provide neat construction and ease of alignment. Slug tuning





Top and bottom views of W2OKO's nuvistor two-metre converter.

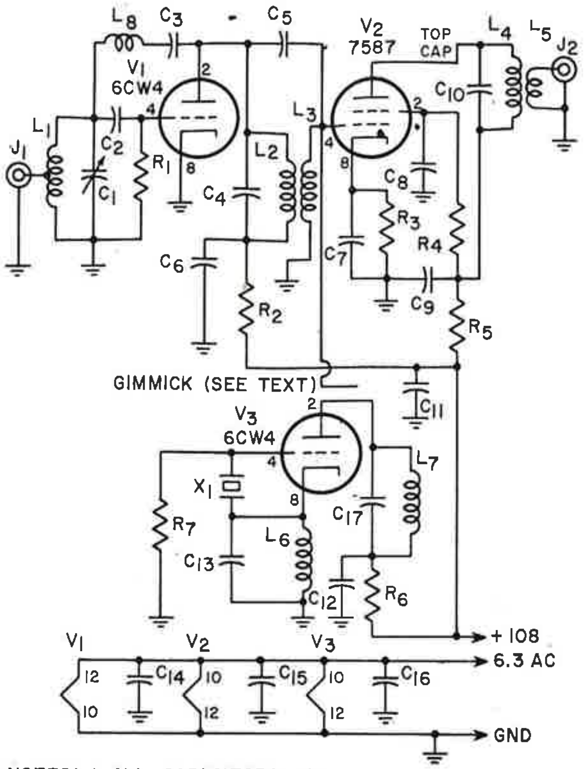


Fig. 1—Schematic diagram of the two-metre converter.

eliminates the need for pulling and squeezing neatly wound coils for proper tuning. If the template given in Figure 4 is used for layout, the coils can be mounted in the same position as on the original model, and unwanted feedbacks and intercouplings will be eliminated. The oscillator coil is coupled to the mixer input by a lead wire from the grid end of the mixer coil to an unused lug on the plate end of the oscillator coil. No further coupling is needed.

Because of their small size, nuvistor sockets are clamped (rather than bolted) to the chassis by bending two lugs on the socket. After the chassis hole is drilled, two notches are hand-filed (see Figure 4) to insure a tight fit of the socket to the chassis. For grounding, both socket lugs are soldered to the chassis, which should be a copper or brass plate. All ground connections for each socket should be made to the socket lugs, except in the case of the rf-amplifier, which uses the rf shield as the ground return. This rf shield for the amplifier valve (shown in Figure 2) is a thin piece of brass or copper soldered to pins 8 and 10 of the socket and to the chassis.

Parts List

C_1—0.5 to 5 pf tubular trimmer
C_2, C_3, C_{11}, C_{12}, C_{14}, C_{15}, C_{16}—500 pf ceramic disc
C_4, C_{17}—3.3 pf ceramic tubular
C_5—2.2 pf ceramic tubular
C_6, C_7, C_8, C_9—500 pf silver button
C_{10}, C_{13}—30 pf ceramic
J_1, J_2—Coax jack type BNC
L_1—5 turns No. 16 bare wire, $\frac{1}{4}$-inch diameter, spaced wire diameter, tap 2 turns up or best noise figure
L_2—4 turns No. 26 enamelled wire, $\frac{1}{4}$-inch diameter, close wound on slug-tuned form
L_3—4 turns No. 26 enamelled wire, $\frac{1}{4}$-inch diameter, close wound on slug-tuned form
L_4—11 turns No. 26 enamelled wire, $\frac{3}{8}$-inch diameter, close wound on slug-tuned form
L_5—3 turns insulated wire, close wound link
L_6—5 turns No. 26 enamelled wire, $\frac{3}{8}$-inch diameter, close wound on slug-tuned form
L_7—7 turns No. 26 enamelled wire, $\frac{1}{4}$-inch diameter, close wound on slug-tuned form
L_8—25 turns No. 30 enamelled wire, wound on 1-megohm $\frac{1}{2}$-watt resistor, approximately $\frac{5}{16}$-inch long; adjust for neutralization (see text)
R_1—47,000 ohm, $\frac{1}{2}$ watt
R_2—6800 ohm, $\frac{1}{2}$ watt
R_3—68 ohm, $\frac{1}{2}$ watt
R_4—18,000 ohm, $\frac{1}{2}$ watt
R_5—470 ohm, $\frac{1}{2}$ watt
R_6—27,000 ohm, $\frac{1}{2}$ watt
R_7—100,000 ohm, $\frac{1}{2}$ watt
Miscellaneous—1 standoff insulator; 1 socket; 1 crystal 39.33 megacycle overtone for output 26-30 Mc; 3 nuvistor sockets (order with valves)

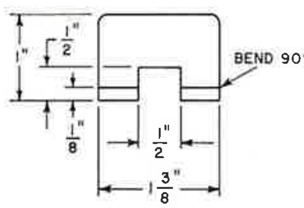


Fig. 2—Base shield.

As in all vhf construction, good grounds are essential. Connection to the top cap (of the tetrode) is best made with a piece of piano wire looped into a tight-fitting one-turn coil.

The converter described in this article was built for use at an if output frequency of 26 to 30 megacycles. For lower if outputs, only the crystal and the if output coil frequencies need be

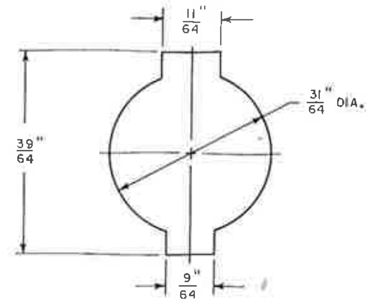


Fig. 3—Nuvistor socket hole.

changed. If operation at 14 to 18 megacycles is desired, a crystal frequency of 43.3 megacycles should be used. No changes are necessary in the oscillator coil. The output coil requires approximately 22 turns to tune to 14 megacycles.

Alignment

Alignment of this two-metre converter is simple. You need only a grid-dip meter and a receiver having an S meter. If available, sweep generators and noise sources can be used for greater accuracy in alignment.

First, use the grid-dip meter to set all coils to the correct frequencies: L_1, L_2, and L_3 to 146 megacycles, L_4 to 28 megacycles, L_6 to 40 megacycles, and L_7 to 118 megacycles.

Next, connect the antenna and receiver to the converter and apply power. The high-voltage input should not exceed 125 volts, the plate-voltage maximum rating for the 6CW4 and the 7587.

Check that the wiring is correct by comparing the voltages with those in the following table. All voltages are with respect to ground and may vary by 20%.

Voltage	*Valve Type* V_1 *6CW4*	V_2 *7587*	V_3 *6CW4*	
Plate to ground	65	103	50	volts
Screen grid to ground	—	50	—	volts
Control grid to ground	0	0	0	volts
Cathode to ground	0	–0.7	0	volts

If the grid-dip meter adjustments are made correctly, signals can be heard on the two-metre band. If no signals are heard, the oscillator should be checked by removing the crystal from the socket. With the crystal removed, the background noise from the receiver should fall off. A slight readjustment of L_6 may be necessary to start up the oscillation. L_7 should be peaked for maximum oscillator output.

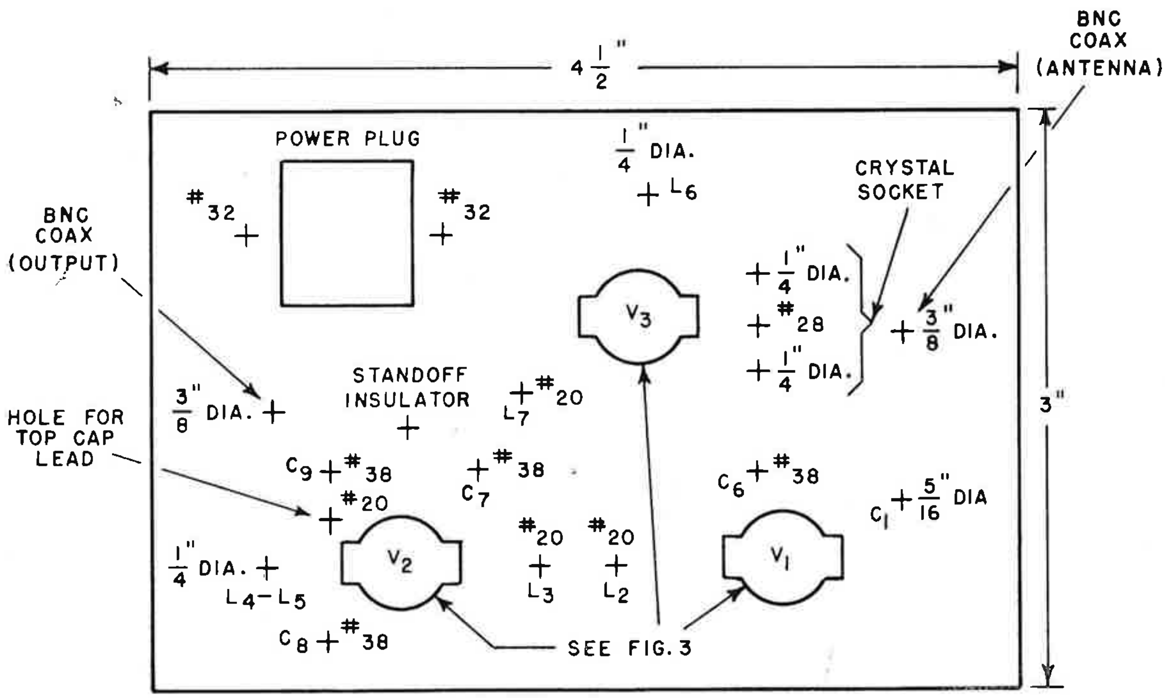


Fig. 4—Top view of the chassis plate, actual size.

Tune in a signal at about 145 megacycles and tune L_2 for maximum S-meter reading. Repeat at 147 megacycles and tune L_3. Find a signal near the middle of the band and tune L_1-C_1. This tuning is very broad.

The rf amplifier is most easily neutralized by first opening its heater lead. Adjust L_8 by starting with a few extra turns and removing one turn at a time to find the point of minimum feed-through of a strong signal when the other valves are operating. This adjustment is not very critical.

Adding AVC

Crystal-controlled vhf converters are usually designed for low noise and maximum sensitivity to improve reception of weak signals. For this reason, no provision is made for adjusting the gain of the rf amplifier.

This converter was so designed, and the 6CW4 triode amplifier is operated "wide open" at all times. With only weak signals present, this arrangement is good. However, strong local signals can cause loading of the converter and crossmodulation.

Crossmodulation can be reduced by the use of automatic gain control on the 6CW4. The newly announced 6DS4 nuvistor triode, however, is much better suited for this application because of its added feature of semiremote cutoff. Because the agc voltage in a communications receiver is not developed until a reasonably strong signal is received, the converter still has maximum sensitivity for weak signal reception.

Circuit Changes

Modification of the original converter is very simple. The new 6DS4 is substituted in the same socket for the 6CW4. One resistor and two capacitors are added. The agc voltage is obtained from the communications receiver with which the converter operates.

Figure 5 shows the modification of the grid circuit of the rf amplifier. The original grid resistor, R_1, is lifted from ground and rewired

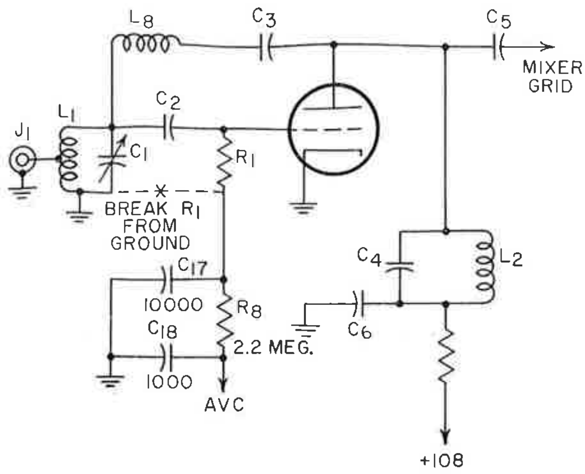


Fig. 5—Modification of the two-metre converter for avc. R_8, 2.2M, ½ watt; C_{17}, 10,000 pf ceramic; C_{18}, 1,000 pf ceramic.

through the new R_8 to the spare contact on the socket. C_{17} and R_8 are added as close to R_1 as possible, and C_{18} is added at the socket.

The source of the agc voltage in the communications receiver is easily found by studying the receiver schematic and locating the agc line in the chassis wiring. The agc voltage should vary from zero at no signal to about 8 to 10 volts negative at maximum signal.

One word of caution is advisable. Some communications receivers use a fixed bias between grid and ground for the rf and if stages. If this bias is applied through the receiver agc circuit, it is always present. Thus, it would also be applied continuously to the converter and would greatly reduce its sensitivity. The receiver to be used must have zero voltage on the agc line in the absence of signals.

The effect of this simple circuit addition makes the change very worthwhile, especially in areas of strong signal reception.

(With acknowledgements to RCA)

Operating Conditions for the 6DQ6A as a Class AB1 AF Power Amplifier

We have been frequently asked for the operating conditions for the 6DQ6A as an af amplifier, particularly by "Hams". These conditions were established with a no-load plate dissipation of 20 watts, maximum plate dissipation of 25 watts, all supplies regulated, fixed bias with matched valves. All readings are "per valve", except power output, which is the total for the two valves.

E_{bb}	300			460			560		V
E_{c2}	150	175	200	150	175	200	150	175	V
E_{c1}	−22	−31	−35	−29	−36	−40	−31	−38	V
I_b (O)	67	67	67	44	44	44	38	38	MA
I_{c2} (O)	1·6	2·1	2·5	1·5	2·0	2·3	1·0	1·3	MA
I_b (MAX)	108	130	145	100	120	140	100	118	MA
I_{c2} (MAX)	6	8	10	5	7	9	5	7	MA
P_{PLATE}	15	18	19	18	20	25	20	23	W
P_{SCREEN}	0·8	1·4	2·0	0·8	1·2	1·8	0·8	1·1	W
R_L P-P	3300	2600	2200	5500	4500	3600	6800	5600	Ω
P.O.	34	43	50	57	71	79	72	86	W
DIST.	2·0	3·0	3·0	3·0	3·0	5·0	5·0	5·0	%
EFF.	53	57	57	62	65	62	64	65	%
I_b PEAK	300	360	440	300	360	440	300	360	MA
E_b (MIN)	50	55	60	50	55	60	50	55	V
e_{g1} P-P	44	62	70	58	72	80	62	76	V

I_b = approx. knee current
$E_{b\ min}$ = approx. knee voltage
$e_{g1\ p\text{-}p}$ = peak-peak grid drive
P.O. = total average power output

RANDOM REFLECTIONS

On a recent date when I broke into print (Radiotronics Vol. 26, No. 8), the main topic was high fidelity and things pertinent thereto. Admittedly some of the statements were mildly controversial, and the incoming mail was most interesting. That adventure led to the idea of making a similar attempt at not too far distant intervals. So this is what is going to happen if you like the idea, and the subjects dealt with will in general be chosen from general queries received from readers (no names). This is not intended to be a monthly article, but will be used when we feel there is something of general interest to contribute.

Audio Response

Engineers and other professional people have a well-known habit of wrapping what they have to say in superfluous verbage, which may be impressive, but can also be annoying and frustrating to the man who wants only a simple answer to a simple question. A typical case in point is the specification of a circuit's frequency response in terms of the time constants of the circuit. This is all very well in the electronic workshop, where it is a very convenient way of talking about the matter. But a reader wrote in recently to say that he had a preamplifier in which the equaliser circuits were described in microseconds. I must say that I agree that this is a little difficult for those non-technical people who may go out and buy the unit.

As it seems likely that the expression of frequency characteristics in microseconds will come into more general use as time goes by, it may be just as well to make sure that we understand just what is involved. Equalising circuits are used to increase or decrease the sensitivity, and therefore the output of the circuit, over a part of the frequency range. The use of the time constant assists to some extent in finding a single term to serve as an indication of performance.

If we study a simple bass boost circuit, consisting of an R and a C in series, bass boost is obtained because the circuit impedance of the two components in series varies with frequency. In fact the circuit impedance increases as the frequency decreases, hence the bass boost. If now we forget about the actual values of the components, and search for a generalisation, we find that if the frequency versus impedance characteristic of such a circuit is plotted in terms of the ratio between the operating frequency and that frequency at which the capacitive reactance Xc equals the value of the resistance R, then the shape of the characteristic remains the same for all similar series combinations of R and C. Remember however that the absolute values of impedance depend on the actual values of R and C.

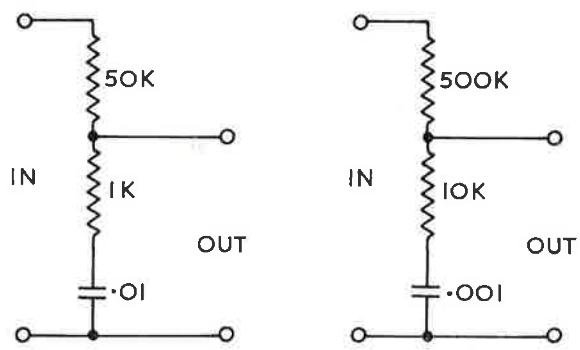


Fig. 1

The standard characteristic plotted as just described is shown in Fig. 1. Two bass boost circuits are shown in Fig. 2. It will immediately be seen that they are identical, with the exception that that on the right has had the resistance values scaled up by a factor of 10 and the capacitor scaled down by a similar factor. Both of these circuits will have an identical characteristic, although the absolute values of impedances across the circuits will of course differ.

Where frequency response is concerned, the important thing is the relative response; this will be the same in both circuits shown. The shape of the frequency characteristic therefore is determined by the time constant of the circuit, the product of C and R (farads X ohms OR microfarads X megohms). This property is called the time constant because it gives the time in seconds required to charge the capacitor C through the series resistor R to 63% of the applied voltage.

Returning now to Fig. 1, which shows the basic frequency characteristic for all series circuits of C and R, it will be seen that the impedance is 3 db up at the frequency at which Xc equals R. As frequency response is also quoted in relation to that frequency at which the response is 3 db above the reference frequency, the correlation between the two systems will now be readily seen. If, for example, the time constant in microseconds is quoted, the frequency at which Xc equals R, i.e., the 3 db point, can readily be ascertained. The relationship is shown in the simple diagram of Fig. 3. Having ascertained the "3 db" frequency, we can gain a rapid approximation of the frequency at which the response is 10 db up by dividing the "3 db" frequency by three.

As a simple practical example of the use of this system, Specification BS.1562 calls for a bass boost time constant of 100 microseconds. From Fig. 3 we find that Xc equals R at about 1600 cps. The frequency response called for is therefore 3 db up at 1600 cps and about 10 db up at 533 cps.

Audio Power

There are a lot of people who seem to confuse high quality performance with high power output. I recently saw that there is available overseas a stereo amplifier with an output of 75 watts in each channel. This 150-watt unit is apparently intended primarily for home use. It makes one wonder where it is going to end. I wonder how many of the protagonists for high power have made an analysis of the costs involved both in buying and in operating these monsters. It has to be remembered that one has to consider not only the initial cost of buying the units, but the cost of operating them, not the least point of which is the cost of the mains power they consume.

Where power is very cheap, this may seem a trifling point, but when it costs between 2d and 2½d a unit, the annual charge for power could be significant. Some of us can still remember the anguished cry that went up in homes nearby when the first power bill after the installation of TV was received, and an extra 200 watts or so for several hours a day had to be paid for.

My own experience over many years has been that very satisfactory performance can be achieved with much lower powers and at dramatically lower cost, both cost to own and cost to run. To make firm statements is always very dangerous because circumstances alter cases. As a general rule however, I would regard 15 watts (30 watts stereo) as a top limit for home use, with the norm in the 5 to 10 watts per channel region. Where high efficiency horn speakers of the Lowther and Brociner type are used, I would say certainly no more than 5 watts in each channel would be more than adequate.

One of the arguments put up for the use of high power is the ability of the equipment to handle transients without overloading. To a limited extent this is quite true. When we remember the nature of a transient however, we are drawn to the conclusion that its duration is so short that one is hardly likely to be able to discover even gross distortion in the reproduction, assuming the distortion to be there anyway.

We can approach this matter from another viewpoint, that of the energy actually present during a live performance. To cover all instruments, take the case of a 75-piece orchestra, quite a sizable combination. As a result of work done at the Bell Telephone Laboratories we know that such an orchestra produces a whole spectrum peak power of the order of 66 watts, but this level is reached during only approximately 1% of the playing time. A level of approximately 13 watts is reached for about 10% of the time. The main difference in the two levels is very interesting, being due chiefly to drums, mainly in the under 100 cps region, and cymbals, mainly in the over 8,000 cps region. Both tympani and cymbals are percussion instruments where the argument about transients is applicable.

The conclusion is that one may argue that 15 watts will adequately reproduce the orchestra in the home for most of the time,* assuming of course that the amount of sound can be tolerated in the home, which seems unlikely. If the peak powers reached during 10% of the playing time are limited to a figure lower than 15 watts, say 5 watts (still high) to enable one to stay in the same room, and the 1% peak power requirement scaled down to suit, it seems that a 15 watt amplifier has more than a good chance of being all that could normally be required in a private home.

* Even with low-efficiency cone speakers

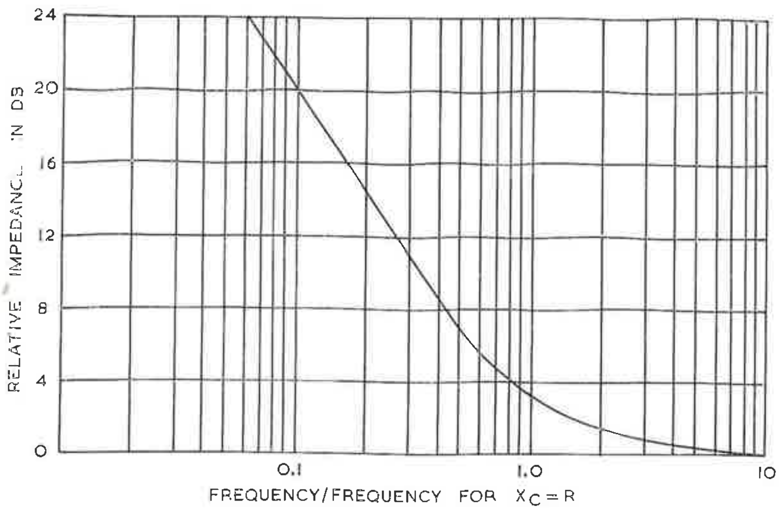


Fig. 2

Defining Power

When discussing power levels, it is important to define exactly what is meant and where it applies. The specification of a completed amplifier will usually mean power delivered to a resistive load connected across the output whilst not exceeding the stated figures for distortion. This is a simple enough convention. There is a tendency these days though to talk of so-called "music power." This figure is usually of the order of 30% up on the output power measured with a pure sine wave input, and is defended on the grounds that it more closely represents what the amplifier will do.

Whilst a sine wave is of course a simple configuration, well understood and easily dealt with, music is a complex wave, rich in harmonics, and subject to constant change during the performance of a work. It therefore seems an unreliable criterion. Admittedly one can probably devise a weighting factor to gain an approximation to music averaged over a sufficiently long time, but even this approach has obvious pitfalls.

So for the time being at any rate, Radiotronics specifications will adhere to the idea of power delivered to the load under sine wave conditions. It is also important to state (so many forget) in the case of stereo amplifiers, whether the power figure is per channel or the total in both.

Where valve data is concerned, a few readers have complained that they have been unable to obtain the typical power output figures claimed for specific types in the valve data. One reason for this, and it applies to transistors also, is that the manufacturer is talking about power in the plate or the collector circuit and not in the load. He has no control over the characteristics, particularly the efficiency, of the output transformer which will be used. He therefore has to use this convention to be able to state a figure which means something.

Let's take a typical case. The RC20 manual tells us that two 6V6G's or 6AQ5's, with 250 volt plate and screen supplies and with —15 volts bias, will typically deliver a maximum output of 10 watts into a 10,000 ohm plate to plate load at 5% total harmonic distortion. Audio transformers range in efficiency between 70% and 95%, depending on size, cost and other factors; we may therefore expect to get between 7.0 and 9.5 watts into the load.

Further, the distortion figure finally achieved will depend on many factors besides the two output valves used, the particular output transformer chosen being one of them. Not only will a poor output transformer mean a lower power output, but the distortion figures will almost inevitably be worse. It would probably be true to say that no amplifier can be better than its output transformer.

Supply Voltages

Before passing on to another subject, there is of course another trap for new players in the operation of valves for specified power outputs. This is the question of plate and screen supply voltages. The conditions specified by the makers are for the actual voltages mentioned to be present on the various electrodes. In the case of the two 6AQ5's previously mentioned, the plate and screen supply voltages are intended to be those actually present with respect to cathode.

If the —15 volts required for bias is obtained by the cathode bias method, and the B+ voltage is not adjusted accordingly, a B+ voltage of 250 volts will actually provide plate and screen voltages of only 235 volts. There may also be other smaller losses, as for example in the IR drop across the primary dc resistance of the output transformer. As the power output of a pentode is calculated from the voltage swing multiplied by the current swing, divided by 8, the condition mentioned could reduce the plate circuit power by perhaps 0.5 watt or more. The plate circuit power is still subject to output transformer efficiency. With a poor transformer therefore, and a plate supply voltage lower than the B+ voltage may at first glance indicate, it is conceivable that instead of 10 watts, an output of the order of 7 to 8 watts may be all that was available, and even then possibly at higher distortion levels. All this is no fault of the valve, but is a user problem.

More on Stereo

The subject of stereo has been discussed at such length over the last few years that one may be justified in wondering whether there is anything left to be said. What is needed now is not so much something new to say, but a summary of the technique, a concensus of opinion. This is not the place to do this, as it would merit an article by itself. There is one point however which will answer a lot of queries received.

The question is one of speakers. As we all know, two speaker systems are required, each of which could be a single unit speaker or a combination of two or more units with crossover networks. Where cost is not important, the problem of choice is less difficult; the indicated approach would be towards using a combination system in each channel, and with perhaps a couple of notable exceptions this approach would provide the best sound.

In most cases however, cost is a major factor, and here the problem is to get the best for the least. One approach here is to buy two of the best single unit wide range or extended range speakers that one can afford, and install them in suitable enclosures. But there is another approach well worthy of consideration which has been mentioned in these pages before. It is the combined bass system. (See Radiotronics, Vol. 24, No. 11).

In this system, two small speakers are used to handle frequencies above about 300 cps from each of the two channels, whilst frequencies below that crossover point, from both channels, are fed to a single low frequency speaker. The low frequency speaker would be fitted in a suitable enclosure, and could be placed almost anywhere in the listening room. The two medium-to-high-note speakers are fitted in simple box cabinets and are placed in the usual way to provide the best stereo effect.

The mixed or combined bass system depends on the fact that the ear is almost completely insensitive from a direction-finding point of view to sounds below the suggested crossover frequency or thereabouts. The advantages of the system are that only one large speaker is required, and it can be placed almost anywhere in the room, whereas the two medium-to-high-note speakers will be much smaller than two wide range systems in enclosures, so easing the problem of placement for the best stereo effect. By a careful selection of speakers there is every chance that the three speakers would work out cheaper than two wide range units.

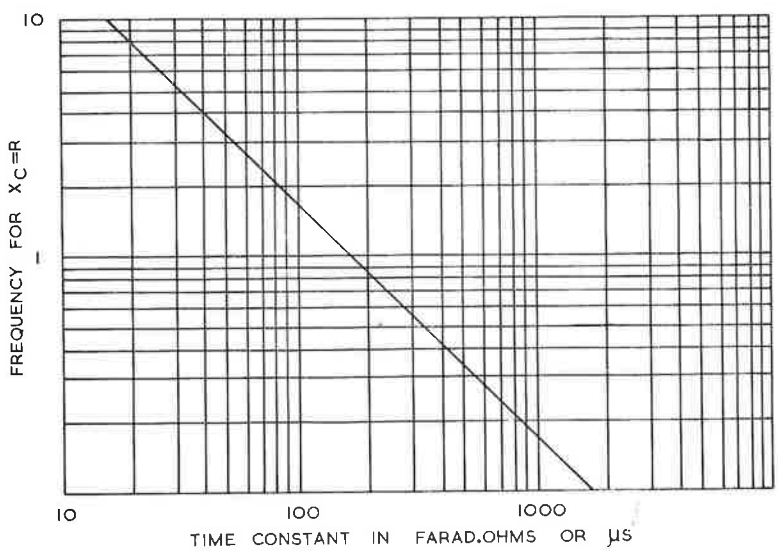


Fig. 3

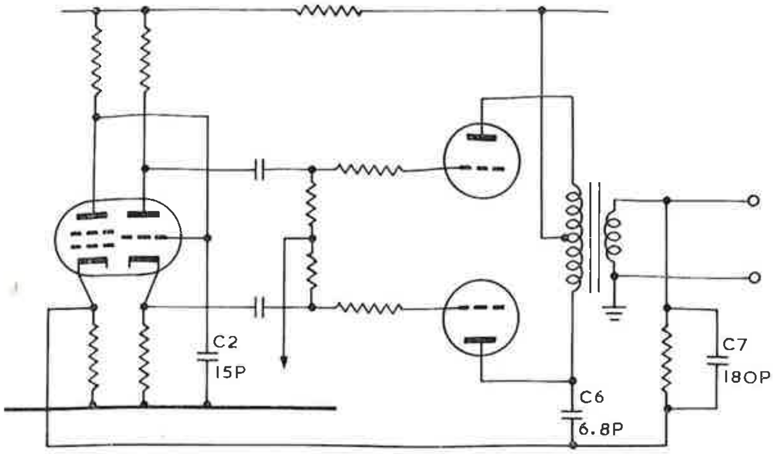


Fig. 4

As with everything, there will be purists who maintain that this system is unsatisfactory. This may be true to an extent dictated by the standards of comparison. If we compare such a low-cost system using speakers costing perhaps £35 or even less for the three, with a system using two top-grade wide-range speakers costing over £200 for the pair, then the result is a foregone conclusion. But here the prime consideration is cost and the reproduction of music of acceptable quality; if these are the weighty factors, then such a system can give results which are acceptable from a quality point of view and provide good value for money.

What is Acceptable?

There are so many dogmatic statements made about high quality reproduction that the average person may be justified in wondering what is happening and when someone is going to agree with someone else on the subject. Let us be completely realistic about the matter, and divide equipment immediately into two classes. The first class is equipment made almost without regard to cost, to provide, in the maker's opinion, the best quality available; this equipment as one might expect is costly, but in general does a good job.

Forgetting about that for the moment, there is another class of equipment in which most people are interested, which provides acceptable quality at minimum cost. In this sense the term "acceptable" is by no means meant in a derogatory sense; it indicates that the equipment provides reproduction to certain minimum standards, in other words that it will sound good, and that it is good value for money. Many commercial radiograms, for example, come well within this classification, although a purist would not dream of owning such an instrument. As it caters for the majority therefore, we tend from time to time to stress the idea of "acceptability" as a balanced assessment of a unit, rather than the idea of assessing outright quality, which must lead to a comparison with the best available.

Changing Components

One of the most frequent queries we receive is concerned with the substitution of alternative components in designs which we publish. In most cases there are many minor changes which can be made without materially affecting the performance of the unit, but unfortunately it is generally in the larger and more important components that the reader wishes to use a component "he happens to have". A typical case is the output transformer of an audio amplifier.

In any amplifier of reasonable quality, the particular output transformer used is an integral part of the design of the unit. It cannot therefore be substituted without running the risk of lowering the performance, or even of buying trouble in the shape of instability or other troubles. Hence our general attitude must always be that components as specified must be used.

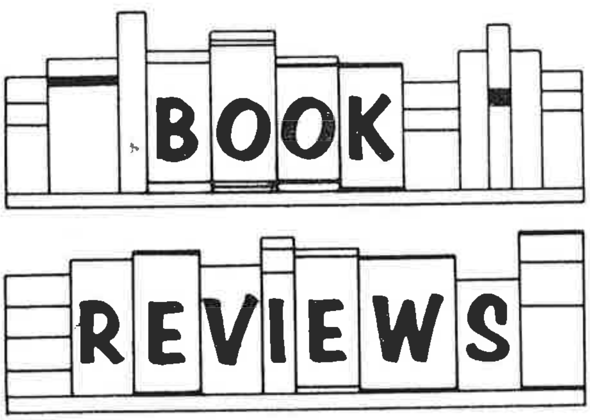
It is surprising how many people fail to realise the work that goes into a good audio amplifier. This is often because they have themselves thrown amplifiers together and found that they have worked. They would probably be horrified if they were able to examine the performance of some of these units with proper equipment. There is a big difference between a unit which on first hearing "doesn't sound too bad", and a unit which is technologically good.

As any engineer will tell you, when he gets his first model built and working, he has only just started the real task of bringing the unit to a pre-determined standard of performance. This phase of the work may take days or weeks, involving countless component changes and measurements, extensive field testing, checking with limit valves, and other measures intended to ensure a sound design.

To show how component changes can affect performance, Fig. 4 shows part of a high quality audio amplifier using negative feedback from the output transformer secondary winding. The original design used a specified make and type of transformer. Now even when a transformer of comparable quality and meeting the same general specification is substituted, differences in winding techniques, leakage inductance, primary inductance and other qualities which cannot be strictly controlled between one make and another, may call for minor changes in the circuit values. These changes can only be made with the aid of suitable measuring and testing equipment, and are therefore beyond the scope of many home constructors. Admittedly they may get the amplifier "sounding good", but that is not quite the same thing.

In the circuit in question, capacitors C2, C6 and C7 are typical components whose values may have to be altered to suit a change in output transformer, even when the new transformer meets the specification of the original. Capacitor C2, 15 pf in the original design, is to ensure critical damping by adjusting the time constant of the pentode voltage amplifier stage. Capacitor C6, originally 6.8 pf, is intended to prevent instability due to that portion of the voltage amplifier plate current which flows through the output transformer secondary. Capacitor C7, originally 180 pf, is of course to provide feedback phase correction at high frequencies. This work amounts to a partial redesign of the unit. So unless the equipment to do this work is available, it is better and safer to adhere to the original specification, which has been thoroughly tried and tested.

B.J.S.



SUPER-RADIOTRON Valve Manual, Publication RVM-4, Amalgamated Wireless Valve Co. Pty. Ltd., 17/6d. post free. Size 10¾" x 8½". 120 pages.

This latest edition of the AWV valve manual has been considerably increased in size, as the number of pages will indicate, and is one of the most ambitious books of its type ever produced. The contents of the book fall into the following main headings: Receiving valve data, covering over 1200 types: Receiving valve equivalents listing: TV Picture tube data section: TV Picture tube replacement guide, covering full replacement data on nearly 60 types: Semiconductor section, covering diodes and transistors: Transistor interchangeability guide.

"High Quality Sound Reproduction." James Moir. Chapman and Hall. Size 8½" x 5½". 660 pages. Copiously illustrated.

This review copy is the second edition, dated 1961. Since the first release in 1958, the chapters on disk recording, magnetic recording and stereo have been extensively rewritten, and other material revised. In the few short years since 1958, this authoritative work has achieved such a position in the hi fi library as to render a review at this stage almost superfluous. Suffice it to say that this book is one of the most complete surveys of the entire problem of hi fi available today. The chapters dealing with the objective and subjective problems, as opposed to the electronic side of the problem, are the most complete and informative I have seen. The book is rated as a "must" for the hi fi engineer and serious audiophile.

"Electronic Games and Toys You Can Build." L. Buckwalter. Howard W. Sams and Co. Inc. Size 8½" x 5½". 128 pages. Well illustrated.

This book is not perhaps in the class we generally review, but even the serious experimenter likes to have fun sometimes. With the winter season approaching, this book may help to keep children (and parents) amused during bad weather weekends. This volume describes 15 games and toys of varying degrees of complexity. All are well illustrated and none require any skill to construct—in fact most of them could be easily put together by children of 12 and upwards. All except one operate on low voltage dry batteries and are therefore completely safe. Perhaps the provision of a couple of toys for the children may make the distaff side of the family happier about the hours you spend in the "den" or the "shack."

"Using the Oscilloscope in Industrial Electronics." R. Middleton and L. Payne. Howard W. Sams and Co. Inc. Size 8½" x 5½". 256 pages. Well illustrated.

This book deals with the capabilities and use of industrial oscilloscopes. The oscilloscopes used in industrial electronics are often specialised units which either have special facilities not generally found in general purpose units, or are developed for a particular function only, e.g., engine analysis. As the authors point out, no one book could possibly cover all uses of the oscilloscope in industry. The purpose of the book therefore is to demonstrate the capabilities and applications of industrial oscilloscopes, together with a series of representative industrial test set-ups.

"Handbook of Electronic Charts and Nomographs." A. Lytel. Howard W. Sams and Co. Inc. Size 11" x 8½". 58 Charts and Nomographs.

A nomograph is a chart which facilitates the solution of numerical formulæ and equations using only a straight-edge. Maurice d'Ocagne established himself as the father of nomography in 1899 in his "Treatise on Nomography." A properly-planned nomograph is often faster and more convenient to use than a slide rule, and its results can have the same degree of accuracy. We see nomographs scattered throughout the literature of the radio art, but this is one of the few attempts to gather a comprehensive collection together. The provision of a plastic overlay sheet avoids marking the charts. A publication of this kind can find a place in any laboratory and workshop; once the habit of using it is formed, it will save hours of time.

"Radio and Electronic Laboratory Handbook." M. G. Scroggie. Iliffe Books Ltd. Size 8½" x 5½". 537 pages. Well illustrated.

I first met this book under the title "Radio Laboratory Handbook" over 20 years ago, and even then it was unique. A large part of the work of engineer and experimenter alike deals with measurements, and there are many pitfalls for the unwary. In his many writings Mr. Scroggie has made an enormous contribution to the radio art; in my opinion this book, in its many editions, has been the largest single benefit to the art. The seventh edition, now under review, is updated with the addition of semiconductors and general revision. To those few who do not know this book, it deals extensively with the techniques of measurement, methods and approaches, equipment, evaluation of results and allied considerations. To say that this book is in the standard reference book class is an understatement, and it is worthy of an unqualified endorsement.

"PRINCIPLES OF APPLIED ELECTRONICS". R. S. CARSON. McGraw-Hill Book Co. Inc. Size 9" x 6". 485 pages. Copiously illustrated.

The object of the author in preparing this book has been to present a general survey of the electronics field, with the idea of providing a fundamentally-sound knowledge of the subject. The book assumes a working knowledge of ac and dc circuits. In my opinion the book, with the co-operation of the reader, is capable of doing what it set out to do.

The arrangement of this book is interesting. The general plan has been to group devices of all kinds into corresponding types, e.g., two-element, three-element, multi-element devices, and so on, and then to go on to discuss the uses of these devices as amplifiers, rectifiers, oscillators as the case may be. Later chapters show how the basic circuits are brought together to form communication and control systems.

The grouping of non-linearity products all together in a chapter of their own was an inspiration, and produced something very worth while. This is not a book for the beginner. Whilst most calculations are restricted to algebra and trigonometry, a thorough grasp of the subject does of course require an appreciation and understanding of the propositions and examples put forward.

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TRANSISTOR INTERCHANGEABILITY GUIDE

This listing is to be used as a guide only. Types shown as replacements are not necessarily electrically and physically identical with the type to be replaced except where marked with an asterisk (*). For more complete information on transistor interchangeability, consult published data on the relevant types.

KEY TO SYMBOLS

- * Denotes direct interchangeability.
- † Denotes discontinued type.
- ‡ 2N247 and 2N274 are identical except for case size and interlead capacitances.
- • This indicates that the replacement transistor shown is a flying lead type, and must be soldered into the circuit. This can be done in many cases by passing the leads through the appropriate socket holes, and soldering the connections on the underside.

Type	Replacement	Type	Replacement	Type	Replacement
2N34†	2N408•	2N61	2N270	2N113	2N218•
2N34A†	2N408•	2N62	2N217•	2N114	2N219•
2N35†	2N647	2N63	2N217	2N115	2N270
2N36	2N217	2N64	2N217	2N116	2N220•
2N37	2N408	2N65	2N217	2N123	2N269
2N38	2N408	2N76	2N217•	2N125	2N585
2N38A	2N408	2N77†	2N105*	2N126	2N585
2N39	2N217	2N79†	2N331	2N128	2N247‡
2N40	2N217	2N85	2N217•	2N129	2N1634
2N41†	2N105	2N86	2N217•	2N130	2N105
2N42	2N217	2N87	2N217•	2N130A	2N105
2N43	2N217•	2N88	2N105	2N131A	2N105
2N43A	2N331	2N89	2N105	2N132	2N105
2N44	2N217•	2N90	2N105	2N132A	2N105
2N44A	2N217•	2N94	2N585	2N133	2N220•
2N45	2N217•	2N96†	2N331	2N133A	2N220•
2N46†	2N105	2N104	2N217•	2N135	2N218•
2N47	2N105	2N105	2N105*	2N136	2N218•
2N48	2N105	2N106	2N217•	2N137	2N219•
2N49	2N105	2N107	2N406	2N138	2N406
2N54	2N217•	2N109	2N217•	2N138A	2N406
2N55	2N217•	2N111	2N218	2N138B	2N270
2N56	2N217•	2N111A	2N218	2N139	2N218•
2N59	2N270	2N112	2N218	2N140	2N219•
2N60	2N270	2N112A	2N218	2N155	2N301*

Type	Replacement	Type	Replacement	Type	Replacement
2N156	2N301	2N238	2N217	2N323	2N270
2N157	2N561	2N240	2N582	2N324	2N408•
2N167	2N1090	2N241	2N217	2N325	2N301
2N173	2N301	2N241A	2N270	2N326	2N301
2N175	2N220•	2N242	2N301A*	2N331	2N331*
2N176	2N301	2N247	2N247*‡	2N344	2N274‡
2N180	2N217	2N248	2N247‡	2N345	2N274‡
2N181	2N270	2N249	2N270	2N346	2N384
2N185	2N270	2N250	2N301*	2N350	2N301
2N186	2N217	2N251	2N301A*	2N351	2N301
2N186A	2N270	2N252	2N1636	2N351A	2N301
2N187	2N217•	2N255	2N301*	2N352	2N301*
2N187A	2N270	2N256	2N301*	2N353	2N301*
2N188	2N217•	2N257	2N301*	2N356†	2N585
2N188A	2N270	2N265	2N408	2N357†	2N1090
2N189	2N408	2N267†	2N247‡	2N358†	2N1091
2N190	2N408	2N268	2N301A	2N362	2N217
2N191	2N270	2N269	2N269*	2N363	2N217S
2N192	2N270	2N270	2N270*	2N367	2N406
2N195	2N217	2N271	2N269	2N368	2N217
2N196	2N217	2N271A	2N269	2N369	2N217
2N197	2N217	2N272	2N217•	2N370	2N370*
2N198	2N217	2N273	2N217•	2N371	2N371*
2N199	2N217•	2N274	2N274*‡	2N372	2N372*
2N200	2N331	2N279	2N217	2N373	2N1634
2N204	2N331	2N280	2N217	2N374	2N1636
2N205	2N331	2N281	2N217	2N375	2N561
2N206†	2N331*	2N283	2N217	2N376	2N301
2N207	2N105	2N285	2N301	2N376A	2N301
2N207A	2N105	2N285A	2N301	2N377	2N1090
2N207B	2N105	2N296	2N301A	2N378	2N561
2N215	2N217	2N297A	2N457	2N379	2N561
2N217	2N217*	2N301A	2N301*	2N380	2N561
2N218	2N218*	2N301	2N301A*	2N381	2N270
2N219	2N219*	2N302	2N269	2N382	2N270
2N220	2N220*	2N303	2N269	2N383	2N270
2N223	2N270	2N307	2N301*	2N384	2N384*
2N224	2N270	2N307A	2N301*	2N385	2N1090
2N226	2N270	2N308	2N1634	2N386	2N301A
2N231	2N218	2N309	2N1634	2N388	2N1090
2N232	2N218	2N310	2N1634	2N394	2N269
2N234	2N301*	2N311	2N269	2N395	2N581
2N234A	2N301*	2N312	2N585	2N396	2N269
2N235	2N301*	2N315	2N578	2N397	2N582
2N235A	2N301*	2N316	2N579	2N398	2N398*
2N235B	2N301A	2N317	2N582	2N399	2N456
2N236A	2N301	2N319	2N270	2N400	2N456
2N236B	2N301A	2N320	2N270	2N401	2N456
2N236A	2N301	2N321	2N270	2N402	2N406
2N237	2N220	2N322	2N406	2N403	2N217

Type	Replacement	Type	Replacement	Type	Replacement
2N404	2N269	2N511A	2N457	2N629	2N561
2N405	2N406•	2N511B	2N561	2N631	2N408
2N406	2N406*	2N518	2N269	2N632	2N408
2N407	2N408•	2N519	2N578	2N633	2N408
2N408	2N408*	2N520	2N578	2N635	2N1091
2N409	2N410•	2N521	2N579	2N636	2N1091
2N410	2N410*	2N522	2N580	2N637	2N561
2N411	2N412•	2N523	2N643	2N637A	2N561
2N412	2N412*	2N524	2N586	2N637B	2N561
2N413	2N218	2N525	2N586	2N638	2N561
2N413A	2N218	2N526	2N586	2N638A	2N561
2N414	2N218	2N527	2N586	2N638B	2N561
2N414A	2N218	2N536	2N578	2N639	2N561
2N415	2N1636	2N544	2N1632	2N639A	2N561
2N415A	2N1636	2N554	2N301*	2N639B	2N561
2N416	2N247‡	2N559	2N645	2N640	2N1637
2N417	2N247‡	2N561	2N561*	2N641	2N1638
2N418	2N301	2N576	2N585	2N642	2N1639
2N419	2N561	2N576A	2N585	2N643	2N643*
2N420	2N561	2N578	2N578*	2N644	2N644*
2N421	2N561	2N579	2N579*	2N645	2N645*
2N422	2N215	2N580	2N580*	2N647	2N647*
2N425	2N1319	2N581	2N581*	2N649	2N649*
2N426	2N1319	2N582	2N582*	2N659	2N578
2N427	2N579	2N583	2N583*	2N660	2N643
2N428	2N580	2N584	2N584*	2N661	2N643
2N438A	2N585	2N585	2N585*	2N662	2N579
2N439A	2N1090	2N586	2N586*	2N705	2N1300
2N440A	2N1090	2N591	2N591*	2N1010	2N1010*
2N444	2N585	2N597	2N578	2N1016A	2N1487
2N445	2N585	2N598	2N579	2N1016B	2N1488
2N446	2N1090	2N599	2N580	2N1017	2N582
2N447	2N1091	2N602	2N643	2N1021	2N1014
2N456	2N456*	2N603	2N644	2N1022	2N1014
2N457	2N457*	2N604	2N645	2N1023	2N1023*
2N458	2N561	2N605	2N384	2N1031	2N561
2N460	2N331	2N606	2N384	2N1031A	2N561
2N461	2N331	2N607	2N384	2N1038	2N1183
2N464	2N217S	2N608	2N384	2N1039	2N1183A
2N465	2N217S	2N609	2N217	2N1040	2N1183B
2N466	2N217S	2N610	2N217	2N1041	2N1183C
2N481	2N1632	2N611	2N217	2N1043	2N561
2N482	2N1634	2N612	2N217	2N1044	2N561
2N483	2N1634	2N613	2N270	2N1058	2N412
2N484	2N1634	2N614	2N1634	2N1059	2N270
2N485	2N1636	2N615	2N1634	2N1066	2N1066*
2N486	2N1636	2N617	2N1636	2N1067	2N1483
2N499	2N371	2N618	2N561	2N1068	2N1483
2N504	2N1634	2N623	2N645	2N1069	2N1487
2N511	2N456	2N628	2N561	2N1070	2N1489

Type	Replacement	Type	Replacement	Type	Replacement
2N1090	2N1090*	2N1490	2N1490*	2SD77	2N647
2N1091	2N1091*	2S30	2N412	2T64	2N647
2N1092	2N1092*	2S31	2N410	2T65	2N647
2N1097	2N217•	2S32	2N406	2T66	2N647
2N1098	2N217•	2S33	2N408	2T76	2N218
2N1101	2N647	2S34	2N270	8D	2N218
2N1102	2N647	2S35	2N218	8E	2N218
2N1144	2N217•	2S36	2N218	8F	2N218
2N1145	2N217•	2S37	2N217	10A	2N270
2N1172	2N301A	2S38	2N270	10B	2N270
2N1177	2N1177*	2S39	2N220	10C	2N270
2N1178	2N1178*	2S40	2N269	206	2N105
2N1179	2N1179*	2S41	2N301	300	2N217
2N1180	2N1180*	2S42	2N301	301	2N217
2N1183	2N1183*	2S43	2N1632	302	2N217
2N1183A	2N1183A*	2S44	2N217	310	2N217
2N1183B	2N1183B*	2S45	2N410	350	2N217
2N1184	2N1184*	2S52	2N412	352	2N217
2N1184A	2N1184A*	2S56	2N270	353	2N217
2N1184B	2N1184B*	2S91	2N270	830	2N219•
2N1193	2N270	2S109	2N1632	1032	2N217•
2N1202	2N561	2S110	2N1636	1033	2N217•
2N1224	2N1224*	2S112	2N372	1034	2N217•
2N1225	2N384	2S141	2N370	1035	2N217•
2N1226	2N1226*	2S142	2N1636	1036	2N217•
2N1264	2N370	2S143	2N1634	1320	2N217•
2N1265	2N408	2S144	2N1636	1330	2N217•
2N1291	2N301	2S145	2N1632	1340	2N217•
2N1293	2N301A	2SA12	2N218	1350	2N217•
2N1295	2N561	2SA13	2N410	1360	2N217•
2N1300	2N1300*	2SA15	2N219	1390	2N218•
2N1301	2N1301*	2SA16	2N412	1400	2N218•
2N1395	2N1395*	2SA80	2N1632	1410	2N218•
2N1396	2N1396*	2SA81	2N1632	A2	2N274‡
2N1397	2N1397*	2SA82	2N1634	AO1	2N218
2N1425	2N1425*	2SA83	2N1634	AR10	2N301
2N1426	2N1426*	2SA84	2N1636	AT874	2N591
2N1431	2N270	2SB68	2N398	AT1138	2N301
2N1432	2N274	2SB73	2N220	AT1833	2N301
2N1479	2N1479*	2SB75	2N215	AT1834	2N301
2N1480	2N1480*	2SB76	2N406	CK13	2N247‡
2N1481	2N1481*	2SB77	2N217	CK14	2N247‡
2N1482	2N1482*	2SB78	2N408	CK17	2N247‡
2N1483	2N1483*	2SB83	2N301	CK721	2N217•
2N1484	2N1484*	2SB84	2N301A	CK722	2N217•
2N1485	2N1485*	2SB89	2N270	CK725	2N217•
2N1486	2N1486*	2SC89	2N585	CK727	2N217•
2N1487	2N1487*	2SC90	2N1090	CK751	2N217•
2N1488	2N1488*	2SC91	2N1091	CK759	2N218•
2N1489	2N1489*	2SD75	2N1010	CK760	2N218•

Type	Replacement
CK761	2N218•
CK762	2N219•
CK766	2N219•
CK766A	2N219•
CK872	2N408•
CK878	2N270
CTP1104	2N301*
CTP1109	2N301*
CTP1132	2N561
CTP1135	2N561
CTP1136	2N561
DR126	2N105
DR128	2N105
GT14	2N217
GT14H	2N105
GT20	2N217•
GT20H	2N105
GT38	2N105
GT81	2N217•
GT81H	2N105
GT109	2N217•
GT122	2N269
GT222	2N215
GT759	2N218•
GT760	2N218•
GT761	2N218•
GT762	2N219•
HA1	2N105
HA2	2N105
HA3	2N105
HA8	2N105
HA9	2N105
HA10	2N105
HJ15	2N215
HJ17	2N217
HJ22	2N218
HJ22D	2N218
HJ23	2N219
HJ23D	2N219
HJ32	2N370
HJ34	2N270
HJ34A	2N270
HJ35	2N301
HJ37	2N371
HJ50	2N217
HJ51	2N408
HJ70	2N370
HJ71	2N371
HJ72	2N1636
HJ73	2N1634

Type	Replacement
HJ74	2N1636
HJ75	2N1632
HS3	2N269
HS4	2N269
J1	2N217•
J2	2N217•
J3	2N217•
JP1	2N217•
L5108	2N247‡
L5121	2N247‡
L5122	2N247‡
MN24	2N301
MN25	2N301
MN26	2N301
OC16	2N301
OC16G	2N301
OC28	2N561
OC29	2N301A
OC30	2N301
OC32	2N217•
OC33	2N217•
OC34	2N217•
OC41	2N581
OC42	2N218
OC44	2N219
OC45	2N218
OC57	2N105
OC58	2N105
OC59	2N105
OC60	2N105
OC65	2N105
OC66	2N105
OC70	2N406
OC71	2N408
OC72	2N217•
OC73	2N217
OC74	2N270
OC75	2N217
OC76	2N586
OC77	2N398
OC139	2N585
OC140	2N1090
OC141	2N1091
OC170	2N384
OC171	2N384
SB100	2N247‡
SFT107	2N218
SFT108	2N219
SFT121	2N217
SFT122	2N217

Type	Replacement
SFT123	2N217
SFT127	2N218
SFT128	2N218
SFT142	2N217S
SFT151	2N406
SFT152	2N406
SFT153	2N406
SFT213	2N301
SFT214	2N301A
SFT238	2N456
SFT239	2N457
SFT240	2N561
SFT250	2N561
SFT265	2N277
SFT266	2N301
SFT267	2N1099
SFT307	2N218
SFT308	2N219
SFT315	2N1632
SFT317	2N1632
SFT319	2N1634
SFT320	2N1632
SFT321	2N217
SFT322	2N217
SFT322-1	2N217S
SFT351	2N406
SFT352	2N406
SFT353	2N406
SFT357	2N384
SFT358	2N384
ST3C	2N408
ST12	2N408
ST16A	2N585
ST16B	2N585
T34A	2N105
T34B	2N105
T34C	2N105
T34D	2N217•
T34E	2N217•
T34F	2N217•
T1040	2N301*
T1041	2N301*
T1164	2N384
T1166	2N384
TS1	2N406
TS2	2N408
TS3	2N217
TS13	2N408
TS14	2N217
TS32	2N270

Type	Replacement
TS161	2N217•
TS162	2N217•
TS163	2N217•
TS164	2N217•
TS165	2N217•
TS166	2N220•
TS176	2N301*
TS620	2N218•
TS621	2N219•
V6R2	2N412
V6R4	2N412
V6R4M	2N219
V15/20P	2N301
V25/50B	2N217
V30/10P	2N301
V30/20P	2N301
ZJ13	2N217•
ZJ71	2N247‡
ZJ72	2N247‡
ZJ73	2N247‡

NEW RELEASES

2N398A

This germanium p-n-p alloy junction transistor in the JEDEC TO-5 package is specifically designed for direct high-voltage control of "on-off" devices such as neon indicators, relays, incandescent-lamp indicators, and indicating counters of electronic computers. The 2N398A has all the features of the industry-preferred 2N398 plus increased current, dissipation, and temperature ratings for use in those applications requiring such high ratings.

8077/7054

The 8077/7054 is a shorter 9-pin miniature version of the popular 7054 power pentode, designed specifically for use in very compact mobile communications equipment operating from 6-cell storage-battery systems. Featuring high transconductance (11500 umhos), low inter-electrode capacitance, and high power sensitivity, the 8077/7054 is particularly useful in class C radio-frequency power-amplifier, oscillator, and frequency-multiplier service at frequencies up to 40 Mc. It may also be used in modulator and audio-frequency power-amplifier applications.

The heater of the 8077/7054 is especially designed to operate over a voltage range of from 12 to 15 volts with momentary excursions from 11 to 16 volts, and to withstand an intermittent heater-cycling test of 2000 minimum cycles at high heater voltage. These features insure dependable performance of this valve in mobile equipment operating under the severe conditions encountered during battery charging and discharging.

BOOK REVIEWS (Cont.)

"OSCILLATOR CIRCUITS". T. M. ADAMS. Howard W. Sams and Co. Inc. Size 8½" x 5½". 125 pages. Well illustrated.

This is an interesting book in the Sams Basic Electronics Series. As with other books in this series, the object is to explain how standard electronic circuits operate. One of the difficulties that both teachers and students have to contend with in the analysis of circuit operation is the fact that one cannot see what is going on, as one can for example in a cut-away model of an engine. This difficulty is overcome in this book in a very striking way, by the use of multi-coloured diagrams.

The treatment in this volume is non-mathematical, and after dealing with oscillator circuit fundamentals, provides a satisfying analysis of the operation of nine basic oscillator circuits. What are the nine? See if you can list them before looking at the bottom of the page.

"SOUND AND TELEVISION BROADCASTING". K. R. STURLEY. Iliffe Books Ltd. Size 8¾" x 5½". 382 pages, 248 diagrams.

This book by Dr. K. R. Sturley, head of the BBC Engineering Training Department, explains the basic principles of sound and television broadcast engineering and operations. It is another of the BBC Engineering Training manuals and was written primarily for new recruits to the

The nine oscillator circuits dealt with in "Oscillator Circuits" are the crystal oscillator, Hartley, Colpitts, T.P.T.G., electron-coupled, phase shift, blocking, multi-vibrator oscillators, and the soft valve (thyratron) sawtooth generator.

BBC Engineering Division. It is the Corporation's policy to disseminate their specialised knowledge and experience to all interested in sound and television broadcasting, and in line with this policy this book is offered to a wider public.

The introductory chapter deals with basic physical principles and their application to broadcasting. This is followed by chapters on sound and television studios, telecine and telerecording. Among other topics covered are apparatus, techniques and procedures; outside television broadcasting, including "Eurovision"; amplitude and VHF modulated transmitters; the problems of conveying the sound and television programme frequencies and communicating between the various studio centres and transmitting centres. The text is amplified by photographs and over two hundred specially drawn line illustrations.

"COLOUR TELEVISION". P. S. CARNT and G. B. TOWNSEND. Iliffe Books Ltd. Size 8¾" x 5½". 487 pages, 233 line figures, 8 pages full colour, 8 monochrome plates.

I do not know when we may see colour TV in Australia, and the subject at the moment as far as this country is concerned is therefore perhaps of academic interest. In England however, the subject is being actively pushed forward.

Colour television overseas is a reality. Already there are regular programmes in several countries, and the BBC are transmitting test programmes in colour preparatory to the commencement of regular broadcasts. Closed loop systems are extensively used in a variety of places from teaching hospitals to horse race meetings.

This book describes the British adaption of the American N.T.S.C. system of colour television, a system which is fully compatible and can be received in black and white on current monochrome receivers. The N.T.S.C. system is explained with particular reference to the 405 line version, but wherever there are differences between the 405, 525 and 625 line systems, these are fully explained, so that no matter which line system is finally used in this country, this book will not become obsolete.

A working knowledge of black and white television is assumed, and though the work is largely non-mathematical the more advanced mathematics is given in the appendices. Introductory chapters are included which will enable the reader to understand the principles of colour measurement and the behaviour of the human eye in relation to colour reception. Most aspects of the transmission and reception of colour signals are discussed, though the emphasis is on the latter.

Editor .... Bernard J. Simpson

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