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THE AUSTRALIAN EEB

→ Commonsense Electronics

February 1971! Vol. 7, No. 1

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PUZZLE:-

How can an oscillator circuit be designed such that there is no voltage across the key at any time -- either up or down? Yet it keys cleanly and reliably. (Submitted by J. W. Campbell, N.J., U.S.A.)

-- One year subscription for the BEST answer. Results will be published in the June EEB, since this "February" issue is just a wee bit late, owing to events entirely ~~beyond~~ within our control. Never mind. EEB staggers On.

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L: Commonsense Receiver Design. Honey Mead; Chapped Hands Cure. (Insolence)^3. General Info.

PLANNED; (April): Around the Airwvs Hop Engineering, Component Avail., Loading, Cross-mod/FETs, Dig. V.M. Design, SCRs replace Diodes, Diode Tester, Reviews, Letters, RLG,RAJR Butler Oscillator Squaretable, etc! All that would take about 50 pages.

A TACHOMETER FOR CAPACITOR-DISCHARGE IGNITIONS -- R. A. J. R. (Asst. Ed.)

A simple answer

A CD Ignition system would appear superficially to lend itself to a very simple tachometer readout: a 100mA current meter and choke placed in series with the lead from the HT supply to the SCR anode. This will work, but has the disadvantages of bringing HT to the dashboard, and difficulty of noise suppression. By the addition of only a few components a more satisfactory system can be achieved, and furthermore one which is uniquely suited to conditions available in a CD ignition circuit. Let us frist consider the general situation:

Tachometer Systems

In general there are two distinct types of Tachometers which derive their information from the ignition system. Both rely on the fact that the ignition spark rate is exactly proportional to the speed of the engine. Fig. 1 (below) shows the first of these types which appeared in the Literature; a 1 mA meter is at the output of a monostable multivibrator having an "on" time less than the time between sparks from the ignition system; the multivibrator is triggered from pulses derived from the spark circuit.

Fig. 2 shows the second type, which is simpler and probably more reliable, as it does not have any active circuitry. This is the type commonly known as the Ferrier Tachometer, and first appeared in RTV&H and Mullard Outlook in 1964. This system takes the pulses appearing on the primary of the ignition coil, passes them through a low-pass filter to remove the high voltage pulse and to prevent loading of the coil by meter, limits the output from this filter to a fixed (zener) voltage in order to reduce dependence on battery voltage, and differentiates this square wave to give a series of pulses having a steep front and an exponential trailing edge. The shape of the latter depend on the RC values of the differentiating circuit. This train is then rectified either to remove the negative-going pulse, or to invert it so that a d.c. mA meter at the output acts as a mechanical integrator. The shape of the pulses applied to the meter is such that the energy associated with each pulse is the same and is independent of engine speed and battery voltage. Hence the energy applied to the meter is proportional to the number of pulses per unit time, and hence to the engine speed.

Pro & Con

Whereas the circuit of fig. 1 uses a relatively insensitive meter (e.g. 1mA) it does use an active circuit, usually two transistors, and needs a source of power other than the ignition coil. Fig. 2 on the other hand, has the beauty of simplicity, drawing its power from the sense circuit, but it usually requires a more sensitive movement, of the order of 100uA in the case of a 4-cylinder motor where the meter is required to read 0-5000RPM.

Both of these types have proved satisfactory when used with CD systems, although fig. 1 system must be connected at the coil, whilst fig. 2 unit must be connected at the breaker points. This is due to the fact that the monostable circuit relies on the existence of a high voltage pulse, while the Ferrier system relies on the existence of the low voltage pulse of the contact breaker. The astute reader will realise that each system will in fact operate in either sensing mode, but problems exist with noise immunity in one case, and with low pulse energy in the other.

A better System just for CD!

Unique conditions associated with a CD system allow a very easy way to make a cheap and simple tachometer. The pulse energy available at the breaker points is of the order of several watts, and the high voltage spikes usually associated with the points do not exist. Thus if the voltage at the points is limited by a zener and then differentiated as in the

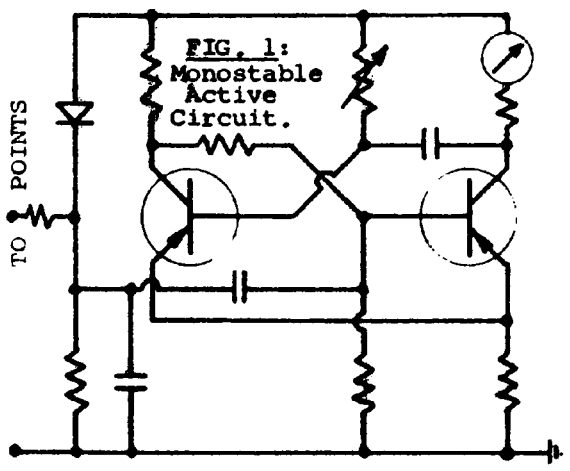


FIG. 1: Monostable Active Circuit.

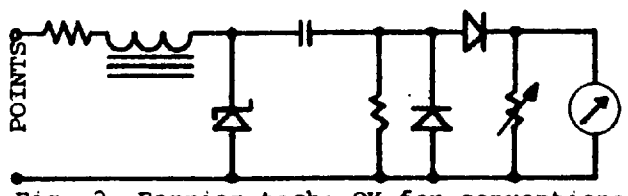


Fig. 2: Ferrier tach; OK for conventional ign, not very good for bipolar tr. ign.

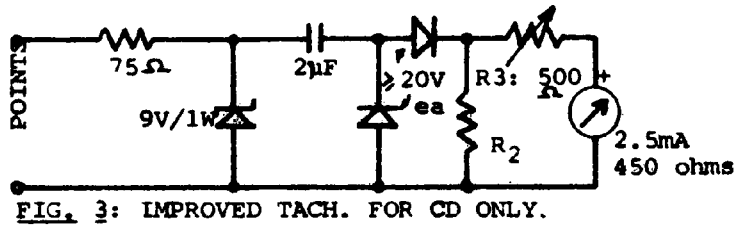


FIG. 3: IMPROVED TACH. FOR CD ONLY.

VALUES FOR R2 (OHMS):

CYL.	5000	6000	8000 RPM
8	120	100	82
6	150	120	100
4	180	250	120

(SEE TEXT FOR ALTERNATIVE VALUES)

Ferrier circuit, a simple tachometer results, and one which does not require the nuisance of the low-pass filter. Additionally, the components in the differentiation circuit can be chosen so that the energy associated with each pulse delivered to the meter is up to about a hundred times higher than that in the conventional Ferrier circuit.

This means that almost any meter movement may be used. To prove that point, I used a 750mA movement (for my 8 cyl, 0-8000 RPM), also because I had that meter available. More moderate values of components can be used to provide good operation with a more sensitive meter.

0-2.5mA 270° movements as found in radio altimeters prove excellent for this application when a new dial is fitted. Fig. 3 gives typical values for the use of such a movement, and the chart gives the range of critical resistance values for various speed ranges for different kinds of engines.

For a meter of sensitivity different than that shown, the value of R2 will have to be adjusted according to the following formula (and R3 to suit):

$$R_2 = \frac{2I_C R_C}{0.12\sqrt{NS} - I_C}$$

where:
Ic is full-scale current in mA.
Rc is coil resistance, ohms.
$R_C = R_3$ nominally; adjust for calibrat.)
S = Maximum full-scale RPM
N = Number of cylinders.

This relationship applies only to the circuit of fig. 3, above. The fomula is interesting, because it shows that if the meter is not sufficiently sensitive (I_C) for a given number of cylinders (N) and RPM (S), it can't be used in this circuit (R2 goes negative), at least not without increasing the 2 uF capacitor (giving a different value than 0.12).

Incidentally, I have been taken to task for the statement that my CD Ign has top speed capability of 36,000 RPM for 8 cyls (Aug. EEB, p. 116), because the trigger network imposes a 1msec or so delay to avoid contact bounce signal giving a spurious trigger. This would impose a maximum frequency of 1khz, so 15,000 RPM on 8 cyls. True, but I applied the signal on the SCR side of the trigger network, showing the true capability of the ignition system. Needless to say, the performance is adequate for any existing automobile engines!

see also P. 19

LETTER: Imports, Synchrodyne Reception

Keep up your rave book and periodical reviews, the only genuine reviews in any electrical publication. But I don't always see the practicability of some of your projects, e.g., some items in your 1970 Index.

How about something on Direct Conversion -- the Homodyne and Synchrodyne receiving system? I need a new receiver, as my old valve job is outdated, and I like this simple approach and high attainable performance.

Why are overseas kits loaded with such high import duties? Even the Disposals Committee of the Victorial WIA have discontinued some component lines because of exorbitant duty imposed on them... Surely if the Australian manufacturers can't or won't produce equipment up to overseas standards they should be penalized, not grossly over-protected! ....

-- K. R. French, Potts Pt, NSW.

((Ed. comment: Last point first: Import Duties enrich Canberra, along with increased income tax that results from inflation. Simple, no?

A good Synchrodyne receiver is described in QST for May 1969; see also the item on solid state product detection in QST for April 1969. The W.A. WIA group has built it recently according to their recent Bulletin; they say it gives good results. Information of this type of receiver is found also in G3VA's excellent Amateur Radio Techniques (see Review, this EEB).

Recently I have started helping with the magazine Reviews for Amateur Radio. I note that my comments therein have been amputated heavily, thereby giving my part of the Review little value. You might be interested, therefore in the full text of the comment on "The Sideband (or CW) Minituner" which appeared in Ham Radio magazine for October 1970:

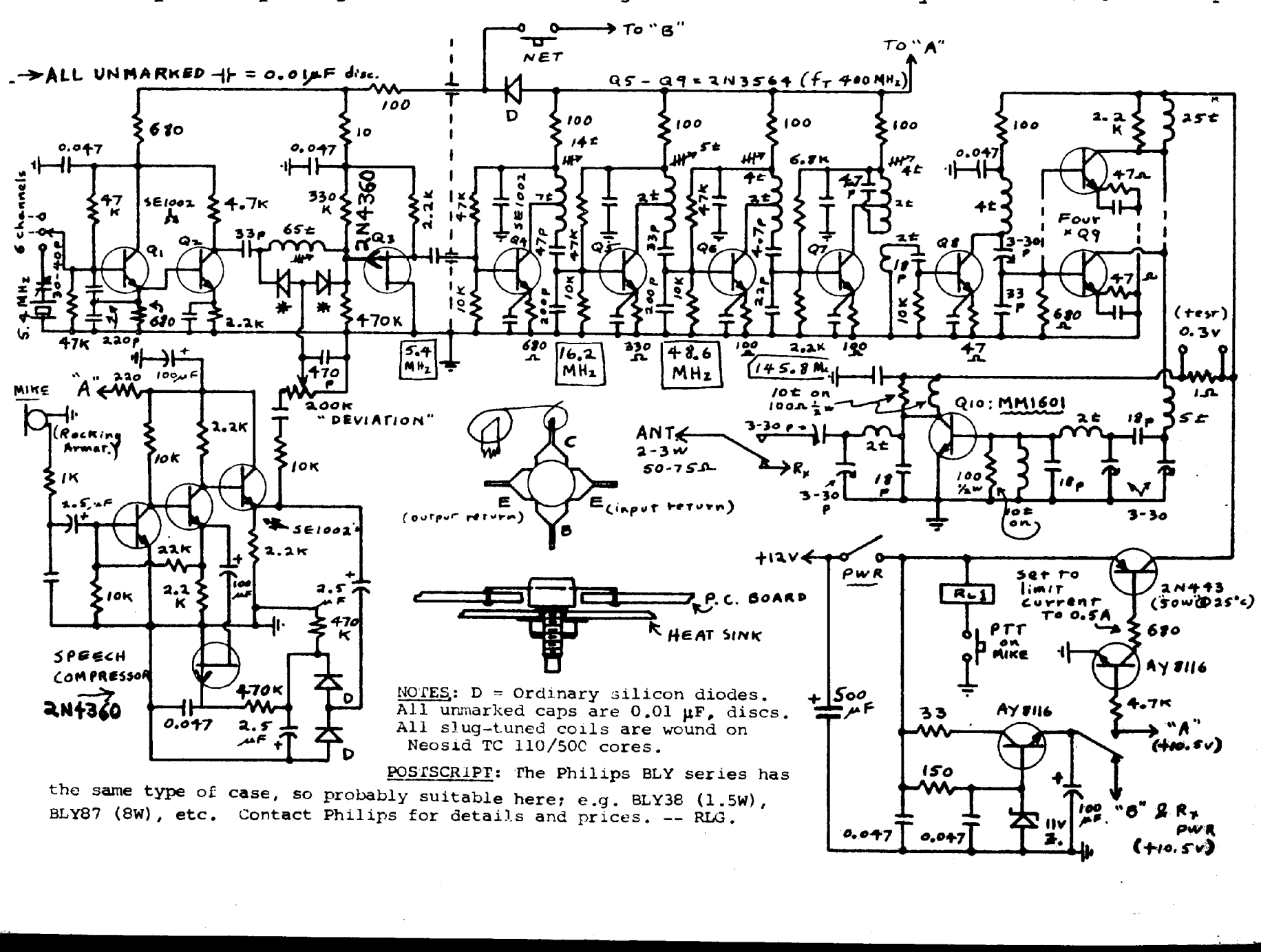
This is a pocket-sized Direct Conversion receiver for 80 and 40M, using an FET product detector in the common base mode. Audio is fed through a low-pass RC filter, FET-amplified, and then into a commercial AF power module (as available from STC in Australia). Since the selectivity of this kind of system depends on the low-pass filter following the detector, a filter with sharper cutoff than the one used here would give better results for a given audio quality. The idea of Direct Conversion is attractive, but there are drawbacks, at which the author only hinted.

Among these is the fact that the oscillator must be very stable, and the author goes to some trouble to ensure this and to minimise radiation feedback. The latter is necessary to ensure reasonable linearity. The linearity of this common-base detector is not bad, but to avoid cross modulation, the overload-immunity requirements are still more exacting than could be expected for high performance from this simple circuit. But as a cheap and simple system, performance from a receiver of this kind can be surprisingly good. It could be noted here, that a.m. can also be received on a Direct Converion Rx if the local osc. is zeroed on the carrier.))

A NICE PHASE-MODULATED 2-watt 2-metre TRANSMITTER -- L. Osborn

I have spent quite a lot of time playing on 2 metres using the transmitter as per the circuit here below. The MM-1601 transistor used in the p.a. certainly delivers the goods. It is obtainable from Motorola agents (Cannon Electric in Melbourne, or Radio Parts P/L), and costs about $10. Cannon will supply the Data Sheet telling all about it. But briefly, it is rated for 15w at 25°C case, and can put out about 3w with about a half watt to drive at 144 Mh_z, or a watt drive at 300Mh_z. If you add some more driver stages you can even use the MM-1602 ($21) to get 10w, or the MM-1603 ($36) up to 25w; of course the higher powers require a bigger power supply; at 12 v the MM-1601 requires about 500mA collector current*. The relative communication effectiveness of the bigger transistors rises roughly in proportion to cost. * 300 mA here.

This all started from an article by Frank Jones in CQ in early 1969, using silicon power diodes as phase modulator. I went through about 100 point-contact reject disposals diodes, testing them on a Q-meter with 6v bias, until I found two diodes with a negligible effect on Q, and a capacitanceof about 8-10pF. I used these (marked with * in the diagram) in the osc/mod unit giving an output in the 8Mhz range, feeding to an SE1002 with its collector tuned to 146Mhz. Q4 is a doubler, and Q5 a tripler. With 20mW fed to Q6, and a couple of feet of wire as aerial, VK3AKB could hear me a mile away. The rest of the unit grew from that with Q7 and Q8 as amplifiers, and the paralleled transistors of Q9 as driver for the power amplifier, Q10. Another MM-1601 could be used instead for Q9, but the paralleled transistors are cheaper... I ground the crystals to freq with the converter of April 1970 EEB, mounted in the "spares" compartment of a transistorised BC221 like that in Dec 1970 EEB... Take the usual precautions for tuning and loading transistorised tx, e.g. EEB 1/69. I am grateful to Ken Nisbet, VK3AKK for recommending the MM-series transistors, which are cheaper and more stable than equivalent AWV/RCA types, because of the "Stripline" package shown in the diagram here below. Try it and see!



NOTES: D = Ordinary silicon diodes.
All unmarked caps are 0.01 μF, discs.
All slug-tuned coils are wound on Neosid TC 110/50C cores.

POSTSCRIPT: The Philips BLY series has the same type of case, so probably suitable here; e.g. BLY38 (1.5W), BLY87 (8W), etc. Contact Philips for details and prices. -- RLG.

A SYTHE-STONE ZENER -- T. M. Palmer (VK2)

A non-linear resistor was needed in the anode circuit of a shunt regulator valve to reduce its dissipation without limiting the maximum current. As no commercial unit was readily available, a compact device for 50 w was made from a 3/4" length of sythe-stone having a uniform oval cross section of 1-1/4" x 3/4". These stones are made of silicon carbide, an impure semiconductor known from "cat-whisker" days as an alternative detector in place of galena.

With a few trials it was not hard to break off the right length and grind the ends roughly flat to give stable results when clamped against the soft aluminium plates serving as contacts and cooling fins. Chopping up carborundum and grinding the ends flat is not really too difficult. A nick either side usually results in a fairly good break, and this can be ground flat with a small grinding wheel on a portable electric drill. Certainly it removes a bit from the wheel, but this process can also be used to "dress" or true up the hollows and rounded edges on your wheel. The nicks are most easily cut with the edge of a "Rawldisc" (made by Rawlplug Co) or similar abrasive disc. The cut piece is held in a vice whilst the other end is tapped with a mallet.

Fig. 1 shows the geometry, and fig. 2 shows the voltage-current properties of the 3/4" length. The voltage scale changes in proportion to the length, and the current according to cross-section. It may be seen that the behaviour is roughly analogous to that of a zener diode, or more properly of a forward-biased junction diode. From this fact it seems reasonable to assume that other uses could be found for this Sythe-stone "Zener". The unit is easy to make; why not try it yourself and let us know how you applied it?

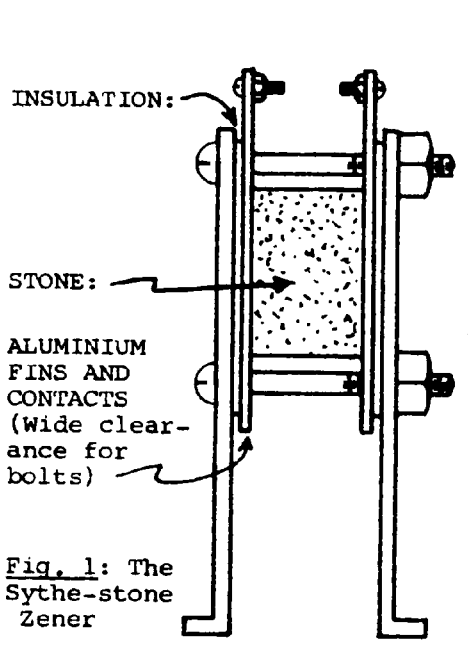


Fig. 1: The Sythe-stone Zener

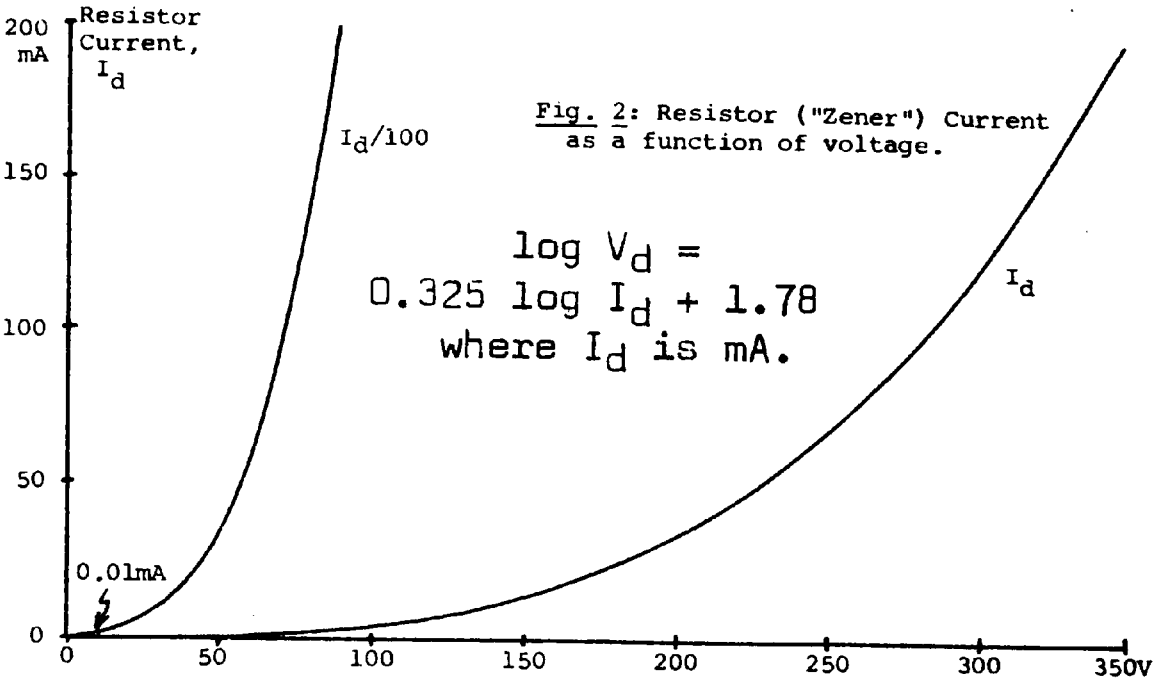


Fig. 2: Resistor ("Zener") Current as a function of voltage.

LETTER: C-D Ignitions and Receivers

Good on your C-D Ignitions, though a bit late for me. I built that one in Wireless World and in use on the "FC" does make it go a bit better. Fastest "FC" Holden in twon for sure (standard engine); just take it off and see the difference. Thanks also for the BC221; will have to try that. I put a Franklin Osc. into it but it doesn't like too much shift on the low band, because it wouldn't work on that end. The Calibration Book doesn't apply anyhow; either someone "fixed" this set, or the book belongs to a different one.

I've had a look in ... Electronics Aust., and that recent Deltahet receiver looks good; but then so did the last effort of theirs (the EA240), and it didn't work for us up here without extensive modifications. With them, it did work, sort-of. I told EA about this, but they reckon that theirs works fine..... I've heard of other people having this kind of trouble too. Wonder why.

Haven't got too much time for radio these days; took up gliding and got landed with a job in the Club. Just building a hangar, thats all, never did realise there was so bloody much welding in just one roof truss. Oh well.

V. L. Schwinger, Whyalla, S.A.

THE USES OF AVALANCHE DIODES (etc.) --RLG

Advertisements have appeared during the past few years describing "AvalancheDiodes" which are unusually effective in withstanding transient voltage overloads. As described in the January 1969 El. Aust., these diodes have special chip and case construction which allows uniform breakdown over the whole chip, and very good thermal bonding to the leads. The first characteristic prevents "hot-spots" which would destroy the chip, and the second removes the heat that is produced, as rapidly as possible.

The result is that these diodes are much less sensitive to burnout from transient overvoltages than are ordinary silicon diodes -- as long as the power in the transient spike does not exceed the transient rating of the diode. This is very convenient, but it is not necessarily a licence to eliminate transient suppressing condensers in some instances; principally it improves reliability, and allows a rather lower safety factor -- if everything else is equal... This is particularly useful in half-wave rectification circuits where transients have their greatest effects on diodes. In full wave circuits (including full wave bridge) transient problems are lessened considerably, because each diode tends to damp out transients which would affect the other. In this case the main advantage of the avalanche diode is to lower the PIV safety-factor from, say 1.5 to 1.2 (if the usual transient-suppressing condenser is used across the primary of the pwr transformer). On the face of it, as I see it, theoretically, if your rectifier is full wave and if you use avalanche diodes, you need not use any transient-suppressing condenser nor any extra safety factor -- but beware! This latter assumes that the mains voltage stays perfectly constant, but it certainly doesn't, and in some parts of Australia it can vary widely through alarming extremes.

In summary, therefore, avalanche diodes improve reliability by allowing a lower safety factor (consistent with mains voltage excursions), and to obtain diodes more cheaply than apparent as described below. It also allows seriesed operation to obtain higher PIV rating without need for voltage-equalising resistors. But if you do use seriesed avalanche diodes you will still need to use an equalising condenser across each (e.g. 470pF).

Testing Bargain Diodes

Avalanche diodes are available in Australia from General Electric. If you want to save money you might obtain them from disposals sources, here or abroad, but in that event it is essential that you test them for the sharpness of the reverse characteristic. This is described in EEB for Feb. 1967 and Sept. 1968, but very briefly it consists of placing a big resistance in series with the diode, and applying HT acorss the combination. Measure current with a sensitive microammeter placed in series with the bottom end of the diode, and measure voltage with a good VTVM placed at the top of the diode. Increase HT until current starts to increase appreciably; at that voltage will be the Absolute Maximum PIV of your diode -- at 25°C. If you are going to run the diode cooking hot in service, you'd best derate that PIV by some 50%. In an actual circuit the safety factor would require that the Abs. Max. PIV be some 1.2 times the peak

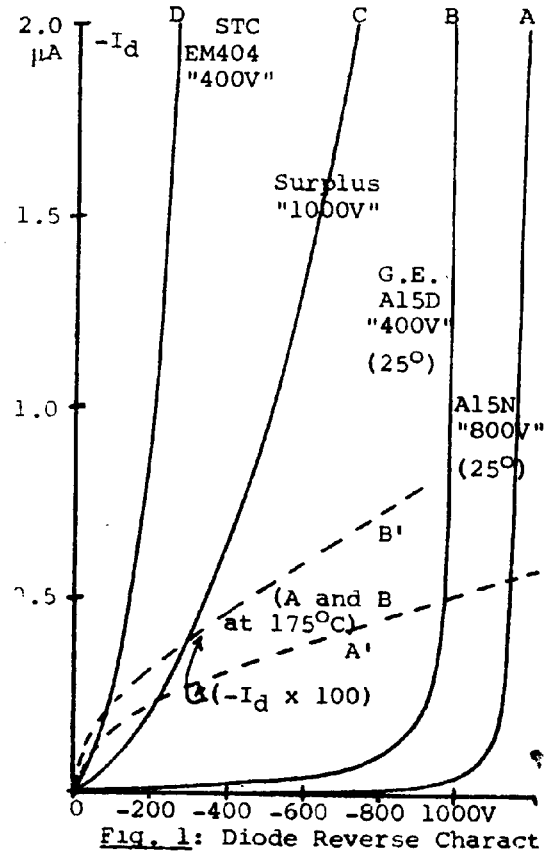


Fig. 1: Diode Reverse Charact

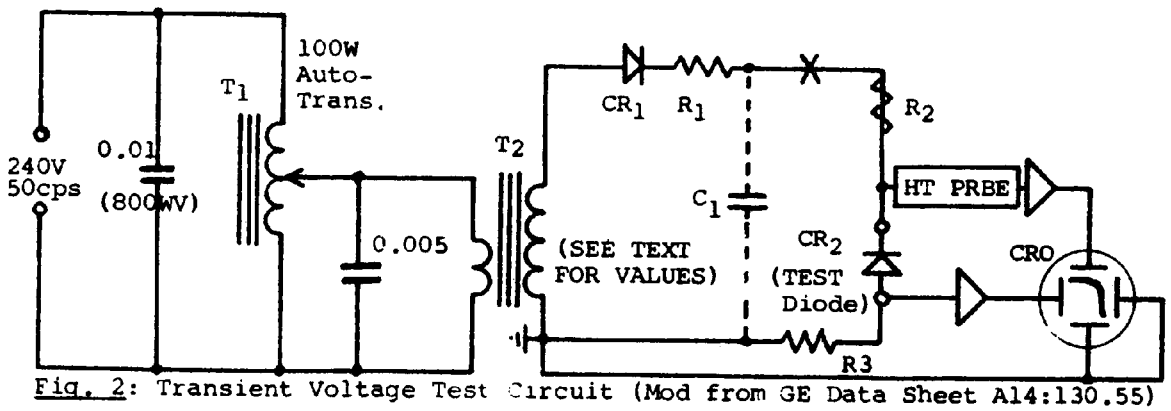


Fig. 2: Transient Voltage Test Circuit (Mod from GE Data Sheet A14:130.55)

(normal) a.c. voltage appearing across the diode if avalanche, or 1.5-fold if an ordinary silicon diode. In neither case, theoretically, is transient suppression needed if in a full-wave ckt, but this is less true for the ordinary diode if used in an area at the end of a long mains line, e.g. in the Bush.

Now the important thing about all of this is that in order to qualify for "avalanche" characteristics, as you increase the diode current there should come a point where the PIV read by the VTVM stops dead, and as you continue to increase the current the voltage should increase only slightly up the rated average wattage of the diode (e.g. 1/2 w for small glass types 1 w for top-hats). That is to say, the diode should exhibit a good zener characteristic. If it is at all sloppy you can't depend on the diode for avalanche performance, though of course it might make an excellent ordinary diode. This is well illustrated by the curves of fig. 1. Curves "A" and "B" represent behaviour of true avalanche diodes from G.E. "D" is a good STC type EM404 rated for 400V, and "C" is a good disposals diode obtained from Weinschenker (U.S.A.)(Aug. 1970 EEB, p. 123) which I rated at 1000V according to the abovementioned criteria.

In fig. 1 there is nothing wrong with the 400V and 1000V PIV ratings of curves D and C respectively, it is merely that they attain the steep part of their slope up around 10μA rather than at some 0.5μA. I have not shown the former, because this graph is to show and illustrate avalanche performance of curves A and B primarily. You can see that the zener-type performance of A and B is substantially sharper than that of the other curves.

Conversely, any ordinary diode which shows a good zener knee for the reverse conduction will work as an avalanche, though not likely with the peak overload capabilities of a true avalanche unit. The latter is able to dissipate a 1000 watt peak in 20μsec (1.25A at 800V!) or 50 watts in 10msec (62mA at 800V), reverse.

I am informed that most of the commercial silicon diodes now being manufactured are, in fact, of the avalanche type, and that Industry has only now decided to make it a selling point. But my tests show that there is a difference between the garden-variety "avalanches" and those specially made (or chosen?) for that function.

All of the big semiconductor manufacturers do sell the special avalanche types in the range of $1 to $5, depending on PIV. I don't happen to have the latest catalogues available at this moment, but Rod tells me that the avalanches are available from STC (ITT) and Philips, as well as G. E.

What is the rated PIV?

If you look at fig. 1 you will see that the "400V" G.E. diode has an obvious PIV of about 1000V, and the "800V" one about 1200V. Furthermore if the STC diode of curve D were shown at a higher current scale you would see that the curve would not really become steep until about 800V. Why then, the rating at half the obvious voltages? To a certain extent the answer is given by curves A' and B' which show the performance of diodes A and B at a much elevated temperature (with the current ordinate multiplied by 100); the reverse leakage increases considerably.

But if you do not intend to run your diodes cooking hot, ie, if you only run some half the rated current through them (derated suitably for capacitative loads), you can operate much closer to the 25°C curves. I have been doing this for years, operating right at the end of the curves, and with a 1.5-fold safety factor and transient-suppressing condenser at the mains have not yet had a failure. This means that with moderate operation you can obtain about twice the "rated" PIV from many commercial diodes (and many transistors too) -- but of course you must test it for yourself to make certain. The BY-100 is a particularly noteworthy example of this situation, rated ostensibly at "800V", but with an excellently low reverse leakage out to about 2000V! That means that the BY-100 can be used with a 1000V (RMS) transformer in a bridge configuration, or 1000V-c.t. in full-wave, and no worries -- as long as you include that 0.01μF across the primary (yes, maybe it is not always necessary in f.w., but for those rare moments when it is I want the reliability) This amounts to pretty cheap rectification.

New could be better.

In this vein we might well examine closely the desirability of buying our

semiconductors from disposals sources. In past years these 'surplus' merchants were the only source of reasonably priced diodes and transistors in a market of outrageously priced merchandise from nominal commercial sources. The computer boards (which we introduced to Australia) still provide a good bargain for many components.

Now, however, the prices of a wide selection of semiconductors have come down to a reasonable level, and it can be worthwhile examining more carefully whether a given disposals item is really such a bargain. If you find an honest and reliable surplus merchant (such as Weinschenker or Brooks Radio) you must still test his stuff, and in these days of good test equipment possessed by surplus dealers you are likely to find that the ratings as sold come out closely to their Absolute Maximum ones. If you consider the 100% or so duty (including various hidden taxes) on imported merchandise (unless you are lucky), and compare the relatively low price of new commercial stuff whose actual PIV may be twice of its stated value -- then you can find that it is just not worth the bother and difficulty to import some merchandise any more.

If the merchant is not reliable or honest, you may find that he takes all his profit in the first shipment, not bothering to send you the goods. Or that there are so many duds in his shipment that the net cost per good item is the same as (or greater than!) that of new stuff. It helps that the British surplus dealers present somewhat less of a problem in this regard than do the American ones, but the main considerations still apply.

I'm not saying that you can't still obtain disposals bargains, but only that you can't automatically guarantee any more that they are bargains merely because they are surplus. And all of the abovementioned considerations apply qualitatively to Australian sources.

My experience is that this situation applies specifically to the obtaining of avalanche diodes. I ordered some from a reliable source in the U.S.A. (Solid State Sales), and the resulting diodes had curves of the type C and D in fig. 1. They were indeed good diodes, but they were not true avalanche ones. In such a situation it is evident that it would have been hazardous to use the diodes and rely on them as being avalanche. The purchase of local items from reputable firms would certainly cost more, but this would be well worth it if you were depending on the avalanche characteristic.

Personally I am not yet convinced that it is all that important, but I present the story here for you to evaluate, and to buy sensibly. If, for a given Absolute Maximum PIV I should have to pay more for an avalanche diode, I would buy the ordinary one, because the difference between a 1.5 and a 1.2-fold safety factor does not impress me very much, nor is it very difficult to find a small condenser to bung across the mains (or secondary, with capacitance in inverse proportion to voltage). But in commercial practice every little thing saves money and that increases profits and that is what makes the world go round.

On the other hand, if I have an HT half-wave system to construct (such as that of fig. 2), where transients really are much more of a problem, and where good transient-suppression ought to employ the series RC combination, suitably designed, and where a number of diodes could be required in series -- then it could definitely be worthwhile to consider the use of avalanches. Particularly if, as I did, you manage to pop a string of ten seriesed diodes in one quick go, even though they were ostensibly transient-protected. Half-wave systems are certainly worse in this regard, and HT half-wave ones are the very devil.

Incidentally, as a footnote to the matter of commercial ratings being substantially higher than stated, remember that it is not necessarily so, and that you must test a typical unit to make certain. And also there are some 'bargain' semiconductors for sale from various sources in Australia. To my knowledge the firms of this type which have advertised in EEB are reputable, but you have still to be cautious in respect to the points I have been making. These firms may advertise a semiconductor as being similar to such-and-such, or even advertise it as being that number, but they may supply you with a different item which is equivalent for ratings. In that respect all is well, but the item supplied may not necessarily have

the same Absolute Maximum characteristics, or even qualitative behaviour, such as regular vs. avalanche. In such cases the bargain item has not necessarily saved you (much) money. It may indeed, but you can't take it for granted without careful sampling and testing. Whether or not this is worth it is something you must decide.

A Diode-PIV Tester.

The circuit of fig. 2 has been rather modified from the device used by G.E. to test their avalanche diodes, such as the "A15" series (100-800V) -- which are now available here. Their version uses:

$T2$ = 5kv, low current sec.
CR_1 = Diode to match (e.g. 10kv)
R_1 = 10 Megs
C_1 = 500 pF/ 6000V
X = Spark gap; adj, with T_1, to 5kv.
R_3 = 100Ω. With
R_2 = 4.3K, this puts a solid 200w or so of reverse bias power through the diode in less than 20 μsec. If you do this with any ordinary diode the results should be spectacular --briefly. The circuit was obviously designed specifically to torture avalanche diodes since they can endure a 1kw reverse peak for 20μsec or 50w in 10msec. Under such conditiins the CRO reads the reverse voltage across CR_2 (the test diode) and horizontal sweep is provided by R_3. We presume that for GE the tester had the extra advantage that if a diode were not able to stand the peak it would fry. Thats real quality control!

Since this circuit is similar to many which have been used to test diode (and transistor) characteristics, we thought it wiser to suggest that for an ordinary diode you use a more generous value for R_1 (omitting R_2, C_1, and X) giving peak reverse power less than say, 100mw. (CR_1 also not needed now)

If you will look closely at the circuit (so modified), you will see all that you need to know to be able to design suitable values of circuit parameters, using Ohm's Law and commonsense ((otherwise you will go through life depending on other peoples circuit values, unable to modify them to suit your situations!)).

Diode reverse current through R_3 develops horizontal voltage for the CRO, and through the diode gives the vertical deflection; this gives a vertical voltage axis and horizontal current one. If you want it to look like the curves of fig. 1 you'll have to interchange vertical and horizontal connections. R_1 simply limits the maximum reverse diode current; it should not exceed some 100μA for most surplus diodes, and for most good commercial ones 10μA will define the curve.

The point is this: you can determine any curve scale you like simply by suitable choice of the resistors and CRO amplifier sensitivities. You can adjust these for a current max scale of 2μA (when looking for avalanches) or 10μA (for general testing) or 100μA (surplus diodes or germanium). And the voltage scale for 100V when looking at LT diodes, or 1000V for HT ones.

A large T_2 voltage (eg neon or CRO type) is desirable to test a wide range of PIVs, but if you have only a TV xfr you can use it too if you switch R_1 to higher values for lower PIV (to keep max reverse current below 100μA); c.f. EEB, Nov 1966, Sept 1967. The earth connection in fig. 2 has been altered from the GE location (which was between R3 and diode) for reasons of safety when T2 is EHT. This makes the vertical reading include V_{R3}, but negligible error results.

If it turns out that you obtain a really sharp zener-type curve from a surplus "avalanche" (or other) diode, you may wish to use the GE spark-test circuit as described above. If the diode doesn't survive that, it wasn't an avalanche type!

A similar circuit can be used to test forward diode characteristics, as described in EEB June 1967, or 73 Apr 1966. The earth connection then goes between R3 and diode, and horizontal goes to the left side of R3 which is a suitably low value. R_1 = R2 = 0, and T2 puts out about 5V at suitable current. Transformers and resistances could be switched back and forth without much trouble. But the forward-bias test is much less interesting unless you are matching diodes for amplifier bias, etc.

Numerous diode and transistor test instruments have been published, but if you want something better than fig. 2 here, surely the best was the "Curve Master" on p. 40 of Ham Radio, March 1968. Next month we shall present the circuit used by Brackmann and Weinschenker to test forward and reverse characteristics simultaneously (or rather alternately). It is a good idea though it does place substantial power requirements on the transformer used...

REVIEW: "AMATEUR RADIO TECHNIQUES", 3rd Edition, Author: Pat Hawker, G3VA, Published by Radio Society of Great Britain, 35 Doughty St., London W.C.1; £1.00 .

Not only does society suffer from chronic pregnancy of the periodical press, but from books as well, thousands upon thousands of new ones each month, and in the technical literature many of them useless.

This book is a welcome exception. It is packed with odd, interesting, useful ideas which have arisen during the past dozen years of electronics, and radio amateurism in particular. It is put together in a somewhat disjointed manner, with new material simply slapped onto the end of each chapter; in other words it is amateur to its core - hi. But this device to keep the price down is consistent with the rest of it: no nonesense or glitter, just good solid ideas and applications. Their endeavour to keep price down has also impelled RSGB to lower the quality of paper and to keep a tight finger on the printing ink -- both of which worsen readability, and of which I disapprove thoroughly.

But the net worth shines through. You may know that I love to wax lyrical over books, but this is definitely one to add to your library. I was going to do a chapter-by-chapter discourse on the new material in the 3rd edition (208 pages) which has been added to the 2nd one (160 pages), but that is silly. For the few of you who do not yet have any copy of this glorious book, here is the table of contents:

1. Semiconductors.
2. Components & Construction.
3. Receiver Topics.
4. Oscillator Topics.
5. Transmitter Topics.
6. Audio and Modulation.
7. Power Supplies
8. Aerial Topics.
9. Fault-finding & Test units.
10. Appendix, i.f. list.
    Index.

If you do not know of this book at all, obtain any copy of RSGB's "Radio Communication" and seek out "Technical Topics"; that's it, the whole book is like that! The book is a compilation of the curious, the wise, the uniquely useful, the new in amateur radio and in experimental techniques generally.

The book will undoubtedly be available in the technical bookshops, and at a more reasonable price from the W.I.A. in Australia, N.Z.A.R.T. in New Zealand, Ham Radio Mag. in the U.S.A.

If I have a constructive criticism to make (aside from that wretched paper and faint print!) it is that the next edition should be completely reorganised -- even though it may be delayed an extra year. All of the new material should be interspersed appropriately into the main body of the text. And the "Semiconductors" chapter must be abolished (same for the Handbook). Semicons have been around long enough that we can begin to take them for granted. The basic information on transistors and the other semicons should be put into the "Components & Construction" chapter, tunnel diodes into "Oscillators", parametric amplifiers into "Transmitters" with a cross reference note in "Receivers" and the Index. Output stages can obviously go into "Audio and Modulation", and so on. Perhaps it could be worth initiating a "Miscellaneous" chapter for those odd things which just won't fit anywhere.

Aside from this is the major problem of our information-explosion. What are we to do as books become thicker and thicker? One obvious answer is to publish a major revision only every 7 years or so (and then in two volumes if necessary), and in interim publish "Supplements", in fact just those items which have been added to the present new editions. When I discussed this matter with Editors & Engineers (before they got taken over by Sams). they said it wasn't practical to publish a supplementary issue of new material. The one time they tried it was a commercial disaster.

But is the RSGB purely motivated by commercial successin this matter (and in the Handbook too)? I doubt it. Their attempts to provide a conscientious high quality at minimum price is the proof of their real attitude. Just look at their fine Radio Communication Handbook, published hardback in this day and age for only $7!

These paragraphs are obviously only a natter with Pat and Roy, and need not concern you in practical terms. If you value the unusual and sensible in electronics (and if not why are you reading EEB?) you'd better get this book. If you have a Second Edition, give it to a good friend, and get the Third Edition. If you are an electronics experimenter not involved with amateur radio, this is a book to excite your interest, though it must be noted that this book is not on a beginners level.

Although I vowed that I would not again get into the book trade, I must get this book into the hands of Australian experimenters. So we ordered a few copies for distribution at this time, at a reasonable price, as described in the Advertising section of this issue.

Ed. Note: SEE Ham Radio, Dec. 1970, p. 68 (Review

THE AUSTRALIAN TAPE RECORDER SOCIETY

The ATRS is the definitive organisation for enthusiasts interested in Tape Recording. There is a whole world of activity in that field. ATRS has a big Prerecorded Tape Library, Newstape service, an extensive tape-correspondence between members, a technical advisory service, and a Sales Division offering considerable discount on a wide variety of tape and equipment. In addition, the Society also publishes The Microphone, a well-reproduced journal which includes reviews, reports on tape recording locally and worldwide, and some technical material. Even I find it interesting, and that is not my primary interest. If it is yours, you will undoubtedly want to contact ATRS for further information: P. O. Box 9, Crows Nest, N.S.W. 2065, Australia. ((RLG))

THE STATE OF THE ART -- RLG

Every so often I feel the urge to look over the periodical literature, gather in loose threads, and make a coherent picture, I don't pretend that this will be inclusive, only illustrative of trends, and perhaps some references useful to you who have special interests. This lot covers only Ham Radio, CQ, QST, and 73 for the past few months, plus a little from Spectrum and EA. I can't include Popular Electronics, because I seem to have lost the battle I have been carrying on with their Computer for a year, nor Radio Communication, because of the solidarity of the Workers and Peasants which has kept the U.K. in splendid isolation.

I have been taught an important lesson by our correspondents: A simple list of references gains little, because people have not the time, patience, nor facilities to refer to them any more. So, our Bibliographies (if you've noticed) have not been simple. And so here I present only a general picture. If you can profit from this, rejoice, otherwise concentrate on Osborn's nice transmitter; concentrate on it very hard; it takes only a page, but it took Rod 5 hours to draw; it would have taken me ten.

Technology: With few exceptions (generally found only in 73 and Autocall) we tend to take our technology awfully seriously. There is no ear like an engineer, and mammon is his profit. The commercialisation of amateur radio is only a surface indication of a deeper malaise, of which other aspects include the communications explosion (with no one to gather the pieces) and a pervasive amorality (≠ immorality). Well, that Technology will one day, perhaps soon, turn on us, and I fear we shall deserve our reward. I see not the slightest evidence to contradict Einstein's dictum that everything has changed except our attitudes. Till then, let us live every moment fully and creatively!

Neutralising Transmitting Transistors

What started me off on all this was two good articles in Sept 1970 Ham (sic) Radio on transistor circuit stability, a not unimportant matter in the modern age (note lower case letters). I covered the subject fairly thoroughly in EEB in 1967 and a couple of years ago in Amat. Radio, but has the picture changed with modern components? Not much. Because of the varicap effect, it is still practical to neutralise only small signal p.a. stages, and then only with adequate neutralising Q and minimum stray L and C; neutralisation is adjusted by placing the signal at the output, detecting at the input. The main improvement of the Art is to provide transistors with higher frequency rating, and more cheaply. The former, at least, does help to reduce the effect of feedback. Good geometry helps, and so does the application of resistance (only) negative feedback, and after all that there are various cunning methods of mopping up the inevitable parasitics which plague semicons far more than valves (HR 9/70, 1/70; RCA Power Circuits, etc). Conclusion: Above 5W or so, valves are still simpler and easier to use, particularly at highish frequencies; their anode circuit efficiency is substantially higher too (and can be made higher because of lack of worry about transients, Q, and loading), and that can help to make up for filaments in mobile work. For fixed station work, however, power supply complexity is comparable, and there high power transistor p.a.'s are clearly a fashion to suit the whim.

Receivers

Several outstanding articles on transistorised receivers, particularly in Dec. CQ, and Dec and Feb QST, and possibly even the Deltahet in the Feb 71+ Electronics Australia. In spite of dark muttering by several correspondents I am not convinced that EA projects are unreliable. EA have an engineering staff with all modcons; they get their projects working well, and they can prove it. We put all the parts in the right place, and lo! birdies and distortion. Obviously its not out fault, is it.

Against this I would measure my own experience. When I started out in electronics I built lots of things and they rarely worked. As the years went on, the things I built worked better and better, or at least I could troubleshoot them better, I wonder why. No doubt because the circuit designers got more competent as I acquired more experience. Coincidence?

A significant advance is reported by Jim Fisk concerning the new Signetics N565 phase-locked loop IC, and in October 73 describes its applications, with some also promised for (HR) Among much else, the N565 facilitates synchronous detection, increasing practicality (CONT:p.14)

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— P. Garde, Dept. of Elec. Eng., Monash University, Wellington Rd., Clayton, Vic. 3168.

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FOR SALE: TS323UR Frequency Meter [20-480MHz], original calibration book and crystal. What offers? — A. J. Van Genderen, 15 John St., Ashfield, NSW 2131.

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WANTED: Service Manual for Navy Receiver B28 [Models A to E] or CR100 [Models 1-5]. Write EEB.

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ADDRESSOGRAPH FRAMES: 2000 or so, no reasonable offer refused, but $1 minimum. Write EEB.

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CQ- PUBLISHED BOOKS AVAILABLE: Ham's Interpreter, $1.50; New RTTY Handbook, $3.95; RTTY from A to Z [even newer], $5.00; Surplus Schematics, $2.50; Surplus Conversion Handbook, $3.00; 103 Simple Transistor Projects [[wot, not 73 of them?? Hi, L.]], $2.95; Antenna Roundup I, $3.00; Antenna Roundup II, $4.00; Shop and Shack Shortcuts, $3.95; Electronic Circuit Handbook I and II, $3.00 each. More detail on description of these books in any issue of CQ, also available at $5.00 per year. Send your order, clearly shown, with name and address CLEARLY! written, and the requisite amount in $A, to EEB. Merchandise will arrive in a few months or so.

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THE NEPEAN DISTRICT AMATEUR RADIO CLUB invites any amateurs in the area to come to any of our Meetings, held on the first Wednesday of each month at 2000h at Civil Defence HQ, Flushcombe Rd, Blacktown, NSW. The Club offers activities such as visits to places of technical interest; Planned for the near future is a trip to Honeywell Computers Ltd; Educational talks are also given of interest to the amateur. After the meetings Library facilities and a good supper are available. Further enquiries to David Nagle, VK2BLI, 2 Crudge Rd, Blacktown, NSW 2148.

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FOR SALE: Amateur Radio Techniques, 3rd Edition, by J. Pat Hawker, G3VA. $2.40 [postpaid] to EEB; you can deduct 10c from that amount, but then we won't Certify it and you might not receive the book, such is the high reliability claimed in glowing terms by the PMG's throw-away propaganda Bulletin. If you are a poor student [or farmer] you can deduct a further 20 cents, but keep in mind that EEB is often painfully frank, and note how so many advertisers avoid EEB with such studied impartiality.... This book has been reviewed by every major electronics magazine in the world, and comments are unanimously favourable. Unfortunately this proves nothing; other than in EEB, have you ever read anywhere an unfavourable electronics book review? But the fact remains that this is a worthwhile book — very much so, or I shouldn't have gone to the trouble to order it; please buy this Edition and do yourself a favour, and also keep my Bank Account from bleeding to death. Thank you. — Yer happy Editor.

of DSBRC which, as we shall one day show, is the most efficient nominal method of radiotelephone communication. That is is also aesthetically pleasing strikes me as a culminating advantage in this crass and ugly age. For real communication effectiveness, of course, CW is unbeatable, and the case is well put in CQ's "In Defense of CW". Not to mention the fact that in CW you'll still find gentlemen, experimenters, and enthusiasts: people who engage the brain before putting mouth in gear.

Every month the Literature bursts with FET preamplifiers, converters, and detectors; you lack nothing if you look at any magazine at all, except EEB -- and nxt month even we'll have a comment about it.

The Differential Preamp in the Nov. HR is, however, noteworthy in that the author uses IC technology with discrete components and achieves thereby lower noise, wider dynamic range, easier matching, and better stability than the IC. Good on him! The experimental outlook is not (yet) dead. Friends and I have had similar experiences; the principal virtue of (most) IC seems to be its ease and cheapness, the engineering virtues of our age.

In the same vein, Fisk et al seem to be wildly enthusiastic about ecched circuit (I guess I mean etched) inductances complete with bandpass filters -- and the promise of "gyrators" to eliminate inductances from circuits altogether; alas poor Yorick. Doubtless a fine idea if we insist on packing more stuff into smaller packets. I wonder whether there is any human advantage in most miniaturisations and microminiaturisations? Military mobile, computerisation, electronic evesdroping, automatic toastmakers, better automobile electronics, more compact HIFI? Perhaps, perhaps, but to what advantage in the noncommercial world of the experimenter -- except for some mobile work?

Finally, Synchrodynes are becoming popular now, following the lead by QST during the past few years. I discuss this elsewhere in this EEB, but I might add tht the Nov 1970 73 has a solid state transceiver using Direct Conversion with an RCA IC. Selectivity is not as good as that of a superheterodyne, "but the results are entirely adequate for general operation. The receiver far outperforms any superregenerative set I have built...". I should hope so!!

Those of you who want to jump on the Direct-conversion bandwaggon, remember tht selectivity depends, there, solely on the sharpness of your audio filters. You'll spend just as much trouble getting <u>good</u> steep flat top audio response as you did for the r.f. equivalent. Nothing is free. Regarding the Active Filter in HR 4/70 and "comments" in HR 11/70, with the good audio filter he gets "better selectivity than with a good receiver and sharp crystal filter." I wonder how good the shape factor is; that is important for intelligibility and true selectivity.

<u>Your Friendly Mortician</u>

I see one of the Letters in HR recommends using crook ceramic valves as heatsink: knock off the ceramic top. If it contains Beryllium and you breathe the dust you'll collect it; c.f. EEB May 1970. For a few bob worth of aluminium, if I were you I'd avoid destroying ceramic valves

<u>SWR Etc</u>.

There has been a rash of articles on r.f. impedance bridges, now that the classical SWR Bridges are falling into deseryd disrepute. The most notable is the Antenna Noise Bridge, described in QST Dec 67 and HR Dec 70, but there is also an ordinary good r.f. bridge (HR 9/70) and SWR meter (HR 10/70). The latter concerns simply sampling signal along a line with a slotted line and simple detector; this can measure power loss or VSWR.

A more primitive version of this "SWR Meter" is described in HR 1/71, where the detector is fed from a loop slipped around the line or coax. Unfortunately for this cunning idea, standing waves in a coaxial cable are confined essentially to its inside surfaces. It is most dubious whether this can, as the author suggests, be reflected by a kind-of leakage to the outer surface of the braid (thereby to be picked up by a loop). Any such outer-surface VSWR would be a function of antenna unbalance (as discussed at length in 1968 EEBs), curable by a suitable balun.

Probably relevant is the article "SWR 1:1, Fact or Fiction?" in the Oct 1970 Spectrum (N.Z.) which, by the way, like all of us has had to raise its subs rate substantially. He shows that the achievement of unity SWR is uncertain, depends on a large number of not-readily controlled variables, and that in any event you can't determine what SWR you do have, by means of an ordinary SWR Bridge (c.f. above). "After all this -- what is an acceptable SWR? Commercial users set a limit of 2:1" but doubtless fearing the wrath of W5JJ and Co. (Dec 70 EEB), he adds, "and 5:1 is bad -- not as far as loss of radiation is concerned (only about 0.5 S-unit), but in relation to breakdown (loses) of the line." I should hardly think this important for low power, but dielectric loses db increase with SWR and length at VHF, and remember that Spectrum is a VHF group. Such loses are less important below 30Mc than generally believed.... See also "Comments" in HR 11/70, a very interesting exchange between a correspondent and an author on the real meaning of reflected power.

<u>Next Month</u>: More comment. Antennas, Teletype, and use of FETs for Rx <u>and</u> Tx. +PLL.

REVIEW: "73 Vertical, Beam, and Triangle Antennas," by E. M. Noll, W3 FQJ; Published by "Editors & Engineers" (sams). $US4.95 from source described in the February 1970 EEB; much higher from Australian bookshops. ((--RLG))

This book is written by the same author as "73 Dipole and Long-Wire Antennas" reviewed in these pages in Feb 1970. Again one marvels at the perseverance of the author, who actually built and tested all the antennas himself. The magnitude of effort does not quite reach the height (I mean breadth!) of the very long wires and rhombics of the previous opus, but his 160M triangle beam runs a close second.

This book is obviously practical, and the author's experience is evident in the many fine points of constructional detail often missed in the Handbooks or even in periodical articles. He gives much thought to the design and construction of the efficient and low loss radials and ground systems so necessary with verticals. He also maintains a sensible attitude to feeding balanced antennas with unbalanced lines (c.f. 1969 EEB's): A coax feed will work, but a better pattern is obtained from a balun, and an open-wire feed line gives this and lowest loses as well.

On the other hand, Ed Noll has done his homework well and brings out the important contemporary fact that if the transmitter itself is properly tuned, the loses from SWR are much lower than imagined for short lengths of coax on the HF bands, e.g. 100 ft! Although this is well in accord with Carl Drumeller's philosophy (EEB, Dec. 1970), Ed adops a rather more gentle attitude toward the harrassed Appliance Operator, urging that since in fact "especially modern transceivers, are quite critical of loading", it is more politic to cut lines to half-wave multiples "to stay away from reactive loading of the transmitter if at all possible." It may well be that rapid and competent tuning can handle any contingency as Carl suggests, but if the termination at the Tx or tuner can be made less reactive, life does become simpler -- if less heroic.

This book contains some of my favourite antennas, e.g. ground plane beam and vee-Yagi (Yuri, I STILL think the Folded Dipole thing will work, and one day I'll build it to prove it; I've got an idea how....), but in common with its predecessor it does share one grevious fault: you have to have a pretty good idea which antenna you want to use in the first instance; once you know that this book is full of ways and means. But there is not at all enough QUANTITATIVE information about bandwidth, gains, front/back ratio, effect of ground distance on patterns and terminating impedance. It is all well and good to trim for minimum SWR and use the wonderful Antenna Noise Bridge (again described in Appendices), but on which antenna and for what requirement? Where are the relative performance figures? Inverted Vees, End fire arrays, and Beams of various kinds are presented with elegant impartiality.

Of course it would destroy this practical book to load it with engineering criteria, and I do realise that perfo rmance depends very much on interrelating factors, but surely a few at least theoretical figures more precise than "good gain" would be in order as a guide to the perplexed. Perhaps, indeed, a whole book could be devoted to the thorny question of how to evaluate and compare antenna performance intelligently. Perhaps no subject in amateur radio has been the subject of more myth-making and prejudice than that of antenna performance. As with many aspects of the information explosion we now have need of some good correlations and methods of making sense of it all.

The problem of plugging-in various cables to change direction of pattern of phased verticals brings amused recollections of frosty evenings full of manipulations of stubborn connectors by frosted fingers, but never mind, such are the joys of efficient operation at low (= "high") frequencies. On the other hand, a few coaxial relays could work wonders.... Just a thought.

The Noll method of multiband operation by use of aligator clips to lengthen wire is a reasonable way of going about it as long as the clipping is not done at too high a current point, and as long as the clip is cleaned periodically -- particularly where clip and wire are made of dissimilar metals.

Thus, except for a certain bewilderment which antenna to use (other than for geometric considerations) I do recommend this book for your reference shelves and for good browsing. It is full of details about wire lengths and angles, yet your intelligence is not insulted by being told what material to use for booms and towers. On the other hand he has some ingenious methods for mounting verticals and feed connectors (which must, in my opinion, be water-proofed in practice). The following are chapter headings; the details of the specific types of antennas would fill this page:

1) Quarter wave verticals.
2) ½ and 5/8 wave verticals
3) Phased verticals
4) Low band Vert. & Inverted Vees
5) Two element parasitics
6) Horizontal phased arrays
7) Yagis, Quads, and Triangles.

Appendices I-VIII: Now including the welcome discussion on using the Antenna Noise Bridge to measure r & f. Also a brief chapter on "Base Tuner for Vertical Antennas."

Reference: See also; "World with a Triangle", Part II, by W. Salmon, VK2SA, Amateur Radio, Apr. 1969; Part III, June 1970.

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LETTER: Concerning Inflation etc.

Its not much good complaining about our present Government, because any other party in office would have to do the same. What is needed is a change in the basic financial policy under which we have to live and work. There is never a change in financial policy with change of Government. The experts know full well what is needed, but are ignored in favour of the amoral policies of politicians and others.

I think you will agree that on a whole we are losing our economic and financial independence, and it is most apparent in Primary Industry. You probably realise, too, that eventually concerns like EEB, etc. will be costed out of business. This could be one of the worst things that could happen to Australia, because it would be a certain sign that individual initiative has been completely stifled....

-- H. S. Gutsche, Loxton, S.A.

LETTER: Quaint Theories??

During the year I have deliberately and accidentally tested Mr. Reynolds's contentions about reversal of connections and omission of components many times -- always with negative and sometimes disastrous results... (This certainly shows the usefulness of being able to predict things from theory).

Your magazine is excellent. You worry yourself unnecessarily over subscribers not reading every article thoroughly. I presume most of your readers are hobbyists, who if they are like me, get a burst of enthusiasm for one particular project and ignore others for a while. But the wheel turns and months or years later there is a frantic search back through all literature looking for an article on another subject that one vaguely remembers reading. For instance your articles on C. D. Ignition don't raise a spark with me presently, but one day, maybe. I don't drive at 100 mph, and the simple recipe of a new set of points before I go on holidays each year seems to ensure ignition-trouble free motoring, with negligible cost.

Another of your quaint theories was on the subject of needless repetition in technical articles. You know, after an exhaustive review in any magazine on, say, "Reverse-coupled Transistors" there would be no need for anyone to mention the subject again. Personally I have found that often I have needed to read half a dozen articles on the same subject to clear up a minor point that no author had bothered to explain...

A variation on this theme is that the number of issues should be reduced as no one can keep pace with the flood of technical articles. There are two fallacies here:

1) You assume everyone has access to all this information.
2) You assume your journal is not one of those that are read from cover to cover, though not necessarily committed to memory in great detail.

If, on the other hand, the reason is that you just simply have not the time my reaction is entirely sympathetic (if regretful).

-- P. J. Kelly, Brisbane, Qld.

((I suppose that I was speaking for myself; I have to receive a number of periodicals, and am deeply impressed by the magnitude of the information explosion. But lets put it this way: that explosion does exist, and is covered in a wide variety of publications. If an experimenter is at all seriously interested in electronics, he has a responsibility to read a representative sampling, say at least two magazines and an occasional good book. Unless he is a retired gentleman, has no family responsibilities, never gets on the air or plays about in the workshop, he will find it a strain to do a reasonable job of such reading. Most people in fact, solve the problem by ignoring it.... Yes, I do not have time for a monthly EEB, and if I did I would feel uneasy about contributing One More Thing to the mountain of UNDIGESTED literature being published. What is needed desperatly is to have more correlations and thought pieces on what things MEAN, and less trivia and facts about permutations of data!--Ed.))

MODEL TRAIN TRACK CONVERSION -- E. Kershaw (VK3)

Since we have children interested in model trains, we have built up stock by acquiring sets. These have plenty of curves and very few straight tracks. Each time a new set is acquired so is this unfavourable combination of rails, but only the straights are useful in extending the layout. This results in a collection of "useless" curves and a dearth of straights.

It was suggested to me that I straighten the curves out. But this gave the prospect of two unequal lengths of rails. But cutting base and rails to match resulted in an irreversible process. Some thought produced an acceptable solution, at least for track which has a flexible base.

Pick a pair of equal curves. Remove the rails by bending the base down just enough to clear the fishplate, and sliding them out. The rails may be straightened between fingers with a little patience. The result is a pair of "short" rails and a pair of "long" rails.

On one base cut all of the ties between sleepers with tinsnips or side-cutters along the short side. On the other base saw all of the ties between sleepers with a coarse hacksaw along the long side.

Insert long rails in the cut base, the short side of which will open up to equal the long side as the rails are inserted. Insert short rails in the sawn base, the long side of which will close up as rails are inserted; if it won't, a wider saw cut is needed.

The result is a pair of straight tracks to which no harm has been done, and they match at the joins too. If required, the reverse could be done, e.g., curving the rails and reassembling as originally. Track so treated cannot be distinguished from normal track unless turned upside down.

((Surely you people must be interested in more than a diet of electronics? Lets have more articles like this on a variety of subjects -- railroading (and indeed there is a world of electronics possible too), models of various sorts and their control, better methods of turning worms (which won't electrocute the gardener), or....? Or are we all stuck permanently to our transistors? --Ed.))

LETTER: Happy Customer!

If I may make a comment on the magazine, then I would like highly to recommend the services of M. Weinschenker of U.S.A. (EEB Adverts, Aug. 1970) and his exceptionally fast and efficient delivery of silicon diodes. The diodes, although unmarked, are very cheap, and with air mail, delivery time was about nine days. They all work too!

-- L. A. Davies, Brisbane, Qld.

((But remember that diodes from reputable dealers like M. W. are rated for Absolute Maximum, and must be derated suitably as described a number of times in EEB and elsewhere. From unreliable dealers the ratings could be anything, and it is invariably wise to test them yourself. -- Ed.))

((P.S. Watch out for that Duty on items costing less than about 50c each! -- unless you happen to be lucky, which you can't assume...))

LETTER: No price Virtue?

Herewith cheque for $1.05; in actual fact I do need the money more than you, being a poor misguided farmer.

Could argue your statement, "no point in using an automatic device if you can do the job better yourself". I have had for some years a system whereby the front gate opens during the day, and shuts at night. It could no doubt be better opened manually, but to do this means a 200-yard walk. I would rather put up with the inefficiencies of electric motors and transistors.

-- R. M. Gebhardt, VK5RI, Mt. Bryan

((OM Gebhardt has a point. I suppose I meant that it is undesirable to use an automatic device if by so doing it achieves an end not well suited to human values, to desirable values that is. Farmers jolly well deserve the bit of help they obtain from automation; the same cannot always be said for some other portions of the community.... The original quotation is still valid if you take "better" literally; it does not necessarily mean easier, it means better for the expression of creative attributes... etc.--L.))

LETTER: Exorbitant book prices

I must agree with all your remarks about increases in postage rates and the "excuses" offered by the PMG. A further cause for concern is the recent unwarranted increase in prices imposed by the booksellers. In Sydney, at least, the prices were marked up overnight! Thank goodness that some texts have become available through EEB and the WIA.

Of course subscription rates must be adjusted to cover the extortionate postal increases. I doubt if anybody can complain.

-- K. A. Harding, Sydney, NSW

((It does strain my resources to offer books through the EEB, though it does happen from time to time when I am unusually impressed by some work. If a given book is not available through the Wireless Institute, readers should feel free to order it directly from the country of origin, usually U.S.A. or U.K. But do note that you cannot order it from the Publishers; only from bookdealers in those countries, as described often in EEB, e.g. FAA Bookshop in Oklahoma City, or Blackwells in Oxford.--Ed.))

CIRCUIT BOARDING SIMPLIFIED -- A. (VK4)

A few years ago in Practical Wireless (England) a writer offered gratis to inventors the idea of formulating a copper foil strip with an adhesive backing to facilitate the layout of circuits on Paxolin, a proprietary name for what is more commonly known locally as Paper Bakelite. This struck me as analogous to urging somebody to set to and invent the internal combustion engine. For a number of years several firms with international remifications have been offering this item, among other various tape products valuable to the electrical and electronics industry.

In a layout of experimental prototypes or a special purpose job that does not readily justify a circuit etched from copperclad bakelite, epoxy or mylar, I have had complete satisfaction from Sellotape's product, No. 842. This adheres well to almost anything, and ordinary soft-soldering heat affects it not at all. Not only is it a spended time-saver, enabling rapid layouts and modifications, but material costs are very low. Manufacturer specifications of Copper Foil Tape No. 842 are as follows:

Backing Material:	Soft Copper Foil.	Temperature Range:	-70^{o} to $+260^{o}C$
Adhesive Type:	Silicone.	Resistance to abrasion:	Fair.
Backing Thickness:	2.2 mils.	Resistance to ageing:	Excellent.
Total Thickness:	5 mils (without Holland Cloth interliner).	Resistance to oil:	Excellent.
		Resistance to solvents:	Very good.
Adhesion to Steel:	40 oz/in. width.	Resistance to staining:	Very good.
Breaking Strength:	60 lbs/in. width.	Resistance to Water:	Excellent.

Special Features:

It has a clear silicone adhesive which is unaffected by dilute acids. Acids will attack the soft copper foil backing of ordinary circuit board blanks, and it is in fact this which makes the etching of printed circuits possible by the usual methods. Sellotape No. 842 also has excellent performance over a wide temperature range, as above, and excellent resistance to shear once applied.

Typical Applications:

Printed circuits, electrical and electronic applications, ground lines and static shields. It is available in various widths (on application), with lengths 36 yards on 3" cores.

Base Material

For base material on which to mount the copper foil tape, punching bakelite, Grades A or B, are suitable for most kinds of radio experimental work. B-grade, the cheapest, is brown in colour, works easily but is more hygroscopic than A-grade material. B-grade is quite suitable for audio circuits and for r.f. equipment operating at medium broadcast frequencies. A-grade, yellowish in colour and more brittle, is desirable for equipment operating at higher voltages and at VHF. The sheet is readily procurable in thicknesses from 1/64" to 1/8" or more. 1/16" is the thickness most commonly used for circuit board. Messrs O. H. O'Brien, 23 Moray St., South Melbourne, Vic (and represented in most interstate capitals) will saw a 6' x 3' sheet into strips of any constant size for a moderate cutting charge, or the sheet can be bought uncut.

Layout, etc.

When using copper tape with bakelite boards I usually layout from the topside -- that on which the components will mount. When holes have been dobbed in with a pen-nib charged with white ink, or pricked with a scriber, they may be centre-popped and drilled.

A special drill-bit with wide flutes for easier clearance of swarf is to be preferred when drilling bakelite, but ordinary wood or metal-working drills function well enough, ground with an included angle of 110^{o} to 120^{o} and run at high speed (8000 to 10,000 RPM if possible for bits up to 1/8"). While drilling, the material should be held or clamped firmly down to a piece of smooth hardwood, and you must feed lightly -- not push -- if the drill is not to exit untidily, shipping a small flake off the laminated bakelite.

With the board drilled, the tape may be cut into strips with ruler and

sharp knife, or it may be scribed and cut with scissors. Then the backing cloth is removed and the foil is pressed down, being placed in correct configuration under drilled holes etc. So, top-side again, to prick the holes in the bakelite through the copper with a sharp round awl or an old steel grammo needle held in a pin-chuck. The foil could be laid as a preliminary and drilled through, but unless your drilling machine and/or your technique is sensitive, untidy burring can occur.

Cheaper Substitutes

If you're the ultra-thrifty type, the cheapest way to run up your experimental boards is to procure from hardware stores or cabinet-making factories, offcuts of Laminex or Formica. This material has excellent electrical properties, and can be used as base for the board.

Then procure from a firm such as Austral Bronze Pty. Ltd., the smallest quantity they will sell you (perhaps a half or full pound) of about 0.003" copper shim, which should last you nearly for ever unless you use it to make static shields and the like. It will not cost you much, even though copper prices are high.

Sliced into strips of any width, this foil may be stuck to the underside of the Laminex with a good neoprene adhesive. This doesn't lift under soldering, and all of its properties including adhesion, improve with age. A suitable brew of epoxy resin also does a good job, though a slow (overnight) cure is the secret of its successful adhesion. If you insist on too fast a curing (assisted by heat or pressure), air bubbles are liable to form under the foil, causing it to buckle and lift.

When the copper strip has been mounted it should be wiped with mineral turps or white spirit, and lightly burnished with steel wool. Do not touch it with the fingers thereafter. You might also, if you aim for perfect solderability, pre-flux the strips with a mixture made by dissolving a little pine rosin in methylated spirit. When this feels just slightly tacky to the touch it is ready for use and can be stored in a tight-corked bottle indefinitely.

Australian H.Q. of Sellotape (Australia) Ltd:
20 Cato St., Auburn, Victoria, 3122. Phone 201-251.

((Editor's Note: The Author included a sample of the Sellotape 842 with this article. It appears to be quite thick, qualitatively, and very durable; indeed it would be desirable to avoid sharp bends in portions that are to be stuck down. Although the under-surface does not appear to be very sticky (once the protective backing is removed), its adhesive qualities are certainly excellent if the base surface is smooth. It would appear to be a simple and relatively inexpensive substitute for printed-circuit boards; the copper-clad stuff is not cheap... Incidentally, the Author is in no way associated with any of the firms he recommends; he is a manufacturer.))

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COMMENTS FROM EEB CORRESPONDENTS:

"We're never on the air except to talk to dear friends in N.J., mainly because we can't stand the general rubbish on the air. ---- gets furious with all the rudeness and utter nonsense." -- N. Z.

"Very few American hams build or experiment any more. Most are of the appliance operator type. I'm sure you know what I mean. There is so much money here that most guys just buy what they want. An experimenter here is one who builds Heathkits." Manufacturer in U.S.A.

"Seems that there should be an easier way of making money, or a better hobby, such as opium eating or ------. As the XYL once told me, 'why don't you get out of the radio shack and play around with women, like other fellows do?'" --Overseas.

"New wife to neighbour: My husband is off someplace shooting craps. I hope he doesn't get one because I don't have the slightest idea how to cook one..." (Autocall, 12/70).... Then theres the one about the chap out shooting a little golf, but this is a Family Magazine and so turn the page for more electronics ⟶

LETTERS: Can Amateur Radio Live?, ICs, etc.

It is pleasing to me that you see fit to include extracts of letters of a mature nature about Amateur Radio being a unique hobby worthy of respect by its members. With the ITU conference fast approaching, it is evident to me that many Amateurs are not prepared to do even a small amount of thinking about the future of Amateur Radio in Australia.

Unfortunate though it may be, our general attitude seems to be that since these events are a long way off, it doesn't matter what we do now that counts; we can put it off.

Hopefully a steady stream of thought-provoking letters may stir a few of the multitude to develop an opinion reflecting a perusal of prospects for the future.

I should like to offer my opinion on ambiguity in the labelling of component values in circuit diagrams. With photo-copying machines in such plentiful and cheap access, many useful circuits are being copied for compiling into circuits books and the like. But the loss of resolution in the process often leads to the gradual omission of decimal points.

Although capacitor values tend to be fairly self-evident, resistor values are not, and an error of an order of magnitude may not be evident. My view is that the value like 3.3K should be written as 3K3 where the decimal point is taken up by the K or M multiplier.

Two examples of the commercial adaptation of this method are seen in the fact theat Corning "Electrosil" resistors are boxed as 2K2 or 3M3, etc; and the small BZY88 series zener diodes, where 6.2V is labelled as C6V2.

In your anti-IC viewpoint you favour the ingenuity of experimenters in using discrete components to achieve results. But may I add to the comments of Jim Fisk, W1DTY when I tell you about two remarkable ICs produced in Australia by AWA Microelectronics in Sydney. The AWM1306 (as described in my article in Amateur Radio, June 1970) is a complete i.f. limiting amplifier and detector (FM) which uses only one tuned circuit to demodulate an FM signal (±5kHz deviation) on 455kHz, the input required for full limiting being only 40uV RMS!! I will agree that it is disgustingly easy to make the beast go -- ten seconds fully to align.

Your comment about "a receiver blob" performing all functions is 75% with us in Australia now. AWA Microelectronics are now just making the AWM1272. This IC contains a cascode r.f. amplifier, two oscillators, and a balanced mixer. Typically the resolvable signal level up to 15MHz or so is 1uV! Presumably they could add in the demodulator too.

To the best of my knowledge no other manufacturer in the world can claim to produce equivalent ICs. Either costs about $4 -- and you cannot do the same job cheaper with discrete components. It is becoming easier to make devices with block functions, but I admit that without the basic understanding of how discretes work, the new science is useless....

Don't starve yourself to death economically -- electronics (and cooks, hi) need your publication!

-- J. Reynolds, VK3ZMU, Kew, Victoria.

((In view of the increasingly commercial aspect of "Amateur" Radio, would many mourn its demise? The decimal point idea sounds good -- but I think we'll just make the dots bigger..... I suspect that Australian manufacture is an echo of large events taking place in Europe and America-- Ed))

((Mr. Reynolds kindly supplied a beautiful photo of his IC FM i.f. Amp & Demodulator, but I think we won't print it; it will take a lot of fussy technology for us to reproduce photographs, and right now I have my hands overfull trying to master the more conventional methods. But tnx.))

LETTER: The Creative Urge.

As an old B in the bush, battling to keep abreast of the state of the art, I still find I am reluctant to take a gadget past the rats-nest stage; once you've boxed it in, its just a Thing.

For all those with a creative urge I see a glimmer of hope in spite of ominous rumblings. People who are fed up with a mass-produced existence, are increasingly patronising craftsmen of all types. I see this as a turning of the tide. Let us by all means take advantage of the electronic marvels, but let us keep them in their place.... If you are still with me, I'll return to a relevant subject.

I have made up a couple of the dwell extenders (ref, Electronics Australia, Feb, 1970) and they do all that is claimed, checked with a dwell meter and CRO. Since it is simple and fail-safe, I think that it makes other ignition improvers obsolete. Any standard system (when looked after) will give a good spark at low revs, and with the new device will give the same output at about double the revs where the spark would otherwise noticeably deteriorate. By your "Grandma's Test" I found no need for the huge heat sink recommended; the SCR remained cool without any. I settled for a small one which gives quite satisfactory results. The current through the device is intermittent, with a duty cycle of about 40%, which at 3A or so no doubt accounts for the cool running.

-- L. Chaplin, Tanawha, Queensland.

((Maybe so, but take a look at the breakerless distribution system described in the September 1970 Electronics Australia. With an SCR-system that looks like about the ultimate -- Ed.))

LETTER: Simple Sums

Some simple sums in the inimitable EEB style:- Consider,

$1.05 = 7 glasses beer at 15c.
7 Glasses = 1.5 Hours enjoyment
$1.05 = 8 EEB's
1 EEB = 1.0 Hour reading, evaluation, and derision (sic). Therefore,
8 EEB = 8 Hours.

And so, for the same outlay I seem to be able to waste an extra 6.5 Hours (and I still have the copies of EEB on the pile for "reference"). Surely on this irrefutable evidence alone it is good value.

On closer inspection it appears I should enclose $1.50 and receive only 6 issues. Oh well, never mind.

-- P. Johnstone, Ashburton, Vic.

((Never mind indeed, your Dollar is merely 43% cheaper, so you need more of it. By the way, beer costs more too. Sic transit gloria mundi (Thus passes the glory of the Monday-after) -- Ed.))

LETTER: Commonsense electronics
(See also: EEB, April 1969, p. 34)

For r.f. and really hi-fi a.f., solid state stuff is simply not as competent as are tubes -- unless space and weight problems and extreme economy of power becomes essential (as in the space shots).

Solid-state stuff is incomparably superior to tubes when you want binary on-off stuff, and want many thousand units. Computers have to use solid-state stuff. Pocket radios, where neither high power nor hi-fi is demanded, naturally call for transistors. For true linearity or for anything requiring an absolute measurement, however, you need vacuum electronics.

For instance, the Fairchild FPT-100 phototransistor has a light sensitivity comparable to that of a 10-stage photomultiplier. It is a relatively low-impedance device, has a response time as low as 30nsec with no hysteresis or overshoot, and a range of some 10^8 in light intensity. And its fairly linear too.

But the old, old 929 type vacuum photocell is linear; it operates directly at the fundamental level of a light quantum kicking loose an electron which is gathered and fed into the circuit. The 931-A photomultiplier is almost as absolute; its got nine stages of electron multiplication, but you can use it as a secondary standard for light measurement. With it you can calibrate the abovementioned FPT-100 unit. The FPT-100 of course, is smaller than a pea -- which makes for a much handier unit, and works nicely on 9 volts instead of about 900. Its definitely got its points.

Consider too, the Texas Instruments nice cheap little FET, the 2N3819 ((or Motorola MPF-102 -- Ed.)) that sells for under $1.00 ((here too)) that does things you simply can't do with a vacuum tube. The d.c. input resistance of the thing is fantastically high; it makes it possible to read the voltage on a 0.05uF condenser without effectively discharging the thing. Used as a source-follower, the 2N3819 can drive a 200uA meter nicely, and hold the reading long enough for easy reading. Makes a great little integrating circuit. A highly reliable instantaneous flash integrating photometer can be made with a 929 photocell charging a small low-leakage condenser, with the 2N3819 reading the resultant voltage. The charge on the condenser will be the integral of light intensity x time; the 2N3819 can read it into the meter, and you've got a flash photometer that is good anywhere from a superfast 1.0usec to a slow old-fashioned magnesium-powder flash. Try reading that condenser with any ordinary vacuum tube circuit.

I think that the matter of which component is suitable is kind of like old structural materials vs the wonderful new plastics. Both have their special values. Wood is cheaper, stronger, easier to work, and easier to shape with hand tools -- but plastics are better insultators, are far more corrosion resistant when properly selected, and hold dimensions better. But you can't make a plastic melting pot for solder, and neither wood nor plastic is worth a darn for conductors.

The trouble is that human beings tend to get fads, and decide that this New and Wonderful Stuff should be used for everything. Currently, to be "modern", everything's got to be solid state. Its the current fad. Even if something else works better.

Incidentally, there are jobs that neither wood, plastic, nor metal will do -- like standoff insulators for red-hot nichrome heating elements, for instance. For that, ceramics.

On the other hand, I wonder how many hams are aware that talc rock can be purchased at most art supply stores, can be carved more readily than soft pine, and can be shaped with files, sandpaper, drills, knives and saws like plastic. And it is one of the world's best insulators. Moreover, after you have shaped it, you can bake it in a pottery kiln; some neighbour probably makes pottery as a hobby, and would be glad to help. Then it becomes regular steatite -- very hard, strong, and very good insulation. It is thereafter stable to a melting point way above that of steel or nichrome..

-- J. W. Campbell, W2ZGU, New York, N.Y.

((Readers may recognise the name of this correspondent as an enthusiastic S-F editor. I was reading his stuff more years ago than I should like to admit. Don't have much time for it any more, but I pick up a good anthology once in a while. For readers who like to keep up with this intriguing genre, the address of ANALOG is: The Conde Nast Pub. Inc., 420 Lexington Ave., New York 17, N.Y., U.S.A., but in fact you can usually see it on the larger newsstands here.

John Campbell's own understandings of electronics plus a very active and creative imagination often combine to produce articles and editorials of great interest. For instance in the February issue he described some quite fascinating research being done by Bell Labs in the U.S.A., "studies of the nature of human sense-brain-mind interactions." The most interesting is the work of Risset who produced a series of tape recordings generated by a computer, which gave unbelievable results. For example, "a musical note, starting at about the middle range of tones, and descending in pitch through about four octaves... Then Dr. Risset played back the first tone, and immediately after, the last tone. The last note was a higher tone than the first!" And yet another recording "carried a constantly descending pitch. It descended at a rate of about an octave in five seconds or so -- and kept it up indefinitely.."

And so forth, e.g. "A tone starting in the mid range, and falling in a wail to lower and lower pitch -- winding up in a shrill screech. Or an ascending note that ends in a deep groan." He points out that the basic fact of these apparent impossibilities lies in the fact that pitch and frequency are not at all the same phenomenon.

Some of these matters were described briefly on the ABC's Sunday morning radio programme a while ago, but I got a preview of it in -- of all things -- a S-F magazine! -- RLG))

((P.S. Ho, John, how about a nice brief article for us on your electronic-flash photometer project? Send us the outline, and the main gab to one of the big mags for money. Hi.))

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"If you drink, don't park; accidents cause people"
"Poverty is no disgrace, merely ridiculously inconvenient"
"Never run away until you've got something to run to." (Russian proverb, I think)

REVIEW: "Basic Electronics", Third Edition (Electronics Aust. publ.) -- RAJR

The Third Edition of this well-presented text book is to hand. It is a compilation of a series which appeared originally in the magazine, and which was subsequently expanded and revised. It was formerly known as the "Basic Radio Course". The introduction claims that the course "will give you a basic insight into electronics..." and it will. It covers basic electricity, valves, antennas, receivers, power, audio, and magnetic recording. A smattering of everything, fundamental details of little, virtually completely qualitative rather than quantitative. Although it is not a sufficient text for preparation for the PMG amateur's operators examination, nor for adequate background in radio/TV servicing, it is good for a person who wants to build his own domestic electronics equipment, be it a radio receiver or a complete HIFI outfit -- or who just wants to become better informed about the more elementary facets of modern electronics.

Although the book was developed from a previous series in EA it has not stopped here. They continue to produce excellent beginners material in the magazine itself, such as the "Fundamentals of Solid State" which began in May 1969. The latter is more complex and should be followed up by the more serious experimenter or budding professional. Indeed, that can be said for the sense of "Basic Electronics". For the serious beginner it is worth scanning for more qualitative detail than found in the Handbooks, but should be followed up by reading some serious educational texts, such as "Electrical Fundamentals for Technicians" by R.L. Schrader, or "Principles of Electronic Technology" by C. B. Weick.

The only adverse comment I might make on "Basic Electronics" is the $2 charged for it even though the format, paper quality, and advertising space is much the same as for the monthly magazine which costs appreciably less. One might observe that it could be worthwhile to reduce the selling price somewhat, particularly in view of the likely restricted financial state of a predominantly young audience.

COMPARISON REVIEW: "Basic Electronics", formerly "Basic Radio Course", published by Electronics Australia. -- P. Cox (VK7ZPA)

"... revised and updated in detail, and in line with recent developments"

New Material

Although various amendments and a change of title have been added to the 1969 (third) edition, I feel that the item quoted above, from the Introduction to the newer work, is rather optimistic. The length remains unaltered at 128 pgs, thus the inclusion of some two pages of totally new material is due to a reduction of approximately 3/4 page in advertising content, and minor revision of some chapters. Innovations include hints on learning morse, the circuit symbols currently in vogue, and prefixes for standard units. Nevertheless, treatment of semiconductors other than transistors and their immediate family seems inadequate.

Revised Material

Usually points of secondary importance, viz., inclusion of FET and unijunction; fabrication of silicon planar transistor instead of germanium alloy-junction type; transistor symbols finally updated (but note second eidition, p.99). Chapter 18 (Amateur Section) contains a more recent AOCP paper, and the morse speed reduction is noted. Electronics in sport is expanded upon somewhat (p.109). Page 128 now carries a short note on tape cassettes and cartridges.

Minor Grumbles

Price increase, to $2.00; lax proofreading, e.g. p. 85, ref. to Pounds.

Conclusion

A useful, if rather basic text (Ref EEB, Dec. 1970, p. 160). If you don't have a copy of the first or second edition, and have previously read only the recipes in EEB, it is, perhaps, worthwhile to purchase this book.

((EEB Editor's Note: Peter is, perhaps, a bit too hard on this elementary book, in my opinion. It is certainly primarily designed for beginners, but constantly one is faced with complaints from beginners that much of the available texts are rather steep. I'd say that this EA book is worth reading by beginners, but that (of course) it should be supplemented by other material, for example the "Outline of Radio and Television" we mentioned on p. 159 of the December EEB.... We have another similar article coming up on further good references for beginners of all types, and that often includes me and thee.))

LETTER: Infallible Engineers?

Hope you continue EEB as it is. One thing -- I like to keep this sort of mag in a two-ring binder. It is easy to file this way, and lays perfectly flat. Could you leave a space in the printing at the correct positions?... If you have to increase the price, do so.

I notice that some advertisers say "used by government departments" in the trade magazines. (Some government departments) are given wide freedom to purchase small items, no doubt to encourage initiative. I therefore think that that phrase just means that some engineer has decided to give it a go -- and he may be even less qualified to decide whether it is useful than some of your other readers. It certainly does not guarantee that policy of the particular government department is in favour of use of that equipment. In any case, I don't thing government departments are infallible, although in some cases they have the money and time to spend in looking for suitable products.

-- J. Muntz, South Oakleigh, Vic.

((Making space for holes for a binder would place a considerable strain on our operations, because material is often "cut and pasted" to arrange it to space available. Best idea is to keep copies of EEB in a suitable folder, and at the end of the year glue them to the spine of the folder with suitable adhesive glue. -- Ed.))

LETTER: Printed Circuit Resist

Being unable to obtain "blobs" etc in Letraset which I've used previously, I now make my own with a punch, using "Con-tact". This also allows you to cut any desired shape and stick on. Sample:  White dot in the centre made with Letterpress. Works OK even if a little tedious.

-- L. Yelland, Prahran, Vic.

((Another reader advises that lines for Resist can be made with "Texta-color" or the Pentel equivalent, but for the latter it is important to ensure that the pen uses an acetone rather than water base, i.e. the "indellible" kind; this can be verified by sniffing it. After the circuit is printed the line can be erased by acetone. -- Ed.))

LETTER: Whence EEB

Since you solicit comments here are a few:
1)Contents too technical vs too infantile: I feel that these comments are merely based upon the depth to which the person wants to pursue a subject. The articles on power supplies would be good and not too technical for a person who wants to build a supply, but pretty heavy for just general reading. I often find that as my interests change, articles which seemed dull when they first came out, become interesting some time later.

2) New format: I like it easy to read, and it looks good.

3) Bibliographies: If you are prepared to do the work involved, OK, but unless one has a huge reference library one can generally remember if he has an article on such-and-such, and if he can't get hold of a reference the bibliography is pretty useless.

4) ICs: Don't be reactionary, ICs ARE becoming more and more part of electronics. Sure they take some of the experimentation out of electronics, but every new development has made it possible to use less components and less "experimenters ingenuity" to set up a circuit. But experimenters are still in business, their energies have merely moved in a different direction with each new development.

5) "Too much gab from Gunther": I do not like the idea of half the magazine being taken up by one article, e.g. power supply in the 1970 series. If you do not happen to be interested in power supplies you don't get your money's worth for that month. Perhaps the articles could be spread out into a longer series.

6) EEB in general: Well, if I didn't like it I wouldn't resubscribe. On the other hand, when you get carried away with long articles I am not too happy. Your little snippets such as recipes and household hints are liked mainly because they are so practical.

-- D. R. Nagle, Blacktown, NSW.

((As you say, interests do change; perhaps the article itself can help to accelerate that change. I do agree that the series on power supply was heavy reading, and if time permitted I ought to have gone through another draft of them before committing them to print. On the other hand, such technical series are NOT designed to appeal superficially to a person "who wants to build a supply", but to show the experimenter community that there is a certain commonsense logic in design, which can sooner or later be very useful -- and which can free one from the servile dependence on exact copy of published circuits.

But I have been reconsidering this matter of how to publish long technical discussions, if only because we seem to have quite ample material available without them! The answer seems to be for me to publish them Elsewhere, and give you advance warning of appearance of a given article in a given publication. I have already started work in that direction for several projects.

Bibliographies: you have a point, but not as strong as you may believe. The publications to which we refer are commonly found in libraries -- public or WIA or private, and increasingly so now that Australians are acquiring a broader point of view, viz., reading the international literature. In any event, we have, where possible, taken to giving a brief summary of the main points of important references in the Bibliographies, and that should help. -- Ed.))

LETTER: EEB staggers on....

Whilst being presented with less attention to formality than any other journal I've seen, EEB nevertheless retains a high degree of technical accuracy and detail, which we in Australia seem to have come to expect and appreciate. Particularly, I was greatly impressed by your bibliographical efforts -- a very valuable service.

-- W. F. Porter, VK2AKB, Artarmon, NSW.

ERROR: Headlight Dip Switch

We are grateful to Mr. J. Fox of NSW for pointing out an error in the "Headlight Dip-Switch" diagram on p. 83 of the 1969 EEB. Diode, D_1 should be the other way about for NPN transistors and negative earth. But D_2 is all right as shown; it discharges the electrolytic rapidly between timing cycles. We might add that the relay should be one which can operate satisfactorily from either coil. If only single coil relays are available it is possible to arrange the circuit to use two relays to accomplish the job. Rod has finished this months draughting, so I won't include the diagram here but you can figure it out easily... Please do go back to your Aug 1969 EEB and make the necessary correction NOW, or you may be sorry.

LETTER: Receiver Design & Commonsense

I am presently working on some material on Receiver Design, but must go through and modify the treatment to be less mathematical, or no one will read it! But in fact there can be a lot of maths involved in the design, particularly in mixers; without getting too abstruse it is important to understand the basics. The usual type of mixer with the local oscillator acting as a switching voltage can be very well covered by treating it as a sampling process, with constraints on the operators. Even so, I think it could be just as well understood with a bit of common sense.

Talking about commonsense, you might add this to the Grandma's Tests idea: Junction transistor action ceases at 150°C. To determine maximum dissipation, therefore, you increase the power until the silicon transistor stops amplifying, then back off a bit (Do I hear strangled sobs in the background?). Then of course there is always water-cooling; don't laugh, I've tried it. By that means you can get maximum dissipation almost to $BV_{CEO} \times I_{MAX}$.... !

I think you are wrong in worrying about the American subscriber ("Whither EEB," 1970, p. 98). If he is an Engineer, then he has the wrong approach for you anyhow. I refer to Design Philosophy, a personal thing. Design is always a matter of compromise; we are always trading one thing against another to get the "best we can with what we've got". There are only shades of grey, and the only way we get the right shade is by discussion. This is where the EEB comes in. It is a much-needed engineering forum, and don't you dare let it change!

-- C. Pitcher, Clifton Hill, Vic.

Honey Mead: Boil 14 lb honey in 6 gal water for one-half hour. Add 4 beaten eggs, ½ oz cinnamon, cloves, mace, and bruised ginger. Boil ¼ hr longer. When cool, toast a large slice of brown bread, spread all over with fresh brewers yeast, and put on top of the mead. Let it ferment for a day, then turn into a cask. Keep it open until fermentation has cleared, then close the bung. It may be bottled in a month, using crown caps or wired bungs. Mead made this way is sparkling and effervescent. An interesting variation is to add two gal. of apple juice for each 6 gals volume, and proceed as above.

Cure for Chapped Hands: This is particularly good for the bloke who works outdoors a lot. Simply mix some glycerine and some tannin, obtained from any chemist. Or: 1 tbs glycerine plus 2 tbs warm thin boiled starch. Or: mix together some warm beeswax and castor oil. Or: beeswax and sweet olive oil!

(STUPIDITY)^2

You won't believe this, but according to information furnished by PMG, it costs less to send a 24-hr telegram to New Zealand than to the chap next door. Wot, you say, Australian telegrams are quicker than 24 hrs? Ho.

STOP PRESS: NZART can now handle EEB subscriptions for N.Z. Details in next EEB.

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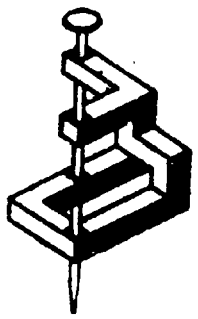
PLANNED (June): Digital Voltmeter Design (maybe). More State of Art. Component availability here and abroad... Crossmod and FETs. Use and abuse of Feedback. Transients. Maybe maybe. Thats a whole month away and who cares now???????????



NEW SHIPMENT JUST RECEIVED

These typrodotes were received too late to include in our offering last month, but since we would not want our readers to be ignorant of these devices, we are including them this issue. A typrodote is a device used to divine how much change someone has in his pockets; thus when the drinks are being served, you can easily determine whether he is loaded (with money) so you can out-fumble him for the check. The device comes complete with full instruction on its use, along with a cleverly compiled illustrations of at least fifteen different ways to out-fumble someone on the check. You appear to be working hard at picking up the check but somehow it always ends up in his hands. Try one, Gus recommends them highly.

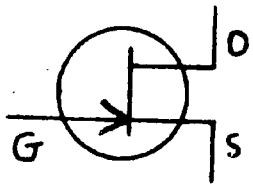
- - - - - - - - - - - - - - - - - - - -

AUTO-CALL

CONCERNING FET CONVENTIONS! -- RLG

I type this after having finished a most frustrating hour correcting a finished diagram, and another hour fighting the clog in a non-clog draughting pen, and I'm in a savage mood. It was all due to the ambiguity that can result when an FET is drawn with the gate connection halfway between source and drain. How that convention got started I can't imagine, but its bloody stupid, if you'll pardon my saying so. One presumably knows which connection is which by virtue of the drain being on top, or perhaps the source and drain are labelled in cases of ambiguity. But I have indeed seen formal printed diagrams in which it was the other way about, and no clarifying labels. Presumably you are supposed to figure out which is which connection on the FET by tracing circuit polarities. Quaint.

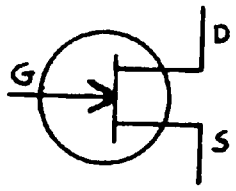
Now can we try to settle this matter once and for all?? We have adopted the much more sane convention of having the gate connection continuous with the source -- thereby removing all ambiguity. Like this:



RIGHT!!

(N-channel shown; ie, same polarity as a valve)

NOT like this:



WRONG WRONG!

I have shown the gate, source, and drain labelled clearly on both diagrams, but only on the right-hand one would it be necessary; on the left-hand one it would not be necessary, and we don't bother.

Now may we please have only the left-hand convention from all authors who send us anything at all involving FETs, and if there are any Engineers out there who determine Official Policies in the Wide World, would they please push for the saner convention. Please? I realise that in some commercial applications, particularly involving MOSFETs the transistors are symmetrical, but lets get into the habit of showing intended source and drain connections explicitly by the use of the left-hand diagram so that where it DOES matter we won't be misled. Thank you.

Kansas joke: The salesman got lost on one of the back roads after a rain. Stopping at the roadside he asked the fellow how far it was to the nearest town and was told by the fellow he didn't know. After driving up the road, he noted in the rear view mirror there were now two fellows, waving him back. Carefully he backed down the muddy road to where they were. Said the fellow, "This here's my cousin Zeke, and he don't know either". (A/C 3/70)

SWOOP -- Elise White

((From the Amateur Radio News Service Bulletin, September 1970))

An amateur is a guy who gets into your transistorised Princess Phone, makes your TV picture look like it had measles, garbles your stereo, squirrles up the record player and superimposes his conversation on your tape recorder.

He also wrecks the esthetic beauty of your property by erecting towers and stringing antennas that destroy your view of the neighbour's back yard.

He has also been accused of causing the washing machine to over-suds, the dryer to blow a fuse, the baby to have colic, the car battery to go dead, the electric blanket to short out and the can opener to act like a mowing machine.

Disaster strikes. Day or night the closest amateur is called in the firm belief that in spite of his sins he has a direct pipeline to the disaster area and can get instant news about Aunt Susie from Pismo Beach or Sonny in DeHilo. We don't have Aunt Susie's address or phone number, we haven't thought of her in ten years, but we're sure she's in the quake area. Sonny wrote he was due for the front and they just told of a terrible battle going on and with his luck he's right in the middle of the mess. No, his serial number and APO are upstairs but we don't want to write to him, we want to talk to him ((So... maybe 3rd party traffic is a mixed blessing?)).

The amateur patiently tries to get solid information depending on the area involved. He will spend from 14 to 24 hours working to get the messages through ((and on Phone, yet! -- RLG)). More calls missed meals, squacks, squeals and screams from the radio but with his one track mind he keeps on working....

The crisis ends and a week later a neighbour comes to the door screeching for Joe to get off the air. His dog had been howling for 2 hours and he was about crazy! He's positive the animal is being bugged by R.F.

The rig hadn't been on for three days, so I suggested he check the dog. Now even the animals are after us!

P.S. The kids had locked the dog in the other car. No R.F. Life could be beautiful -- I think.

SCR-REGULATED POWER SUPPLY, Part I · -- L. J. Yelland (VK3)

When Silicon Controlled Rectifiers are used in place of diodes, a power supply shows a marked improvement of load voltage regulation when the SCR gates are fed with a.c. through suitable resistances. For a fully regulated supply it would be necessary to use a Zener reference and relaxation oscillator arranged for phase-control of gate triggering. The unit depicted below uses the simpler arrangement to give a reasonably constant output with little added complexity.

The gate resistances are chosen so that a substantial portion of the positive half cycle is traversed before triggering occurs. For instance, the SCRs used in the model required two milliamps on their gates. Thus, with 10K ohms, the incoming half cycle must rise to 20 volts before conduction takes place. That happens at first switch-on, and then the filter condenser (1000μF in this case) becomes charged up to whatever value it has had time to reach during the remainder of the half cycle. On no load, except for the 50K bleeder, this should theoretically be E_{max} (62V), but owing to the impedance of the circuit, it reaches only a little over 50V. Other supply voltages would, of course, require suitable alteration of component values.

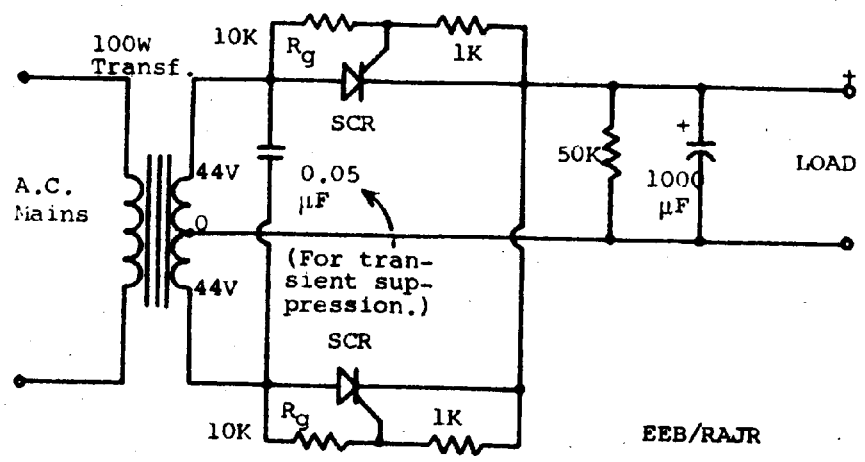
When the first positive half cycle has ceased, the SCR in that leg of the transformer winding ceases conduction, and a positive half cycle appears in the other leg. But the SCR in that leg will now have the condenser voltage on its cathode, so the difference between cathode voltage (50V) and peak supply voltage (62V) is only 12 volts. This is insufficient to pass triggering current though the gate resistance, so that SCR does not fire. The same applies to the first-mentioned SCR when it again receives a positive half cycle, so it does not conduct either.

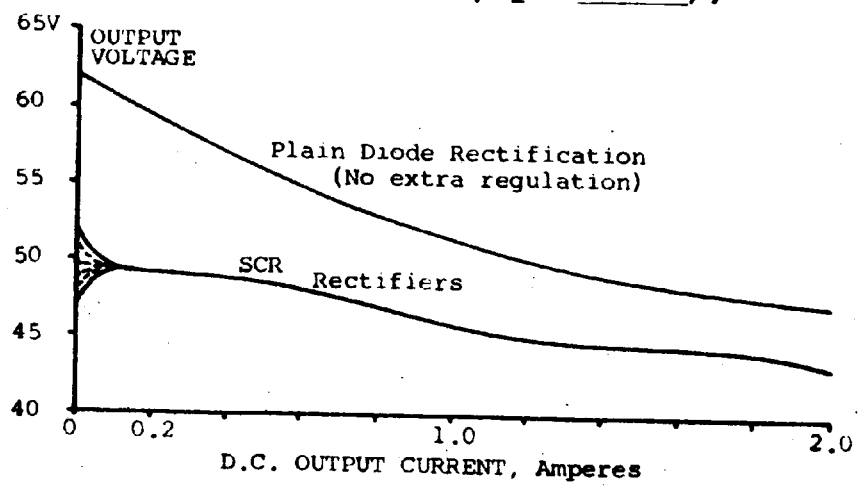
The result is that both SCRs remain non-conducting until the condenser voltage reduces by discharge, sufficiently for the required gate current to flow. In practice, with only the 50KΩ load (about 1mA in this case), it takes about one second before conduction again takes place. A voltmeter placed across the output will show a voltage oscillating between about 45V and 50V at one second intervals.

When an external load is applied, this variation becomes lower in amplitude and occurs much faster. At 100mA the oscillations cannot be seen,and the meter shows a steady 49V. To obtain a constant output voltage from any given small load it is evidently necessary only to provide sufficient no-load bleed current.

From the graph it will be seen that this voltage remains fairly constant as the load is increased to around 500mA, after which further increase of load causes a drop down to 45 volts at 1.2 amps, and then a more gradual drop down to 43 volts at 2 amps.

For comparison, a curve has been plotted showing the drop in voltage when ordinary diode rectifiers were used. That voltage variation was from 62V at no-load, down to 47.5V at 2A -- about 23% drop; on the other hand, with the SCRs the drop from 49V to 43V was only 12.5% and it had the added advantage of having two regions where it remained almost constant. ((CONTINUED, p. 47))





MAKE YOUR OWN COMPUTER -- R. S. Maddever
-- A Circular Slide Rule (VK3)

There are two main types of computer, digital and analogue:

Digital Computers use pulses, adding and sometimes subtracting or multiplying them. An example of one which uses the decimal scale is the odometer, or distance indicator on a car. Scientific or large business digital computers usually use the very simple binary scale, wheras a few, such as a calendar, use much more complicated scales.

Such computers or counters have one important thing in common: In reading their output it is not possible to estimate between successive numbers. Merely from looking at the date on the calendar it is not possible to tell what fraction of a day has gone past, because that number applies until the next one is used.

Analogue computers, by contrast, use continuous scales. Information given to them is converted into lengths or perhaps voltages or currents etc. These lengths, voltages or currents are then added, subtracted, multiplied, divided or scaled by different functions, and the final answer read from a scale.

An example of this type of computer is the speedometer of a car. In this computer distance along a scale, frequently a circular scale, is made directly proportional to the speed of the car. Other examples are a clock, which makes distance along a circular scale directly proportional to the number of minutes elapsed, or a thermometer on which the length of a column of mercury (or alcohol) is proportional to temperature above a certain standard temperature (usually 0°C.). Information is often converted into voltages or currents in analogue computers used in engineering design.

The property which analogue computers have in common is that their scales can be estimated to as many significant figures as required.

Thus at a particular time it might be possible to estimate a car's speed to be 42.6 or even 42.64 mph, though to do so might require a magnifying glass -- and even an additional paper scale if the speedometer were marked only every 5 mph... Whether or not the speedometer is accurate or steady enough for this to be meaningful is another matter again.

The Slide Rule

One of the simplest but most useful of analogue computers is the slide rule. This can be made with two paper scales on which different numbers correspond to different distances along a scale. Consider how this relates to the type of scale:

A Linear Scale: Consider a scale on which the numbers are directly proportional to distance along it, for example a centimeter scale of a ruler. Put the top edge of a piece of paper just under the first scale below and mark on the paper a similar scale. Then shift your paper scale to the right so that the "0" on your scale is opposite the 2 on the page scale. It is obvious that each number on the page scale has added 2 to the number on the paper scale. And conversely each number on the paper scale represents two subtracted from the number opposite it on the page scale.

You have thus made an analogue computer for adding and subtracting numbers. Notice that with care you could add 2.14 and 3.68 if you couldljudge where these values were on the scales.

0 1 2 3 4 5 6 7

A Logarithmic Scale:

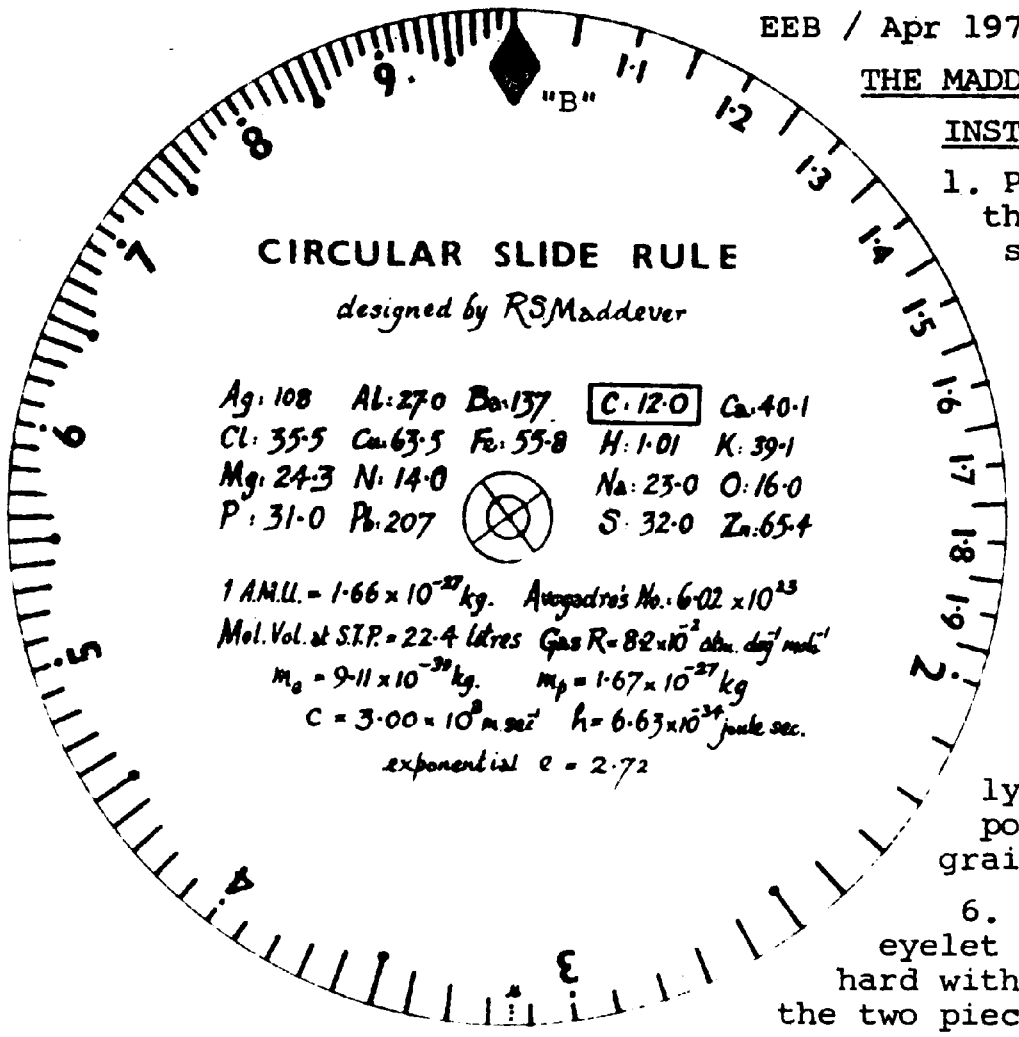
Consider next the very interesting scale below.

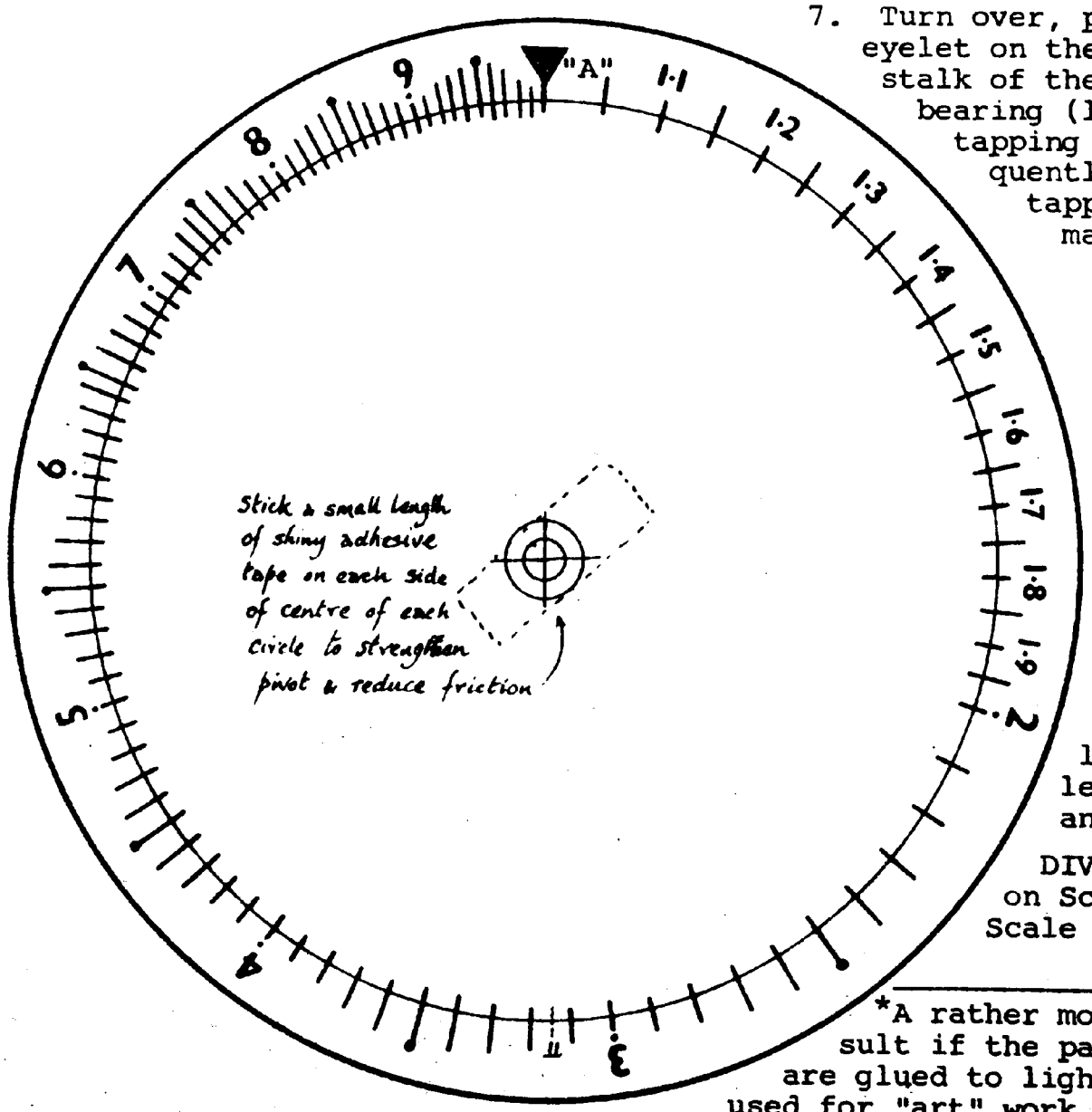
1 1.5 2 3 4 5

Again put a piece of paper below the page scale and produce your own scale on its top edge. Now put the"1" of your scale (notice there is no "0"!) opposite the 2 on the printed scale. Now it becomes obvious that opposite each number on the paper scale we find on the page scale the result of multiplying it by two. And conversely for division.

This time you have made a simple computer which can multiply or divide numbers, because the lengths of the second scale have been taken as the logarithms of the lengths of the first scale (by counting out spaces on the typewriter according to the figures in a log table), and since, $\log(XY) = \log(X) + \log(Y)$, so addition of the log lengths gives the same result as multiplying the numbers.

Since the scale from 10 to 100 would be exactly the same as that from 1 to 10 except for the extra noughts on it, if to 1 to 10 scale is made into a circle we can go round and round up to any figure we like provided we get the number of noughts right by rough calculation FIRST. Try it by cutting out the circles on the opposite page, according to directions. ((ED. NOTE: Unfortunately we have had to reduce the figures by 30% for reasons of space. If you wish a copy of the original size printed on stiff card please send cost price of 10c each, in stamps plus envelope at least 7" square with your address and a 6c postage)). →p.29





THE MADDEVER CIRCULAR SLIDE RULE

INSTRUCTIONS:

1. Place transparent "contac" over this sheet. Carefully cut just inside the outer circle of each part of the Slide Rule. Place cellulose tape across centres.*

2. Place upper circle just over lower one, making sure that marks at 1, 2, and 5 coincide.

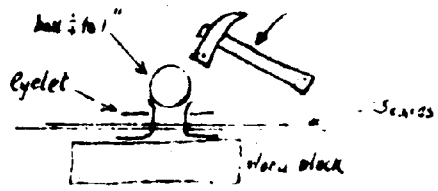
3. Holding firmly in position, prick through with a pin.

4. Fasten with a paper clip, or much better, with an eyelet from a sailmaker or saddler. For best fixing of centre, use an eyelet up to about 3/8" hole diameter.

5. After centring scales carefully, and pushing in pin to keep in position, set pin into crack in end grain of a block of wood.

6. Place the sharp circle edge of the eyelet exactly over the centre, and hit hard with a hammer to punch own hole through the two pieces of paper or card together*.

7. Turn over, put the female part of the eyelet on the male part, and spread the stalk of the eyelet by placing a ball bearing (1/4" to 1") on it and tapping with a hammer. Test frequently for rotation whilst tapping cautiously; do not make the eyelet too tight.



ALWAYS: Do a rough calculation first to find ans. to one sig. figure, ie, to know where to put the decimal point...

MULTIPLICATION: To a length along Scale A, add a length along Scale B; read answer on Scale A.

DIVISION: Subtract a length on Scale B from a length along Scale A; read answer on Scale A.

---

*A rather more durable unit will result if the paper circles from this page are glued to light cardboard of the type used for "art" work. In that event, cut out the circles roughly, apply contact cement (no other) to the rear of the circles and front of the card, allow to dry till tacky, press together firmly, cut out exactly...

THE DAFFODIL

I wish I were a daffodil,
A fragrant little bloom,
So you could come and gather me
And place me in your room.
And when you came up to your room
And jumped into your cot
Still thinking I'm a daffodil,
You'd soon find out I'm not!!!

((-- Anon...?))

LETTER: Disposal of Industrial Wastes

I read with much interest the suggestions on Production Engineering advanced by I. N. Wormwood in the July 1970 EEB. Yes, the April recipe was real, and very good too. His suggestions about burning white sugar to give a caramel taste are not too well advised, because of the danger of overdoing it; when sugar is burnt too much it imparts a vile taste to the brew. Far safer is the use of the tsp of brown sugar to prime each bottle. I have tried this and it works well.

I might note here a few further improvements to the April 1970 recipe. Mr. Wormwood's technique of steaming and seeping the hops is wasteful of hops. Nearly as good results may be obtained by simmering the normal quantity of hops, but at a heat very carefully chosen to avoid raising the hops above the level of the liquid. Two such successive simmerings of 30 min each are satisfactory, and result in a very satisfying hop aroma in the final brew -- ordinarily missing from home-prepared ales.

The recipe given in April may have been a bit strong for some tastes. More generally acceptable might be the use of 7 (rather than 9) pounds of Malt Extract per 10 gals of brew, though this applies only to the dark ME. The light extract requires quite a lot more quantity, e.g. 10 lbs/10gals. The Hops may be reduced proportionally, e.g. 7 oz/10 gals for the Fugle strain, about 5 oz for Ringwood Special, or 10 oz for Supermarket type.

It is rather important to note that an excess of Isinglass (or gelatin etc) used to clear the brew can result in excessive frothing. Do not use more than about a thin 1" square (or 1 tbs) of the dried Isinglass.

Finally, many people use Bakers Yeast, but this must be discouraged; such yeast settles only poorly. It is well worth obtaining the Brewers Yeast, e.g. from the source given in the April article. But I have been advised by Australian friends that Brewers Yeast obtained from commercial breweries there is not always reliable.

In passing I hear that there is some legislative activity in process in Canberra to legalise home brewing. Let us hope that it is true, and that Australia joins the ranks of the civilised countries in this regard.

-- J. Coote, Northumberland, U.K.

POSTSCRIPT

Please note that white of egg makes amuch better settling agent than Isinglass. Stir the white of one egg (or two if small) in some cold water, and add to brew about a day or two before bottling. Settles with much less frothing.

And: For the first half of the bottles, add 1 level tsp of light brown sugar to each (NOT "coffee crystals"!). The second half of the thoroughly rinsed bottles receives one level tsp of white sugar. This difference gives an interesting variation in taste, with the brown-sugar primed lot to be drunk first.

The process of filling the bottles will proceed considerably faster if the end of the filling tube is fitted with a glass tube about 5mm to 10mm diameter (depending on dexterity and volume), and the filling done smoothly to one bottle after the other without turning off the flow between; tip each new bottle a bit to ensure smooth transfer. Needless to say, this requires that the filling-tube be fixed in position so that both hands be free to manipulate the bottles for filling. This process will result in a puddle on the floor, but to clean it up will take only 5 minutes, whilst the time saved may be substantially more.

Age in a cool place while the brew does the same, and sample in one to two weeks, depending on patience. If bottles etc are clean the brew should keep well for many months.

If these instructions and the relevant ones in the original recipe are followed carefully (being sure, of course, to dilute the recipe severalfold with dirty tap water to ensure compliance with legal regulations), you will never have a bad brew, no exploding bottles.

But there are few brewers who have not had some catastrophe happen at one or another moment, so be patient. For some it was a box of soap powder falling into the brew just before bottling. For some it was the rupture of the vat just at the crucial moment. For some it was the delightful taste of cod-liver oil which had been bought included (at no extra charge) with the wrong-kind of Malt Extract; these tins are clearly labelled, take care! For some it was the use of store-bought Hops when the farm-fresh variety were used up, and the consequent "sticking" of the brew; it stopped fermenting halfway through, and could not be rejuvenated again by any of the classical methods. This problem has NEVER arisen when farm-fresh Hops were used (but be certain to keep them packed tightly together in a covered box). Then, there was the chap who put his M.E. into pickle jars, with aroma to match, but strange to say this never appeared in the final taste. Perhaps it was beneficial...??? It is still debatable whether tea is a desirable additive to the brew. I'll let you know about it next April.

A fine book is: Home Brewing without Failures, by H. E. Bravery (Parrish, London) (stg 11/6), also including good wine recipies. But no beer recipie ever invented can compare with mine. Try it. Suitably diluted, of course.

-- J. C.

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Quote with Comment: THE ARNS

"The average reader is a lazy lout. He wants to be informed, amused and inspired -- but with as little effort on his part as possible. He wants to be assisted in forming an opinion, but he wants to feel he has made up his own mind. He wants a lucid explanation, but he does not want his intelligence insulted by a belabouring of the obvious..." ((WA5CKJ, Jim Pfeiffer, Amateur Radio News Service Bulletin, May 1970, as part of an excellent and entertaining series of articles on how and why to publish anything. The ARNS is a fine organisation and their monthly Bulletin is full of highly helpful hints of interest to those who publish Club Bulletins. Interested Editors of radio or other club publications should contact Al Marcy, W4ID, 461-3rd Ave., Seapark, Eau Gallie, Florida 32937, U.S.A.))

STATE OF THE ART -- II (RLG) (et al)
-- Synchrodynes and sloppy thinking.

There are several other things I was planning to discuss in this column, but first I think we'd better clarify some important definitions on a topical sbjt.

Last month I made reference to Direct Conversion "or" Synchrodyne, a system showing current popularity, wherein the signal is tuned briefly, passed into a linear balanced mixer which detects it, with all selectivity obtained at AF; subsequently the major gain of the receiver is at AF; See fig. 1 (reprinted from Amateur Radio Techniques, 3rd Edition, p. 82).

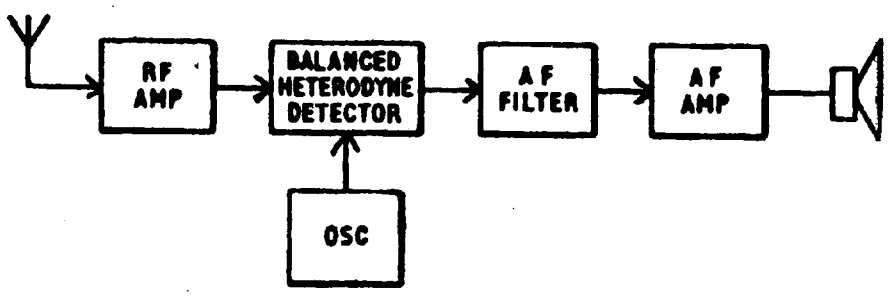


Fig. 94. Basic circuit blocks of a homodyne/direct conversion receiver . If either Schottky (hot carrier) diodes or a beam deflection balanced detector is used, it should not be necessary to use an r.f. amplifier. Prime considerations should be a well balanced linear detector, high-gain low noise a.f. amplifier, very stable oscillator and effective audio filter.

Fig. 1(EEB)

This receiving system has a number of real or implied advantages, not the least of which is simplicity whilst attaining impressive performance. But it should not be swallowed whole without realising its limitations as well as advantages. And most of all it is necessary to avoid some conventional confusion.

We see quite a lot of discussion in these times about the benefits of "Synchronous Detection" and "Direct Conversion" in receiving systems -- and often this discussion ignores some fundamental distinctions between them.

With very much help, prompting, and chastising from Dick Ferris and Rod Reynolds I hope here to untangle the mess. I am uniquely unsuited for this, but if I can understand it (and if RHF and RAJR agree), then anyone can.

The Synchronous Confusion

PRODUCT DETECTION ENVELOPE DETECTION DIRECT CONVERSION PHASE LOCKED LOOPS SYNCHRONOUS DETECTION HOMODYNES EXALTED CARRIERS -- and the rest! The jargon of today's exalted receiver terminology with exciting new (?) developments. And a large measure of widespread misunderstanding of basic definitions -- leading to some exalted rubbish being published in the experimenters and amateur literature.

Lets see whether we can straighten it out:

Product Mixing

This is simply a process in which an r.f. signal is modulated by a local oscillator, in a "product mixer", as in fig. 2:

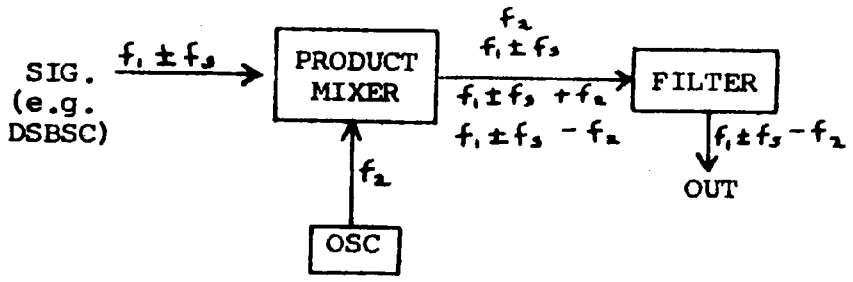


Fig. 2: Simple Product Mixer (f_s = sideband frq)

Here the signal and oscillator frequencies are multiplied and mixed together -- therefore "product". In this mixture are the original frequencies and a host of others.

Usually (but not always!) we are most interested in the difference between the signal and oscillator frequencies. When the mixer is, in fact, the "First Detector" of a superheterodyne, the output is the I.F. When the mixer is the "Second Detector" of an SSB superhet, the oscillator is at the same frequency as the signal from the I.F. (viz., $f_1 = f_2$), and the output is A.F. (or keyed output for FSK etc). IT IS THEN CALLED A "PRODUCT DETECTOR".

Thus, the oscillator frequency in a product mixer need NOT be the same as that of the signal -- though it IS when used as a Product Detector. And this is just as true whether the Detector is used in the first stage of a Direct Conversion set, or in the last stage of a Superheterodyne.

When the oscillator frequency is the same as the signal frequency, the demodulated output is the audio in the sideband, but this works only for SSB. It will not work adequately for DSB or AM, because when the phase of f_1 from the local oscillator is different from the phase of f_1 from the signal (fig. 2, above), the two sidebands interfere with each other and you just get Ducktalk. On the other hand these modes can be demodulated by a simple product detector if the receiver slices off one sideband first (and for AM the carrier too while you are about it; we discussed this in EEB in 1968).

CW is detected by heterodyning, with the output note being, of course the difference between f_1 and f_2.

Synchronous Detection:

This is the same process of product-mixing when the local oscillator is definitely synchronised to the carrier signal*, not only in frequency, but also in average phase**. This system is shown in fig. 3.

Aside from the ability of fig. 3b to receive DSBSC, what is the advantage of the synchronous system? It gives more linear demodulation and less critical adjustment for f.m., it provides an excellent Automatic Frequency Control (though over a more limited range than discriminator-type AFC), it possesses a high inherent selectivity (with limitations to be discussed next month), it exhibits inherently better signal/noise properties (because it discriminates against non-coherent noise), and possibly better performance under selective fading conditions.

→ P.33

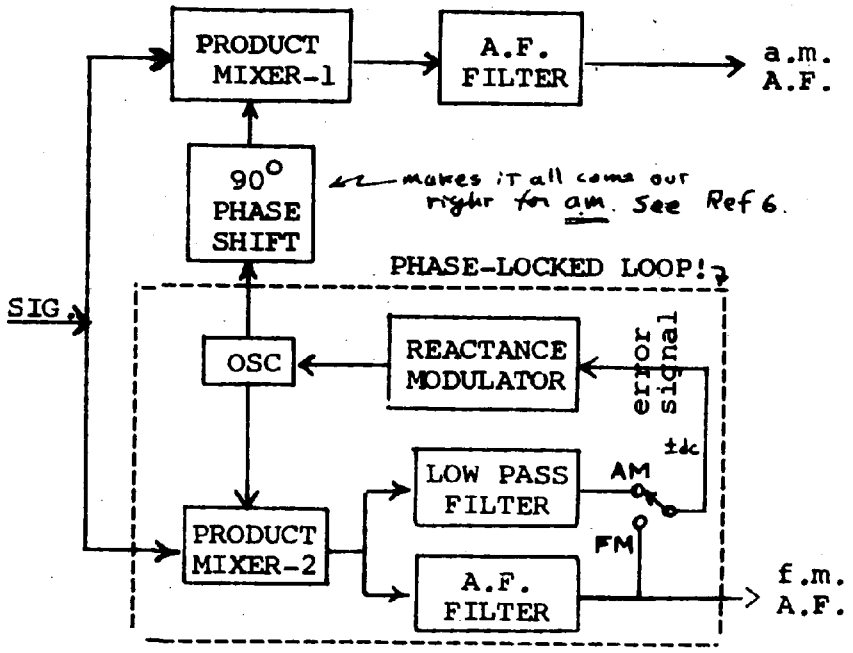


Fig. 3a: SYNCHRONOUS DETECTION; for Carrier signals only. For a.m., the signal goes to Product Mixer-1 to be detected, and it goes to Product Mixer-2 to keep the oscillator locked in phase with it. This is accomplished by the notorious Phase-locked Loop, shown in the dotted area. For f.m., the error signal includes the demodulated audio, so the PLL alone is sufficient (with P.M.-2 acting as a phase comparator). SYNCHRONOUS detection must have a synchronised oscillator, and can be used for a.m., f.m., MCW, FSK, etc (sigs with carr.)

Fig. 3b ((Not yet shown)): SYNCHRONOUS DETECTION; for everything except SSB ((how nice!)). Somewhat like fig. 3a, but rather more complicated (See A.R. Techniques III, p. 88)-- Each mixer feeds a phase shifter, and a separate phase detector produces the error signal for the VCO. Two sidebands are necessary. This system will be discussed in our forthcoming major article on Relative Communication Efficiency. All this is the Prelude.

The Phase-Locked Loop

To receive AM, FM, or DSB we require extremely good control of the local oscillator, and this is accomplished by the famous "Phase-locked Loop": It is simply the combination of circuit elements within the dashed lines in fig. 3a. It consists of a Product Mixer acting as phase-detector, suitable filter, reactance modulator, and local oscillator in a closed loop. The reactance modulator (a varicap is a simple type) and oscillator are usually lumped together as a "Voltage Controlled Oscillator", VCO.

The operation of the Phase-locked Loop is a bit involved, but if we are to share in the benefits of modern techniques we might as well get stuck into it. Very briefly, if the phase of the incoming signal is not the same as that of the oscillator, the phase detector produces a d.c. signal which p the reactance modulator translates into a reactance which corrects oscillator phase and "trues it up".

Now, phase can be considered rather as a special case of "frequency", as is obvious if you realise that "phase" refers to time interval between the maximum of one wave and another (different one). Since frequency is also a measure of time, namely repetition rate of waves (I don't know where Hertz comes into this, but never mind), you can see that if a phase between two signals is sufficiently different, it becomes a frequency difference. In this respect, phase can be considered as a type of "fine tuning" of frequency, though I suppose that Rod and Dick will moan when they see that stated. An ordinary discriminator-type AFC system may correct frequency, ie., repetition rate of the local oscillator is the same as that of the incoming signal, but the phases may not be the same; i.e., the oscillator and signal waves may not reach maximum at the same time.

If, however, phase is corrected, the oscillator and signal waves are forced to have their maxima occurring at exactly the same time; obviously therefore their frequencies must be identical. I'm writing this after Rod has finished the draughting, and I'm no good at drawing sine waves, so you'll have to do it yourself -- but draw a few figures and you'll see what I mean.

As in any feedback system, correction of phase in this instance is never perfect, but even if phase is not exact, frequency must be if the phase difference is less than one cycle. Thus, a Phase-locked oscillator is superbly frequency controlled. And even more importantly when this phase-correction is applied, it allows us to obtain coherent information from a double-sideband signal (with or without carrier), including of course, FM.

With the PLL, FM or AM detection arises as a consequence of frequency difference between VCO and sidebands. Detection of DSB requires a more elaborate arrangement (fig. 3b) in which the VCO is essentially synchronised to the original carrier by extracting information from the sidebands alone!

The PLL will also function for SSB where some residual carrier (or a "pilot carrier")is available, e.g. at > -30db, or in any event just above noise. Of course amateur transmitters always suppress their carriers perfectly, don't they...? Then why is it so easy to phase-lock a receiver on so many superbly suppressed amateur SSB signals found commonly on the bands? → P.34

Previous Page notes:

*or it can be derived from the modulation, e.g., as in DSBSC. Or it can be synchronised by the modulation, e.g. as in TV sync of sweep and frame, or in RTTY character initiation. This latter system is potentially capable of incredible signal sensitivity ("detecting signals too weak to be heard"), but is hardly relevant to the Amateur experience, since it requires adding redundant information either by some pilot signal or by the ability of the receiver to reproduce the modulation independently. In the case of the pilot signal, the overall S/N can hardly be better than that of the pilot, though this can be taken advantage of in diversity syst.

**Instaneous phase correction is not practical in a simple practical communication system, because doppler effects randomise phase sigs.

Envelope Detection is the classical system which has been used for a.m. It derives its name from the envelope form of the modulation (as seen on a CRO) extracted from the r.f. after rectification of the latter and suitable filtering. About the simplest form of envelope detector receiver is the Crystal Set, shown in fig. 4:

This is fine for AM, NBFM (more or less), or CW with a BFO. ((Wots wrong with the good olde iron-filing coherer? -- RAJR)) ((Its a bit slow. -- RHF))

Among other things, an important disadvantage of this system is that it has a "threshold effect" which requires that the input signal exceed a certain threshold to be detected. This effectively worsens signal/noise under adverse conditions, but is generally countered by providing plenty of pre-detector gain. But there are also other alternatives and these will be discussed further presently in an EEB "Squaretable" on Detector Efficiency.

Direct Conversion:

This describes a receiving system in which the modulated r.f. signal is converted to audio by the heterodyne process: the oscillator frequency = the signal frequency. It need not be located at the front end of the receiver, though the current use of the term "Direct Conversion" implies that it is.

The converter in this instance should be a "linear detector", i.e. one which reproduces the modulation as faithfully as possible; this linearity requirement is needed to allow practical design of the selectivity filter. See fig. 5.

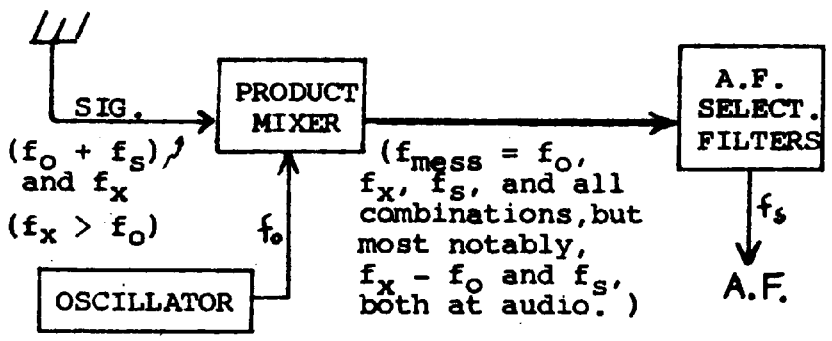


Fig. 5: Direct Conversion with simple Product Detector. Selectivity depends on suitable sharp A.F. filter. (Here, f_o is the desired signal carrier, f_s is its sideband, and f_x is an adjacent interfering carrier to be filtered out by the A.F. selectivity filter(s))

Now to look squarely at this situation, it is essential to realise that the process of Direct Conversion does NOT dictate a specific type of detector to use, but only that r.f. is demodulated directly by the heterodyne process; this commonly-accepted requirement for heterodyne detection prevents the crystal set of fig. 4 from being consid ered as a simple direct conversion receiver.

It so happens that a Product Detector of one sort or another usually is employed as the detector of a Direct Converter, and often a double-balanced mixer is employed. But again note that the balanced function of the mixer is not inherently required for this, but that linearity is easier to achieve that way.

Direct Conversion has a reputation for reducing overloading (therefore crossmodulation), but this is most misleading. The reputation is often justified, but not because it is Direct Conversion per se, The reason is because by the time we got around to making Direct Conversion popular, we had considerably better components -- e.g. Hot Carrier Diodes, good Beam Deflection valves. These gave better linearity and lower noise, and they could be operated at lower signal levels. It is the lower signal levels which reduce cross modulation, NOT the Direct Conv.

If you use comparable components with a classical superhet you'll get comparable results. It makes no difference whether you obtain your post-mixer gain at i.f. or at a.f. And all considerations involving r.f. stages apply equally to both.

An r.f. amplifier will increase tendency to mixer overload, whether that mixer has an output at 455kc or at audio; similarly the r.f. stage will tend to improve signal/noise with either, simply because it is easier to design an r.f. stage for low noise than a mixer.

If you use some good low-noise low-loss detector component such as Hot Carrier Diodes (see A. R. Techniques) as the product mixer of a Direct Conversion system, there is little need for an r.f. amplifier, and this is one of the reasons Direct Conversion receivers have earned a reputation for good results with simple circuitry.

Some of this reputation may be a bit premature. Although the a.f. selectivity filter used may be simpler than a bank of double=tuned i.f. transformers, the shape factor of the latter (i.e., how the square the passband is) may be considerably better -- leading to better usable selectivity and intelligibility; many are the signals I have "heard" with magnificent receiver selectivity, but I couldn't understand a word they were saying!

So, it is easy enough to get good sensitivity with a Direct Converter if a.f. gain is high, but selectivity is still a problem in the same way and for the same reasons. To get good selectivity you'll certainly have to use good (therefore not simple) a.f. filters. This is probably best achieved by the use of active filter circuitry, no doubt assisted by ICs.

Another problem with Direct Conversion appears to be the "Audio Image". If the mixer is linear, adjacent signals will not interfere if they are far enough away. But if they are within the passband of the audio selectivity filter, they'll be received as happily as the desired signal. If you reduce the passband (re: improve the selectivity) to get rid of them, you'll amputate the

→ P.39

EDITORIAL -- RLG

We just got this typewriter from our Printer, and its a beaut! Allows more talk from Gunther at no extra charge. I think we'll pay for it by printing one less sheet on Offset for a few months, using this device to produce a sheet on the Gestetner. Rather a dirty trick to play on our Printer, but its the only practical way to absorb the extra expense; besides we won't keep it up indefinitely. I'd be tempted to use it for the Advertising too, but we would have to increase the commercial advertising rates... The main problem with this machine is to type lightly enough that the "o"s don't fall out. Amazing.

Weltanschauung ("Things are not always as they seem")

A while ago we asked the Melbourne branch of a newsagents firm about the possibility of putting EEB on the nation's newsstands. We had the dream of giving the nation the choice of EEB without the rather cumbersome method of periodic sample postings.

We were informed that it was not practical. It was said that hundreds of magazines are distributed to newsagents and never see the light of day; the copies merely lie on a shelf in a back room, because it simply isn't practical for newsagents to find room for them all.

Why then, we asked, do certain large electronics publications seem to have no difficulty displaying their wares? Oh that was because they had a proven market and sales appeal. How could we go about obtaining such a market? Wouldn't the newsstands be ideal for this? No, not a hope, your best bet is to continue promotional mailings.

We did just that. The results have been discouraging. Last month's results are typical. We sent out about 100 copies with promotional sheets, and got 5 new subscriptions back. With 17 lapses we had a net loss of 12.

We'll never reach 1000 that way.

We have tried advertising in Electronics Australia (for which we are grateful) with quite good response, but the net cost per new sub comes to about the same. Possibly better response could come from larger adverts, but at $8.00 per inch per month, our bank account would need a massive transfusion. At present the rate in Electronics Today is only $7.50 per inch, but now the entire readership will be split in two (or so), and to cover the same number of readers we should have to spend perhaps some $12 per total inch; this is Progress?

So, now we see that an electronics firm recently published a new popular magazine widely claimed to interest the nontechnical hobbyist, and which does in fact appear to cater to the technically unambitious. We note also that the first issue of the magazine has appeared most prominently displayed on the newsstands. Obviously it conformed to the gentleman's criterion of "proven sales appeal". Proof: It sold very well after an impressive sales campaign on the newsstands.

No comment.

This and That

Obviously the only way we can break the subscription stalemate would be a promotional mailing to every amateur in Australia and New Zealand -- and to every other electronics experimenter too if we could find out where they were. This kind of thing was done by HR in the USA, with impressive results --- at a Cost!

I notice that Australia (or at least Hobart) is doing well in the fight for Social Progress. Easy to tell: Teenagers lean out of the windows of flashy automobiles and shout nastiness at pedestrians, cyclists, and such. I saw this happen in the USA first in about 1955, in England in about 1960, and now here in this year of Grace 1971. As you can see, it dispells an old myth, that Australians are 20 years behind the Yanks. Not so, only 16 years.

Several EEB correspondents have stated that they have no trouble keeping up with "the great flood of electronics literature"; they are reading only The Australian, Amateur Radio, and The EEB. While we are gratified to be classed in such exalted company, it seems to me that that solves nothing. Even if you don't read the flood of periodical literature, you must at least look at its non-periodical counterpart: published books. If you look at nothing you will fall behind the State of the Art, and you'll be struggling to get a 6Q7 working on 2 Metres where a 3N189 would do it with ease. (You haven't heard of a 3N189? You'd better look at the article "Deluxe MOSFET Converters for Six and Two Metres" in the February 1971 issue of Ham Radio. Most significant).

Like it or not, the field is progressing at an alarming rate, and if you are in electronics you must take part in it -- or fall into the limbo of that ((PTO))---

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WANTED TO BUY OR BORROW: April 1969 and July 1969 issues of Wireless World" (amplifier and pre-amplifier articles) — Write: J. L. Shann, Kalamia Estate, Ayr, Qld 4807.

WANTED URGENTLY: One copy of EEB, October 1970. No more separate issues are available from EEB, and I need this one to complete my collection; can anyone spare this issue? Wes J. Keeman, P.O. Box 140, Thursday Is., 4875.

FOR SALE: Workshop manuals for Austin A70 and A90, 49-54, and Morris Oxford Series 2 & 3 '56-

can certainly find plenty of nominal technical pyrotechnics in all of the ordinary electronics magazines. Why should we clutter up EEB with them? I don't think that it is right or proper for EEB to compete on the same terms with anyone.

The same chap also wants us to give a good description of the real meat of the Bibliography material, because it is rather difficult to find the originals. Seems to me tht this ignores the fact that we have often presented Bibliographies in which we extracted the essential

FOR SALE: Workshop manuals for Austin A70 and A90, 49-54, and Morris Oxford Series 2 & 3. $3 each, including postage. J. BROWN-SARRE, Box 32, Red Cliffs, Vic, 3496.

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ANNOUNCEMENT CONCERNING AMATEUR RADIO TECHNIQUES (III)

The response to our February advert for this book was startling. We have sold books before, books over which I was enthusiastic, and out of 20 copies we might expect a half dozen to take 6 months to unload.

The response to A.R. Techniques? In the first five days our 20 copies evaporated like snow upon the desert's dusty face, and in the next three weeks some 40 more orders came in. For the luvapete, PLEASE STOP! I can't devote the rest of my life handling books, even good ones. Its enough that we let you know about them in detail in EEB. Now you take it from there.

In this instance, if you want the book, check first with your local Division of the WIA (or NZART), and if they are not ordering it, send a draft in £stg for about £1.20 to include post & pack, to: Radio Society of Great Britain, EEB Section (hi), 35 Doughty St., London WC.1, England. Obtain the foreign draft from any large bank or via International M.O. from the Post Office. This will cost you some extra, but it can't be helped. Maybe the best idea is to ensure that you get it through WIA....

EDITORIAL (Continued from p. 35)

Nontechnical Hobbyist who puts together his MOSFET crystal set, and then comes to me begging to explain why the MOSFET doesn't seem to work any more.

Grounded-base FETs (Feb., p. 3)

Wot, you've never heard of the common-base mode of FET opeeration? Just shows you haven't been keeping up with the State of the Art. If you must know, its a closely guarded Secret process developed in (apologies to KØNL) the Sandy Bay Basement Laboratories, and let slip only accidentally in the Feb EEB. Its a secret with enormous potential (as it were), since at present Our Side seems to be having a wee bit of trouble finding enough Bases to keep the world safe for Pot.

Other EEB innovations appear on p. 18 with remifications involving spended time-savers and shipped flakes. The first million words are the hardest....

More Technical Material?

A correspondent who does not wish to be quoted has suggested that there should be more technical matter in EEB, and less chatter on non-technical items. He

graphies in which we extracted the essential information of each reference. Furthermore, what I can only describe as a vast amount of writing has appeared in EEB for years, examining the essential details and real significance of various important articles and books. One of many cases in point is the material on Synchrodynes in present issue.

He says further, "Also, I'd like to see more details on unreliable Electronics Australia projects mentioned in the February EEB (p. 11). I've made an EA240 also, which works -- with a very good signal/noise ratio! Other technical subjects would also be appreciated; my main interest is radio control (all homemade) of models".

On that same February editorial page I mentioned specifically the matter of references (which I have repeated here), and I also said specifically that I was in fact skeptical about the difficulty some readers may have had with E.A. projects. Here is a reader who has had success with them. From his position in Society I suspect that it resulted from his using much careful and competent engineering technique, applied to complicated constructional projects.

Indeed, the only reason I am devoting so much space here in reply to what appears to be a complaint based on too casual a study of EEB, is the fact that this person in particular ought to be one of the ones who reads material most carefull and gleans the most important elements from it. If he has missed the point of our coverage in EEB, what hope for getting it across to ordinary experimenters?

It can be discouraging.

Sure, I'd like to see articles on radio control too; how about someone sending us some? I manage to cover other subjects of more immediate interest to me, but that's no reason why we shouldn't receive articles on others... But what seems to happen is that when we publish stuff on Power supplies and CD Ignitions, we get more articles from people stimulated by the subject, on the same subjects.

Incidentally, a word of apology to the authors who have sent material on power supplies and CD Igns. I have not presented them recently, partly because it will involve some work to straighten it all out, and because it seems to me that we have had a rahher heavy dose of that kind of thing during the past year, but we'll return to them, never fear.

You'll notice that EEB subjects tend to run in cycles, with some months -- even some years -- concentrating on some subjects more than others. This is undoubtedly bad for the subscription tally, but I can't help it. Its enough work getting everything together in the way it seems to fall each month, without sorting it out more carefully....

(Editorial -- Continued from p. 37)

Phase-locked Frustration

It is remarkable how much work Dick, Rod, and I had to put into the article on Synchronous Detection ("State of the Art II") in this issue. Sessions far into the night, after which I would resummarise it all into clear language, thinking "surely this will be right now", only to have it torn to pieces again at the next session. The final result is probably still not perfect, but we have delayed publication for an extra week on its account, and thats enough; it is substantially correct. I'll make a bit of summarising next time, and perhaps I can induce Rod to say a few words about phase detection, and perhaps a few words of comment on the significance of the article "Detecting Signals too Weak to be Heard" in the Jan 1968 QST. Then, more from Dick, I hope. Then Rel. Comm. Effect.

The problm is not that these ideas are new -- they are conventional to the engineering community (the Amateur is in the Forefront of Progress). But what is new is amateur interest in sophisticated receiving systems. I sudder to contemplate the future, because from Rod & Dick I have seen some of the other things that are possible in optimising communication technology. And its ghastly complicated. Whats going to happen to us? Are we going to have to become engineers merely to be good Amateurs?

This is another good reason to study good books on Fundamentals, as mentioned in this EEB. Yes yes, you know all that? Perhaps, if you are at home with vector algebra, equivalent circuits, and port impedances. If not, you'd best read fundamentals (again?) if you intend to do anything more serious than tune someone else's receiver.

For the next step in our effort to keep you informed, what? I've asked Rod to see whether he can find us a good book on communication engineering, with minimum maths and maximum readability. I hope one exists.

If the "State of the Art II" article in this issue is too complicated for you, there are two alternatives:
1) Ignore it, and go on to Hop Engineering, or
2) Read any good Handbook, Receivers chapter. And Weick.

Good News for New Zealand

We are most pleased to announce that the New Zealand Association of Radio Transmitters has offered to handle EEB subscriptions in New Zealand. Since N.Z. currenty is not negotiable elsewhere without quite a lot of bother, this will make it much easier for our New Zealand subscribers to send us their subscriptions and renewals. If said subscribers (both of them) don't belong yet to NZART its high time they joined, for patently obvious reasons. In the same vein, closer to home, frequently we receive enquiries asking where people can find technical guidance. We always refer them to the WIA, and suggest that they join and attend meetings regularly.

The Art of the State

Finally, y'know, if we weren't such unwilling participants, the state of political Art could be amusing. The Gov't almost discovers Inflation (maybe their salaries are too high?), makes a noble effort to stem the non-existent crisis by abolishing public services, schools, hospital benefits, adequate pensions, and other common non-essentials. Then the Gov't fights the unions who (and would you believe it??) are leading the way in establishing price controls for business (but not themselves?) and in finding international markets for our obscene food surpluses, and finally the Establishment decided that the real way to solve unemployment and inadequate purchasing power is to impose massive new taxes. Note that the same formula is applied impartially for Inflation as for Depression.

I have a friend keen on Scientology, others on Zen, and some on Political Philosophy. They would all claim that the only way to get on in the world is to view it as it REALLY is, without preconceptions. From Information Theory, so say I: without adequate data you can't make the decisions necessary to act in accord with the real environment.

A person who ignores these strictures in the extreme, we call "insane". Would that apply to governments too, who hold such awesome power? A sobering thought.

A curious note in the news comes from New Zealand where Price Control is arising spontaneously from citizens and businessmen to whom it has occurred that a higher income does not necessarily mean a higher standard of living -- a sane nation in a queer world... If any such movement were to arise in Australia we should be pleased to support it. At present we are making a bit of "profit" as a hedge against the inevitable rises (past and future). If voluntary price control occurs, we'll be willing to reduce the subs rateto the bare minimum. Are you willing to make a comparable effort? Why not try to spread this idea?

Inflation uncontrolled is going to wreck our whole way of life, will eventually result in devaluation, economic disintegration, and unemployment. Can we prevent it??

Spread the word, won't you??

-- Cheers, Leo

desired signal too, though of course this is less of a problem with CW than with sideband material.

The intra-channel QRM can be reduced if a very sharp filter is placed in front of the Detector, to reject all signals below oscillator frequency, for example, but a phasing-method would be easier; as G3VA describes, it can be done by suitable phasing of two balanced detectors, but he does not like this because it"would be getting away from the point of the receiver which is simplicity". With this I cannot agree. A superregenerative receiver, or a crystal set is simple, but they have their drawbacks. If you want high performance you have to be willing to add all necessary complexities to a good basic design. Pat Hawker (p. 82) does say further, "Nevertheless a really high-grade receiver on these lines might be interesting." Yes indeed; I have just been on the phone to Rod, and he says he is toying with the idea of building one up -- using the new IC PLL material now available. If any of you people do something significant with Direct Conversion receivers, too, let us know?

Incidentally, the addition of an r.f. stage will not do much to help those "audio images", because the selectivity afforded by the extra tuned circuits is not very impressive; that is strictly for superhet lines. The only reason to use an r.f. stage with a Direct Converter would be to reduce noise, and as I said, that is better accomplished by a low-noise mixer, to avoid overload problems.

And: Well in accord with our previous statements, a product mixer at the tail end of a superhet with inadequate i.f. selectivity will also give audio images. The only reason this is more of a problem with Direct Conversion is that we have no significant pre-detector selectivity. That this is simple is unquestionable; that it is desirable is debatable.

Last month I mentioned briefly these problems, pointing out that with Direct Conversion you are merely exchanging one set of problems for another, though we may find the second set of problems easier to solve!

In one respect, however, I was misleading: Requirement for (absolute) oscillator stability is indeed exacting for the heterodyne oscillator. But that is because the process is PRODUCT DETECTION, not because it is direct conversion. The requirment is just as exacting for oscillator stability of a product detector at the tail end of a superheterodyne as at the front end of a direct conversion set.

Only in an ordinary superhet is oscillator stability not particularly critical, where the detector is an envelope type (e.g. diode). Where the second detector is a product type, however, its oscillator ought to be "spot-on", although in practice SSB can be somewhat intelligible if the oscillator is detuned some few cycles -- if that is your idea of communication.

Direct Conversion with Product Detection:

This is the system of figs. 1 or 5, employing the system of fig. 2 as a detector at the front end of the receiver. It has the various benefits and liabilities of Direct Conversion and of Product Detection. I mention it here separately to emphasize that we are mixing two ideas:

Direct Conversion, and
Product Detection.

They are not necessarily the same. This is one way in thich a product detector can be used and it is one form of direct conversion. There is no magical reason why those two have to go together uniquely. Product detectors will work fine elsewhere, etc.....

Direct Conversion with Synchronous Detection:

In the same way, this happens to be just another way in which we can accomplish Direct Conversion. It uses a detector of fig. 3 type in a circuit of the type of fig. 5: in fig. 5 merely add a Phase-locking facility to the oscillator. It has all the advantages and limitations described for fig. 3, no more and no less -- with the added complications of the Direct Conversion situation.

As I mentioned, it allows a much better tracking of frequency, i.e., Automatic Frequency Control (even with DSBSC), and it allows more efficient detection of FM or AM; it also allows detection of DSB if properly arranged. If you need only SSB you don't need synchronous detection, though as mentioned there can be some advantage in it if the carrier is inadequately suppressed.

Synchronous (or "Coherent") Detection must incorporate some method for phase-locking the oscillator to the frequency, and the PLL is about the best way to do this. If phase-locking is not achieved (by whatever means), it isn't synchronous, no matter what people call it.

Synchronous Confusion -- II

Here is where the fun starts. Let us restrict ourselves to Direct Conversion systems, since thats what we are talking about (I've made all the needed qualifications, Dick!). Here, simple Product Detection (figs. 1, 2) has been called variously:

Direct Conversion,
Homodyne, Synchronous Detection, or
Synchrodyne;

but NOT "Coherent" or "Phase-locked". From our discussion it will be evident that the term "Synchrodyne" must be reserved for the Phase-locked system of fig. 3 (or equiv.). Pat Hawker (Amateur Radio Techniques, III) gets around this by calling the latter "true synchrodyne", but he (and others) contradict themselves by turning around and applying that term to the non-synchronous system. TO BE TRULY SYNCHRONOUS, THE PHASE AND FREQUENCY OF THE LOCAL OSCILLATOR MUST BE SYNCHRONISED (!) TO THAT OF THE SIGNAL. If only the frequency is adjusted to be the same, you have only a simple product mixer used as detector at the front end of a receiver; call it "Homodyne" if you like.

The fact of the amateur literature is that the word "synchronous" is widely used to describe everything from the most exacting modulation and carrier synchrony, to sloppy product detectors.

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Essential Distinctions: a summary of sorts.

The take-home lesson from all of this is that there is an important distinction between true synchronous detection and simple product mixing. Each method has its distinctive properties, uses, and disadvantages. And further, they need not occur only at the front of a Direct Conversion receiver, but in various parts of ordinary superhets, as discussed.

Simple product mixing ("Homodyne") is quite effective for the common run of Direct Conversion receivers now becoming popular, where only SSB or CW are to be detected (or AM with an amputated sideband and carrier; c.f. EEB 1968, p. 111-115).

The "true" Synchrodyne system employs the additional Phase-locking of fig. 3 here, so that the oscillator has not only the same repetition rate, but also starts each cycle at the same time as the signal. This is required for DSB, and is highly useful for FM, AM, or CW (etc).

Complicated Synchronous Detection?? (RAJR)

Although phase-lock systems can be relatively complicated, the use of ICs to make them "practical" has brought them within the reach of nominal experimenter technique. This is presented succinctly in Reference 5 here, involving the use of Signetics PLL units (handled by Pye in Australia) -- at a price.

On the other hand, they need not be complicated; Exalted Carrier systems (see G3VA book), for example, can do the trick without excessive complexity. Or a highly filtered carrier fed to a high gain discriminator will give a d.c. output voltage which can be used to lock a VCO. Its just that now we have transistor technology to provide the phase-locking in a neat little Monolithic Chip.

Thus, if as much effort had been put into a single valve designed to be both a product detector (e.g. 7360) and phase modulator (e.g. 6SA7) all in one bottle, it would be just as simple -- or possibly more so. Very elaborate valves have, in fact, been designed to do specific jobs which modern thought would assign only to the task of semiconductor technology.

In any event, unless ease of tuning is important, phase-locking may be an unnecessary complication where only SSB/CW are to be received (and is this not a majority of cases nowadays?). In that case the simple product mixer of fig. 5 is quite satisfactory as long as the injection-oscillator frequency is adjusted precisely to reduce the SSB gabble to lucid ducktalk.

Something for Nothing?? (NEVER!!))

One could note here that the function as well as purpose of these various detectors can also be confused. Thus a teletype enthusiast was telling me (RLG) recently that "synchronous" RTTY demodulation techniques enabled his typewriter to clack away happily on a signal which was virtually "unhearable". Here again we have the reputation of the synchronous system to perform miracles, to "detect signals too weak to be heard".

Yet, except for the special case discussed briefly in a footnote here, the synchronous detection system is not capable of miracles, although the coherent nature of the phase-locked system does improve S/N slightly (e.g. 3db).

Information theory maintains that you can not extract more information from a channel than it can possess inherently (as it were). But certainly there are some extraction methods which are more effective than others. (And Direct Conversion in general, and Synchronous Detection in particular do possess some attractive features in this respect.)

Namely, where bandwidth can be restricted, Signal/Noise sensitivity can be improved. The narrower is the bandwidth, the better results you can get -- within certain limitations, of course (viz., the information channel narrows).

Digital systems (e.g. RTTY, CW) can be improved greatly by the use of Signal Regeneration, e.g. clipping and keying. We are all already familiar with this concept in the technique of using the demodulated wave from a CW signal to key a local audio oscillator. It becomes even more effective when the received CW signal is severely clipped, as when passing through a limiter. Similar considerations apply to RTTY, and in fact the good results reported for that mode were probably due to Signal Regeneration techniques rather than Synchrony.

The take-home lesson here too, is that wings can be lent to receiver sensitivity by restricting bandwidth or use of carrier regeneration, but that this has little to do with the fact that the mixer sports a beat-oscillaotr, nor the use of more elaborate carrier-reinsertion techniques.

There has been some gory nonesense published on this subject in the Amateur Literature, and I do hope that Dick will one day amplify for us the truth of that matter, and describe the uses and abuses of bandwidth as an aid to sensitivity.....

NOTHING IS FREE (Loc Cit)

Mostly, I suppose, for the sake of those poor souls who were put off by this formidable dissertation, next month I shall summarise relatively briefly the various strengths and weaknesses of Direct Conversion (using simple Product Detection). It will be taken mainly from and summarising material in the Receivers chapter of G3VA's Amateur Radio Techniques, III.

Till then, I leave you with these thqughts:

You never get something for nothing, well summarised in the Murphy-Heisenberg Dictum that "The closer you look at something, the less certain you are what it is"!

Selectivity is a problem, whether at i.f. or at a.f.

Images are a problem, whether at rf or af.

Oscillator stability is a problem, whether as critical terminal oscillator in a superhet, or as critical initial oscillator in a direct conversion setup.

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And: more complicated systems are generally needed to produce more complicated results. Aside from Rod's comments, Phase-locked systems can be complicated -- See:
"Prelude to a Solid State Deltahet" in Electronics Australia, Jan. 1971. And:

REFERENCES

1. R. H. Ferris and R. A. Reynolds, many personal communications, much anguish on both sides as they expressed pear-shaped technology and I struggled to put it to pear shaped words. I fear that this article ought to undergo yet another revision, but time has run out.

2. Amateur Radio Techniques, by Pat Hawker, G3VA (RSGB, 3rd Ed.). "Receiver Topics". Full of good oil, with a bit of the confusion which prompted this article.

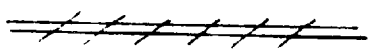
3. "Phase-locked Local Oscillator", by VE5FP, Ham Radio, March 1971, advance copy kindly supplied by the Editor. A particularly lucid description of the operation of the Phase-locked loop, and a clever circuit employing it.

4. "Editorial", Ham Radio, Nov. 1970, including a list of the various other things the PLL will do.

5. "The Phase-locked Loop Comes of Age" by K5JKX 73, Oct. 1970. A somewhat less lucid description, but a good summary of the applications notes from Signetics describing their IC which makes it all possible -- for more than $30 each.

6. "The Monolithic Phase-locked loop -- a versatile building block", by A. B. Grebene, IEEE Spectrum, March 1971, p. 38-49. A more technical but remarkably lucid presentation (for an engineer) of this subject. Shows the insides of the ICs involved. 45 Trs.!

7. "Build an SCA Adapter for FM Reception" by V. Wood, Popular Electronics, Dec. 1970. An interesting further application of the Signetics NE565.



Advice is what you take for a cold
Thomas J. O'Brien

Chocolate Mint biscuits

Melt a 6-oz pack of semi-sweet chocolate chips in a double boiler, water heated to 110°F. Add two drops of peppermint flavour. When the chocolate reaches 95°F (using candy thermometer), put cold water in the bottom of the double boiler. When the cholcolate temperature drops to 82°F, replace the cold water with hot water at 110°F. Reheat the chocolate over a low flame to 88°F actual chocolate temperature, stirring constantly. Pour the mixture in a wafer-thin layer on a biscuit sheet covered with waxed paper. When the chocolate hardens (in about 2 hrs), cut in five bob circles. Makes four dozen.

Among the best of all steaks, it is said, is filet of foal. That is to horse meat what veal is to beef...

SERVICE WITH A SMILE -- Paul, HH2PR
(QSP Sentinel via ARNS Bulletin 2/71)

The following letter has been received from Miss Fifi Paree, Manager of the Seymour Nudist Camp for girls.

Gentlemen:

I wish to express my sincere thanks to you for the excellent service your linemen performed last summer. It was explained to us that the transformer on the pole next to our swimming pool was of a special type that had to be dusted twice a day, oiled once a week, and have the bolts tightened every ten days.

A Mr. Watt explained to me that unless the transformer was dusted regularly, the dust would coagulate with the paint which would set up a chemical imbalance of the hydrofoil and cause a great deal of trouble. I am happy to report that your line crew stopped every morning and afternoon and spent 15 minutes dusting the transformer....

Your crews were always very conscientious in making repairs. On one occasion a crossarm broke on a pole next to the tennis court where some of the girls were playing tennis. Nine men with three ladder trucks worked 4 hours to replace the crossarm. They had quite a little trouble making the repairs, as they would put up a crossarm, put a level on it, then unbolt it and install another. A Mr. Shock explained to me that unless the cross arm was absolutely level, the wires to the transformer by the swimming pool would sag, the power flow would be uneven and as a result only half the swimming pool would be heated while the other half remained cold.

Evidently we have a special type of meter by the swimming pool. The meter reader told us it had to be read twice a week by two men so that an exact average of power could be calculated. One of your meter readers is rather clumsy, because during last summer he fell over two lawn chairs, a picnic table, and a garbage can while walking over to check the meter.

I wish to thank you again for the wonderful attention your line crews and meter readers gave us last summer. I have been assured that all the men will be on the job again this summer. I understand that last summer two men gave up their vacations just to make sure that our electrical equipment worked properly.

(Signed) Miss Fifi Paree, Manager
Seymour Nudist Camp.

(From Columbia Chapter Newsletter)

((EEB Note: Among all that we're not sure where this gem originated, but rest assured that it has only been exposed to the eyes of electronics experts...))

You've got to hand it to the Income Tax people -- if you don't they'll come after you! /..... If you don't think a girl is dynamite, try dropping one..... Diner: "Waiter, I don't like all these flies in here." Waiter: "If you'll point out the ones you don't like, I'll try to get rid of them." (ARNS Bull 4/70)

LETTER: Britain's State of the Art?

I read with interest the Review of the 1970 ARRL Handbook in the October 1970 EEB. I agree it is an improvement over the 1968 edition, and with most of your other comments. But I was very surprised by RAJR's last paragraph. He implies that the RSGB Handbook represents the so-called "state of the art". If this is so, I don't think much of Britain's "state of the art".

I have the latest edition of their Handbook beside me now, and I have studied it in some detail. I could not find a single reference to silicon transistors in it. There is an SSB Transmitter and an SSB Transceiver using transistors, but the transmitter uses all OC170's and the like, and the transceiver uses very few silicon transistors. The transmitter is very similar to the Electronics Australia SSB Transmitter, except for the type of transistors. For almost half the price, I think the ARRL Handbook is by far the better buy.

To another subject now. If you're going to publish EEB bimonthly, how about publishing it on time? The October issue was two months late.

How would an article on transistorising the Crammond "Karphone" on 52MHz (yes, I know it hurts, but Hertz it is) be for publication?

Regarding "long haired youths" (but where did you get the "pink blouses" from?), I don't quite have hair that long, but I still bend over a hot soldering iron.

The article on feedback was very informative; keep it up.

-- C. P. Stubbs, VK4ZCS, Cairns, Qld.

((Shux, if EEB is invariably late, why not merely depend on it in that undependable manner? One month is usual, two is PMG, complain to your local Prime Minister -- except for February which got a bit out of hand.

Yes, certainly we'd like a transistorisation, but keep it terse, with commonsense observation on technique or theory where practical.... The pink blouses etc can be seen on some of the bods (?) in Hobart --Ed.))

already in A.R.!

RSGB REPLIES:

Sorry that we cannot include VK4ZCS amongst the 35,000 or so satisfied readers of the RSGB Handbook. He should know that RSGB deliberately pursue a policy of producing a completely new edition at intervals rather than add or replace sections annually. By this means we cannot cover all developments as they occur. To do this one would need not one, but a series of Handbooks. Further, RSGB feel that the constructional data is of value wherever the reader may be located.

Factually, the 1971 ARRL Handbook retails in the U.K. at 50/- and the RSGB Handbook at 63/-, not double the price. The 1970 ARRL Handbook contains (including valve etc data) 641 pages. The RSGB Handbook runs to 832 pgs, the maximum that can be accomodated in a hard bound volume of the type.

RSGB will continue to produce what they believe will be the best of amateur radio handbooks.

-- R. F. Stevens, G2BVN, Romford, U.K.

((We might note that the transistors used by RSGB were the best available, and are still widely available even in areas of the world where transistors of any kind are in short supply. Furthermore, Silicon units are not necessarily better unless selected for a specific job. A well designed circuit will perform well with germanium, and the circuits in the RSGB Handbook have been well designed, well tested, and proven.

Whilst we consider RSGB to be a fine book, we agree that more up-to-date circuits would be justified, and these will undoubtedly appear in future editions. What is important, however, is not necessarily using the latest gadgetry, but to employ good design. In this respect the RSGB work is quite satisfactory, and the sections on theory are better than most.

We have just seen the 1971 ARRL Handbook, and it appears to be well worth a review -- to appear here next month. -- RAJR))

((The RSGB Handbook can be obtained here at a very reasonable price if you order it through W.I.A. or N.Z.A.R.T., but of course not necessarily through the bookshops.-- RLG))

REVIEW: 1971 ARRL HANDBOOK -- RAJR

These are tentative conclusions from a bit of browsing; more details later (August) when our copies will have arrived by snail mail from the USA (at a considerable financial saving).

The ARRL Handbook appears FINALLY to have been rearranged and rewritten in a serious effort at competence. Valve and solid state circuits are compared properly, with a pronounced swing to solid state -- including a fully-protected dual gate MOSFET system.

ARRL have suddenly discarded the bulk of the description of individual constructional items. The theory has been expanded drastically, with corresponding improvement in technical level.

The reason for this revolution seems evident: ARRL are catering to the wishes of the majority (rather than leading): the majority of amateurs (etc) are in fact not constructing their own equipment. In consequence, ARRL have greatly truncated the constructional project details.

The emphasis is not now so much on how to build a high power final, but how to design it. In this it is similar to the approach by Orr or RSGB but rather more updated -- and even more down to earth. The ARRL theory is directed to the practical rather than educational.

Although this remarkable development might appear to be the right move for the wrong reasons (will they also publish a separate volume to encourage

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sophisticated experimental projects?), we still welcome it, because it is now generally applicable to diverse circuits, and WE can take good advantage of it.

Thus, my general impression of this book is that it is one to keep on the shelf, and refer to it first when considering the design of a new project. When I receive my own copy, I may also be tempted to read it from cover to cover, just to see what is happening of value in amateur circles nowadays ((Me too -- RLG)).

Australian price, $6.50 from book sellers. American price probably $US4.50 (they had a sticker on it!), i.e., $A4.05.... If you are willing to wait for a few months you can save money by ordering it from FAA Bookstore, Postal Station 18, Oklahoma City, Oklahoma 73169, U.S.A.; probably about $US4.75 postpaid (because they give a discount). For any left over, ask them for a credit slip, and we can redeem it for you.

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REVIEW: RADIO HANDBOOK (W.I.Orr), 18th Ed.

We planned to present a good Review of this latest in the renowned series of Handbooks published by Sams (formerly by Editors and Engineers). But there appears to be some difference of opinion between us about the Review. Accordingly we are going over the book more thoroughly and comparing notes.

In this age of increasingly sophisticated electronics equipment and decreasingly sophisticated radio amateurs it is becoming more difficult to evaluate the overall worth of general Handbooks, unless of course there is a cataclysmic change -- as for the 1971 ARRL. The questions arise as to just what can be the function of a handbook which must be inclusive without being stretched to six volumes, and of asking which of the many fields of endeavour are the most important. Whatever answer is chosen, there can be disagreement. For example, even the excellent RSGB Handbook can come under this attack, as we have seen above.

To those who would feel complacent about such matters, I invite you to compile a good summary of sme technical topic from the periodical literature. Its oloody difficult, I tell you.... It seems evident that one answer would be for the various Handbooks only to publish at infrequent intervals, and then in at least two volumes -- paying very careful attentio to meticulous organisation. The State of the Art is becoming most demanding.---RLG.

AROUND THE AIRWAVES -- J. Van Staveren/7JV

PLACE	STATION	FREQ.	TIME(Z)
ANDAMAN IS.	VU9KV (QSL W6KNH)	14195	1100
DAHOMEY	TY2ABE (QSL Box 29, Porto Novo, D.)	21006CW	1700
EUROPA IS.	FR7ZP/E (Sked with JAØCUV/1)	14195	1300daily
JORDAN	JY9AA,AB (Mary + OM with K.)		
Juan FERNANDEZ	W9IGW/ CWØZ	14025, 21.025, 28025	QL W9IGW
LESOTHO	7P8AB (QSL Box 389, Maseru, Lesotho)	15M	CW/SSB
MACAO	CR9AK (QSL JA1AEA)	14200	1200
MARKET REEF	OHØMA (Formerly OJØ)		active
MONGOLIA	JT1AM (QSL Box 639, Ulan Bator, Mong. Peoples Rep.)	14042	CW
NAURU IS.	C21DC	14175	1100
PORTUG. GUINEA	CR3VV (QSL Box 306, Bissau, Port.Guinea)	21300	1100
TOKELAUS	ZM7AG	20M	
TONGA	VR5DK: Active Apr 16 to May 16, Darlene (YL). Skeds via VR2FT, P.O. Box 3722, Samabula, Fiji Islands.		

((The above items extracted from DX-Press))

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ELECTRONICS TODAY

A new Magazine has appeared in Australia, called "Electronics Today". It claims to be "Australia's Dynamic New Electronics and Hi-Fi Monthly". It seems to be similar in format and coverage to "Electronics Australia".

We intended to publish a Review of "Electronics Today" in this issue of EEB. The Editor of that magazine wrote:

"Your offer to review Electronics Today is greatly appreciated. May we, however, suggest that as in the case of EEB, one issue may not be typical, and that you wait until you have seen two or three."

He also paid us the considerable compliment of expressing interest in EEB. We shall indeed defer the Review until our next issue -- June. In the interim, would you people please buy a copy or two of Electronics Today, and let us know of your opinions? This will help us greatly in making the Review, and it will also help a new enterprise to get started. In a Capitalist society competition benefits everyone (except perhaps the poor old advertisers!).

We might note that with the April issue, Electronics Australia by a strange coincidence has developed a new format and editorial arrangement.....

REVIEWS OF TWO BOOKS ON ELECTRONIC FUNDAMENTALS FOR BEGINNERS (etc) -- RAJR and RLG

Electrical Fundamentals for Technicians, by R. L. Shrader (McGraw-Hill, N.Y. 1969).

Principles of Electronic Technology, by C. B. Weick (McGraw-Hill, Toronto, 1969).

Since the beginning of Radio there have been large numbers of publications on the same basic subject, attempting to teach the basics of Radio, usually to the young experimenter.

We feel that in general these publications fail in that they are directed, say, to the construction of a basic receiver. Some are more adventuresome, and go on to TV or Amateur Radio, whilst others describe gadgets that do nothing more than tell you that it has been raining for some time. But how many tell the beginner the basic principles so that he will have the essential knowledge to design his own circuits? The book by Pat Hawker, reviewed here in December 1970 was not bad in this respect, but would be appropriate principally for the beginner at his very first stages (although the coverage does go through radio theory). What is lacking is a more thorough grounding in circuit fundamentals rather than circuit applications.

Several organisations involved with the training of technical staff (e.g. U.S. Army, British Post Office) have produced some very good books dealing with the general subject of electronics. These books can give an enthusiastic reader with no previous knowledge of radio theory a very good coverage of the subject, but a major criticism of these works is that they are old.

Since the original review of Shrader's book (see heading) was prepared for these pages, we have obtained the one by Weick as well (at our own expense, because the miniscule circulation of EEB seems hardly sufficient to request complimentary copies). This has complicated matters somewhat. Our initial evaluation of Shrader indicated that his book did indeed provide a modern treatment of fundamental electronics, and did it well. Quoting from RAJR,

"Containing nearly 500 pages, this hardback book covers all facets of an education in general electronics from the fundamental reasons behind a series circuit, right through to the design of complex classical filters, and it does this without resorting to mathematics more complicated than plane Trigonometry, including vectors -- and these are explained fully.

"As I thumbed through the pages I realised that there was no effort to hurry the reader through the more simple theory... I can see that a novice would probably have to call on the help of a more advanced technician to get a secure grasp of the subject matter in the latter half of the book, but I also feel that the advanced technician would have to sit down and do a little bit of study for himself too if the whole book were to be covered."

The fact is, of course, that we who think we do know electronic fundamentals are often considerably less well educated than we should like to imagine; and the reckoning comes when we try to work up a circuit from our own resources, rather than taking an already-digested bit from a book.

In any event, the arrival of Weick has changed our appraisal a bit. Let us say at the outset that it will not be possible to say that one of these fine books is "better" than the other; their approaches to electronics are very different, and one may appeal more to one kind of person than to another.

Basically Weick's approach is more mathematical, but it is not that simple; his diagrams are also more elaborate, and he can go into much detail on simple matters he considers important.

Basically Shrader's approach is non-mathematical, but of course some maths is quite unavoidable in electronics, so he manages the solution of complex functions, for example, by graphical vector analysis, and only then introduces the "j" notation, more as an also-ran.

Weick claims that the problem is not complicated maths, but complicated problems. He does indeed present simple and highly illustrative examples (and real problems), but his maths are not exactly high-school level, though in fact they do not exceed matriculation level. On the other hand this reflects the fact that nowadays a quite sophisticated approach is being made to teaching children on a secondary level. If we have not been exposed to such fundamentals in our learning years, we might find it not inappropriateto review them ourselves.

Shrader, on the other hand appeals to the general distrust of maths by claiming to be almost non-mathematical, but his devices can sometimes be devious. He avoids the problem of impedance by graphical analysis, but in the end must present it in Euclidian form, and finally with treatment of imaginary quantities. This kind of contortion does lead to a highly descriptive text. Is this good?

cont'd P.45

Perhaps it is for a "rank" beginner, but only at the beginning of the text. Beyond that the effort to avoid maths seems laborious. But is is unquestionably adequate for those people to whome mathematics is anathma. We might pause only to suggest that such people might not obtain their best advantage from the study of electronics.

Weick uses mathematical examples, but avoids extreme design criteria, concentrating rather on demonstrating the exact working of simple circuits. And his mathematics (and theory) are on a double level: a relatively simple and straightforward one in the main text, but beside it in shaded-background text is the more elaborate treatment. One is free to choose the appropriate treatment based on one's own progress in understanding; again this is consistent with the newest teaching methods -- which have been found to be effective.

Shrader starts out with A Basic Electric Circuit describing atoms and force fields, goes to Current and Voltage, thence to Resistance and Conductance and onto the heart of the matter: Ohm's Law in Series Circuits.

Weick's first chapter treats not electrons but very fundamental maths. He starts with simple sets, develops ratios, adds and subtracts, and goes on to explain exponentials and "J" notation -- but in a most understandable form, calling on electronics for examples.

Whether this be your cup of tea or not, is the question. We think it is good because it is in accord with modern ways of thinking about teaching, where children are presented with set theory at an early age (at least in Australia). The treatment here is very simple, but it is not babytalk; it requires some definite concentration or hard study, depending on the background and abilities you bring to it....

Weick then goes on to A Review of Electrical Concepts (note that "Review") and then Resistance, Circuit Fundamentals (including Ohm's Law and Kirchoff). In other words, Weick covers basic physics in no uncertain terms, from the definition of charge and field theory to atomic structure -- finally ending in Ohm's Law. But even there his approach is very basic. Rather than, for example, feed you the formula for parallel resistance, he shows that it is a logical consequence of the distribution of currents in an electrical network. I wish I (RLG) had learnt it that way; it could have saved a lot of grief later.

Shrader talks about the basics of electric current, behaviour of resistance and current, and then Ohm's Law in series circuits. In other words he spoonfeeds you all the way, while Weick experiments in modern techniques that make you think (therefore learn?), and using illustrations of more modern equipment.

Weick's approach is, in fact, more modern, from his use of techniques to his treatment of MOSFETs. As far as we have been able to see, Shrader devotes one whole sentence to FETs, and that is all. He would, of course, argue that the main idea of his text is to present circuit fundamentals, dealing mainly with circuit constants and their behaviour, but surely in this age active devices are as important as passive ones.

Now in fact Shrader has a considerable body of material on Alternators, Dynamos, Motors, Superposition and Thevenin Systems, and Filters -- all treated in quite a lot more detail than by Weick.

Weick choses rather to use this room to treat transistors in much more detail. A chapter is devoted to "Current-Operated Devices", namely transistors and diodes, and includes construction, typical characteristics and curves, and the simple calculation of current gain. Another chapter is "Voltage Operated Devices" containing several pages on JFETS, MOSFETS, and to be sure -- valves! Weick does indeed cover Kirchoff (but not Thevenin) and filters, but in less detail than in Shrader.

Both books have Questions and Answers. Shrader leaves spaces blank for the student to fill in answers, whilst Weick fills them up with additional Questions for the mathematically-minded. This difference in emphasis pervades both books. Weick is more detailed in fundamentals and in some applications where he believes it follows freely from previous basic material. Shrader goes into more detail in applications he believes important, and that appears to cover a large slice of motor and dynamo work as well as filters. This is certainly useful, but is it basic? On the other hand, it can be difficult to find good sources of information on these subjects (other than in the abovementioned Army or PO works), and Shrader may well have had this in mind.

Which book is Better? From our discussion you see that we cannot say. RLG feels tht both have enough to offer him for review or reference that it is worthwhile to keep both. Unless you have a spare $20 to spnd it would be well to decide on one of them. Shrader = $US12, Weick = $US10 which shld also cover post from the Oklahoma Bookshp we have mentioned often in these pages.

VOLT-AMPERES-REACTIVE (and Power Loss)
-- C. C. Drumeller, W5JJ
((From: Collector and Emitter, 7/67))

In the quiz program presented at the Club a month or two ago, one question concerned a CW transmitter of the "100-watt" class. This transmitter first was loaded into a feedline that was not matched properly to its termination (the antenna). Under this condition, a "Forward and Reflected Power" meter ((the so-called Reflectometer)) indicated 80 "watts" forward "power" and 20 "watts" reflected "power". The transmitter, of course, was tuned to resonance before noting the meter indications. The DC input voltage and current were also noted.

Then the load was changed to one that was purely resistive and equal to the impedance of the transmission line. The transmitter was retuned to resonance and reloaded to exactly the same DC input values as before.

The wattmeter indicated 60 watts forward power and zero watts reflected power under the second set of conditions.

This concept of "less power output under matched load" has been a hard pill to swallow. It just doesn't sound right. You're correct; it isn't right. The reason it isn't right is that the true forward power in each of the two instances was the same: 60 watts.

The item that caused the misleading indication is known as volt-ampere-reactive. You read about it more in power-line circuits than in RF transmission lines. It can affect any circuit carrying alternating currents, irrespective of frequency.

To make matters more confusing, we often speak of watts when we really mean VARs (volt-amperes-reactive). To compound the confusion, many "wattmeters" respond quite readily to VARs. Is it any wonder, then, that persons are led astray by what they believe to be creditable indications?

VARs and Watts in Transmission Lines

Lets consider the case of a transmission line a little over a half-wavelength long. Put a dead short across the far end. A quarter-wave back from the end (namely, the voltage anti-node point) put an RF voltmeter. A half-wave back from the end (the current anti-node point) put an RF ammeter. Now try to feed some RF power into the transmission line -- this will not be easy to do! Note the extremely high readings of the voltmeter and the ammeter. If the line were lossless, the readings would be infinitely high!

For the second step of your experiment, remove the short-circuit and substitute an RF wattmeter having terminating resistance matching the transmission line. Again note the voltmeter and ammeter readings. For the same amount of power being fed into the line, these readings will be much lower than in the first step. Their product (E x I), however, now will equal the indication of the RF wattmeter.

If you had recorded their product in the first step, you'd have been recording VARs. In the second step, you'd record watts.

Useful Watts

Keep in mind that any time your RF transmission line is terminated in anything other than a perfect match (a rarity in amateur practice), the RF flowing in that line will have both watts and VARs. A very few of the watts will be lost in heating your transmission line; the remainder will be radiated. The VARs will not be radiated.

As a VAR is constituted of E and I, the E will heat your transmission line at its voltage anti-nodes; the I will heat it at its current anti-nodes. Some small power losses will result. These losses are all in the transmission line. None are in the transmitter. Read that again: None are in the transmitter.

Again: NONE ARE IN THE TRANSMITTER!

((EEB Note: See our December 1970 issue, p. 170 for illustrative diagrams. It is a point well worth repeating, particularly in Carl's clear prose.)) ((In lieu of a similar discussion by RAJR, this month it is worthwhile to include this item, which rounds out the subject nicely:))

XXXXXXXXXXXXXXXXXXXX

MYTH DEFLATION -- VSWR -- C. Drumeller
((Collector and Emitter, Sept. 1970))

For those die-hards who still give credence to the hoary superstitions about horrendous effects of a VSWR of, say, 4:1 or 3:1, on a reasonable length of transmission line, they might do well to read the article by Yardley Beers in the August 1970 issue of QST. Beers has a Ph.D. degree and a supervisory position in the National Bureau of Standards, so he can hardly be laughed off as an irresponsible crackpot.

In his article (which deals primarily with another subject), Dr. Beers makes a statement on p. 28...: He says a VSWR of 3:1 does not cause appreciable loss (at HF). In this, he's a bit more conservative than the Mosley Antenna →p.47

people, who say VSWRs of 5:1 or less do not cause appreciable loss (at HF). My own experiments, repeated in public demonstrations show that actual losses with a VSWR of 4:1 at 25MHz are too low to be measurable with standard commercial test equipment.

The trouble is that some persons are inclined to confuse transmission line losses with the sharply limited ability of commercially manufactured transmitters to effect an impedance match between the RF power generator (usually vacuum tubes) and the impedance presented by the sending end of the RF transmission line.

When the VSWR is other than units, this impedance can be resistive, resistive plus capacitative reactance, or resistive plus inductive reactance. Most manufacturers, to cut expenses, make their products with tuning networks designed to match only purely resistive loads, and these with only moderate departures from the "ideal" 52 ohms.

Cuss the manufacturer, if you like, but don't entertain any false concepts about high RF losses on a transmission line less than 2 or 3 wavelengths long! (at HF)

-- W5JJ

((Australians: Consider these points well when you contemplate buying or operating a piece of commercial "amateur" gear! --G.))

xxxxxxxxxxxxxxxxxx

For further reading on this curious subject, see the following:

"Effect of Mismatched Transmitter Loads," by C. Drumeller, W5JJ, Ham Radio 9/69.

"The Mismatched RF Transmission Line," by C. Drumeller, W5JJ, 73, Nov. 1969.

"Some Reflections for Reflected Power," by W. Anderson, VE3AAZ, Ham Radio, 5/70.

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HOW TO ELIMINATE BALDNESS!

The Hounslow Wireless Society earned International fame recently by declaring that baldness would be eliminated when everybody used a radio set with headphones. The bad news for manufacturers of loud speakers is to the effect that the electrical waves of the headsets stimulate growth of hair. The Society proves its point by stating that all radio operators have luxuriant growths of hair, forgetting, of course that no barber will tackle a man who wears a headset.

-- Wireless Age, Sept. 1922

"Did she blush when she broke her shoulder strap?"
"I don't know, I wasn't looking there". (A/C 2/71)

SCR-REGULATED POWER SUPPLY ((From p. 27))

Further improvement could be obtained by increasing the value of the gate resistors, but this results in a lower output voltage and a much slower oscillation on very light loads -- 16 sec with 22K resistors and 50KΩ load.

A portion of each gate resistance may be made variable to give voltage control.

The SCRs used were rated at 4.7A, 200PIV, as tested from a disposals supplier. Ample power rating should be provided for the transformer. The one used for the model was 100 watts, with 90% regulation at 2 amps d.c. load.

It is also possible to use SCRs in place of valves in series regulators following conventional diode supplies, and this has been described in the article, "SCR Regulated Power Supplies" by W.E. Chapple, Ham Radio, July 1970, p. 52.

By suitable adjustment of the gate resistors it is possible to even out the regulation of this SCR power supply, and this will be described next month.

xxxxxxxxxxxxxxxxxxxx

PSYCHOKINETICS???

I wonder if we have any talented mathematicians in our readers who specialise in probability? At our local Bingo game, if one wins during the course of an evening it is very likely he will win once more. It has happened time after time, and according to my mathematics the probability of this occurring is much more remote than actually happens.

The figures: Presume 100 are playing, and each has three cards. The game is honest (it has to be in a small town where everyone knows everyone else...). So, for example, I've won the last four weeks, and won twice each night. The YF won last week also -- twice. Its a regular occurrence...

(KØNL, R.V. Anderson, Autocall 1/71)

((EEB Ed. Note: Seems to me you need a Control, e.g. do your friends win as much as you do; if not you have a Talent which could be useful in this world, and ought to work well on any other system which depends on random selection.....))

If you eat slowly you will eat less. This is particularly true in a large family.....

The teacher asked the class to list their choice of the ten greatest Australians. One boy seemed to be having troubles, and she asked him if he couldn't think of any. He replied, "I couldn't make up my mind who was the fastest bowler". ((Slightly modified from Autocall, June 1969))((Incidentally, KØNL and his gang has a regular daily schedule on about 14.285 at 2100 GMT))

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SANDY BAY.
TAS., 7005
AUSTRALIA.

VOL. 7, No. 3: "JUNE" 1971 P. 49

A SPECIAL EDITORIAL

Sorry for the late appearance of this "june" issue, but we've got problems. And on top of them is the fact that we have been threatened with legal action by an Australian firm, and recent days have been full of telegrams and hasty letters.

More than that I'm not permitted to say at this point, because of legal restrictions.

So -- no technical EEB, at this moment.

For one thing, it just isn't compatible with the way I feel (wretched). For another, if we're going to be in big trouble, we're going to need every penny we have -- and the rest.

If the legal action is not followed through, we shall tell you as much as we're allowed to, and continue more or less as before. In that event, of course you'll receive the full number of issues of your subscription.

If we're brought into court, we'll explain what happened (but afterwards, again because of legal matters), and that could be the end of EEB. Because court actions are terribly expensive. In that event, of course, you would be refunded your remaining subscription, in due course.

(Continued on p. 52)

(Special Editorial, continued):

So, what now? We'll wait a bit and see what happens. We shall certainly let you know the outcome as soon as possible.

Please don't write to us about this matter -- yet.

Yours,

Leo

R. L. Gunther, VK7RG
Editor

= =

We don't usually work on Saturday mornings, but we were happy to help, this time.

-- ADVANCE PUBLICITY CO.
Hobart, Tasmania

(Printers for EEB)

THE AUSTRALIAN EEB

30c. PER COPY.

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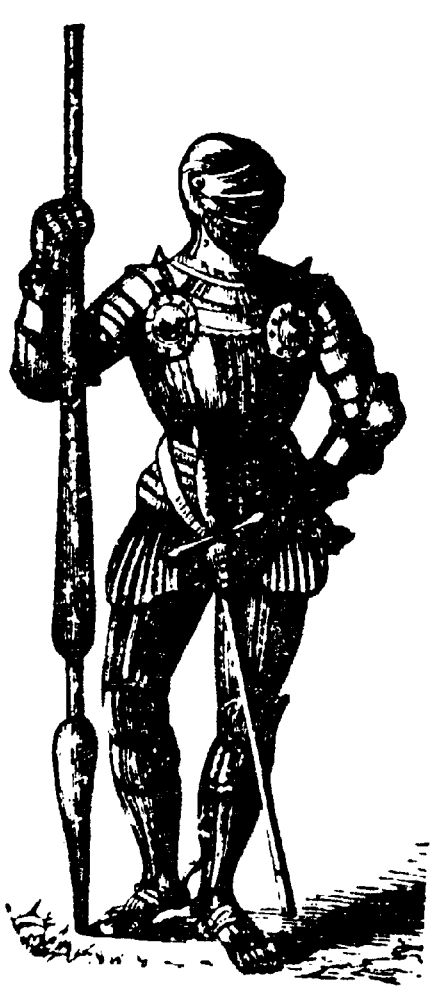
AN INFORMAL ELECTRONICS EXPERIMENTERS BULLETIN

September 1971 Vol. 7, No. 4 P. 53



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NEXT MONTH (October):

Transistor voltage and gain testers.
Digital Voltmeter Design.
Some modulation monitors.
The State of the Art, and Experimenters (Direct Conversion and Synchrodynes will be continued in November ++).
Commercial vs. Home-constructed Eqpt..?
Another Go at the PMG etc. Don't miss it.

OUR COVER

This seemed somehow appropriate, and came from an advertisement for subscriptions by Motive Magazine (Nashville, Tennessee), about which we were to have had kind words. Motive was a fine philosophical/art magazine, but in August we received the bad news that Motive was going to cease publication, owing to its far-out methods and consequent conflict with various Establishments. This is truly a blow to the world of enlightened journalism, and the world will be poorer for the absence of Motive Magazine.

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➧THE MILLIWATT: A New Magazine, and Good --RLG

The world still moves, there is hope for Technology.

Believe it or not, an EEB-type magazine has actually arisen in the United States of America. Remember the hopelessness of the VIP who wrote us about the Yankee experimenters situation (EEB April 1970, p. 63)? Now there is hope.

Adrian Weiss is Editor of The Milliwatt the "National Journal of QRPP, devoted exclusively to under five-watt amateur radio". More like its New Zealand equivalent Spectrum (P.O. Box 5268, Auckland; $2.75), The Milliwatt covers more radio amateur topics ("ham") than EEB (usually), including WAS, gossip and the rest.

I find that aspect moderately interesting, but what excites me is the general approach as well as the fine technical coverage, and all printed on offset in an aesthetically pleasing format. That general approach is genuinely amateur, a dying race now -- being replaced by a gaggle of "hams".

Its effect on the American scene? A quotation from a letter by Jeff Brower (WA8HGR /8) in the June 1971 issue:

"The Milliwatt is responsible for my (amateur) rebirth. For the first time since I was licensed in 1963 I am starting to build my own equipment...." and he furnishes details thereof.

And here is the mark of craftsmanship and the truly amateur spirit; confusion!: (W2KFB states):

"I enjoy The Milliwatt very much, even though I got only two issues of the first year's output, followed by a renewal notice! ((We've done that too!)).. I appreciate the effort you fellows are putting into things and hope you can keep it up..."

And ARRL's Doug De Maw (W1CER) has an Editorial in the April 1971 issue, defending QST Technology...

The Milliwatt presents a solution to a quandry EEB has faced for years: a relatively minor amount of technical article contribution from its radio amateur readers. Now, if you are interested in amateur matters, subscribe to The Milliwatt, and if you are interested in EEB subjects (whatever they are??), subscribe to EEB -- preferably both, of course.

The Milliwatt costs $US3.00 per year ($A2.60 at present rates), and with relative costs and incomes that means that Adrian is getting as rich as I am from his magazine.

As a public service, and to introduce this magazine to Australia we shall accept subscriptions to The Milliwatt on your behalf. Send us $A2.70, and in due course you'll receive your issues from America; if you want a receipt from us, please add another 7c or stamp. If you have $US cheques or wish to pay the 50c bank charge here, write directly to The Milliwatt, Meckling, South Dakota 57044,USA.

Postscript: ((From The Editor, RLG))

I've been accused of being too enthusiastic and of riding off wildly in all directions when I find a book or idea I like. Its true, and in these years I've tricked you into spending your dollars wildly for a variety of books or magazines, or computer boards. In about 4000 such transactions since 1965, we've received only about two really nasty complaints, and a flood of satisfied comments. The most recent affair was with Amateur Radio Techniques, where we were simply innundated with orders. Finally we had to drive them off; order through W.I.A.

Our audience is small, but a good mob. Why, look at this issue, for example. It is some 6 months late, but we haven't received a single complaint -- only a few enquiries! Our readers know we are still with them -- and we are; we'll be publishing "monthly" until the end of the year to catch up.

STOP PRESS POSTPOSTSCRIPT: See the excellent article by Adrian, Editor of Milliwatt, in CQ, Sept. 1971, p. 16++, continuing the MW QRPP tradition of describing the best ways to get results from antennas, and other ways to achieve high efficiency to make use of low power.

%%%%%%%%%%%%%%%%%%%%

LETTER: Commercial gear and Amateurs

Those fellows who won't open their little black boxes in case something goes wrong just because they looked at it, really annoy me.

Sure I've got quite a bit of commercial gear, but I like to know what is going on inside it. At the moment I have my commercial SSB/CW rig down for checks, as I recently got reports of key clicks, so as soon as some of the panic dies down in the next week or so, I will get down to some solid checks on the unit. The ALC doesn't work properly on 40 metres either, although not having a good CRO I haven't been able to confirm what I suspect is wrong -- namely wrong operating conditions on the driver tube.

Here's a thought: How about doing some research into methods of detecting sources of radio and television interference on power authority transmission systems?... There is a device on the market which supposedly does the job, but in fact gives erroneous readings. It consists of 4 transistors and a few other components and sells for $230. I am working on a device that uses 2 ICs, 2 FETs and a bipolar...

-- R. Champness, VK3UG, Warragul, Vic.

LETTER: "I feel pretty bloody angry"

Just a letter of encouragement (I'm sure, one of many) in this time of trouble.

Looking over the last few issues, I am quite unable to find anything to offend, injure or otherwise adversely affect anyone. Apart from having a sympathetic lump over the whole situation, I feel pretty bloody angry. If its something you've written or done, then I know it was done without any intention of damaging anyone. Why they should bother with EEB and its (relatively) tiny circulation I don't know.

((Offer of financial assistance if needed))

I'm afraid the best I can offer in encouragement are inanities like "keep plugging", stiff upper lip" etc, but I think you'll understand the true sentiments -- there's only one EEB, and we need you.

-- Bruce Bonamy, Sydney, N.S.W.

((You're quite right, its nothing we have yet published, but something we sent to someone for their opinion prior to publishing in EEB. The ensuing results were startling, to say the least. ... Our Friendly Solicitor sugggests that we say nothing further about it, but return to the mundane details of publishing EEB. Thank you, all of you for your expressions of support, even though I said not to write. No financial assistance is requested at this time, thanks, but we won't mind at all if people renew when receiving renewal notices)

LETTER (We're non-professional moaners)

I have found your Editorials much more thought-provoking than the usual run of Editorials and books from the professional moaners and whingers like Whitlam, Nader, Packard, Galbraith .... you know the sort? The practicality and informality of EEB is truly a refreshing change.

For the past few months I have been struck dumb at your story of your Assistant Editor making a copy camery; my, what perseverance! Printing quality certainly seems good. You say you have problems with "High Contrast" techniques; you are using line film aren't you? I do hope so! ((Yes, of course, but there are many other problems.-Ed))

Also, could you please clarify in EEB whether you would like subs for other mags sent to you or to Mr. Yelland? I wasn't sure whether you intend that all subs be sent to him or not...

-- J. C. Young, Hunters Hill, N.S.W.

((I don't suppose Les Yelland (in Victoria, one of our Authors) would mind those subs, at least the money, but it might be quicker to send them to Bob Walton in Huonville, Tasmania -- HI! In general, if you're in no hurry, send even subs for other magazines through Bob, but if speed is important send them to us at Sandy Bay -- if we have time, we'll take care of them sooner. -- Ed.))

LETTER: An Excellent Idea!

I find yours the best magazine around for clear explanations, not to mention recipes!

The only change you could make would be to add more months to a year, seeing you don't want to write more. Keep up the excellent work.

A.E. Morgan, Townsville, Qld.

Quote without comment (Auto-Call)

I know you believe you understand what you think I said, but I am not sure you realise that what you heard is not what I meant.

LETTER: Availability of MTOSFETS

EEB readers may be pleased to know that I have uncovered details of relatively inexpensive protected MOSFET Transistors (c.f. EEB April 1971 p. 35 mention of 3N189). Actually they call them "Discrete MTOS Transistors"!? Here are the specs of the units most likely to appear useful:-

MEM 564C: Dual-gate VHF N-ch. depletion, V_{DS} 20v, G_m 12mA/v, $V_{GS(off)}$ -1.5v, 225mW, TO-72. Virtually identical to the 3N140/1, but with gate protection.

MEM 571C: VHF N-ch. depletion triode, V_{DS} 20v, $r_{DS(on)}$ 200Ω, G_m 10mA/V, $V_{GS(off)}$ -1.5v, 150mW, TO-72 case. Appears similar to the 3N142.

Prices for these devices are about 13/- and 14/- respectively, from: S.D.S. (Portsmouth) Ltd., Hilsea Industrial Estate, Portsmouth PO 3 5JW, Hants, England, U.K. Add about 7/- for airmail post and packaging for safety, plus Registration if necessary ((Necessary nowadays to ensure reliability of the Post Offices!!! -- RLG)). You may be interested to know that a parcel sent from England via Registered Post has arrived weeks ahead of an Unregistered Parcel sent a week before that. Good service, don't you think? ((No doubt; you're lucky you received the Unregistered one at all -- Ed.)).

Concerning EEB itself, I do like the new Offset printing, even if the rag has lost a little in formality, but I do think the looks would be greatly improved if the characters were set closer together in the words, and thus look a little less like typeing. ((Easy, for a mere $700 -- Ed.)).

That matter in EEB some time ago, about the dangers of teflon being heated is nonsense. I thought that piffle about teflon being deadly when heated had died down long ago. Because of its fire-resistant properties, teflon is used as heat-proof suits!

-- John Young, Hunters Hill, NSW

((New semiconductor prices have come down so much here that you want to look carefully at prices and availability compared to imports -- particularly if duty and sales tax are charged... That "Discrete MTOS" likely means two transistors hooked in series, as described on p. 38 of EEB, April 1969 -- being essentially a "cascode" configuration. It will work as dual-gate all right, but with degraded frequency response etc; the interesting part is the gate protection, if true. -- Asst. Ed.))

LETTER: Power Supply Theory and Practice

I don't agree with criticism you have received about the Power Supply Design series you ran in 1970 issues. In my opinion its about the best thing you've done, as the power supply is just abt the most basic item in electronics -- unless you are running a crystal set! Even if not of immediate use, there's little doubt that almost every reader of EEB will have cause to refer to it at some stage...

-- A. Hill, East Victoria Park, W.A.

((I understand that beginners in radio classes nowadays are forbidden to use a.c.-supplied equipment -- only battery power, for safety reasons. I'm glad I wasn't so restricted when I learned about electronics, or I might not have got interested in power supplies. Of course there is also a finite chance I could have got electrocuted long ago.--Ed.))

XXXXXXXXXXXXXXXXXXX

To Cure Itch:

Before retiring wash with strong good Brandy; imbibe any remaining. The itch will go.

AN ACCURATE INDUCTANCE BRIDGE WHICH THE YF CAN BALANCE! -- C. Pitcher (VK3)

The above claim has been verified under actual experimental conditions, and although your wife may not fall in love with this 1% Inductance Bridge, you may.

Anyone who has ever used a Wheatstone inductance bridge knows the difficulty of balancing interdependent R_s and L controls. This problem has been circumvented by Turner's adoption of the Owen bridge (about 1950), and allows measurement of low values of inductance at audio freqs, while involving no complex transformer arms etc.

The diagram shown below is largely self-explanatory ((not altogether; see Addendum -- RAJR)). S-1 is a 2 x 3 wafer switch, the Range Switch. The variable capacitor, C_v, and associated C_1 balances the coil resistance, and the 10K variable resistor, R_v, balances the inductance.

The standard is C_s, 10000 pF, which ought to be good quality and reasonably accurate. The range resistors of 1, 10, and 100 Ω should likewise be reasonably accurate, though carbon resistors seem to be OK.

R_v could be made up from nine 1KΩ resistors and a 1KΩ pot, with switch to achieve reasonable resolution. I cheated and used a ten-turn pot!

The transformer was the speaker-transformer from a transistor radio; some such device is recommended since the bridge looks like a low impedance to the audio frequency

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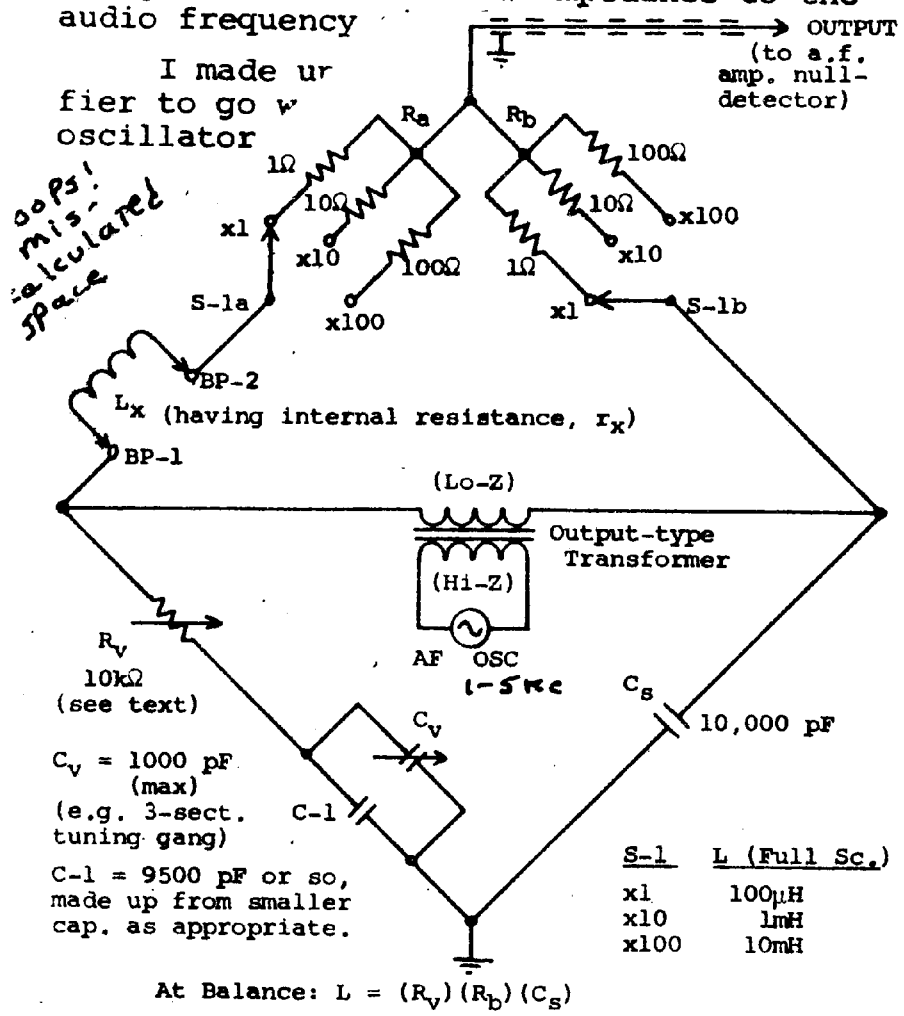
fier to go w
oscillator



oops! mis-calculated space

In use, the terminals, BP-1 and BP-2 are first shorted (e.g. by a shorted plug or shorted aligator clips). With $R_v = 0$, the bridge is then nulled by C_v. The inductance is then inserted in place of the short, and the bridge rebalanced by adjusting R_v only; don't touch C_v for a given scale-factor.

The inductance is then proportional to the variable resistance:

$$L = (R_v)(R_b)(C_s)$$

or in this instance,

$$L_{mH} = (R_v)(SF)(10^{-5})$$

where R_v is in ohms, and SF is the scale-factor as chosen by S-1. This gives three ranges having full-scale values of 100μH, 1mH, and 10mH.

This unit has proved immensely valuable in the past few months; I can recommend it most highly for anyone who uses coils between 1μH and 10mH.

((Ed. Note: So can I. I tried modifying a simple Heatkit capacitance bridge, for inductance by adding an audio oscillator, with appalling results!)

Reference: "Radio Laboratory Handbook" by M. G. Scroggie (Iliffe; London), p. 240.
EEB, Feb. 1972: A sensitive a.c. null detector.

ADDENDUM -- RAJR (Assistant Editor)

We have modified the circuit and text slightly to conform with certain mathematical requirements which allow the use of the very simple equation indicated.

Mr. Pitcher has stipulated that

(1) C_v balances r_x, and that
R_v balances L_x.

But it can be shown that this is a fortuitous consequence of a situation where r_x must be small compared to X_L (i.e high Q) at the audio frequency used. Furthermore, appearances notwithstanding, R_a and R_b are not inherent scale-multipliers. They are balancing functions needed to balance C_v against C_s when L_x is shorted; this would obviously not be possible without R_a.

Note that as shown here, $R_a = R_b$ in each position of S-1. That a scale-factor is introduced at all in spite of apparently equal resistance arms, is due to a curious consequence that after C_v balance has been achieved, we are balancing R_b against X_L, not R_b against $Z = (R_a + r_x) + jwL$.

→57

((Editor's Note: To save scribbling, I am using "w" to represent small omega, i.e., $2\pi f$))

The only reasonable way to "explain" this is by examining the mathematics, which shows some unexpected consequences.

For First Balance,

$$(2) \qquad \frac{R_b}{R_a} = \frac{1/jwC_s}{1/jwC_v}$$

and for Second Balance,

$$(3) \qquad \frac{R_b}{R_a + r_x + jwL} = \frac{1/jwC_s}{R_v + 1/jwC_v}$$

I.e.,

$$(4) \qquad \frac{A}{B + C} = \frac{D}{E + F}$$

Now if

$$(5) \qquad A/B = E/E$$

we may ask what is the relationship between C and F? We find that if

$$(6) \qquad B/A + C/A = E/D + F/D$$

substituting (5) gives

$$(7) \qquad C/A = F/D.$$

Using the relevant substitutions from (2) and (3) we get

$$(8) \qquad \frac{jwL + r_x}{R_b} = \frac{R_v}{1/jwC_s}$$

Thus,

$$(9) \qquad jwL + r_x = R_v R_b jwC_s.$$

Now if $r_x << jwL$, then,

$$(10) \qquad L = R_v R_b C_s$$

where L is in henries, R is in ohms, and C is in farads.

This remarkable result is odd, because it is independent of frequency, and the units are all wrong! All that can be said for it is that it works.

You may now see that this is not the simple balance which appears at first signt. Eqn (9) is useful to show that the relationship may be used exactly even if r_x is not small. In this case C_v must also be varied in Second Balance, and a calibration chart must be used to find L. Such a chart is not simple, because it must correlate all bridge elements in a mixed rectangular-polar diagram, i.e. a Bridge-Locus Plot.

In such a circumstance, however, it is probably simpler to use an ordinary Wheatstone Universal Bridge, for example a commercial Wayne-Kerr unit (costing $K).

Experimenters should note that it is not easy to build a good Universal Bridge, because of substantial difficulties brought in by distributed capacitance and inductance even at a.f. In fact many commercial engineers have gone up the wall attempting to solve this design. Even the Wayne-Kerr bridge is difficult to drive because of these complications.

Moral: Use Pitcher's Owen Bridge for remarkably simple results as long, say, as $r_x < 0.1\ X_L$.

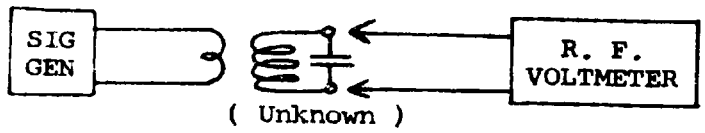
XXXXXXXXXXXXXXXXXXXXX

LETTER: Problems of Trouble-shooting Equipment

I was very interested to read of your experiences in troubleshooting (EEB, Feb 71 p. 11). This has also been my experience, although I haven't got to the stage of things working better and better yet. But I refuse to succumb, and I won't buy anything I can build myself, even if I can't get it going. How's that for dedication?

Take for example, the Gate Dip Oscillator by OM Holliday, in the Aug 1970 EEB. I could get it to oscillate beautifully, but it never gave one µA of gate current. Which prompted me to read all about oscillators and conclude that what I saw before me was impossible and couldn't really work anyway.

At any rate I now use a signal generator and diode voltmeter to check my tuned circuits,



and it seems to work OK. Why don't more people do this way, or don't I hear about it? ((They do, and from time to time it gets published again, as a momentous discovery -- RLG)).

Anyway, my point is this. Why don't you run a series of articles on fault finding in home-built equipment. Beginners like myself would appreciate it, I'm sure, and experts must have their own problems too, and you might even help them ((I'm touched by such Faith, but fortunately Electronics Australia and Ham Radio mags already do just this -- RLG)).

I like reading book reviews and letters, but basically I subscribe for the electronics contained in EEB. So I suppose that a 50/50 mixture is a fair balance. ((Ha!))

Often I find that a rash of circuits or articles proves interesting months after the series has finished, e.g. power supplies. Everyone gets fads from time to time; what a pity they don't coincide.

-- Les Smith, Lileah, Tasmania

((Maybe you didn't get any gate current because you used a MOSFET instead of a JFET? Also note various corrections in October EEB. -- RAJR))

LETTER (One of many in similar vein)

.... Finally, thanks to you, Rod, and the frequent contributors to EEB for a magazine that reads like a long letter from a good friend.

-- R. Martin, Marrickville, N.S.W.

SCR-REGULATED POWER SUPPLY, Part II

-- L. J. Yelland (VK3)

In the April issue we showed that a marked improvement of load voltage regulation can be obtained when SCRs are used in place of diodes. That article should be consulted for relevant details.

This system has been investigated with a CRO to ascertain the reason for the sudden drop in voltage at half full load. The result was rather interesting. It showed that at low loads only one SCR was firing, and that both fired only at higher loads.

In consequence, the gate resistor, R_g of each Silicon Controlled Rectifier was adjusted to balance function. This improved results substantially, with only a half volt drop up to 1 Amp; after that the fall-off is due mainly to IR drop.

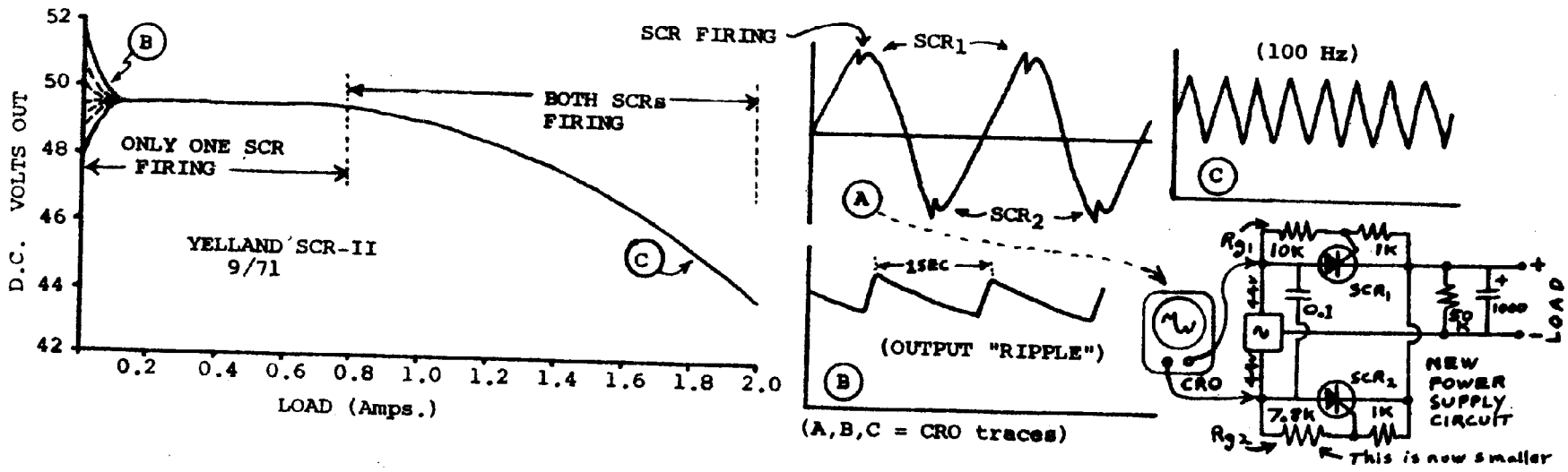
In the test system shown, only one SCR fires up to about 800mA load if R_g values are the same; whichever fires first blocks the other. By connecting a Cathode Ray Oscilloscope across the full secondary winding, the gate currents may be equalised for simultaneous SCR firing by adjusting the appropriate value of R_g until a trace similar to that at A is obtained. In the unit at hand, this was obtained with one R_g = 10K and the other R_g = 7.8K.

The pulsation at low frequency at light loads was discussed last month, and may be eliminated simply by providing some suitable bleeder. The 100 cycle ripple obtained at high loads was roughly sinusoidal in shape, and could be filtered further by conventional means if desired. The best load regulation would be obtained either by increasing filter capacitance, or by using a conventional π-type filter with iron core choke.

The SCR unit shown is simpler and more robust than a conventional series-regulator. An SE3033, rated at 10Amps/ 15W will not stand up to this application, with zener control. I blew up three trying to do it, one right after another. At full load of 2 Amps it is quite OK, because the power dissipated is only 1.5W, but at 1 Amp load, dissipation is 4 watts, owing to higher output from transformer and rectifiers; the transistor just won't stand this for long. Possibly relevant is the fact that collector voltage rating is lower at high collector currents than at low ones -- as discussed in the EEB, May 1967, and the RCA Silicon Power Circuits Manual or Transistor Manual.

Editor's Note: In general, semiconductors are able to stand relatively high peak currents, owing to the fact that it is the average temperature of the junction which matters. Thus, the 0.75A diode, e.g OA610 or BY100, can take peaks of some 30 Amps over the first 20ms surge, and less current over longer intervals; on the other hand, that 0.75A ought to be derated to 0.5A average for a condenser-input filter, because of the higher peak charging currents on each conduction cycle; we have a nice article detailing just that subject, to be published in EEB.

The 4.7A SCR can take a lot of current over a short time, but the actual figure it can take reliably will depend very much on the time and magnitude of the overload. This is best estimated by consulting the curves presented by Mullard (oops, I mean Philips) for a typical or equivalent item, in Vol IV of their big Technical Manual -- or whatever has now replaced it. If you don't have a Technical Manual which details SCR characteristics and curves, it could be well worth finding one for examination at some large firm or institution. If you belong to the Wireless Institute, ask the members about it at your next meeting....



THE NEW AMERICAN PHONE BANDS -- RLG

Last June we were going to cover this subject with information, analysis, and speculation. Now it is much later in the year, and we have had several other things to worry about.

The first I remember hearing about American expansion was a request from ARRL to WIA, soliciting opinion about such a step. Our meeting voted pretty solidly against it, as I presume did most other non-American bodies. Whence ARRL modified their stand, and this has been reflected in various Editorials in QST, the most recent one of which to hand is July 1971, where they state their position to amend the FCC proposals.

I imagine that the American regulatory authority, FCC will proceed one way or the other, and it doesn't much matter how; if it doesn't come today it will come tomorrow. With about half the world's radio amateurs in North America, and a good share of its hams as well, it might be expected that pressure would be inevitable to increase band space allotted to gabble.

I doubt that such pressure will dimish. In spite of the relatively sparce occupancy of VHF bands, and even some portions of HF ones, there is an overwhelming urge to crowd certain parts of High Frequency bands for the joy of working DX. I suppose thats us, but it seems not to have occured to Them that we might also like to work DX, and that there is quite a lot of it outside of North America.

Here are some comments from the other side of the waters:

"This proposal by the FCC, is an attempt to alleviate the almost intolerable conditions under which U.S. amateurs have been operating since.. 1951. It is too late to do a complete about face and return to the old system... so this is the best they can now offer. Needless to say, in general it has tremendous support. John Griggs, W6KW found it supported by 90% of his people in the Southwestern Division.... The most surprising result of my poll was the strong support given to the proposals by the Extra and Advance Class licensees....."

-- Roy Albright, W5EYB, Director, West Gulf Division, American Radio Relay Lg.

(A summary of W5EYB's poll appears herewith:)

Class	Percent	Vote	Percent
EXTRA	16.0		
ADVANCED	40.0	ACCEPT	67.5
GENL/CONDTL	33.6	REJECT	17.9
TECHNICIAN	3.5		
NOVICE	5.9	CHANGE	14.0
NO OPINION	0.6	NO OPINION	0.6
OTHER	0.4		

(4864 ARRL members were polled; 1418 replied)

.....

The new bands cut into non-U.S. phone bands, but "most of the foreign phone activity takes place within the U.S. phone band segments these days, and that an expansion of our phone bands will have far less impact upon DX operators today than it would have in the old AM phone days."

-- Editorial, 73 magazine, May 1971

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"7. Heretofore, there has been opposition to such telephony sub-band expansion by telegraphy proponents on the basis that the foreign amateurs using telephony would shift downward and cause severe interference in the informally, but internationally recognized exclusive telegraphy segments*. Since the use of single sideband suppressed carrier techniques by foreign amateur telephony stations has become predominant, descructive interference to telegraphy from telephony carriers is no longer a significant factor. In fact, it appears that foreign amateurs using suppressed carrier telephony now avoid the popular telegraphy segments apparently because of the interference suffered from telegraphy in receivers being operated for reception of suppressed carrier telephony."

--Excerpt from Federal Communications Commission (U.S.A.) Docket 19162.

.....

"In looking at the increased phone bands proposed by the FCC, in my opinion it is grossly unfair that the amateur majority, the Americans, are limited to approximately 65% of the high-frequency radiotelephone allocation. On the other hand, in view of the limited power capability of the overseas amateur, I feel he should have a certain amount of operating spectrum where he can operate without interference from the huge W/K contingent.

"For some reason unknown to me, the original radiotelephone allocations for the American hams were considerably less than that for the

60

DX, probably because of foreign pressure on the ARRL. The post-war allocations perpetuated that same basic inequity.

"When incentive licensing was passed in 1967, there was an opportunity for the FCC to expand phone-band privileges for the higher license classes. However, they failed to do so, and instead barred lower-class licensees from certain portions of our high frequency bands. The furor was tremendous, and it hasn't died down yet.

"The result was practically intolerable operating conditions in the General-class sections of the bands, particularly, 80, 40, and 20 meters. The new proposal will alleviate this problem somewhat, and will provide an incentive for going to the higher-class license. The present system actually provides no incentive to those operators who had complete run of the bands before November 22, 1968.

"In the new proposal 50 kHz of additional operating space is provided on the 80, 40, 20, and 15 meter bands (plus some on 10 meters, but that should cause no problems). This still leaves considerable space for the overseas amateurs who want to avoid the crowded U.S. phone bands. Also, the lower 25 kHz of the larger bands will be limited to Extra-class licensees, a mere 12,000 operators. I doubt that any of those 25 kHz segments will be that crowded at any one time.

"In general, I think the improved phone coverage is an equitable solution to the operating problems here in the United States. There is still room for the unencumbered operating of DX stations, but the Americans gain needed elbow room. In fact, on 80 meters, I would go even further, moving the Extra-class phone segment down to 3700 kHz. However, this would have little effect on any of the DX stations except the Canadians -- and they are raising the devil about the whole idea. But, is it fair for the 12,000 Canadian amateurs to limit the operating privileges of 290,000 Yanks?

"I think the DX hams of the world should look at the matter objectively. Twenty meters is the BIG problem, but from 14200 to 14225 kHz there is very little operation (that I can hear). It would seem to me that if the FCC proposal is approved, most of the DX hams who don't want to work U.S. stations will simply move down 25 kHz or so....."

-- Jim Fisk, W1DTY (20 Aug. 1971)

.....

"As this is written, FCC has issued a Notice of Proposed Rule Making which will drastically alter the operating pattern on the amateur HF bands...

"Whether the 'CW only' operators like it or not, FCC proposes to expand the 'phone bands - and diminish the exclusive CW segments. In general, the proposal shoves the 'phone segments another 25 kHz lower into the bands, creating another 25 kHz of General/Conditional Class 'phone space at the top. If this solves any existing problems, consider the new ones created: (1) CW operators who eagerly demonstrated superior skill and knowledge in the field of radiotelephone by passing the Extra Class exam, and who enjoyed 25 exclusive kHz at the bottom of the bands from 3.5 to 28 MHz, are now squeezed into the bottom 1 kHz.... a find reward for CW excellence! (2) CW traffic nets, which, unlike 'phone nets, do not masquerade as 'nets' merely to gain rag-chewing rights, will be further compressed. (3) Canadian amateurs can be expected to ask for preservation of 'our phone band' -- and will move lower into U.S. CW segments.

"On the positive side, DX-chasing U.S. amateurs are finally given a place for working amateurs in other Regions on mutually usable frequencies. Inter-zone 'phone contacts will be permitted in the segment 7075-7100, and since Extras will have 3750-3775, and Extras and Advanced 3775-3875, it will be a lot easier to work Europeans on the low end of '75. During the last 2 years or so, VE's have moved in on top of Europeans just below 3800, and frequently conducted a "Master of Ceremonies" type of operator for other VE stations, with Americans participating only by the obnoxious method of CW break-in....."

-- George Goldstone, W8AP in "Reflected and Directed", Amateur Radio News service Bulletin, April 1971, p. 9.

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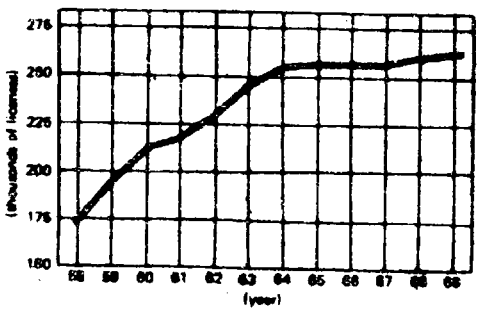

Fig. 1. Graph of total licenses issued from 1958 to 1969.

U.S.A. AUGUST 1971

73 MAGAZINE

BUNYIP TALK

HOW WOULD IT BE TO HAVE THE CW SEGMENTS AT THE OTHER ENDS OF THE H.F. BANDS?

Amateur Radio, July, 1971 Page 29

EXPANSION OF PHONE ALLOCATIONS

(Reproduced, in part from The Milliwatt, "Devoted exclusively to under five-watt Radio",4/71)

... Needless to say, the opening of most of 40 meters to the KW SSB boys would all but eliminate regular c.w. of a reasonable power level, and would simply eradicate entirely any hope of QRPP operation on the band. An S5 signal just cannot be copied through the hash and QRM generated by an S9+30db SSB signal.

That this would be a definite result of the expansion can be proven by listening in on 40 c.w. any evening -- even with the entire 200 kHz alloted at present to c.w., a QRPP operator has a difficult time finding a clear spot. There will be no clear spot if the expansion goes into effect...

EEB Ed Note:

The international implications of the proposals are well presented in the article, "Mandatory Considerations Relative to Expansion of American Phone Bands", by A. Prose Walker, W4BW, QST, September 1970, p. 78-80.

Please Turn to p. 65→

EDITORIAL -- RLG

"All Orders for Yesterday must be placed before Noon Tomorrow" -- Note on Door of our patient Printer.

Surprise

Here we are, and I have been grinding out three issues in one go. The delicacy of that manoeuvre need only be left to the imagination. If your correspondence has not received a reply you're not the only one.

EEB is back, as you can see. Newcomers can be informed that we had a bit of difficulty a few months ago, but now all is (probably) well; we're still breathing in and out, so we must still be alive.

Newcomers may also note that their renewal date (on the address label) may look odd, but it will come out right in the end: we are publishing four issues this spring and summer, and will be caught up by December.

One further concern: In the process of organising all that I had to reorganise some of my files (it took a solid week) and I seem to be missing a considerable article I remember someone sent in. Most embarrassing. If you sent in an article this year, and if your name isn't Amon, Beck, Burlinson, Cengia, Cohen, Ferris, Fisk, Hill, Iscra, Kallam, Kelly, Lumb, Maddever, Muntz, Pitcher, Turner, Vieritz, Ward, Watson, Watts, West, Witchell, or Yelland — if not, then would you please contact us to remind me what the subject was; it was a typewritten script. Knowing the subject I'll have a better chance of extracting it from the Files. I know its somewhere in there! Amazing. Thanks.

Circulation

On page 66 we hazarded the opinion that a promotion recently pursued might have yielded us vast returns. Since that article was written, results from said promotion have been received, and have been disappointing. What we did was to make up a collage of pages from typical issues, to give prospective subscribers a sampling of our coverage; this saved quite a lot of cost. The result was that the response was directly proportional to the lowered cost; people want to see whole issues to decide whether they like EEB. Murphy's Law triumphs again.

Incidentally, in June I said not to write, yet Bx 177 has been full of messages of support and reassurance from everywhere on the globe. It would appear that we do have some friends. How about exercising that friendship by showing EEB to your friends, and suggesting that they might subscribe? (Please turn to p. 64)

P.S. A few printed Covers for 1970 EEBs are still available, 15c each, postpaid, while they last.

Quote without comment:

".. I could see no reason why I had to learn so much (electronics). For one thing, I never intended to build my own radio; all I wanted to do is push a button and keep track of my old man." -- Betty Daniel, WB6AOF, 73, 1/71

AROUND THE AIRWAVES -- J. Van Staveren (VK7JV)

(Note: In these columns we shall not necessarily specify times or frequencies of operation, assuming that an operator will not necessarily keep to a given schedule, and in any event such specification need not be necessary for DX operators interested in this subject. This list is provided merely to let you know who is active in countries of interest to Australasians.)

ANDORRA: C31DS: 14.195, 1030Z, QSL via F6ARV.
C31DM: 14.125, 1200Z, QSL via F5HX.

BHUTAN; AC5PN: Expects to change his callsign shortly to AC5PY. QSL to Thuji Yonten, Director Wireless Communications D/TSHE, Thimphu, Bhutan.

EGADI IS.; IF9PUG: 14.230, 0800Z, QSL via IT1ZGY.

LIECHTENSTEIN; HBØTH: QSL via DJ9MH.
HBØXTL: QSL via WA6GDS.
HBØXUW: QSL via DJ9KH.

SAO THOME IS.; CR5AJ (ex CR8AJ): 14.012 CW 2100Z, QSL Horacio G. Torres, P.O. Box 68, Sao Tome.

SIERRA LEONE; 9L1WS: Opr. 9J2WS, 14.050 CW + 14.250 SSB, QSL via W4LF.

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The above items have been selected for maximum relevance to Australasian conditions, from the Geoff Watts DX News Sheet. That sheet is issued weekly by air and includes a comprehensive reference to worldwide DX conditions, circulated to about 70 countries. "It will keep you informed during times when you are busy and cannot get on the air." Interested parties may subscribe to it for £1 per 13 issues. Write: Geoff Watts, 62 Belmore Road, Norwich, NOR.72-T, England, U.K.

ADVERTISING

This Page: Personal = (SEE BELOW), Commercial = 20c/line or 80c per vertical inch. We guarantee nothing.................

PERSONAL ADVERTISEMENTS: Payment only after successful completion of transaction. About 5% of value of the goods bought, sold, or traded -- or less if the transaction is substantial. Use commonsense, and send us what is appropriate.

WANTED: Handbook of Chemistry and Physics, published by the Chemical Rubber Publishing Co., 1960 or earlier. R. Reynolds, 46 Jennings St., Newtown, Tas. 7008.

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FOR SALE: BC221 Frequency Meter in Polished wood case with crystal and regulated power supply. $32; freight extra. Also: New copies 73 Magazine, complete from Jan 1968 to May 1971 [[or possibly later, now -- Ed.]]. $9, freight extra. P. Garde, 184 Warrigal Road, Burwood 3125.

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CHATTERBOX RECORDING CLUB: Tapesponding, Club Magazine, Sound Magazine, Round Robins, Tape at discount prices. Membership Fees $2.50 per year. P.O. Box 118, Wellington, N.S.W. 2820.

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FOR SALE: COMPUTER BOARD COMPONENTS. 15 transistors, 15 diodes, 15 resistors: all for $1.00 Postage 10c. With computer board [stripped], 15c post. Certified Post: 15c extra. The transistors are NPN and PNP, germanium good quality. Removed from board without heat. Write: L. Mac Donald, Geelong Road, Buninyong, Vic. 3357.

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COMPUTER BOARD NOTES: We have reprinted these, and here is your opportunity to obtain them if you have not already done so. They contain the four pages from the out-of-print July and March 1967 EEB, and seven pages reproducing the articles from the August and December 1969 issues of AR. Added has also been an item reporting briefly on the characteristics of the 077/078 special SCRs found on the boards [sometimes]; see also EEB July 1970. And a brief note on how to order from a reliable overseas supplier at low cost [if a quantity order]. If you need this information to help make sense of the characteristics of the components found on the Brds send three 7c stamps to EEB, Box 177, Sandy Bay, Tasmania 7005.

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HOT CARRIER DIODES: HP 2800, $1.30 each, post paid; add 5c per order if payment by cheque. These a re high efficiency linear mixer diodes with characteristics superior to those of conventional point-contact germanium doides. We shall have more to say about these diodes in the November issue. For now we offer these diodes in event of your knowing about them already, &

November issue. For now we offer these diodes in event of your knowing about them already, & wanting an inexpensive source of supply of them. Further technical information may be found in Amateur Radio Techniques, by Pat Hawker, G3VA [RSGB; order through WIA or NZART], and in several articles in the October 1969 issue of Ham Radio. Send orders to EEB, above address.

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FASCINATING BIOCHEMISTRY: Story of the body in simple terms with do-it-yourself problems for the layman, student and professional: "The Definitions of Biochemistry", by David Morgan, Ph.D., FAIC, K6DDO. Only $US3.50 to: **Dr. David** Morgan, 6262 Sunset Blvd., Hollywood, California 90028, U.S.A. [[Ed. Note: The same author has also written "Enzyme Circuitry", being a discussion of enzyme function with numerous analogies to electrical structure and feedback concepts -- quite fascinating to anyone with a knowledge of electronics and an interest in enzymes! Unfortunately I have loaned the book out, and it is not available at this moment **for further description, but same price** and well worth it if that is your interest. If you wish, we can orderthese books for you [bank drafts are dear], or David's equally lucid "Business Communication" [$US2.50] if you send $A0.85 per $US1.00 plus 20c for cheque and post. Send to EEB at Sandy Bay.

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FREE: 2000 Addressograph "B" Plates. You pay freight. $200 worth or more, and they go to the tip unless we get a definite reply soon. Write to EEB at Sandy Bay.

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COMPONENTS FROM KIT-SETS AUST., Mail Order Dept: P.O. Box 176, Dee Why, N.S.W. 2099.

	NORMAL PRICE	EEB SPECIAL PRICE
10 × OA91 Germanium Diodes	$1.70	$1.50
10 × BC108 transistors [all brands]	5.00	3.50
10 × BC109 transistors [Philips only]	5.00	3.80
10 × EM401 Silicon Diodes [S.T.C.]	3.70	2.20

Resistors: $\frac{1}{2}$w type, 5% tolerance. Pack contains 3 of each value from 10 ohms to 1M. Makes a total of 171 resistors. Normal price: $4.95. Special: 4.50

Much other merchandise available. Why not try us? Send for a Free Catalogue [Just a S.A.E. will do. Orders are despatchd on the same day; all parts new and guaranteed. Postage: add 15c to each order. Kit-Sets Aust., P.O. Box 176, Dee Why, N.S.W. 2099.

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EEB SPECIALS: Subscriptions now reduced to rock bottom minimum, a very valuable opportunity for EEB readers, and not likely to last: CQ Magazine, $A5.03 per year. Ham Radio Magazine, $A8.50 per three years. These offers are limited to Australia and Territories, and to New Zealanders who can obtain $A. All books available from CQ [as advertised therein, or in Feb 1971 EEB] can be ordered through EEB for $A equal to the $US figure; shipment made from USA.

(Editorial, continued from p. 61)

That Extra Money

When you renew, PLEASE don't send more than the normal one or three-year remittance, and please, no ten dollar sub renewals; I refuse to guarantee that EEB will last that long, even if I do. An extra penny helps to pay for the lacking penny or the impecunious student, but extra dollars are an embarrassment.

If you want to do something nice, get us another subscriber, or send us an Article on some really useful topic, like the Production of Uranium-235 from Old Condensers.

Incidentally, I note that a certain British firm is offering Uranium-235 (93% enriched) for sale at £40 per gramme. Maybe I shouldn't be saying this, but doesn't that mean you could build your own Bomb for a modest outlay of cash....?

Coaxial Feed to Dipoles

It is interesting to see that OM Merritt (Letters, this issue, p. 70) has singlehandedly come to the same conclusion as we did after a heated year of discussion & controversy in 1969 issues of EEB on the "Coaxial Line Feeder Dilemma". Because that is out of print, I had best summarise it briefly here:

The point is indeed true that without a balun the antenna pattern will be distorted, and this can be shown both practically and theoretically. Without a balun, an unbalanced feed poses an electrically impossible earthing condition on a dipole, causing a radiation loop to be formed including that nearby metallic mass, the coaxial braid, the house wiring, and the microphone. At best this distorts the antenna pattern (which in any event is not the "ideal" unless the antenna is at least a quarter wavelength above earth), and at worst it increases loses of efficiency. The take-home lesson is to use a balun, if you MUST use coaxial cable transmission line.

In the case posed by Mr. Merritt, the use of a 50-ohm coax with a 1:4 balun would be expected to present a mismatch to an ordinary dipole, somewhat less if the dipole is folded. Whether or not this matters depends on factors which have been discussed by W5JJ in the Dec. 70 and April 71 EEBs.

Frank Merritt is involved with the Canadian Amateur Radio Teletype Group, and we hope to have a series of articles from him on commonsense approaches to RTTY.

This & That

The recent devaluations of the American Dollar are cutting somewhat into our receipts, but we'll not worry about it until the next price rise a few years hence. ANOTHER price rise? Certainly, or do you see any end to our runaway inflation? If matters continue as they are, we'll be paying a dollar for an orange at about the same time we are all out looking for jobs. Insane.

Quotes without comment:

"There is a theory that advancing the discount rate by the Federal Reserve will check inflation, but recent monetary history, alas, shows this to be an illusion. Such changes, furthermore, can be dangerous by checking business investment and encouraging unemployment, while administered prices soar majestically upward.."
-- Stuart Chase (1958!)

"... but if the Government takes more money from the Taxpayer, it is naturally inclined to spend it."
-- Editor, Hobart Mercury, 25/5/71.

The comparative revaluation of the Australian dollar (as of early December...) has had one useful consequence. We are able to reduce somewhat the charge for subscriptions to Ham Radio and to CQ magazines -- but if the Gnomes decide on a precipitous drop in the value of the Aussie dollar.**after** this sees print, kindly add a bit to the advertised prices (overleaf). Our recent efforts in organising receiver design does show that Ham Radio is unquestionaly the leader in the amateur radio field, and that CQ is often full of interesting matters of less spectacular sort, often good oil on antennas too. Recent CQs have had material on an R.F. Magnetometer, Radio remote Control, and making meter dials.

This & That, II

For those who are confused by Rod's simple maths in this issue, we would recommend strongly the book we reviewed in the April issue: "Principles of Electronic Technology" by C. B. Weick (Mc Graw-Hill, 1969). It is well written and very readable.

There is, in this modern age, no excuse for the complacent amateur view that "I don't really have a head for maths", any more than "I can't be bothered to learn how to bias transistors; I'd rather use published designs". Might as well be proud of not knowing how to read. If someone reads aloud to you, it isn't impractical, merely jolly awkward. Modern Handbook editors take note too....

((EXCERPT FROM "CURRENT COMMENT", Radio Communication (R.S.G.B.), April 1971, p. 232.)):

Broadly, the effect of the proposals is to increase the USA telephony sub-bands and to make the additional frequencies available to USA extra- and advanced-class licensees. For instance, on 14MHz the extra-class licence holder will be allocated 14,150 to 14,175kHz and the advanced-class licensee will have the use of 14,175 to 14,250kHz without interference from operators holding lower grade licences.

At a recent meeting of the Board of Directors of the ARRL it was resolved to make no approach to the FCC for the alteration of sub-bands. Among the reasons given for this decision was the effect on the facilities at present enjoyed by the members of other IARU societies. With their vast numbers and use of high power on all modes, USA operators dominate any band when propagation conditions are suitable.

One other disturbing feature is the allocation of 28,150 to 28,250kHz to novice operation. This cuts right across the IARU world beacon plan (including the operation of GB3SX) on which a considerable amount of time and money has already been spent and in connection with which a Canadian beacon station was due to commence operation later this year on 28,175kHz. Allocation to novice operation will prevent use of this part of the band for scientific purposes.

G2BVN

But spare a thought for those worse off, especially those with a QTH nearer the USA (eg Canada, West Indies etc.) If these proposals go through, it will probably be some time before you hear your next VE owing to States-side QRM. If the FCC feels that the phone segments of their bands are too cramped, why permit phone patch traffic on an amateur band? This is nothing less than using the band for commercial purposes and it would seem logical and equitable to get rid of this type of operation and restore the band to a true amateur status.

The Americans contend that a larger phone segment will induce their General Licence holders to strive for a higher grade of licence. No greater inducement is apparently necessary, as an analysis of the various classes of licence in operation last year revealed that the total number holding Advanced or Extra Licences in the autumn was 66,235, an increase of 3,589 since the spring of that year.

If the American proposals go through, one can assume that there will be more than 66,235 extra amateurs licensed to operate phone between 14·150 and 14·200MHz, who already enjoy the privilege of higher power limits and larger frequency allocations.

Yours faithfully,
Findlay Baxter, GM3VEY

RADIO COMMUNICATION May 1971

"Now that AM is about gone from our DX bands, perhaps it is getting to be time to do away with the concept of separate American and foreign phone bands? For that matter, with the percentage of amateurs using CW growing smaller every year, perhaps the time is not far away when we will be able to do away with sub-bands entirely? I'd like to see it given a try for a while to see how it works out.

"The present day CW op has filters available that can virtually remove sideband. The sideband op can virtually remove CW, if he uses a couple of notch filters. Our bands can hold many times the number of phone and CW signals that they could a few short years ago just because receivers have come such a long way..."

-- Editorial, 73 Magazine, Jan. 1970

"When we remember the furor created by the original 'incentive licensing' proposals, the latest phone band expansion proposals was (sic) hardly noticed. The latest count, with the deadline for comments two weeks past, was about 100. Is this a massive agreement with the band expansion or massive apathy? It certainly is massive something."

-- Editorial, 73 Magazine, Aug. 1971

The Editor
Radio Communication
Sir—It was with great concern that I read of the proposals for the extension of the American amateur phone frequencies.

From the outset, I wish to make it quite clear that I have no objections to the bulk of the proposals put forward by the FCC, but oppose the proposed lowering of the 20m phone band to 14·150MHz. I would be obliged if you could kindly give space in *Radio Communication* to air these views in the hope that other amateurs will respond with their comments and, I hope, their support.

The segment between 14·150 and 14·200MHz is at present occupied by dx stations and the rest of the world wishing to work amateurs **other then Americans.** If they wish to have QSOs with Ws then they move above 14·200MHz. If the proposals come to fruition, these stations will be obliged to move down and operate between 14·100 and 14·150MHz, a sector which is at present predominantly occupied by non-English-speaking amateurs. Imagine the difficulty of English-speaking amateurs trying to induce our foreign-speaking counterparts to QSY! The only alternative to this is for the average amateur (running about 200W to a dipole or perhaps a three-element beam) to compete with a kilowatt and/or a six-element beam or four-element quad. Hardly fair competition is it?

>>>>>>>>>><<<<<<<<<<

The Yanks have the Last Word

((In the EEB post has just come a copy of an item from the November 1971 issue of Auto-Call: "FCC Report" by Bill Grenfell, W4GF, who used to be Chief of the Amateur Radio Division, FCC. The Report is condensed and rearranged here, for reasons of space, with apologies:))

... The FCC proposal would provide space for about 20% more amateurs on HF telephony during the "heavy" hours. Looking at 80, 40, and 20 meters alone, it would provide 33 to 44% more depending on whether you count the 7075-7100 inter-regional proposed bands...

Will it affect CW operation? Of course it will! This should come as a surprise to no one who can add and subtract! The most compression will.. take place on 80 and 40 meters...

In view of many, the 20 meter band is the most critical (in) international aspects. The FCC would move the U.S. phone band edge down to 14,150 kHz. (But) the occupancy of 14,100-14,200 by foreign phone is light enough that it should be able to operate in a 50 kHz segment (14,100-14,150) without any significant handicap -- certainly with far less QRM than is present in the U.S. phone band!

(The foreign group is unlikely to move down to 14050, because of the RTTY barrier below 14100, because of heavy CW below 14075, and because of historical reasons)

When 14,300 - 14,350 kHz was included in the U.S. phone band several years ago, operation below 14,100 kHz was not disturbed -- in spite of dire predictions... I predict that it will not be disturbed this time, by adoption of either the FCC or the ARRL proposals.

RLG Comment: Now that reminds me of a Story; there was this here old horse, and his Master decided one day that the horse ate more than he was worth, so he decided to try an experi-

== oh dear, we've run out of space.

ANNOUNCEMENT —

EEB IS PLEASED TO ANNOUNCE:

A CIRCULATION IN EXCESS OF 800* to 900**!

At our advertising rate of $10 per offset page, this places us in the top four most expensive advertising media in Australia (unless you compute each EEB subscriber as being worth twice his weight in others!). Comparison with other firms yields some astounding insights, rounded off here for purposes of oversimplification:

MAGAZINE	APPROXIMATE CIRCULATION	WHOLE PAGE, ESTIMATED APPROXIMATE COST PER 1000 rdrs.
BRAND A	5000	$30
BRAND B	7000	30
AMATEUR RADIO	5000	20
AUSTRALIAN EEB	900**	11
BRAND C	25,000	8
BRAND X	50,000	4.75****
BRAND Y	40,000	4.83****

From this we may conclude several things, for example, EEB is not altogether the most expensive advertising medium in Australia; and in fact if you make the double valuation referred to above***, EEBis nearly the least; indeed, if you refer to the Blotter Paper advertising (80c per inch) and make that double valuation, you will see that when we reach a circulation of 1000 (probably next year) we could be considered to have the least expensive advertising rate per page per reader per Australia!

The next obvious step is for EEB to be deluged with commercial advertisers, who certainly are not in ignorance of our existence, and for this Editor to promote that valuable possibility by keeping his peace on the value of commercialism to amateur electronics experimenters. Will this exciting event occur before circulation reaches 1000? Renew your subscription if due this year, to find out. Don't delay!

---

* Source: estimation of the total thickness of address plates.

** Estimated result from a big promotion in September (to avoid new Postal Charges).

*** We have a bit of evidence for this.

**** Some uncertainty here about the figures at this date, but this would be about right

XXXXXXXXXXXXXXXXXXXXXXX

LETTER: Publishing and the Experimenter

((Ed. Note: This letter was received in early 1970 and my comment thereafter was written then....))

I note your comments on the joys of magazine publishing in EEB -- newsstand sales, circulation, etc -- and sympathise with your lot. It would appear that any technical journal has a circulation "plateau", above which it is very difficult to rise.

For instance, the plateau for a general purpose amateur magazine in the USA appears to be 70-75 thousand. CQ reached this a few years ago, 73 more recently. QST with its captive audience runs over the 100K mark, but does this mean that 30 - 40,000 copies each math go into rubbish tins after little or no reading? It is quite possible that EEB has reached its plateau as well.

With regard to a competitor for Electronics Australia, I am becoming more and more convinced that this would be desirable. EA is moving more and more into the realm of the technical engineer and scientific egg-head, while largely ignoring the new comer.

True, it does occasionally have simple projects for the newcomer, but these don't occur with sufficient regularity to encourage the newcomer to spend 40c each month.

But EEB is not the magazine to challenge EA ((AMEN!! -- Ed.)). Whatis required is a commercially-backed magazine along the lines of the EA of 20 years ago, plenty of the basic theory backed up with plenty of constructional projects.

I myself "learned all about radio" wholly from the pages of Radio and Hobbies, as it was known then, and a New Zealand magazine. Till about only 10 years ago, the only text book I ever had was an RCA valve manual!

One feature of Radio and Hobbies in the early fifties was called "The Junior Experimenter" where in readers could send in circuit diagrams for analysis and criticism, and boy, was old Neville really tough on them. Not only on major design blunders but even obvious draughting faults, such as a suppressor grid connected internally when it should have been brought out on a separate pin! This is the sort of thing the newcomer needs, not how to build frequency counters et alia in 100 easy (and expensive) integrated circuits!

-- "Old Peth", Auckland, New Zealand

((Ed. Comment: --> I think EA is a fascinating publication, with a little for everyone. But EA has indeed arrived at its large circulation through presenting a variety of diverse subjects -- just the thing for which it is criticised. EEB would do a lot better to include a wider variety....

((But I note that EA continues with its very fine theoretical articles on State of the Art basic electronics of all kinds, not to mention the interesting "Reader Built It", "Serviceman Tells", and above all "Forum" conducted by that same old(er) Neville. Nowadays can't we find plenty of Peth's "basic theory backed up with plenty of constructional projects" -- in a wide variety of good BOOKS now available to the experimenters?

((As for training and criticism, what better for a young person to join the W.I.A. (or N.Z.A.R.T.) technical classes, or the Youth Radio Club Scheme? Anyone in Australia interested might contact the Editor of their fine beginners publication, Zero-Beat: D. F. Reid, 355 O'Heas St., Pascoe Vale, Vic 3044.... I'm sure equivalent programmes are in NZ))

ANSWER TO THE FEBRUARY PUZZLE

On the cover of our February issue we proposed the following puzzle: "How can an oscillator circuit be designed such that there is no voltage across the key at any time -- either up or down? Yet it keys cleanly and reliably. (Submitted by J. W. Campbell, N.J., U.S.A.). -- One year subscription for the BEST answer. Results will be published in the June EEB, since this "February" issue is just a wee bit late....."

This June issue is also a bit late, owing to EEB's relative Unimportance in the scheme of things. Never mind.

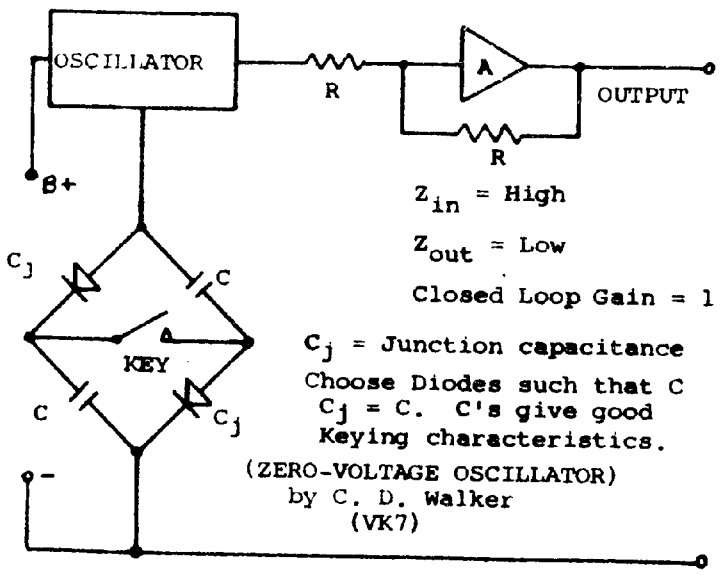
The answer supplied by the Author:

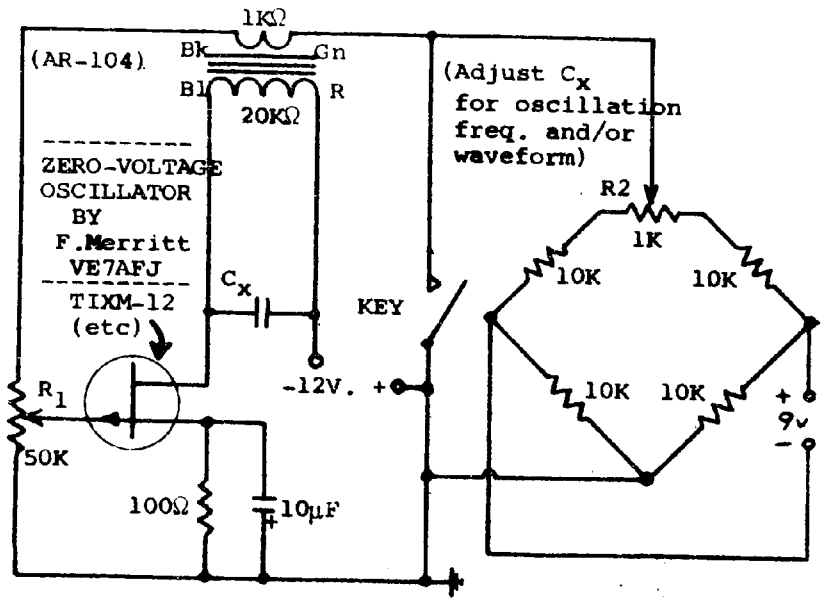
> The keying is literally imaginary -- in a technical sense. You key the imaginary component of the system. The simplest way... is to use a standard triode oscillator, or an equivalent FET circuit, with a fairly high-value cathode resistor. The cathode is bypassed to ground through an adequate bypass condenser, in series with the key. With key-down, the cathode circuit impedance is low, and the circuit goes into oscillation; key-up and the cathode impedance is high enough to provide negative feedback that damps out the oscillation. It gives clickless keying, and a simple code-ractice oscillator, or more. DC instruments would show that there was zero voltage across the key at all times, and that there was no current flowing either key-up or key-down.

I suppose we cheated a little, and I was tempted to insert "no DC voltage" in the original text, but that would certainly have given it away. I was curious to see what readers would generate. The results were rewarding, as far as my primitive electronics senses. Richard Maddever of Geelong provided a good answer, but he has subscription credit with us till about 1984 owing to a substantial volume of his articles in our files, so we pass on to two other contributions by readers, which are self-explanatory.

The left hand one, below was supplied by C. D. Walker of Launceston, Tas, and the right hand one by F. Merritt of Parksville, British Colombia. Of the latter, the author states, "This circuit really works! Adjustment: 1) With all voltages applied, adjust R2 for 0 volts d.c. across key with key open. 2) With key closed, adjust R_1 for sine wave output and proper keying."

Well done, chaps!





COMMENT BY RAJR (Asst. Ed.): The above text was written by RLG, and I've got news for the four of you, before we apply that "well done"! In every one of the circuits there is an r.f. component as the key opens. Consider each:

1) The System by Campbell (oirigal puzzle): It is keyed degeneration. When the key opens, the oscillation stops, delayed only by the distributed →68

capacitance across the key. It obviously works, but "clearly" only if distributed capacitance across the key allows an extra couple cycles of oscillation. If not, you'd best add a few pF there to ensure it, or the keying waveform will look terrible.

2) The odd bridge setup by Walker: This seems unlikely. The equivalent circuit would look like a key with two condensers across it, since if the oscillator is being fed at the cathode, the diodes are irrelevant. If on the other hand, the oscillator is keyed at a source of opposite polarity, the key cannot control the output since it is in a balanced position! Furthermore, the input impedance of the amp is R, which is not necessarily high. Remember the virtual earth created by the feedback resistance? Refer to the article "Feedback in Complementary Symmetry Audio Amplifiers (and the Rest)" by Dick Ferris, p.136+ in the October 1970 EEB.

3) The circuit by Merritt which "actually works": Brilliant, but for the fact that the whole bridge network at the right hand side of the key is quite superfluous! Omit it entirely, and the voltage across the key is still zero (assuming leakage from the FET is negligible), and you just have a garden-variety grid-keying, I mean gate-keying setup. If a bipolar transistor were used, you might indeed use the bridge to cancel needed bias, but not in this case.

4) The circuit by R. A. J. Reynolds (me), even more brilliant, and furthermore the best: We might call it "Light beam Interface Communication"! Simply put a Light-dependent Resistor in the base (or gate) bias system, shine a beam of light on it so that the key interrupts (or obscures) the light beam, and lo, no voltage across the key, key-up or key-down.

Incidentally, the original puzzle on the cover of our February issue stated "no voltage across the key at any time -- either up or down". One might observe dryly, that any keying circuit at all will yield no voltage across the key when it is down, unless the contacts have high resistance.

RLG Rejoinder:

My face is red. Doc Maddever's suggestion was just that proposed by Rod, namely to interrupt a beam of light by the key. We'll extend his sub to 1985. It seems that things are never as simple as they seem.....

RHF Reminder:

If there is no voltage allowed across the key, it cannot control any current. Therefore it doesn't matter whether the key is present or not. I.e., with no voltage across it the key can control nothing. This even includes the electric field vector of the light beam crossing RAJR's or RSM's key.

RAJR:

Yes, that's what I told RLG too, but he didn't print it. But how about this? A key whose motion increases the inductance of a coil controlling the frequency of an oscillator feeding a discriminator. In that case you are controlling a magnetic field, not an electric one.

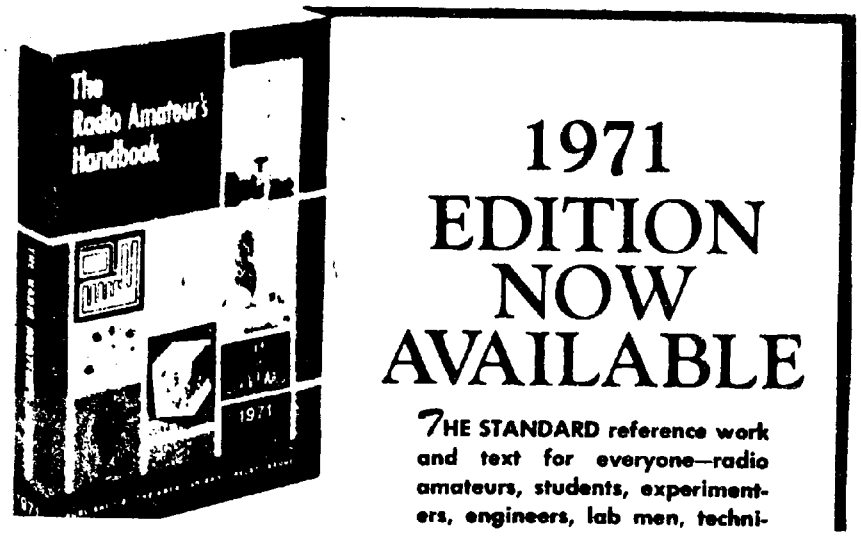
RLG

But Dick's point is still valid. If the key is controlling anything it is causing a magnetic flux change. With any change of magnetic field is included an associated electric field, I dL/dt. Thus saith Maxwell. Nor can all your piety nor wit avoid the Second Law: "Nothing is free"! Any increase in information content must reduce Entropy, and that cannot happen by itself.

ΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩ

There ain't no justice in this here land,
I get's a divorce from my old man
And I had to laugh at the judge's decision
He gave him the kids, and the kids ain't his'n.
((-A/C 12/70))

"But he emphasized that his Government at least would be out to do its best to protect the family man against greater financial hardships."
-- A Premier announcing higher Payroll Tax.



REVIEW No. 2: ARRL HANDBOOK --RAJR
(Ref EEB, Oct 70, p. 149; Apr 71/P.42)

Although the 1971 edition of the ARRL Handbook has been available for a few months, it is not yet too late to review it. The usual way that this is tackled, is to compare the new edition with the previous edition, assuming that you the reader have the previous one. In this case the time has come to review the book as though it were a completely new volume.

But for those who do want a comparison, in spite of my previous comment (April EEB), the new edition is almost exactly the same as last year's. A few months ago I reported that the 1971 one appeared to be emphasizing theory rather than high power articles. In this I had merely forgotten what was in the last 3 or 4 editions. The fact is that although they talk about a lot of items, little is said about any one of them.

In this edition, variations include small changes in some of the theory text*, circuit modifications in a few of the existing projects, and approximately 12 new projects, each broadly replacing an existing project. The tendency has been to use more modern technology, including the use of ICs, although in one case a SSB transmitter has been scrapped in favour of a valve linear and in another case, a FET VFO has made way for a bipolar VFO... But they are still neutralising that FET r.f. amplifier in the Receivers chapter (although they new use a self-protected MOSFET) about which we commented in the 1969 Review, p. 137.

*Although one may note that the chapters on VHF have been rewritten.

I have my own ideas of what I consider should be in a reference and design manual for amateurs, and this may form the subject of a future article, but the fact that Time magazine mentioned the ARRL Handbook as the only technical book in its list of the world's best-selling non-fiction books, indicates that maybe this manual is what the average amateur wants -- or at least is prepared to buy, sales having now passed the 4 million mark. Indeed, even though I think that there are better Handbooks around, I have no less than 8 of the ARRLs on my own shelf ((though several of these may have resulted from doing EEB Reviews? Hi. -- RLG))

So, what is in this book that commands so much attention? Broadly, the 1971 ARRL Handbook contains only broad outlines of radio theory, and very little of the theory (i.e., physics and electrical) used to develop radio fundamentals. Could it be that the average amateur does not want detailed theory?

My own experience of talking to other amateurs is that a fair proportion of amateurs are primarily operators (even in Australia!), and as such, learned enough theory to pass a three hour paper, and from then on, remembered only enough theory to keep themselves on the air -- and in some cases failed to do even this. So, if by some chance these people are in the majority, then it is no wonder that this book sells well -- for it is certainly not on the theory content.

I would make an observation here. There is no doubting the fact that the ARRL Handook is generally accepted as the standard handbook for amateurs, and a budding amateur would almost certainly turn to it at some time to find out what it (amateur radio) is all about. And having gained the impressions promoted by ARRL, he goes away and every 3 or 4 years buys the current ARRL just to keep up with "modern trends". ((so, why publish every year?))

There is one area in which ARRL is very successful, and that is the construction articles. These describe something for everyone, from the novice to the advanced, and from the kilowatter to the flea-power mobile. There

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LETTER: The Construction of a Converter

On a farm and in need of a converter for various fire control frequencies, and not being able to find a circuit for the purpose, I made this one up. As a first attempt it leaves much room for alteration and improvement, but it works quite well. It tunes from 2Mc to about 5.3Mc with an IF of 600kc, covering the frequencies of fire control, fishing boats, Flying Doctor radio etc.

The coils are Aegis prewound type RFT2. These coils with the tables by Aegis make this part fairly simple.

For the output, at first I wound about 40 turns of wire taken from the aerial secondary on to the ferrite core of the RFC, alongside the main winding.

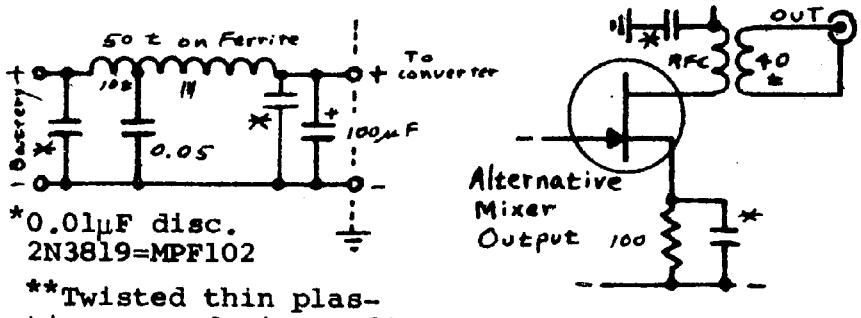
This was perhaps as effective as the emitter follower, but having put this in, I left it. I set the converter up using a valve mantel wireless, but found when I connected it to the transistor car radio I had to put the pot in the output to get it to work (see diagram, below).

With care in placing the coils and leads and plenty of decoupling, instability was overcome. The 3-gang tuning capacitor is from an old broadcast set, and the dial is an 0 to 100, 10:1 reduction type from a 1928 wireless.

It is fitted in an ice cream tin, about 5" x 5" x 5", and mounted under the dash of the Utility. With a miniature tuning gang it could be made much more compact.

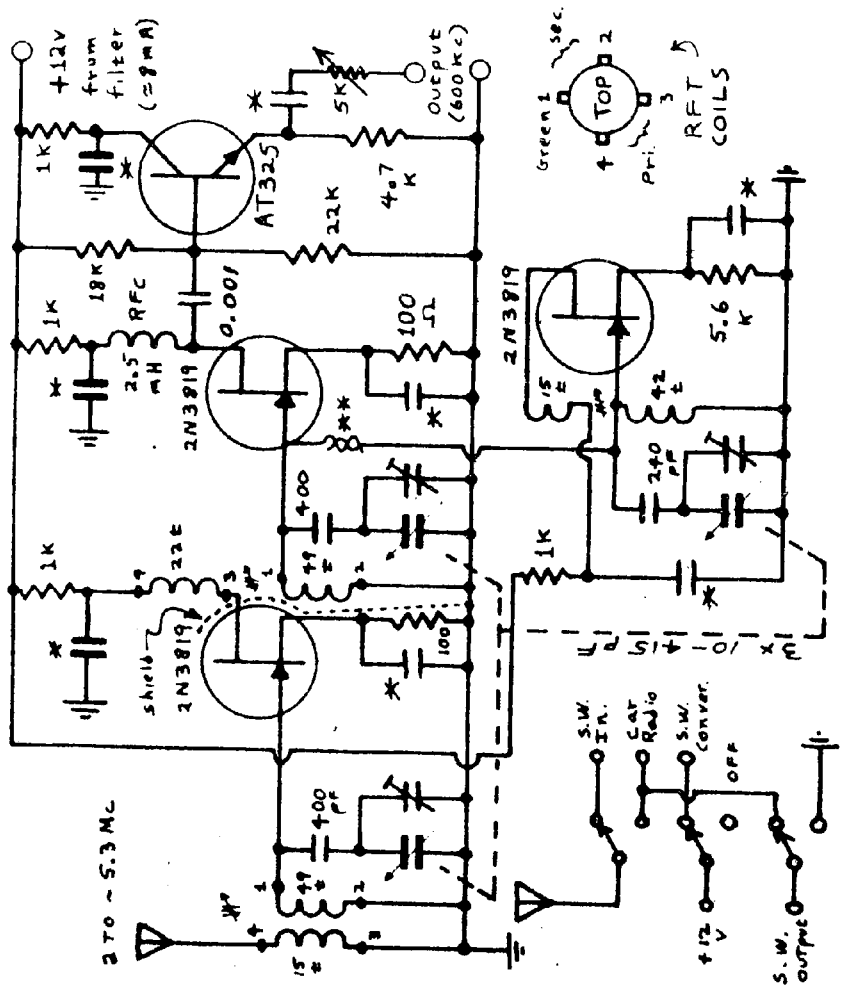
For mobile use a filter in the 12 volt line is necessary. The one shown, from the RSGB Handbook is fairly effective, but not completely so; probably a choke in the aerial is needed?

The switch introduces no measurable loss when used straight to the car radio. The unit works probably as well as could be expected



*0.01µF disc.
2N3819=MPF102

**Twisted thin plastic covered wire, adjusted for best results...



with an ordinary car aerial.

During a large fire last summer, some distance from here, I could read everything that Emergency Fire Service units 10 miles closer could read, and much that some of them couldn't, but I was on higher ground.

-- R. H. Beinke, Pt. Lincoln, S.A.

P.S. To mount a few components, the base of a photographic flash cube can be just the thing. It has a hollow spigot to take a bolt, and keep it clear of chassis, and has a number of holes already in it.

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LETTER: Coaxial Feed to Dipoles (See Editorial)

Over the years I have used dipole antennas which have been fed directly with coaxial cable. I have never been completely satisfied with this approach, but the things did SEEM to work.

I have attempted to use an Omega-T Noise Bridge to determine basic resonance, with no results. After much cogitation I am forced to conclude that with a 60 ft coax line there is about 1800pF expressed at the "eye" of the dipole.

This means that the electrical resonance is greatly lowered in frequency with an attendent reduction in efficiency. The reason that the antenna does SEEM to work is that the wire does represent a mechanical efficiency that will propagate a signal. This gets off into the very stick area of the efficiency of the transduction of energy from the antenna to the propagating medium. With the very muddy conditions of Amateur Radio HF practice it is most difficult to approach a reasonable instrumentation to determine the interface efficiency

When using dipole antennas fed directly with coax, I have noticed that they function quite well as omni-directional antennas when there is a vertical mass of metal within a wavelength or so. The logic is quite simple: the coax is coupled so tightly to the metallic mass that the "textbook" radiation pattern is but a dream.

To deal with this phenomena more adequately I have been experimenting with some folded dipoles with a 4:1 balun at the "eye" of the antenna. By carefully feeding the coax shield to the center of the balun I find that the results more closely approximate the textbook pattern. The reason that I selected to use the 4:1 baluns is simply that they were left over from a previous project and required no further construction, testing etc. Food for thought?

-- F. Merritt, Parksville, B.C. Canada

LETTER: The Problems of Coil Winding!

I have been able to marvel at the enthusiasm some people have shown for an inexpensive "automatic" coil winder which is available commercially. I think that electronic experimenters ought to absorb some simple facts before embarking on a coil-winding orgy.

The device in question retails for less than $20 in Australia. Every tiny shaft, sprocket and worm, handle etc, can be bought for about $3 from any dealer in Meccano sets, and a frame to hang them together could be made quickly, or even obtained as well from Meccano. Cams to give the desired throw (for width of coil of weave-wound type) could be cut or filed out in minutes from Meccano hubbed sprocket blanks. I had a better thing than this going when I was 13 years old, and it was power driven by an ancient double-spring gramophone motor...

The fact is that in order to obtain a desirable pitch factor for all wire gauges, a compound gear train is required, with good shaft alignment, and above all some reliable method for maintaining suitable wire tension.

This is not dilettente perfectionism. With a simple coil-winder you are not going to be able to obtain and reproduce coils with a reliable Q when using most Litz gauges, or single wires from about 36 B/S up. A winding must have a certain amount of tightness to obtain any height of build up in a pie. Tensioning for this is delicately arrived at. Any formula describing sheet inductance, inbuilt capacitance, Q-factor, etc, cannot be applied without correct tensioning. A too-spongy coil will fall over. A too-tight coil has overstrained (stretched) wire in it, increasing R, which lowers Q -- not to mention causing burnout in coils inducing a high voltage.

An experimenter... is an optimist who might attempt the design of weave-wound pies without applying Langford-Smith on fundamentals, and simple coil-winding gimmicks only add to the pains... The experimenter who knows what he wants in a coil would demand something with higher precision, something over which he could exercise sensible control.

In my experience, cheap tools are almost invariably rubbishy. They can kill that precious thing -- an aspiration to craftsmanship.

I notice as a sad thing that many a man taxes his pocket hard to fill his belly with booze or play at games, but when it comes to doing something constructive (e.g., fixing something around the house or the car) he is filthy mean, lousing up jobs that need only the persuasion of a few decent quality tools.

One might argue that a simple coil winder would be good at least for solenoids, single layer or more. But these can be carried out better by a robust hand-drill held in a vice. This would chuck heavier weights -- coils for power transformers, for example, and it isn't hard to improvise a turns counter, and a simple SCR speed controller.

A screw-cutting lathe is close to the ideal makeshift tool for coil winding. In fact the only difference between this and a machine specially built for the job is that the latter traverses automatically -- i.e., switches itself at the completion of a layer, while the lathe has to be switched manually. But this is really no disadvantage when a winding is being paper interleaved. Automatic interleaving is used only on high production machines. It is seldom worth having it on a jobbing machine because most systems take time to set up, a dead loss when quantities are small...

The fact is that pi-wound coils are becoming a thing of the past, what with pot cores and printouts. The cost of a suitable weave machine with suitable feed and tensioning system runs in the vicinity of $500. Even these need careful adjustment for good work. The compound gear train in each can draw on about 40 wheels to cover all gauges and forms, but even then the operator can run into trouble with wire characteristics -- as one time when we had to wind a certain kind of nylon-covered wire which behaved like spring steel!

-- A.

((In our files we have an interesting design for a simple coil-winder using a sewing machine as basic instrument. Another chap, now in Queensland has shown me a very simple hand-operated arrangement of cogs and gears (in best Meccano tradition) with which he has wound a number of highly satisfactory windings, particularly for use with C-Cores, the use of which he recommends highly. -- Ed.))

LETTER: Soldering Aluminium

I wonder how many of you thought as I did that aluminium could only be soldered at high temperatures, using special flux and solder.

Having some familiarity with the complexities of welding aluminium with argon-arc high-frequency welders (which require the exclusion of air by an argon "pool" and the use of radii-frequency surge-injection to maintain the arc) and having seen the prices of special fluxes and solders, I have always regarded soldering of aluminium as impracticable.

A friend recently demonstrated that it can be done with a hot iron and ordinary resin-cored solder. You first scrape off the oxidation with steel wool or a screwdriver. Then form a "puddle" of solder with the iron. The trick is to use the screwdriver or steel wool (or tip of the soldering iron --Ed) to scrape <u>under</u> the "puddle" of solder. This prevents re-oxidation as the solder excludes the air. Once it has been scraped, the iron can be removed and you will find that the solder has "taken" firmly. Ideal for earth tag-points.

-- J. Mc Kenzie, Hamilton, New Zealand.

((There seems to have been quite a lot of discussion on this subject in New Zealand, both in <u>Spectrum</u> and <u>Break-In</u>. In <u>S</u>., July 1969, ZL1TIA describes an Aluminium Solder made by Stanzol Chemicals N.Z., requiring a special flux which allows soldering at rather hot-iron temperatures. In the <u>S</u>. issues of the next few months are more comments to the effect that the new solders work, but the fluxes can be corrosive, and ZL2TFL says that they tend to make a pretty joint but without strength; a proper job ordinarily needs aluminium brazing rod and a lot of heat. One possible exception may be a solder called "Eutectic" which is said to melt at a much lower temperature and to wet the metal better; it is available in Australia -- any one know how well it works??

((ZL1TFI proposes a variation of Mc Kenzie's idea: Coat the aluminium with thin film of lard, rub with fine emery, and tin with ordinary resin core solder and a <u>hot</u> iron; solder paste works even better than lard.... In <u>B-I</u> of 4/71, ZL2FT tells of "ALI-RUB", but it requires a lot of heat, and this could prove destructive if the metal is thin -- as I found with a similar compound applied to the YF's favourite saucepan! Beware. -- Ed.))

is a good sprinkling of test gear, and even the chap who would normally buy all his gear pre-built, might even build for himself a few of the bolt-ons that are described.

There is, in my opinion, the one facit missing: any general discussion of the reasons behind the choice of designs and their improvements from year to year. This is, however, in line with the requirements of the class of amateur mentioned above, who appears not to want much theory, and prefers concise wire-by-wire descriptions, which, if followed accurately will yield good results. In this respect, the American Radio Relay League has succeeded in their endeavour. We might argue about the desirability or not of such and such a circuit in the Handbook, but these circuits are often in the theory section, which the above-mentioned reader might not read in any event.

My overall conclusion is that as far as the contruction articles are concerned, any recent ARRL Handbook is good; but the superficiality of the designs renders these articles rapidly obsolete (else, why publish every year?). It appears to be popular taste and consequent profits that guide ARRL in their selection of material. This is not necessarily a bad thing, but it is not necessarily the leadership one might expect from the authors of the "Amateur's Bible".

AND YET ANOTHER VIEW, Same PICTURE:
(Reproduced, in part, from the article "Reviewing the 1971 Radio Amateur's Handbook" by D. Stivison WB2MYU, 73 Magazine, May 1971, p. 42.)

You might say that The Radio Amateur's Handbook is crystal controlled – very little drift from the standard. Year after year the Handbook appears with basically the same format, pictures, tables, and charts. As a guide to the avant-garde in ham technique and construction, the Handbook is certainly lacking. Yet it remains the cheapest and most popular handbook of standard amateur construction and communication techniques.

I built my first CW rig from the Handbook, and my first VHF project, and my first homebrew test equipment, and I used its tables to put up my first antenna, and to figure out the color codes on all those weird surplus components. Dog-eared and smudged illegibly on the dozens of oft-used pages, with burn holes from hot solder globs, and with schematics traced in pencil, my 1963 Handbook has been consulted countless times. I've built no less than six rigs from it. I've never purchased a newer Handbook because the book just doesn't change much from year to year.

However, I think I might invest in the 1971 Handbook.

For those long-familiar with the Handbook, the 1971 version will not be any earthshaking break from the past but will show a healthy and immediately apparent infusion of solid-state circuitry and theory. The groups of construction projects in each chapter do rely heavily on transistors and diodes and even ICs. But the book does not ignore the experimenter with his huge tube junkbox. True, tube projects end up too big, too hot, too heavy. But to the fellow with the well-stocked junkbox, the disadvantages are worthwhile tradeoffs for expense. Tube projects can be cheap, cheap, cheap if you've a 10-, 20-, or 30-year accumulation of tubes, sockets, and junkbox parts.

There are all the familiar charts; and the transistor tables have been expanded although they are still lacking in breadth. A few of the old standby projects were deleted and a few new projects were added. → If you buy new Handbooks as infrequently as I, this is the greatest bargain going at 50¢ a year. Even if you buy your Handbooks more frequently, it is still one of the few bargains around today. And for the radio beginner, it is an essential one-volume reference library.

WB2MYU■

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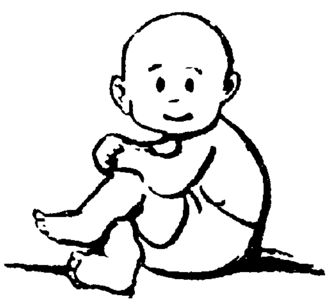
Radio Handbook requirements, dissected.
High Power Transient Suppression.
The real Art of Communication......

Just ordered EEB



Success Formula

Just received my EEB

(Courtesy 73 Magazine)

A SIMPLE BREAKDOWN-VOLTAGE TESTER FOR SILICON TRANSISTORS -- R.L.Douglas, VK2ON

The writer has had the experience of buying small signal silicon transistors by the dozen, and finding they were not all suitable for a particular job. Some of them failed due to their voltage ratings being exceeded. It would, therefore, be desirable to apply some simple test to test breakdown voltage ratings safely, particularly if the circuit is to use more than 9 volts supply. Normal simple transistor testers test only current gain, but this is obviously not much use if the transistor fails in service.

A useful rating to know is the BV_{ceo}. This is the voltage applied between the collector and emitter (correct polarity, base not connected) at which the transistor commences to pass appreciable current, e.g. 100µA.

Under this condition, of course there is no forward bias, and in theory there should be no collector current. In fact there is a small leakage from collector to base which forward biases the transistor, and limits the amount of collector-emitter voltage which can be applied in practice.

Another type of test is the BV_{ces}, maximum practical collector-emitter voltage when the base is shorted to emitter. This value is always higher than BV_{ceo}, and one often sees it quoted for the "voltage rating" of a transistor. But the actual voltage rating of a transistor in a given circuit depends on the resistance between base and emitter (See: "Transistors on Computer Circuit Boards", AR August and December 1969*). It is always safest to choose the BV_{ceo} because it is the pessimistic value. The instrument here described is designed principally for this test.

The instrument shown below, operates by applying an increasing voltage between collector and emitter, until the emitter current reaches some pre-determined level, at which point the collector voltage is measured. This is BV_{ceo} for the transistor. It should be noted that this tester will be suitable only for silicon, not germanium transistors, because the leakage level of the latter is substantially higher, e.g. 0.5-1mA at BV_{ceo} (although the resistance values could be altered to take this into account --Ed.). For the same reason, the tester cannot be used for power transistors, whose leakage current can run into the hundreds of mA, depending on the transistor type.

The 100µA meter could be a plug-in job. There is about 1.5mA through VR1, giving about 0.1W dissipation (most pots will stand 0.2W or more). R_1 should equal the internal resistance of the meter, and was 800Ω in this instance. R_1 can be replaced by a 5K variable to find out the approximate value which reduces the 100µA meter reading from 100% to 50% scale in this circuit. Layout and circuit values are not critical.

In operation, a silicon NPN transistor is inserted into a linear transistor socket, with polarity as shown. The "Test" Pushbutton is depressed, and with the switch in M_1 position, VR_1 is advanced until the meter reads half-scale (100µA actually through the transistor).

Then change to M_2 switch position and read the breakdown voltage. No harm will come to the transistor at this current. A PNP silicon transistor is checked by reversing the transistor position in the socket -- or for greater elegance a polarity reversing DPDT switch may be incorporated in the unit. It is assumed that the leads are arranged in the conventional "EBC", and not "ECB" as with some GE transistors.

A number of silicon transistors of a type available at $4 per dozen were checked, and figures varying between 20V and 60V were obtained. Some of them had measurable leakage at 10V, and these would probably be unsuitable for audio amplifier use because of noise.

Testing BV_{ces}: In the diagram a switch has been dotted-in, labelled "CEO" and "CES"; in the latter position it simply shorts base to emitter. It provides a less useful test, but is shown in event of someone being curious about it. If you wish to measure BV_{ces}, however, it is important not to allow the meter to read higher than 5% of FSD on switch position M_1 for ordinary TO-5 case transistors, or higher than about 2% of FSD when testing the small (TO-18) metal cased transistors found on the computer boards... In general it is wiser only to test BV_{ceo}...

*Available as part of the EEB "Computer-Board Notes" as advertised in this issue.

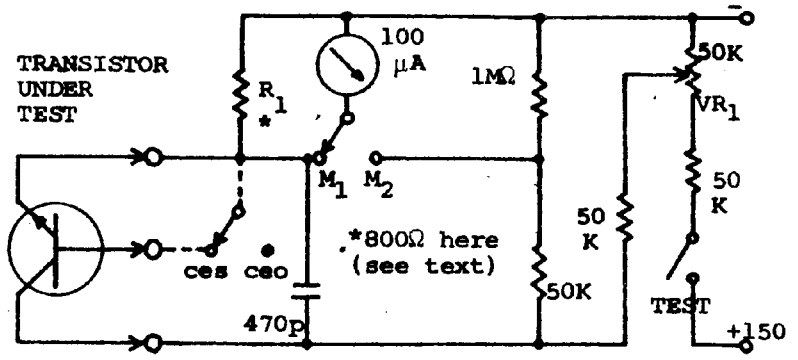


FIG. 1: The Breakdown-Voltage Tester

GRANDPA'S TRANSISTOR GAIN TESTER

-- L. J. Yelland (VK3)

We have heard quite a lot from EEB in terms of "Grandma's Tests for Transistors", wherein is made the tenuous assumption that if Grandma knew about transistors, she would have treated them with the same kind of commonsense with which she approached bad eggs or children...

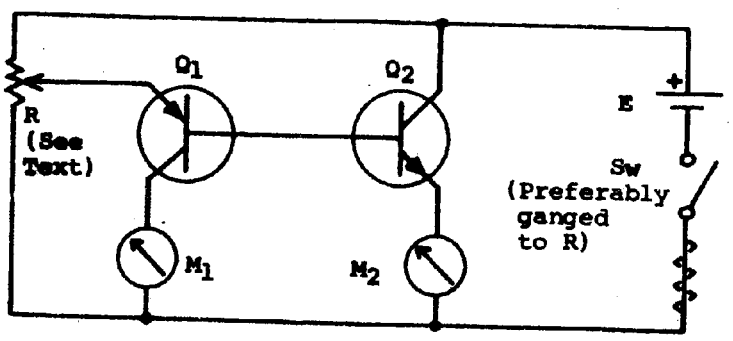
Now designs for transistor testers appear often in the periodical literature, ((and EEB is planning a big review of them one of these days)) but almost inevitably these test transistors under conditions of a fixed and sometimes unrealistic collector current -- as when the gain of a power transistor is tested at 1mA (or 10).

Yet everyone knows that transistors are famous for their nonlinearity, and that means simply that they have different gain at different collector currents. The gain usually rises sharply at some low current, reaches a broadish maximum, and decreases more or less slowly at high currents. Only for exceptional transistors is the gain fairly constant over a wide range of collector currents, e.g. the Fairchild 2N4250 or 2N4354 (c.f. EEB, June 1967).

It would be quite desirable to test transistor gain at various collector currents, to assay linearity actually encountered, or to find actual gain at currents to be found in a given circuit; the latter can make circuit design rather more reliable.

This can be accomplished by putting various base currents on the transistor and measuring collector currents, or by inserting various resistors in the base circuit and measuring I_C resulting. The first method is awkward for small base currents, and the second method requires a fairly high supply voltage to ensure constant current.

The very simple circuit shown below solves these problems with little trouble. It compares the d.c. current gain of Q2 with the gain of Q_1, when the transistor polarities are as shown, viz., the unknown is NPN; for a PNP unknown you could add a switch to insert an NPN standard Q_1.



Both transistors should be of the same type (e.g. germanium) and the same power range. Where I_1 is the current read on meter M_1 and I_2 is the current read on meter M_2, R is adjusted until I_2 is at the desired level, whence

$$h_{FE_2} = (I_2/I_1)h_{FE_1}$$

A calibration curve of gain vs. current could be made for each standard transistor, Q_1, for which (h_{FE_1}/I_1) is plotted as a function of I_1. Then

$$h_{FE_2} = I_2\ (h_{FE_1}/I_1).$$

((Ed. Note: A typical curve of this kind is shown on p. 23 of Amateur Radio for December 1969, also appearing in the Computer Board Notes which we have made widely available.))

For the special case where I_1 has unity value (e.g. 1 mA), h_{FE2} could be read directly from the ordinate of the plot.

In my setup, E consisted of a few torch cells, and R was a 5K pot to be used for small transistors. As a socket to plug in the transistor under test I used three 1/16" eyelets in a triangle a little larger than the spacing of transistor wires. It might also be an idea to plug in Q_1 too so that a known power transistor can be used to compare higher ratings, though for these the base/collector current comparison method is more practical because of the higher current involved.

The dotted-in resistor should be used in event of Q2 being a shorted unit, so that you don't blow up M2 ! It can be chosen in conjunction with the value for E, to allow a not-excessive current under that condition, consistent with at least 2V across the transistors at the maximum test current.

As an example, consider a typical test using Q_1 = Anodeon 2N220, with gain = 35 at 0.1mA to 45 at 1mA (for a transistor with moderate linearity over the range of interest, approximate results are obtained easily without a calibration plot). With an SE4001 on test, I obtained I_1 = 0.25mA, I_2 = 1mA. At 0.25mA, Q_1 has d.c. current gain of 40, so Gain of Q2 = (1.0/0.25)(40) = 160; The book specifies gain 60 to 300.

Probably about the only caution would be to avoid tests which push I_1 to excessively high values for a given type of Q_1, to avoid thermal runaway. On the other hand, for moderate values of I_2, base of Q_1 is stabilised.

FUN WITH FIGURES

((Drawn from the Federal Budget 1971, and the Bureau of Senses and Sadistics))*

Essential Expense:
GOVERNMENT ADMINISTRATION (ETC.): --> 2,100 Millions **

Useful Expense:
MILITARY PROWESS:
--> 1,300 M.

Incidental Expense:
SOCIAL SERVICES, ETC (from Pensions to Free Milk):
--> 5,400 M.****

Total Government Expense:
--> 8,800 M.

Government Revenue:
Direct Taxation on Average Bloke: 3,800 M.
Thus, Hidden Taxes (57% !): 5,000 M

Some Comparisons and a Conclusion:

1) Fate of Average Blokes Income (about $4000):
Pay for Government, etc: 10%**
Pay for Military 6%
Pay for People 24%****
Thus, portion of Average Bloke's Income which goes for Direct and Indirect Taxes: 40%

2) Portion left over for breathing in and out, luxuries, rent, and grog: 59.96125% (approximately)

3) Amount remaining to spend on EEB Subscription $1.55
QED

---

*Rounded off for purposes of oversimplification.

Covers everything from Computers to the Post Office and Postage*

***This is being solved nicely by further telephone and postal increases which already bring the PMG such a neat profit (c.f. EEB, Dec. 1970, p. 160-161!. As of this October, PMG continues to impose disproportionately higher postal rates on newspapers, magazines, books, and other means of communication in a democratic society; which is, of course, why we mention this here.

****Not including costs of "free" education, nor of expenses for medicines, dentists, eyeglasses, and similar luxuries....

>>>>>>><<<<<<<

Moulding public opinion is like driving a mule. First you decide which way the mule wants to go, and then you drive like the devil.
-- J. Pfeiffer, WA5CKJ, ARNS Bull. 2/71

Quote without Comment

It is to be hoped that the change from the current government Post Office Department to a governmental administration operating on a separate and non-political basis may be the beginning of improved mail service. Of course, any improvement at all will be very welcome to those of us who use the mail facilities in the conduct of business.
-- Auto Call, October 1970 (USA)

LETTER: Forbidden Fruit

The following recipe for Creme de Menthe A L'Antique may be of interest to you:-
Ingredients: Sugar
90-100% Ethyl Alcohol
Oil of Peppermint
Green colouring (vegetable, NOT aniline!).
Mix equal volumes of sugar and boiling water; shake until dissolved; cool. This will give a total volume only slightly greater than the original volume of each. When cool, add just sufficient alcohol so that a pale blue flame will appear when a lighted match is held almost in contact with the surface. Then add the oil of peppermint to taste (this may be hazardous) and enough green colouring to make it look right.

I never did record the exact quantities because I found it much more exchiting to be guided by the shenshe of thshte.

-- A. N. Kallam, Cardiac, NSW.

((IMPORTANT NOTE!: Aside from being most highly illegal, since Absolute Ethanol is generally not available to the Public, it is also potentially dangerous to the user. Absolute Ethanol is only "drinkable" if it has been prepared by distillation from aqueous solution and then dehydrated; if it has been prepared from a benzene azeotrope there will be a trace of benzene in it, and I want none of that thank you!! Far safer and considerably more legal would be to use Vodka or perhaps even Gin; since these are mostly alcohol they ought to substitute, but since they also have a fair bit of water in them, it would seem advisable to dissolve the sugar in the least possible amount of water; this can be done with patience and a fair amount of careful heating-- or boil the sugar solution down to a thick mess.

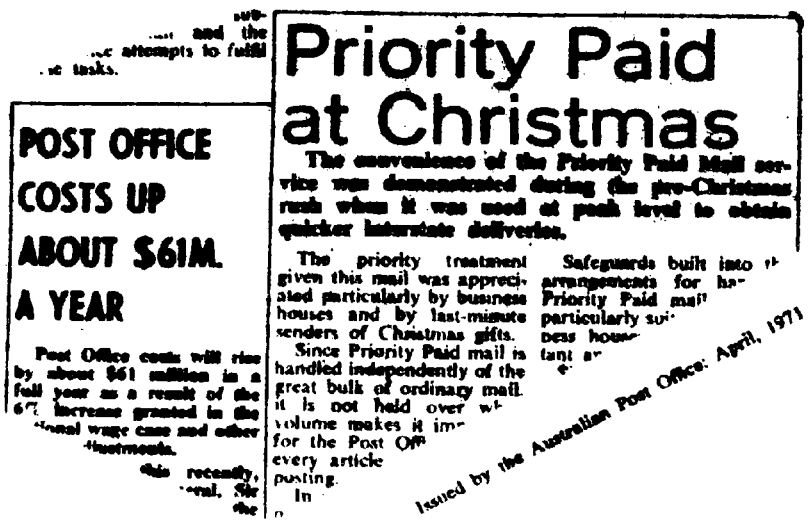
I have also heard rumours about a potent liqueur which could be prepared by using some 95% n-2-hydroxyethane as desiccant in a desiccator containing an orange, but obviously I couldn't describe it here, because I don't know the recipe..... -- Ed.))

LETTER: ??????

Please cancel my subscription. Your magazine is OK and good value, but I have lost interest in Electronics.
((Correspondent)) -- N.S.W.

When a six-legged insect goes for a walk, it keeps three feet on the ground at all times. The fore and aft feet on one side and the middle foot on the other!

An English major had been apprehended, stark naked, by military police in the corridor of a Cairo hotel. The arresting soldiers testified the major appeared to be in pursuit of an unnamed damsel, similarly unencumbered by clothing. The major was acquitted in a court martial, on the basis of a suitable regulation in the British Army's Manual of Regulations: "It is not compulsory for an officer to wear a uniform at all times as long as he is suitably garbed for the sport in which he is engaged."



POST OFFICE COSTS UP ABOUT $61M. A YEAR

Post Office costs will rise by about $61 million in a full year as a result of the 6% increase granted in the ...onal wage case and other ...tments.

...this recently, ...eral, the ... the ... and the ... attempts to fulfil ... its tasks.

Priority Paid at Christmas

The convenience of the Priority Paid Mail service was demonstrated during the pre-Christmas rush when it was used at peak level to obtain quicker interstate deliveries.

The priority treatment given this mail was appreciated particularly by business houses and by last-minute senders of Christmas gifts.

Since Priority Paid mail is handled independently of the great bulk of ordinary mail, it is not held over when volume makes it impossible for the Post Office to guarantee every article posting. In ...

Safeguards built into the arrangements for handling Priority Paid mail particularly suit business houses ... tant ar... e...

Issued by the Australian Post Office: April, 1971

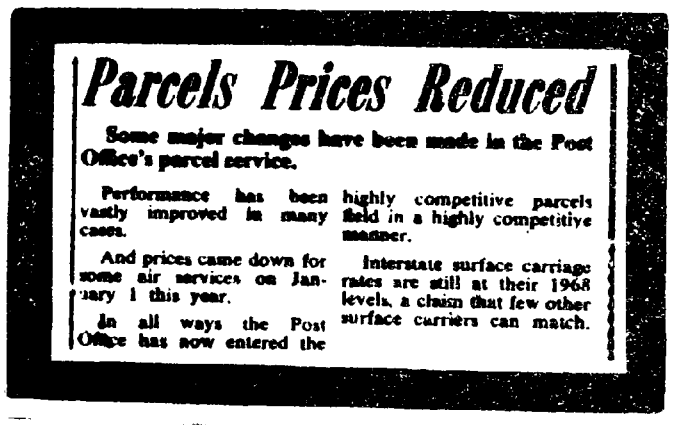
LETTER: How to beat the PMG

EEB has become more condensed and less frequent, to make digestion easier. Despite all that I have only just managed to read through the February issue...

In reference to your crusade against the PMG prices etc, it is unfortunate that we can not overcome the crazy prices we must pay for postage, telegrams and telephones. The big organisations do, however, manage to beat this problem to a certain extent:

A departmental manager of one of our client companies told me that they have been sending all correspondence between their Melbourne, Sydney, and Brisbane offices by express road transport. Mail picked up at 4PM in Sydney is at the Brisbane or Melbourne office by 9AM the next day -- AND more cheaply than by post! And it is there reliably; no nonesense about it being "lost" en route.

-- K. Harding, Sydney, N.S.W.



Parcels Prices Reduced

Some major changes have been made in the Post Office's parcel service.

Performance has been vastly improved in many cases.

And prices came down for some air services on January 1 this year.

In all ways the Post Office has now entered the highly competitive parcels field in a highly competitive manner.

Interstate surface carriage rates are still at their 1968 levels, a claim that few other surface carriers can match.

LETTER: How to be beaten by the PMG:

If you think 3 weeks from Melbourne to Hobart is performance from the PMG, consider what happened to me:

1) Letter posted in Canberra on Jan 26 arrived in Newcastle in nice time for leasurely reading over Easter.
2) Letter from Melbourne to Newcastle which reached the Newcastle P.O. in 2 days and then went backwards through 3 previous addresses before finally reversing and coming home to roost. To give PMG credit, each of the eight steps took only two days.
3) Xmas card posted in Sydney December 9th arrived in Newcastle on March 24.
4) The best of all: Xmas card posted in Bristol in November 1969 arrived first mail after the New Year -- 1971!

So, take heart, it could be worse.

-- J. Anderson, George Town, Van Diemans Land

P.S.: Keep your city clean; eat a pigeon every day.

((Oh mail to Melbourne doesn't always take a week; its quite fast at times -- if it doesn't get lost. At EEB we have found it necessary to Certify every Bound Volume sent in Australia and Register the ones sent overseas. Since we have been doing this we haven't had a single loss. Isn't that nice? And all it costs is money. Cheap at half the price.

((On the other hand we have also had favourable results using non-PMG services even on a one-off basis. Knowing that we have suffered a 10 day delay for first class air mail between here and Gosford N.S.W., we were in a hurry once to send a bulky package. We took it to the city office of TAA, and they had it in Gosford the next day! The price was a bit higher than by post, but it was well worth it for the speed and the reliability))

ΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔ

SWOOP (Continued from P. 88)

The against'ers are out in force again. License fees, loss of band space, nets, rag chews, DX,CW, teletype, repeaters, incentive licensing, ARRL, Congress, the weather and the neighbours across the street. Dear dear, they sing their songs daily and at great length. But as thairman of the benevolence committee, I have not received any reports of broken arms, right or left, financial disasters, can't-afford-a-6c-stamp, mail strike, or national disaster that would hamper communications.

I've heard all the "agains" detailed, amplified and emphasized, but what heck are the hams for? It sure isn't for hams or hamming.

((EEB Editor's Note: Commonly we usually translate "ham" to amateur on principle, but we just couldn't wreak such havoc on Elise's pungent style this time!))

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RADIATION HAZARDS at Microwave!

((Taken from: "Microwaves - 1000MHz and Up" by D. S. Evans, G3RPE, Rad. Communicat. 7/71,p.467))

I have been reminded that many newcomers may not be fully aware of the potential radiation hazards associated with their (microwave) equipment. It is an unfortunate characteristic of the human race that they cannot resist peering up the waveguide to see where the r.f. is coming from; and the eye is one of the more vulnerable organs.

A generally accepted limit of power density to avoid damage to delicate tissues is $1mW/cm^2$. Even the smallest equipment in current use exceeds this value within the waveguide by five to 10 times, although the radiation density of course, quickly falls off at moderate distance.

The message is obvious:

NEVER LOOK UP CLOSE TO THE END OF A WAVE-GUIDE UNTIL YOU HAVE MADE CERTAIN THAT THERE IS NO R.F. PRESENT. ((EEB emphasis))

ΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩ

LETTER: Cure for Literary Diarrhoea

I found last issue of EEB most illuminating and I read every word of it more than once. The letters were most interesting. But if I may make a suggestion it would be that you make your reply comments which follow the letters, much briefer, in some cases and eliminated altogether in others, to give other readers ooportunity to "come back" at them in later issues.

-- L. J. Yelland, Prahran, Vic.

THE MOTOROLA SEMICONDUCTOR DATA BOOK

-- L. L. Sharp (VK4NS)

In reference to our Review of the 4th Edition of this work (EEB Aug 1970), this excellent general reference to all major 1N, 2N, and 3N semiconductors is now available in a Fifth Edition. If possible, it seems even bigger than the 4th. If you need to keep up-to-date on semiconducyor specs it could be worthwhile getting the Fifth, and selling the 4th to someone else.

I believe that the price for this book in the Shops is rather high, but it is not too bad obtained from Motorola agents. A supplier who says he is willing to sell to EEB readers is:

Dresser Australia Pty Ltd.,
P.O. Box 47, Corinda, Qld 4075.

With packing the book will probably weigh about 6 lbs, and sufficient postage must be included as calculated from the new (improved) postal charges. The price for the book alone is $6.00 -- prepair, of course.

Dresser will also be willing to handle the Updating Service available by your filling out the coupon at the front of the Book. If you recall, there was a problem of obtaining the Updating Service, mentioned in our previous Review. For this Service, price is $2.00 plus a small amount for postage on the supplements which they suggested would be about 20c per supplement.

Incidentally Dresser say that they also try to keep stocks of the following Motorola publications, though they can be hard to get at times:

Power Circuits Handbook
Switching Transistor Handbook
Silicon Rectifier Handbook
Zener Diode Handbook.

As with similar material from RCA, GE, or Westinghouse, these are excellent compendia of theoretical and practical information on the subjects indicated; they appear frequently in EEB Reference Lists.

When I get around to it I am going to buy the ITT publication "Reference Data for Radio Engineers" published by Sams, and which sells in the States for $20 in the 5th Edition. It is expensive, but after seeing some of the $5 and $6 electronics paperback books in the bookshops it does not represent such bad value for money.

((OM Sharp seems to have had better results than EEB, since we've been unable to obtain a reply on this matter from Motorola in Australia or in the U.S.A. But we have discovered an additional supplier of the Data Book: Total Electronics, 239 Bay St, North Brighton, Victoria 3186; also H.M. Bamford, 228 Murray St., Hobart 7000/RLG))

SWOOP -- Elise White (YF/ KØCNV)

((ARNS Bulletin, Nov. 1970))

Will someone please tell me how a group of intelligent amateurs will get completely addle-brained? I've long suspect the morse code but can't prove it.

Joe installed an antenna for a fellow amateur several months ago. Since he lived on a hill and it was at least a mile to water, provisions were made to water the base to provide an adequate ground.

Being a perfectionist and a cautious soul, he invested in new gear, checked everything a million times, and had a 1:1 SWR on his antenna. His receiving was wonderful but he couldn't be heard a mile from home. Two gallons of water applied to the base of the antenna improved the situation, but being an amateur he wanted to talk to the world.

After much consultation and cogitation, he trucked down to the grocery store and bought a box of salt. This was poured in the hole and water applied. Wonderful! He talked to New York and California and points in between.

This situation lasted for several weeks until one night in the middle of a QSO the bottom dropped out. Repeated applications of water didn't solve the problem. The stores were closed, the landlady was on vacation. No salt! Finally in desperation he dumped 5 lbs of Epsom salts in the hole and filled it with water. It disappeared faster than he could carry it out. He hooked up the hose, turned it on, shoved it in the hole and dashed upstairs to see if his problem was solved.

The SWR was out of sight and the transceiver was lighted up like a pin ball machine on fire. Frantically he twisted knobs and pushed buttons until the lights that were supposed to be lit were lit and the ones that weren't, weren't. There would be a sudden drop in the SWR and it would begin to build up and then drop. Forty five minutes and a $5 water bill later he remembered the hose.

It was running full force, but not one drop of overflow, the basement wasn't swimming, but in the far distant underground he could hear 1-2-3-4 test, 4-3-2-1 test, WB6--- this is WØ--- Do you read me?.... Well!! Its a good story and I believe every word of it.

THE STATE OF THE ART: A CRISIS? --RLG

I find that the many specific things I have wanted to say about remarkable things happening in electronics, are being pushed aside because of the need to examine some of their implications. Thus, in April it was pointless to consider the several interesting developments taking place in Phase-locked loops (and not only for receivers), until we made certain that we knew just was meant by "synchronous", and when. More synchronous stuff next month.

Unsophisticated complicated designs

This month I must examine a further general syndrome of our age: the sophistication of design. Recently we have had to turn down three good articles (of which one will be salvaged), because their treatment was not optimum. This is what comes from having a capable Engineer on one's staff, and sometimes I feel that I am riding a Tiger.

Let me make one thing very clear: we are NOT becoming "too good" for the common experimenter. But said experimenter is beginning to dabble in some of the engineering marvels of our age, and he may not be good enough for them without some considerable study. When these pretty baubles involve complex levels of feedback and control, particularly in digital signal systems, the cheerful experimenter may be getting out of his depth; worst of all, he may not realise it.

To effect technical continuity I ought here to insert a couple of paragraphs of examples, after consulatation with Rod and Dick; I personally understand only every third word or so of that stuff. But I wish instead to consider more fully its significance.

Are Experimenters Obsolete (again)?

In 1970 EEBs (p. 130, 151) we had some interesting exchanges on the significance of Integrated Circuits, and what they would do to/for the hapless experimenter who was being overtaken, alone and afraid by a robot he never made. The point was well made, that he was in danger of being forced into the role of unessential dreamer, a builder of gadgets which

a) Were irrelevant to the demands of our high pressure age, or
b) Had already been developed more fully and more competently by teams of Engineers working in brightly lit and expensively equipped laboratories.

Against this was postulated the opinion that tomorrow's experimenter will have no difficulty being either competent or creative if he is careful to learn how to be effective, and careful in applying his knowledge.

Rubbish

I see the increasing amount of rubbish being published in the experimenter literature by people who are trying to use the new technology because "it is there". And as I mentioned above, we seem to be encountering some of that ourselves.

But, the use of ICs and a variety of other electronic wonders is not necessarily a simple matter of plugging-in new gadgets to do old tricks better -- though that is being attempted.

The New Technology

Instead, Rod says, the new Technology is requiring an entirely new approach, of "thinking digitally", of realising that for reliable operation a modern switching transistor's base may have to be driven hundreds of milliamperes into conduction, or of considering not merely that a feedback loop can be used to correct error-functions, but that it should do this in the most efficient manner possible (or at least feasible)... Again I resist the temptation to furnish examples -- perhaps Rod will grace our pages with a discussion of Optimum-design one day.

How to use Complicated Tools

What is the conclusion? Is the experimenter becoming obsolete? Or is he being led to greater heights of creativity? As I see it, the answer is: both, or either. The fact is unquestionable that we are being presented with tools of great complexity. Whether we use them to sculpture monuments or golden calfs is ostensibly within our own choice. And we shall achieve a goal commeasurate with what we bring to the task: ourselves.

If we LEARN how to be competent with the many new devices and techniques, we shall be able to use them intelligently, and presumably therefore well. If we are unwilling to make this effort, we shall create banal shadows of the gadgets Engineers can make better.

In EEB we have always laid a considerable stress on the value of references and reviews, particularly of books imparting high value for effort expended. The fact is true that these have not covered much of the abovementioned High Technology -- although Pat Hawker's Amateur Radio Techniques may be a tentative step in that direction. But at least they have examined various fundamentals and optimum practical methods: you have to walk before you can run.

"Wait for us!"

To much of this I know we have numerous "beginners" out there who will cry with anguish, "wait, not so fast, we're just learning Ohm's Law!" To which I shall snap, "So what? I've been learning it for years, but that is no excuse to stop there!"

We have recently reviewed several competent elementary and intermediate experimenters books (and if you know of others, please give us a good and honest Review of them). If you are lacking those basics, and if you want to create something useful in electronics, isn't it time you took them seriously? And eventually I hope we'll be able to present further references to more sophisticated stuff -- but they must be good: clear, logical, and well adapted for individual study.

And there you have the key word: serious. Modern experimenter work must become serious and earnest, competitive with and using the best approaches of the engineering world.

Quo Vadis...? ("What profiteth a man if...?)

And EEB, what?? A seascape painter in a sea of artists? Perhaps. When -- as it must happen one day -- all of the articles sent to us incorporate the New Technology, it will be good time to call it a day, and retire to the workbench and some good books.

I am trying to learn about the new stuff too, but I am not basically an electronics person, and although I can probably follow it, I don't feel I can lead. Rod could, but he has other things to which to devote his life.

Rejoice! (but be careful)

For now: You ordinary blokes, tell us about your ideas for spark coils (how about a good, simple Tesla Coil, with several suggestions for using it spectacularly -- and safely?), model control systems, useful instruments, automobile gadgets, and to be sure receivers and transmitters where insight is to be gained -- or a better Way found.

But if you tackle digital or servo or computer or loop-control systems, make jolly sure not only you are doing it correctly, but that you are doing it within the best scope of the State of the Art. And that requires much specialised knowledge -- books and books worth.

And a suggestion: If you do come up with something good like that, why not merely send us a block diagram and a good commonsense explanation of how it works, and send the Details to the Serious Magazines (But tell us you are doing that, so that we can rush it into print -- hi).

STATE OF THE ART? -- II

The following collection of items from the periodical literature is, perhaps, a self-explanatory comment on the effect the abovementioned Revolution is having on theamateur experimenter (here broadened most certainly to include not only radio amateurs, but all experimenters!). On P. 91, John Andersen and Tom Moore take the matter one step further by examining the role of commercial vs home-constructed equipment.

Various Quotes:

WHAT HAS HAPPENED TO "SIMPLE RADIO" ?

The Editorial in the September OC VHF ARC News spoke of the death of 50MHz 6A3 ("AM"). This should cause sincere regret and mourning among the amateur fraternity. How, now, can one break into amateur radiotelephone operation without spending a sizeable chunk of folding money?

Time was, you could make (or even buy) a cheap and dirty 50MHz transmitter and a converter for use ahead of just about any hunk of a receiver, then get on the air and be a full-fledged radio amateur. Those days must be gone, from AW5BEN's editorial comment. A shame too. ((See also Break-In 4/71. --RLG))

There should be some way an interested person can get a rig on the air-- preferably at least partly homebuilt -- for a modest dollar expenditure.

--C.C. Drumeller, W5JJ, Collector and Emitter, October 1970.

... who floundered in carrier QRM until 2 AM or so. But times have changed, and SSB no longer spells a clear contact. Everybody is using it almost! Thus, no one has much advantage over the other by reason of SSB technique. Linear amplifiers have gone from big to bigger -- and where does one go now?

The answer (sic), so far as equipment is concerned... is to improve your antenna system....

-- W8AP (Auto-Call, August 1970)

... Looks to me like its time to cool incentive licensing and find some other way to thin the ranks of amateur radio and maintain high standards -- like stiffer examinations for initial licensing, and state-of-the-art refresher examinations for renewal of licence. At least, lets do something to eliminate the QRM -- and soon....

-- K3LFD (Auto-Call, July 1970)

((Throughout much of the discussion in amateur radio runs this thread of conflicting aims: how to get more amateurs; how to reduce QRM....!--RLG))

↳85

"When experience is not retained, infancy is perpetual... Those who cannot remember the past are condemned to repeat it" — G. Santayana ("Reason & Common Sense").

Adverts

From the look of things it does look as though Australia will definitely appreciate its dollar by some margin or other, relative to the U.S., therefore the special subscription rates mentioned on p. 63 last month are probably OK. Asked by my son whether higher prices would be caused by revaluation or devaluation, I hazarded the opinion that either would do; whatever happens, prices go up. We are pleased to attempt to swim against that stream, in offering lower subs rates for HR & CQ. That can apply to the Milliwatt too, and the figure quoted on p. 54 is the suitably adjusted one.

Here is an item for which there was insufficient room, obverse: we still have a few of the 6" circular slide rule/. This is the item which was published in our April issue, but these are the original size, and printed on stiff card. Its not as elegant as the $5 model, but it works well, and is rather cheaper; accuracy is about equivalent to a 16" linear slide rule!, but it has only the A & B scales (the ones used 90% of the time). Also included is an appropriate sheet of words, mostly taken from the April artcle. While they last, available for three 7c stamps. Offer is good, world-wide; send your own national postage stamps.

If your advert needs repeating, please notify us accordingly; the cost for private insertions is negligible, but we don't want to repeat an item if you have sold it, etc.

PLEASE tell people you · saw it in the EEB !

John Campbell

In reference to the item on p. 87 here, I note that 73 magazine has reprinted his marvelous article, "How to be an Amateur", in the October 1971 issue. It should be must-reading for every serious amateur. He showed how the creative amateur is gloriously impractical and justifiably egotistical (and ignorant, inconsistent, etc..) — all to good purpose. Do read it.

Two Editorials, October 1971

The first is by Jim Fisk in Ham Radio (MUST you keep that ghastly word "ham", Jim? Your magazine is anything but that!). He discusses some new semiconductor microwave power devices, e.g. Gunn Diodes and Avalanche Diodes. The Gunn Diode has been available for some time in Australia and is sold by Philips as a regular item: the MD8-case, CXY series having output power from 8 to 65 mW at 8 to 12,000 Megacycles. Jim's description of how this odd device works is very concise and interesting; it makes the production of appreciable power practical at incredible frequencies — as much as one watt at 5000 MHz, or pulse powers of 2000 watts!

Jim also describes IMPATT and TRAPATT avalanche diodes which attain remarkable frequency capability by a drift processes in the solid state that sounds remarkably like Klystron operation (to me, anyhow). Although equally impressive frequencies are specified, the most exciting thing about this is the fact that ordinary garden variety silicon rectifier diodes can be selected for TRAPATT oscillator characteristics. Here is a real opportunity for the enterprising experimenter; the Engineers have discovered that ordinary rectifiers can be made to work as avalanche diodes; here is your opportunity to take it further. Can you?

Incidentally, Electronics Australia is presenting a two-part article on IMPATT diodes applied to microwaves, in their December 1971 issue, and probably Jan 1972.

The other Editorial is in 73 Magazine, by Wayne Green. Wayne is taking the remarkably sensible step of arranging his articles so that they start on a right hand page and end on a left-hand one. This makes it possible to file articles according to subject, without agonising which is more important, and without cross-referencing notes. That this very sensible idea has not been adopted by other magazines attests, in my mind, to the vast uselessness of most of the material appearing in the periodical literature. What, I ask you, is more useless than five or six feet of beautiful periodical magazines (even bound, yet!), when you want to find an article on Some Subject? Indices? HA! They have very limited capability, and are a tedious nuisance, not to mention the fact that they are not always complete, nor current. (P.T.T. p. 84)

ADVERTISING

[Items continued from the September issue. No listings in November issue because it is being sent at the same time as this issue. If you want an advert in the December issue, please send it in immediately. Same conditions as specified in the Sept issue, p. 62.]

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BRAND 5 RECORDING TAPE AT DISCOUNT PRICES!
1800' on 7" reel 1 mil mylar base $3.99; 2400' on 7" reel 0.5 mil mylar $4.75; 2400' on 7" reel 0.5 mil tensil mylar $5.25; 1800' on 5¾" reel 0.5 mil mylar $3.75; 900' on 5" reel 1 mil mylar $2.25; 1200' on 5" reel 0.5 mil mylar $2.50; 1200' on 5" reel 0.5 mil tens. mylar $2.75

3" REELS: 225' 1 mil mylar $0.70; 300' 0.5 mil mylar $0.85.

CASETTES: C30 $1.55; C60 $1.65; C90 $2.65.

WEIGHT PER REEL: 7" = 18 oz; 5¾" = 11 oz; 5" = 8 oz; 3" = 3 oz; Casettes = 3 oz. Please send sufficient postage according to the new postal rates; any excess will be refunded.

EXTRA DISCOUNTS: Over $10, 5%; over $20, 10%; over $50, 12½%. All orders & enquiries to:

---- SANKO SOUND SYSTEMS, P.O. Box 25, Stones Corner, Qld 4120

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FOR SALE: Medium Power Silicon Transistors, new ex-Anodeon, selling at cost price. Their beta linearity and complementary matching are better than similar items by RCA or Philips, with price about half that of any similar device by other manufacturers:

AT464 [PNP] and the complement AT474 [NPN], 4W Max Power Dissipation. BVceo 60, Minimum beta = 100 at ½A; avg beta = 200. Icmax = 1A, T039 case [T05 with ½" leads], ideas as 2N3055-drivers or as output stage. $0.73 each. Postage EXTRA, please.

-- P. Garde, Dept. of Elec. Eng., Monash University, Wellington Rd., Clayton, Vic. 3168.

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FOR SALE: TS323UR Frequency Meter [20-480MHz], original calibration book and crystal. What offer? -- A. J. Van Genderen, 15 John St., Ashfield, NSW 2131.

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WANTED: Service Manual for Navy Receiver B28 [Models A to E] or CR100 [Models 1-5]. Write EEB

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CQ-Published BOOKS: Ham's Interpreter, $1.50; New RTTY Handbook, $3.95; RTTY from A to Z, $5.00; Surplus Schematics, $2.50; Surplus Conversion Handbook, $3.00; 103 Simple Transistor Projects, $2.95; Antenna Roundup I, $3.00; Antenna Roundup II, $4.00; Shop and Shack Shortcuts, $3.95; Electronic Circuit Handbook I and II, $3.00 each. More detail on these books in any issue of

Electronic Circuit Handbook I and II, $3.00 each. More detail on these books in any issue of CQ, also available at $5.00 per year. Send order to EEB at Sandy Bay with name and address printed CLEARLY, and the amounts shown above, in $A. Merchandise will arrive from U.S.A.

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(Editorial, continued from p. 81)

The only argument against filing interesting articles in suitably labelled manilla folders (leaving presently less interesting items still in the magazines -- to be re-investigated at some future date), is that it will spoil the magazines. Spoil them for what? Is the purpose of periodical magazines to use, or to admire?

How about EEB? Uh, yes, well its like this. When we get some full-page adverts, we'll separate articles like that. The alternative is to separate them with Letters and odds and bits. Perhaps later when we conquer the problem of satisfactory contrast photography (progress is being made -- slowly); at present we try to arrange it so that type of a given reduction-ratio fits on the same sheet. To adjust this also to separate articles would require the services of a computer, assuming we had enough pages....

Avalanche Transistors

Before I leave the subject of avalanches, one should not overlook the fact that it is possible to force quite ordinary transistors into the avalanche mode of operation so attaining remarkable frequency response (still-- the idea of making a rectifier diode oscillate at 1000 Mc is hard to better). This subject has been discussed in the September 1967 issue of Electronics World, p. 30 (you see how useful an Indexed Articles system is?), and in the December 1970 Ham Radio.

To produce avalanche, merely apply some 200V to a transistor in common-emitter mode through a large resistor and drive the base over the conduction threshold at, say 10MHz; if the driving signal is tuned to WWV it will determine the accuracy of all of the harmonics this device exudes up to some 1000Mc, I mean Megaehzzzes, gah! A 5kHc drive gives S9 signals to 30Mz -- or the like ". Avalanche can be generated at low voltages simply by turning the transistor upsidedown. Most interesting.

The avalanche process works by inducing an unusually strong depletion layer between the collector and base, & a strong electric field extends over the base region. Electrons from the base are strongly accelerated in the collector region, causing IMPACT ionisation, and avalanche rather as in a Geiger tube, but in solid state.

The result is astounding frequency response and peak power from ordinary silicon transistors -- though this will not work with some of the older types having low avalanche voltages. How about some good material from the workbench from you experimenters who want to get away from the dreary round of ordinary circuits? -73, Leo

---

SPACE FILLER pilfered from KØNL's Auto-call:
It takes two to make a marriage: a young girl and an anxious mother... The girl had a long and complicated operation -- removal of the telephone from her ear... A politician: a chap who appraches every subject with an open mouth... Prision Yard: Guards Little Acre ((A pun in Americanese, where "o" is pronounced like "ar".))

AROUND THE AIRWAVES -- J. Van Staveren (VK7JV)

These items are selected from the Geoff Watts DX News Sheet, as described in the September EEB (p. 61); they have been selected for Australasian conditions.

ASCENSION IS.; ZD8CW: 14.026 CW, 7007 CW, 3508 CW; QSL via W2MUM.

CAMBODIA; XU1AA: Club Station on 40, 20, & 15 M.

CAMEROUN; TJ1AW has a new QSL Manager: K4MPE.

CAYMAN IS.; ZF1WF: QSL via K4CDZ.

GEORGIA (S.S.R.); UF6FE is QRV 1st Monday in each month on 3645 SSB at 2400, then QSY to 7040 or 7070.

KENYA; 5Z5KSA: Px. Scout J.O.T.A. Station; QSL 5Z4MD.

LUXEMBURG; LX1BW, Willy is QRV weekends on 3795 + 7085 SSB Friday and Saturday 2300-0800 (phone only).

MALAWI; 7Q7CY: Op. Bob, ZE1CY; QSL via K9BNF.

MARIANA IS.; KG6SW: QSL via W7YBX.

MONACO; 3AØGC: Simon, F9OW; QSL via K3RLY.

MOZAMBIQUE; XX71K and XX7FR: Active during CQ Contest. QSL via LREM P.O. Box 1234, Beira, Mozambique.

NEW HEBRIDES; YJ8BL: QSL via W6NJU.

PAKISTAN (West); AP2KS: QSL with 2 IRC to Mohd Khalid Shakur, P.O. Box 1270, Lahore.

SOLOMON IS.; VR4BM: Ralph; QSL T.O. Box 400, Honiara.

VIETNAM; XV4BP: QSL via his QSL Bureau, P.O. Box 2008, Bangkok, Thailand.

ZAMBIA; 9I7--: All 9J2 stations are permitted to use this special prefix during the 7th Anniversary of independence celebrations.

Is it true that the ham of today does no more than gossip on the air while twiddling the spun aluminium knobs and peering at the gleaming perspex dials of a shiny piece of commercially constructed equipment? If so the frequency bands allocated to amateurs are being wasted and should be re-allocated to a more deserving cause.

-- Wireless World, October 1970.

Another excuse for the lack of experimental transmissions is that techniques have advanced too far too quickly for the older generation. Should this not be the excuse for an increase in experiments?... Then there may still be time for us to prove that we can still make proper use of the frequency spectrum allotted to us, make journals such as Wireless World eat their words, and return to the days when being a radio ham (sic) meant more than being an amateur radio telephone operator. But hurry, time is not on our side.

-- A. Godfrey, ZL1HV (Bk-In, 3/71)

I have just about decided that amateur radio in itself has enough possibilities in general or specialised interest phases to serve as one's sole avocation, capable of absorbing one's entire attention outside of business interests and home life.

In fact, I have seen more than one case where the individual has allowed himself to become so engrossed in amateur radio that he has allowed it to become such a preponderant interest that his home life and even his health has suffered.

I admit that it is such a very interesting and intriguing activity that it can easily become an overwhelming and ever-demanding part of one's life, but this must not be allowed to happen.

To repeat previous warnings from people who knew what they were saying, "An amateur is balanced; he does not allow the amateur radio activities to overwhelm his responsibilities to his family, his business, and himself."

-- Autocall, Feb. 1971 (probably KØNL)

((EEB Ed Note: We have made the substitution of "amateur" for "ham" in the above text, because it was fairly obvious that the author was in fact talking about radio amateurs rather than their loutish imitators on the bands))

.... What's unique about "Principles of Electronic Technology" is the thoroughness with which it prepares the student for progression to other levels of electronic technology, whether it be maintenance, engineering, or being a true amateur of radio..... Like many other books, though, a home reader with real determination can master the text well. This, as always, requires reading, rereading, and thinking about each element presented, working out every problem and using every review question.

Don't be too ready to look down on basic electronic theory. There are few, other than practicing engineers and instructors who deal with such topics as daily routines, who truly have a comprehensive understanding of the basic subject.

Why? Because engineers touch lightly on basics only as a hasty stepping-stone to the higher and more complex subjects. Once learned, the basics are quickly pushed to the back of their minds, to be recalled, if at all, only with studied effort.

Radio amateurs often scan only the surface of the basics, grasping only those facets we believe will be of use in passing the various grades of licence examinations. We dig a bit deeper when we plan a construction project, but then only in a narrow specialised field of our immediate interest.

If you feel your mastery of electronic theory is not as complete as you'd like, "Principles of Electronic Technology" may be just what you're looking for!

-- BOOK REVIEW in Ham Radio, 9/70.

((See our Review of this book, last April)) ↓ 1971

RELEVANT LETTER: The State of the Art in VE

It would seem that there is a more developed interest in building electronic equipment in Australia than exists in Canada. I find VERY few Hams in Canada who build anything! In this respect I would conclude that amateur radio is much healthier down under. For myself, I appear to be out of step; in these times of gallons of SSB, I still prefer CW.

To the best of my knowledge we have only one national publication that makes any attempt to publish good technical material. I am referring to the Canadian Amateur Radio Teletype Group Bulletin. I will send a few copies of this publication to you.

Incidentally, in the event you have any miscellaneous Australian electronics publications extra I would appreciate them. I find your perspective most interesting indeed.

For my own activity, I have been working on some old WW-2 Command Receivers recently. At latest I have changed the RF and IF amplifier tubes to 6GM6 and the first conversion mixer is a dual triode (cathode-coupled). The results are amazing.

Other features are double-conversion (2nd IF is 85kHz from the Q5'er) and triple triode product detection. For a small package this makes quite a receiver. I also have a chassis stripped for rebuilding it, all solid-state.

The only remaining problem is the warmup drift which on 40M is 7 to 8kHz!

-- Frank Merritt, VE7AFJ, 152 Morison, P.O. Box 309, Parksville, B.C., Canada.

((One hazard of putting "hotter" valves in the front end of a receiver is that you will improve sig/noise ratio at the expense of linearity, and thereby increase susceptibility to cross modulation overload fron adjacent-freq. strong signals. This subject is discussed cogently by G3VA in "Amateur Radio Techniques" (which was reviewed here last February), and also a couple of years ago in EEB.

((That 6GM6 is certainly better than a 6BA6 for noise, and likely about the same as 6EH7, 6FV6, and the other Frame Grid bottles from TV. But the problem of controlling the gain of these valves whilst retaining linearity can be appreciable unless you let the screen float. The 6BZ6 has lower noise and better inherent gain control (remoteness), and the 6BY7 (British EF85) is still better.

((I have also tried cathode-coupled mixers, and their sig/noise is marvelous, but if any adjacent strong signal comes past your r.f. stage, this mixer can be a crossmod headache.

In fact, the above letter started me off on a review of recent receiver articles and some earnest discussions with our very capable Asst. Ed. The result is included in a bit of next month's article on "Synchrodynes etc", and subsequently. For the impatient, take a look at 1971 issues of Radio Communication and QST for some good oil on modern Rx design. I don't dare to try to go through it further in this issue of EEB or it will be delayed even more! I get sidetracked easily.

((I have seen the Teletype Bulletins which OM Merritt has sent, and find them interesting, although I know nothing about teletype. I am thinking that it could be worthwhile to start a Teletype Column in EEB....

==> ((Does anyone have any Australian technical publications to send to this chap (address as above)? Mine get torn up to file the essential bits, with the rest thrown away.-- Ed.))

STATE OF THE ART IN RADIO TELETYPE

((An interesting letter on this subject was published in the Technical Correspondence page of the August 1971 QST, by this same VE7AFJ as above. It was titled "The RTTY Crystal Ball", and appeared originally in expanded form in the abovementioned CARTG Bulletin, May 1971.

((In it, Frank tells how the old Models 14, 1e, and 19 have become obsolete, with spare parts becoming unavailable -- yet these have been the standbys for surplus equipment available to amateurs. Further, the 5-character teletype code is being replaced by the 8-level one, and machine speed is going from the usual 60wpm to 100wpm or more! All of this is going to require a considerable exercise of engineering skills from the amateur community; he continues:))

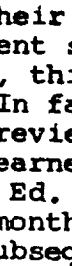
"These facts tell us with considerable exactitude what the future holds for us in teleprinter operations. In fact, it is possible now to buy very exotic teleprinters on the surplus market for a price that is directly competitive with the 14, 15, and 19 models. Usually these machines require overhaul, or at a minimum, service. This, however, is the byword of "our gang." RTTYers build.

"In the next few years we can expect to become much more familiar on the air with names such as Kleinschmidt and Mite. In fact, each upgrading of commercial equipment means an eventual upgrading of ham equipment when this equipment has completed its tour of duty in commercial service. It is (thus) true that the release of newer equipment from commercial service to amateur service will make our operations more involved..... The future holds the promise of more intensely challenging equipment to work with, which is what it is all about."

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

PUZZLE -- RLG

FREE ONE YEAR SUB (OR RENEWAL) FOR THE FIRST (Corrected for distance from Hobart) CORRECT ANALYTICAL (NOT NUMERICAL) ANSWER. IN EVENT OF A TIE, THE SIMPLEST ANSWER WINS ((Mathematicians like Barrie not eligible -- hi!)).



We know that $I = E/R$, and $P = EI$, and so $P = (E)^2/R$. So, where E_t is total voltage applied to these two resistors in series, $P_t = P_1 + P_2 = (E_1)^2/R_1 + (E_2)^2/R_2$

But $E_t = E_1 + E_2$, $R_t = R_1 + R_2$, So $P_t = (E_t)^2/R_t = (E_1 + E_2)^2/(R_1 + R_2)$,

whence, $$\frac{(E_1)^2+(E_2)^2}{R_1 + R_2} + \frac{2(E_1E_2)}{R_1 + R_2} \stackrel{?}{=} \frac{(E_1)^2}{R_1} + \frac{(E_2)^2}{R_2}$$

FIRST satisfy yourself whether this is true, by numerical substitution, and then attack it algebraically. You may find yourself in for some surprises in this apparently simple problem. Good luck! -- P.S.: I told you all I know was Ohm's Law. -- Leo.

((ANSWER IN DECEMBER ISSUE BECAUSE OF UNUSUAL LATENESS OF THIS SEPTEMBER ISSUE. But since this is November you'd best be quick answering!))

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

WHY NOT TUBES?

((The following item reprinted from Radio-Electronics, October 1970, by permission, because it seems a fair summary of the position))

Letter to the Editor ((of R-E)):

I want to congratulate your magazine for the challenging projects that are published in its pages. But I notice that most of the electronics magazines publish only construction articles based on solid-state components. I agree that this type of project has its advantages over the tube-based ones, but I feel that tubes are not yet out and that the reader should have a chance to acquire some practical background on the operation of tube equipment.

Also, many readers have various amounts of tubes on hand and the surplus market is loaded with inexpensive ones. So how about some articles with vacuum tubes?

-- Ubaldo Orgnero, Calgary, Canada.

Reply by R-E Editor:

We agree that tubes are not dead, but in many instances there is little excuse for using them. The transistor is often easier and less expensive to use, and always smaller. When you use tubes you have a much more complex power supply associated with the circuitry too.

We will present articles using tubes whenever the use of tubes gives the reader a tangible advantage; perhaps in high-frequency applications or extremely high-power circuits, otherwise we will continue to present projects based on solid-state components.

Postscript by EEB Editor:

To these categories we might, however, add a further portion. Reading of the recent literature seems to indicate that for mixers, beam deflection valves are even better than dual-gate MOSFETs, and less critical.....

--> LETTER: A Modulation Monitor, etc.

I thought you might be interested in (Sept. ECE) that trick oscillator circuit; my major interest in electronics has been in figuring out ways of doing something I wanted that appeared, at first glance, very difficult or impossible to achieve.

I had an amateur license, W2ZGU, primarily to test my ideas in practice; I have been far too busy recently to have time to get on the air, and my license has expired. But I can still have fun when I have some free time, dreaming up "impossible circuits".

Consider this one: PROBLEM: -- To build a modulation-monitor for AM transmitters which will give instant warning of overmodulation when plugged in to any transmitter, of any power, on any frequency, with no need for any adjustment when you go from a 5 watt beeper on 144 Megs to a kilowatt on 3.5 Megs.

I realise that straight, old-fashioned AM modulation isn't popular these days -- but that's what I was running then. ((It still sees good use on VHF and in New Zealand -- Ed.)).

Now the Federal Authority doesn't mind a bit if you go to 200% overmodulation on the positive swing, but its the negative modulation they care about.

So the question to be solved is: "How can you detect 100% negative peaks of modulation, have a signal flash to warn you, and not have to diddly-futz when you change transmitters?". This comes down to: "In what way are all transmitters, of any power or frequency, alike when they are overmodulating on negative peaks? Answer: They're all turned off. Zero power output. Nothing.

Then all we need is a zero-output detector!

Simple: One diode feeding signal to the grid of a 6E5 cathode ray ("magic eye") tube, with a small condenser to hold the zero signal long enough for the eye to see that the 6E5 "eye" has closed down. You can make it sensitive enough to work on a little 5-watter, and it will work just as well on a kilowatt-- because it works only when there is no wattage.

The actual contraption involves a coax T-coupler, with the 72Ω antenna feedline running straight through -- and the little diode hung on the T-branch. The impedance of the diode circuit is so high that the thing has no detectable effect on the SWR of the feedline. But since you may have a bad SWR hot-spot right where the monitor happens to be plugged in, it is a good idea to use one of the vacuum-tube type diodes, small size, rated for over a kilovolt (SWR voltages can peak up unpleasantly high!). Since you're using a 6E5, you'll have filament heating current handy anyway -- small solid state CRTubes aren't exactly handy to come by yet!

Solving complex equations by substitution of 0, 1, or infinity for the unknown is, to a mathematician, a "trivial solution". Multiplying by zero is mathematically abhorrent. But in engineering, multiplying by zero -- as in that monitor -- is useful and valid.

-- J. W. Campbell, Mountainside, New Jersey, U.S.A.

Editor's Note:

Science Fiction is a type of escape literature with relatively little characterisation, but lots of plot. When it is good, it is inspiring, and when it is bad it is horrid.

For about 35 years John Campbell has guided and inspired this genre in its best and worst moments, as Editor of "Astounding Stories" and later of "Analog". I was reading his authors and his stories at an age when I ought to have been studying more maths and history.

Maths now help me to make a living, and history shows me that men hardly ever learn by experience. But good Science Fiction showed me that men can dream creatively; and events have given these dreams some strange twists.

Dreamers of names von Braun and Asimov have shown the world the stuff of which dreams are made. Dreamers of names Frost and Wyndham have drawn nightmares from such dreams perverted from the lessons of history. Dreamers of names van Vogt and Henderson have lifted us from the nightmares of an insane world, to show what can happen when men are brought together from the depths of their lonliness.

John Campbell guided much of this in the days before rockets became a reality and then a nightmare, and he wrote some illuminating non-fiction essays, his Editorials.

He has sent us a few more of his ideas on electronics, and a nice article on an integrating flash photometer, characteristically doing something difficult with simple equipment. We shall publish it in due course.

Now John Campbell is dead, and we who knew him in the empathy of idea and imagination may grieve.

-- RLG

A CARRIER LEVEL AND MODULATION-INDICATING METER -- J. L. Reinartz, K6BJ

((Reproduced, courtesy Eitel-McCullough, Inc., San Carlos, California.))

A most useful device in the radio shack is a carrier level and modulation meter.

The circuit diagram below shows how simply such a meter can be constructed. The only item not readily found in the Ham Shack is the 0-50μA meter ((although even these are becoming available nowadays at moderate prices.)). If necessary, a 100μA or even 200μA meter can be substituted, although this article assumes the use of a 50μA meter fr the circuit constants shown.

If similar diodes are used for D-1 and D-2, no trouble should be experienced in the calibration of the device. These diodes should be point-contact germanium types, e.g. 1N34, 1N38, or 1N52 ((or OA200, computer board diodes etc)).

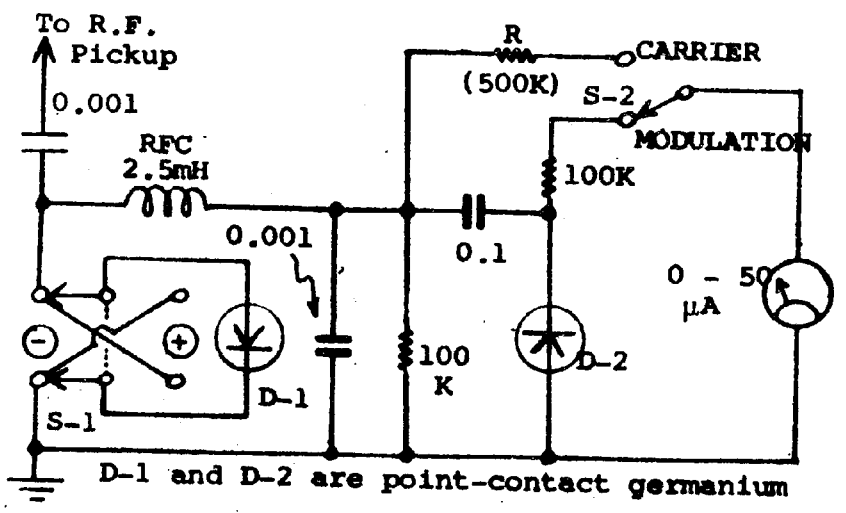
osc.

Any change in/carrier output with modulation (as from an improperly regulated d.c. supply) will cause undesirable "carrier shift", and can be indicated by this meter with the switch S-2 on "carrier" position.

To calibrate our meter for 100% modulation you can adjust R for equal meter reading with S-2 on "Carrier" and "Modulation" positions when the transmitter is 100% (a.m.) modulated. An easy way to do without a calibration oscilloscope etc, is to feed the oscillator of the transmitter with raw (unfiltered) d.c.; the two readings of S-2 should be equal under this condition. If they differ, adjust R until they are the same.

Our meter is now calibrated at the 100% modulation level. When coupled to a normally filtered a.m. voice modulated transmitter hereafter, it is necessary only to read first the carrier level (which can be adjusted to some convenient level by the strength of the r.f. feed), and then to switch S-2 to indicate modulation level, and then talk into the microphone. If the modulation indication goes to the same reading as the carrier did, 100% modulation can be obtained from your transmitter.

((Some allowance should be made for meter needle inertia, since it will not follow sharp voice peaks. This can be estimated quite closely by comparison with a CRO trace, or even with Campbell's simple "Magic Eye" type monitor, described elsewhere in this EEB -- Ed.))

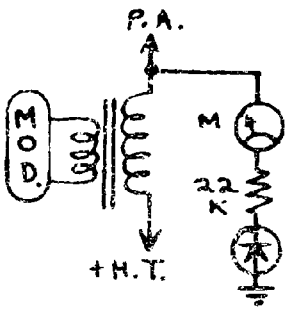


As an additional refinement, the DPDT S-1 has been included, allowing you to measure either positive or negative modulation peaks by reversing polarity of diode, D-1.

((Normally a.m. is monitored by the negative peaks, but relative measurement of positive peak level gives a useful measure of the effectiveness of various positive peak-expanding systems. The simplest of the latter involves the classic diode clipper and output filter on the modulator, but OM Reinartz has developed a rather unusual one which we should like to present here. But first we must test it out, because there have been reports that it is not as effective as claimed.

((Anyone have a good idea how to modify this useful device to work for Sideband? --Ed.))

>> From Technical Topics, Radio Communication, January 1971 comes a note of a very simple a.m. overmodulation indicator, using the circuit shown here at the left, from G3JKY. By the use of a switch and a shunt the meter also serves as Power Amplifier anode current indicator. Negative modulation peaks make the meter just lift off zero.



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SWOOP: -- Elise White (YF / KØCNV)

((From Amateur Rad. News Service Bull. 5/71))

Hams, like Sir Chancleer, bragging about getting the sun up, speculate on their prospective accomplishments of a national convention, Olympic Games and assorted glory, giving deals, but spook ((whinge)) like a fowl over a common everyday problem.

Don't misunderstand me, anybody bull headed enough to get his or her brain pounded full of holes for the privilege of taking on a mike or pounding a key can do anything individually or collectively they set their minds to if they get "I" and "me" out of the road, and start thinking and working "we"....

The hams have echoed with screams of pains, laments, opinions and classifications pertaining to car license call plates.

I have listened in awe as the complaints and excuses rolled in, same volume, in noise and number, after two called meeting with a composite attendance of 33 out of 5,000.

The old saw, "Let George do it" is more than evident, but I've found that as long as George was in the box he couldn't and didn't do a thing. Use a teaspoon in a gallon of water and no results; a cup to a gallon and the dirt flies. The principle is the same, the ingredients different.

Yes, yes, I's a fritter-brained blonde that don't know come here. With my inferior intelligence, I'm incapable of evaluating the situation. ((CONTINUED ON P. 77)) --

SOME THOUGHTS ON DIGITAL VOLTMETER DESIGN -- C. Pitcher (VK3)

Tentative Specifications

1) Low cost, e.g. to use as few parts as practical.
2) ±0.01% accuracy, or so.
3) Four figures, preferably with over-range (e.g. this gives one range of 19.999V, with 1mV resolution.)

At the moment I am looking hard at the Recirculating Remainder Encoder. This is similar to an idea suggested by RLG entitled "Idea for DVM using zeners and neon indicators."

Results so far:-

1) An accurate reference voltage from 1.000V to 10.000V, adjustable in steps of 1.000V, has been constructed. It meets the first (and most important) specification. The method of making it may have wider applications. I have broken it up into separate articles.

2) A readout I used on a counter has been successfully adapted.

3) A comparator has been developed from that on p. 325 of the G.E. Transistor Manual (fig. 13.36) using a 2N2646 Unijunction Transistor, which seems to be successful. But more testing will be required; I need a DVM to test it!

4) The amplifier will take some doing. It remains to be seen whether the complete instrument will be stable enough. If not I will either
   a) Revise the specifications,
   b) Try a different approach, or
   c) Take up fishing.

But the third alternative would follow several years work ((Ah, a well-deserved reward! -- RLG)).

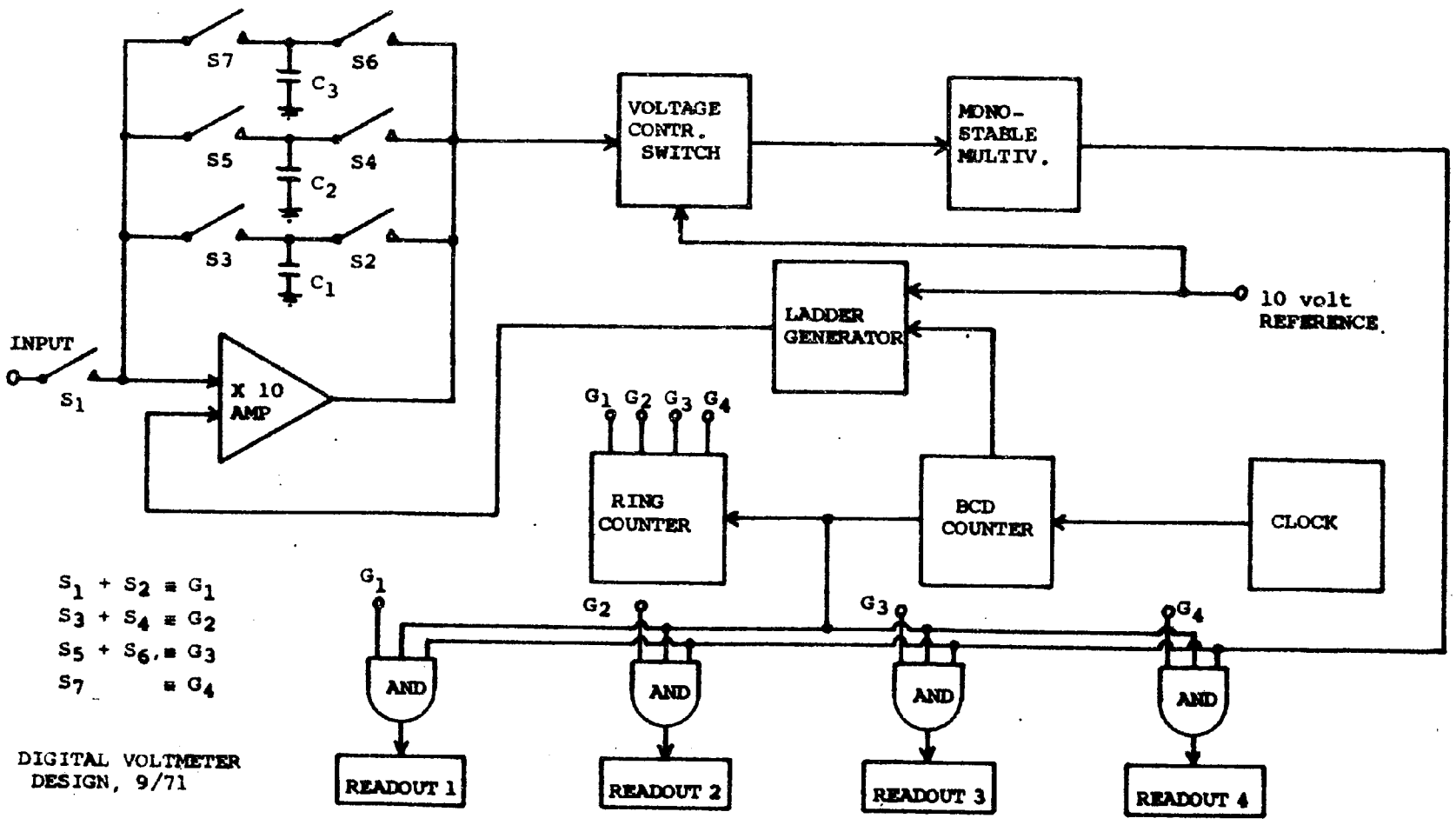
The Recirculating-remainder Analogue-to-Digital Encoder

This is a fundamental part of the simplified system envisioned, and is shown below. The operation is rather involved, but I'll give it a go; there was a full explanation, as used in the Fluke 8300A, in Radio-Electronics some months ago.

Consider an input voltage between 1.000 and 9.999V applied to the input. Suppose S1 and S2 are closed, and S3-S7 are open. The decade voltage ladder will be at zero, so the output will be ten times the input (Amplifier gain = 10).

The input to the voltage-sensitive switch (or comparator) will be a voltage between 10.00 and 99.99 (actually the saturated output of the amplifier, which must be >10V), and it will switch to the high output state, enabling the Voltage Controlled Oscillator; the positive transition will not trigger the monostable.

→90



The V.C.O. will generate pulses, which are fed into the Decade Divider. This drives the Voltage Ladder, producing a voltage at the inverting input to the amplifier which increases in 1.000 volt steps, until it equals the first digit of the input voltage. At this point the output of the amplifier falls below ten volts, and the comparator switches to the low-output state, disabling the V.C.O.

At this point, the readout column associated with the first digit will be displaying its value, since it will be gated on by the ring counter; this gating is also responsible for closing S1 and S2.

Also, capacitor C_1 will be charged to the difference between the voltage from the decade voltage ladder, and the input voltage, multiplied by ten.

The negative transition from the comparator has also, meanwhile, triggered the monostable. After its delay period, the monostable switches back to its low output state, triggering the ring counter. The ring counter (perhaps shift register would be better) opens S_1 and S2, closes S3 and S4, and enables the next readout column (x0.1).

At this point, the input to the amplifier is the voltage stored on C_1, as described above. The entire sequence then repeats, with the remainder being multiplied by ten and stored on C2 -- hence the name "Recirculating Remainder".

Descent from the Clouds

Consider a numerical example:-

INPUT = 2.613 volts. STEPS:-

1) S_1 and S2 closed; all others open.

2.613 - 2.000 (from Decade Ladder)= 0.613
0.613 x 10 = 6.13 (Stored on C_1),
"2" displayed as Digit No. 1.

2) S3 and S4 closed; all others open.

6.13 - 6.000 (frm Ladder) = 0.13
0.13 x 10 = 1.3 (Stored on C2),
"6" displayed as Digit No. 2.

3) S5 and S6 closed; all others open.

1.3 - 1.000 (from Ladder) = 0.3
0.3 x 10 = 3 (Stored on C3),
"1" displayed as Digit No. 3.

4) S7 closed; S_1-S6 open.

3 - 3.000 (from Ladder) = 0,
"3" displayed as digit No. 4.

((RAJR NOTE:
However, due to the uncertainty of this last digit "3" which could be 2.999 for example, in which case the last digit would register as a "2", the last digit may include an incorrect round-off error.

The usual way to overcome this problem is to process an extra digit and then correctly round off the previous digit, or employ another Voltage Controlled Switch, which in effect performs a ± 5 comparison on the following remainder.

This, however, introduces further complexity and higher cost, and anyway, if you really want 0.01% reproducibility, you will have to expect to pay out lots of very real money.))

Result

The main advantage claimed for this system, over other DVMs of comparable accuracy, is that it uses very few parts, and since the amplifier and comparator always work over the same range of voltages, their requirements are less stringent. This may be true, but the main sources of error introduced are:

1) Gain and offset of the amplifier must be controlled accurately. In this case, $10 \pm 0.001V$; input offset $< 1mV$.

2) The triggering level of the comparator must be defined accurately. In this case, $10V \pm 0.01V$.

3) The charge stored on the capacitor must be sufficient not to change appreciably due to the input current of the amplifier, yet small enough not to load the output.*

4) The actual voltage to be measured is only connected for a small portion of the encoding cycle. ((Hence, average voltages would be hard to evaluate in the case of varying voltages or noise. -- RAJR))

5) The design of the Ladder Generator would be difficult, as each step would have to have an accuracy of 1mV.

I feel, however, that it is possible to produce a workable result.

RAJR Note on the Block Diagram

This is not intended to be a constructional diagram. Many of the operational lines are just that. In a working unit one of these lines might be a loom consisting of four wires of BCD (Binary Coded Decimal) and a clock sync. system as well!

Author's Note:

I wish to express appreciation for assistance by the Asst. Editor, Rod Reynolds, in working out various points of this design.

---

* I.e., Z_{in} of the x10 amplifier very high.

COMMERCIAL VS. HOME-CONSTRUCTED ELECTRONIC EQUIPMENT -- J. Andersen (VK7ZFO)
((From Bulletin of the Tasmanian Division, W.I.A., Nov/Dec 1970, p. 2))

The primary fact to be remembered in the debate on commercial versus home constructed gear is that the Amateur Licence is an experimental licence. In granting the licence the Authority presumes the purpose to be:-

A. Educational: I.e., to instruct in the methods of construction and operation of radio together with the relevant theory.

B. Experimental: I.e., to advance the state of the art both in equipment techniques and the knowledge of the process of signal propagation. Routine or recreational use of frequencies is tolerated presumably on the grounds that any activity will at least increase operating skill. It also means that an amateur operator and his equipment will be available on request in times of urgency. Historically it should be remembered that the great majority of advances in communication techniques has resulted from Amateur activities ((Historically, indeed! -- Ed.)).

In order to maintain our privileges, amateur activities must be relevant to one of the criteria mentioned, and the level of activity must justify the frequency space allotted. Here a few further facts of life are important:

1. The standard of signal radiated is now necessarily very high, particularly on HF Bands.

2. Not everyone capable of passing the exams has the time, test equipment or constructional dexterity to produce equipment of an acceptable standard.

3. The range of activities in the amateur service does not require construction of equipment as a pre-requisite.

4. Emergency work is probably better undertaken using commercial gear where the fact that the gear is well known in design simplifies servicing and spare parts are more readily available.

Justifiable Uses of Commercial Gear

With these points in mind, some of the justifiable uses of commercial gear can be readily seen:

1. Operating skill. All DX-working and the majority of regular operation can come under this heading.

2. Serious VHF, UHF and SHF work. There is no need for the HF link, the main receiver, or basic signal generator to be home built. The time saved on these can be used where it matters -- in antenna and receiver front-end design and in research and operating.

3. Band Occupancy. Where time or travel or other circumstances precludes construction, one can at least remain operational.

Drawbacks

There are two major drawbacks to commercial equipment. On HF there is the tendency to use the bands only for recreational purposes. And on VHF there is a flood of activity on certain channels only.

Examination of Goals

Amateur radio now covers an innumerable range of activities. The main thing is to be doing something worthwhile. Here the recent letter by David Tanner, VK8AU in October Amateur Radio (1970) is worth reading and taking to heart.

My own preference is for the traditional approach of building something oneself to accomplish what is difficult or has not been done before. But in my view there is definitely a case for commercial equipment being readily available and used. It is most desirable that there be a high level of home-built construction, but this is not essential for the ((Continued, P. 92))

well being of amateur radio, providing it is realised that amateur licences are a privilege and that every licence holder has an obligation to conduct his activities to the advancement of one or more of the aims of the service.

RETROSPECTIVE COMMENT BY THE AUTHOR:

In reference to the EEB Editor's note about historicity of Amateur activities, I would comment that the opening of the HF and VHF bands was not a bad start, but sadly, history.

Since the above article was written, Novice licensing has become the "in" issue. Reasoned discussion of this raises the whole question of the justification of the Amateur Service, and this is implicit in the many discussions of the subject which have appeared recently in Amateur Radio.

Is the Service providing a pool of trained operators for the armed forces? -- the latter seem to be well supplied these days. Is it WICEN? Civil Defence is considerably better than even 10 years ago. Is it circuit and equipment design? Commercial neddies have this pretty well taped.

In short, why are we all here (and I do not accept, "because we're not all there"). Everything I've ever read in Amateur literature pussyfoots around this question. We should be very sure of what we are about here, as upon the answer depends the solution to nearly all the problems facing the Amateur Service, of which Novice licensing is but one.

How about an open forum on the subject?

-- J.E.A.

EXPERIMENTER, OPERATOR, or CONSTRUCTOR ??

-- Tom Moore, VK7FM ((From QRM/VK7, Aug 1971; truncated))

I suggest there is a useful place for all three types of Radio Amateur. Our qualification is called the Amateur Operators Certificate of Proficiency, even though the regulations are slanted towards Experimenters.

A good operator is a national asset, and being a good operator is deceptively difficult. It requires good procedure, articulate thinking, and a lot of practice.

How many real experimenters are there in our ranks? Very few in the final count, I guess, and this avenue requires... a sound knowledge...

A really hard look at we amateurs as a group reveals an almost universal shortcoming. Most of us have the"jargon" and can fluently discuss "this and that" using technical terms, but closer examination reveals only a thin veneer of real knowledge and a sad lack of the real foundation of electronic basic theory, without which it is extremely difficult to reason or understand the "how and why" or circuitry. (Thus both knowledge and operating skill are nec.)

Wonder Drug: A medicine which makes you wonder whether you can afford to get sick these days..... The woman who henpecks her husband is liable to find him listening to some other chick! (A/C 5/69

"Of course I know what a home is without children; its quiet"..... Budget: A device for making you worry about money before you spend it..... Inflation: A raze in pay.... Gossip: A wordy cause. (A/C 5/69)

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AN INFORMAL ELECTRONICS EXPERIMENTERS BULLETIN

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Puzzle Answer
Direct Conversion, an Evaluation; IV
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Worldradio. Solid State QRP Projects, W3FQJ.

OUR COVER

Its an ant of normal size, about to suffer indigestion. "Integrated circuits are made by building up layer by layer, on a tiny chip of silicon, minute equivalents of the individual components and providing the interconnections between them. A tiny Australian-made IC chip, containing 32 transistors, 7 diodes and 30 resistors is just a mouthful for an ant."

Reprinted, by permission, from "Discovering Integrated Circuits" -- an educational project information poster from Philips Industries Ltd,

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LETTER: Problems with the Leader LSG-11

Having attempted the FET conversion of the Leader LSG-11 Signal Generator as described in Amateur Radio, I have a problem which I suspect other people have had also.

The modulator will not modulate correctly. To me it appears to be intermodulating with the audio signal. Unfortunately I didn't check the output of the Sig. Gen. before modifying it, so I don't know if it was the same.

If other readers are experiencing trouble with the oscillator section I might suggest they check out the wiring comparing with the circuit diagram supplied. The way mine was wired I am surprised it worked at all.

If anyone has struck this and found an answer I would be pleased to hear about it.

-- R. L. Beckett, P.O. Box 98,
Carnarvon, W.A. 6701.

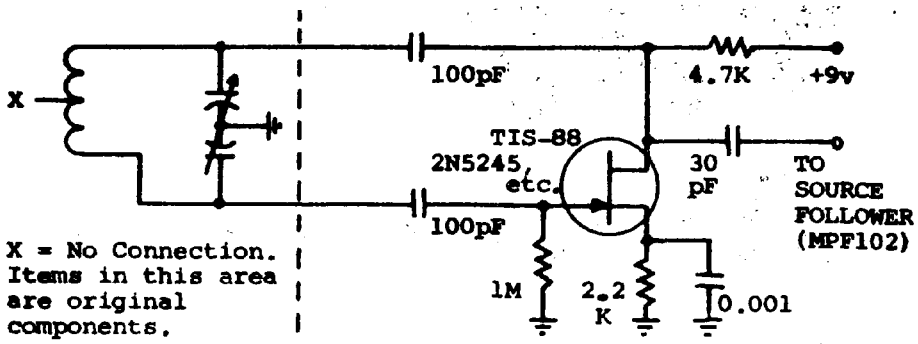
((Ed. Note: Perhaps the item here below may prove helpful?))

LETTER: State of the Art in Australia

While looking through sundry EEBs for a quick audio amp circuit idea, I came across the Letter in April '70 from "An Authority on the State of the Art in America" on p. 63. The Editorial Note said that the situation in Australia is also becoming grim. I would agree with this, but it can be fought, e.g. when magazines such as EEB and individual groups in the WIA still encourage an atmosphere of build-it-yourself, and learning in the process.

While prices for commercial equipment remain at an inflated level due to Customs Duty, freight costs, etc, the average electronics-oriented person will remain a home-builder or surplus-modifier. Parts, whilst expensive compared to the U.S. are still relatively easy to obtain, and there is nothing more satisfying than switching on the home-brew device (after considerable trouble-shooting, no doubt!) and watching it work -- a product of your own effort. Who said craftsmanship was dead? ((Ed Note: American correspondents say that American prices for components are not necessarily lower than many advertised in EEB))

Touching on another subject, many readers will have been interested in the article in Amateur Radio, March 1970 on the FET-conversion of the popular Signal Generator, Leader LSG 11; I have found that my LSG 11 is not wired as in the circuit shown in AR. In fact the original wiring was completely different. So, naturally the r.f. oscillator is now running in a different system:



Acknowledgement to ZL1BEB in June 1969 AR for the circuit idea. The signal generator now runs quite happily on the bench at the moment (still out of its box whilst the a.f. oscillator is worked over).

Finally, I must take issue with you on ICs. Contrary to your belief I feel that the Fairchild 900RTL series are priced at a rate interesting to the experimenter, and give you scape for dabbling in digital techniques cheaply. They can be used for all sorts of non-digital purposes, e.g. Geoff Cohen's (VK1ZVG) FM discriminator, E.A.'s FM detector (June '70), EEB's own multivibrator 100KHz calibrator. Linear ICs are still a bit on the expensive side, though, for most people.

EEB is still without equal in Australia. Keep it informal, argumentative, and miscellaneous.

-- D. Thomas, VK3ZVT, Mt. Waverley, Vic.

THE PUBLISHING BUSINESS (etc) IN AMERICA (etc)

((Inspired from the "VE" Column in Electron, November 1970))

1. QST (Canada)
2. CQ
3. 73
4. CQ goes elegant
5. 73 goes elegant
6. CQ backtracks
7. Ham Radio
8. 73 backtracks
9. HR economises format
10. Popular electronics reorganises columns
11. Science and Electronics discontinues amateur radio column.
12. CQ retrenches further: "none of the amateur radio magazines can be making a significant profit."
13. 73 starts a new magazine for novice, CB, etc, and pushes for a new no-licence at UHF.
14. National Radio Corp., U.S.A. (HRO etc) goes bankrupt.

and now retrenched

And on the Australian Scene, The Australian Experimenter and Coryra have ceased publication, while EEB has had to increase prices substantially, and W.I.A. membership fees have more than doubled. Yet Electronics Australia has brought out a new magazine for hobbyists, and Electronics Today has just appeared in obvious competition with E.A. What does it all mean?

Brandy Hair Tonic: Add one dessertspoon of salt, and four dessertspoons of good brandy. Put into a bottle and shake for 5 minutes (the bottle!). A sediment of salt will remain in the bottom of the bottle, but it is quite ready for use, and must not be shaken again. Rub well into the roots of the hair twice a week, and grey hair will be surely restored. Will work only if the brandy is sufficiently good.

REVIEW: "Transistor Ignition Systems Handbook" by Brice Ward (Foulsham-Sams, 1966). British Price £1.13 (22/6)

-- Reviewed by G. Johnson (VK7)*

This Handbook is suitable for anyone requiring a basic knowledge of how transistor ignition systems work, both bipolar and condenser discharge types.

It is essentially an American book, with an introduction to the "English" reader, regarding the position of obtaining components and making suitable substitutions. It may well be of value also to Scottish, Irish, Australian and other non-English readers.

The book consists of eight chapters and gives a good outline of the working of the internal combustion engine itself as well as coil design, switching circuits, energy storage, etc.

There is a chapter on practical transistor control systems, giving several commercial circuits, with component values. Capacitor-discharge types are also mentioned, with the theory of operation and several practical circuits. Details of installation are shown pictorially for all systems, complete with troubleshooting guides.

The amount of detail of commercial gear included suggests that the book is directed primarily at the Automotive Service Technician. But there is also sufficient detail given for some complete designs, to enable Aust/NZ constructors to duplicate their own. On the other hand, the briefness of detail given would not encourage a beginner who had no constructional experience.

In any event, the book is of value at all levels because of the wealth of information it contains on circuit fundamentals in the first half of the text, and is recommended to all experimenters interested in this subject.

Ed. Note: The book may be ordered directly from England at a substantial financial saving by sending a draft for about £1.25 to Blackwells Ltd, Broad St., Oxford, England, U.K. This applies as well to all other books published in the U.K., and Blackwells maintains quite a good stock of material on the shelves. The one difficulty with direct ordering is that Australian Banks have now raised charges for drafts rather steeply!

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* This item is for EEB readers who have indicated a need for coverage of fundamentals; see also 1970 EEB p. 114 ff, and Electronics Aust. series of late 1969 or so. Soon: "CD Ignition Squaretable" here.

SWOOP -- Elise White

((From Amateur Radio News Service Bulletin, March 1971, p. 9))

I had a couple of calls to make and after dialing the number I got some gentleman dictating a bunch of legal jazz. I broke the connection and I got into a discussion of the local PTA ((= Parents and Friends)) meeting. The third dialing connected me with a pair of youngsters who blew their minds over a local rock group. Joe White wasn't in sight so I demanded to know what in the Sam Hill he'd done to the phone and if by chance he was on the air and had the patch in the line.

He came wandering out of the bedroom looking confused and wanted to know what I was talking about. He hadn't been on the air but asleep. He hadn't fiddlefaddled with the phone and I must have flipped my marble or else I couldn't dial properly.

Not only was the phone (deranged) but (I had gone out of my mind) and my dialing finger goofed.

I gave him the phone and told him to dial. Very slowly and methodically he dialed the number, a smug look on his face. Guess what! He got a mother with a squalling baby talking to a doctor. Junior had just fallen and bumped his head and she was sure he had a concussion.

I thoroughly dislike inanimate objects that perversely decide at inconvenient times that they won't work, go, or are tired and want to rest. Joe gave me one of those, you-did-this-on-purpose looks, and muttered he better have lunch pretty soon or he'd be late to work.

I'll grant you I accused him unjustly but the telephone had that hollow sound like when he gets into the telephone. How was I to know that he wasn't. I guess I'll be forgiven some day.

<<<<<<<<<<<>>>>>>>>>>>

Fiddle-dee-dee
Oh fiddle-dee-fuss
Make what you will or you want of us
We talk about theory and recipies too
And talk about books that we think will do
And if such 'lectronics be not right for thee
Go read the good straight stuff in IEEE.

Unique Weed Killer:

Boil three whole eggs in a quart of water for 15 minutes; ensure that the eggs are brought gradually to temperature so that the shells do not crack. When the eggs have been boiled, discard them, and apply the water to the weeds. Is said to work wonders.

For large amounts of week-killer the commercial stuff is cheaper than eggs. But beware of those 'hormone' preparations; unless they are used properly they just encourage the weeds to grow!

STATE OF THE RECEIVING ART -- III -- RLG/RAJR et al

-- Homodynes, Synchrodynes (briefly).

"A little learning is a dangerous thing,
Drink deeply or taste not the Pierian Spring
Where shallow draughts do but
intoxicate the brain,
Whilst drinking largely sobers us again."

-- Alex. Pope (Essays)

((The same Author was also responsible for something about Fools Rushing in..... but we'll let that pass.))

In Part II of this series (April 1971) we examined some fundamental definitions of mixing and detection in an attempt to clarify nomenclature in this field. From some response we have had, this has been a mixed success.

We summarise a few main points here, and amplify and clarify them as appropriate? We include the main arguments for and against Direct Conversion, and we prepare the way for a better discussion of "true" synchrodyne detection. We shall also be discussing some letters we have received on these subjects, and eventually present a number of relevant References.

1) PRODUCT MIXING (fig. 2)

This is just an "ordinary" mixer, as you would use for First Detector or Product Detector in any receiver. Consists of mixer, local oscillator, and suitable output filter. The other name for Product Mixer is "Product Detector", same beast, because the audio signal it produces (after suitable filtering) is a result of the products of frequencies fed into it.

2) DIRECT CONVERSION (figs 5 or 3a)

2A)) Output is at a.f.,

and input is at signal frequency, usually at the front end of the receiver. Selectivity is obtained by a.f. filtering and no i.f. is "needed". It can involve simple product mixing as in fig. 5, or synchronous product mixing as in fig. 3a. More about the latter under "Synchronous Detection", below.

IN COMMON USAGE, "Direct Conversion" usually refers to the system of fig. 5, using a Local Oscillator not necessarily locked to the signal. This can also be called "Homodyne" (Ref. 2).

2B)) Advantages of Direct Conversion

In contrast with the superheterodyne which provides most of its gain at i.f. (etc), the (Homodyne or Synchrodyne) Direct Converter gets its signal gain from high a.f. amplification. Similarly, se-

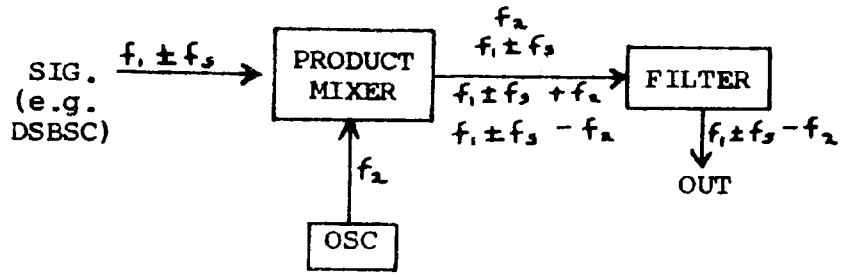

Fig. 2: Simple Product Mixer (f_s = sideband frq)

Here the signal and oscillator frequencies are multiplied and mixed together -- therefore "product". In this mixture are the original frequencies and a host of others.

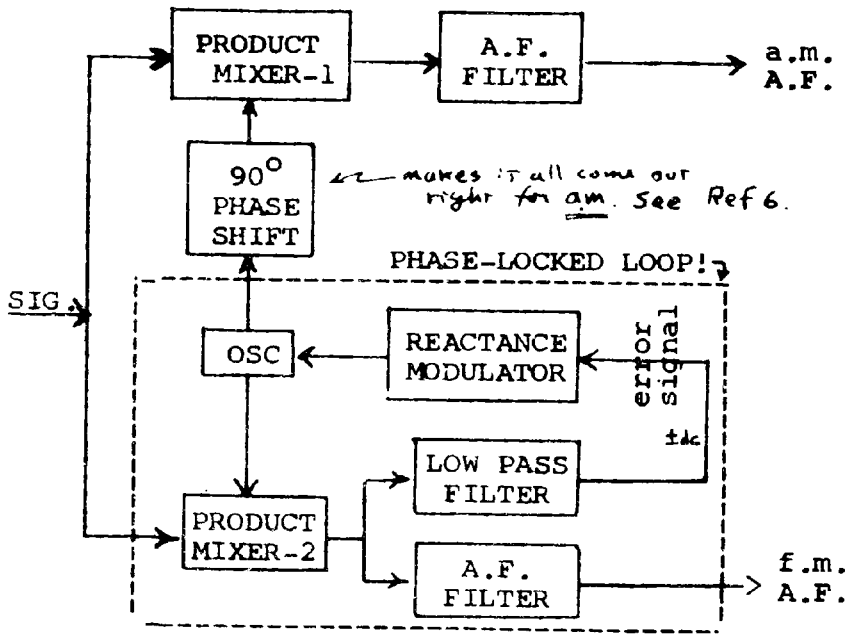

Fig. 3a: SYNCHRONOUS DETECTION; for Carrier signals only. For a.m., the signal goes to Product Mixer-1 to be detected, and it goes to Product Mixer-2 to keep the oscillator locked in phase with it. This is accomplished by the notorious Phase-locked Loop, shown in the dotted area.

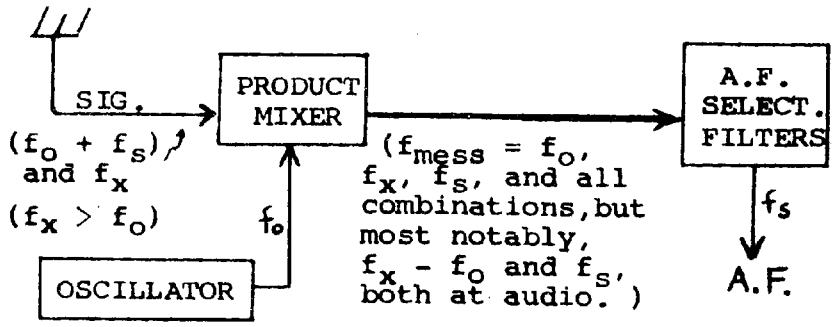

Fig. 5: Direct Conversion with simple Product Detector. Selectivity depends on suitable sharp A.F. filter. (Here, f_o is the desired signal carrier, f_s is its sideband, and f_x is an adjacent interfering carrier to be filtered out by the A.F. selectivity filter(s))

lectivity is governed by bandwidth of the a.f. rather than i.f. filters.

The principal advantage of the Direct Converter, "DC" (I'll use "d.c." when I mean direct current) is the simplicity with which it achieves remarkably good sensitivity and selectivity. As Ed Noll puts it (Ref 16d), "Solid-state direct conversion is encouraging receiver construction; simplicity, low cost and good performance are its virtues....." *

2C)) The Uses of Linearity

"Proper" mixing is indeed nonlinear mixing: The local Oscillator beats with the signal and the simple product frequency is the desired output.

This mixing occurs within the valve (or FET etc). If the mixing occurs at the grid (gate, etc), the grid has no way of telling the difference between the L.O. signal and any interfering signal -- so it mixes the lot!

In "proper" mixing you can separate desired from undesired signals, because they are mixed separately with the L.O. and not with each other.

When crossmod occurs, the desired weak signal is in fact mixed with an undesired strong one at the grid, so that they cannot be separated by ANY output filtering. Its obviously important to know when this is happening (Ref. 10).

The grid is supposed to pass the two signals LINEARLY, but to mix each one independently with the oscillator NONLINEARLY. This allows the signals to be separated by subsequent filtering. There are various ways to do this mixing most effectively, e.g. "balanced modulators" (10, 12, 13, 16a,e, 26, 30, 31)

This subject was also discussed in the Receiver Front-End Series in 1968 EEB, but for the first time I (RLG) am beginning to understand how a mixer needs to be both linear and nonlinear at certain times; Rod says that no "single port" device can do the former very well -- which is why a dual-gate FET is better at it than a single-gate one.

A mixer with high linearity will handle comfortably a wide range of signal input levels. This is called "wide dynamic range". For a given dynamic range, a low general input level will give less X-Mod than a high input; thats why antenna attenuators are used; but they then require more i.f. or a.f. gain.

Why, then, do we want highly linear mixers? To maintain a good S/N ratio. If you attenuate the strong signal to avoid X-Mod, you'll lose the weak signal in the valve (or FET) noise.

Thus there must be a compromise between sensitivity (re S/N) and linearity (e.g. X-Mod tendency). This is illustrated by the chart at the bottom of this page.

The Chart is fairly self-explanatory, but we'll still explain it.

((1)) The nasty mixer needs PMG to overcome its internal noise, but this increases the tendency to overload, ecce X-Mod. But this X-Mod can be reduced by better pre-mixer select.

((2)) The triode or sharp cut-off pentode mixer is often hailed as a godsend, with a Noise Resistance some 100 times lower than a pentagrid converter: "its amazing how quiet the receiver becomes, the signals just pour through" -- and indeed they do, and all together.

If you plug that 6J6 into a socket preceeded by an RF Stage (or two), cross-mod becomes certain. If you remove the TRF Stage you'll worsen r.f. selectivity, so increasing X-Mod. The only answer is to keep the r.f. stage while decreasing its gain -- but doing this by more bias increases noise; properly you should decrease coupling, adjust impedance matching to suit the 6J6, etc -- but this is far removed from a simple "plug-in jobbie"!

((3)) Now when we install a Beam Defection valve or a properly biased and matched MOSFET, we now get nice low noise without the RF stage, and better linearity AND a lower →98

MIXER	TYPICAL	FAMILY	PMG	W.S. S/N	S.S. XMOD	NOTE
Nasty Pentagrid	6BE6, 6SA7	Noisy, Nonlin.	NO	--	±	((1))
			YES	+	+	
Cathode Coupled	6J6 (Re: 8,27, 29)	Quiet, Sharp	NO	+	+	((2))
			YES	+	++	
Beam Deflection	7360, 6BJ6	Quiet, Linear	NO	+	--	((3))
			YES			
DUAL gate MOSFET	3N141, 40673	Quiet, Linearish	NO	+	-	
			YES	+	±	
BIPOLAR Transis.	2N2996 etc!	Noisish, Nonlinear	NO	±	±	((4))
			YES	+	++	

HEADINGS:

PMG = Pre-Mixer Gain. We didn't say "RF Stage" because an RF needn't have gain. One important use for a Tuned RF Stage is to increase selectivity; see RAJR Addendum for details. Without appreciable gain, a tuned RF stage can thus reduce X-Mod by tuning out adjacent QRM. But for a given selectivity ahead of the mixer, X-Mod is worsened by RF gain. Everything in Receiver Design is a compromise ((and a headache -- RLG)).

W.S. S/N = Signal to noise ratio for a weak signal. This may not be the same S/N as for a strong signal, but we assume that for amateurs the W.S. is the one of interest ((For telecommunications, the strong one is best --RAJR))

S.S. XMOD = Strong signal modulation of the weak signal. These comparisons apply only for the same pre-mixer selectivity, for reasons mentioned under "PMG". Better r.f. selectivity will, of course, reduce X-Mod.

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* This excellent article in the Nov 71 Ham Radio does a good job on theory and practice of DC, but I am rather embarrassed by Ed crediting me with the knowledge which comes principally from Rod Reynolds, Dick Ferris, and a little reading. I'm just the Scrivener! -- Leo.

input signal. The bigger is that input signal the worse strain you'll be placing on the linearity (Ref. 24).

((4)) A bipolar or any single-input device won't distort too badly if you don't feed too much signal into it -- thats why those triode mixers do work. But if you are using one, is that chap across the street overmodulating, or is it happening in your own receiver? Better be certain before you pick a fight.

Now, the high linearity is attained best if the mixer is "balanced" (10, 12, 13, 16a,e), but if the valve (etc) is good you can get away without it (Ref 24a, 28 - 31).

Alternatively, Hot Carrier Diodes (13) may be used, or a gual gate MOSFET for good linearity. Ref. 21 claims that this semiconductor can be made "equal in all respects to the best that can be had with vacuum tubes" but Ref 24a quotes facts and figures to show that this is not so. The beam deflection valve will handle some five to ten times more input voltage for a given distortion; but FETs <u>are</u> fine if the signals are not too strong. The next best thing to beam deflection appears to be use of FET + H.C. Diodes (<u>13d</u>).

All right, now a <u>Linear Mixer</u> is good, wherever it is used, and now you can understand why there is no special magic in DIRECT CONVERSION: it is the high linearity of the mixer which reduces Crossmodulation in a DC, and that mixer merely happens to be located at the Front End. The linearity also makes audio filtering more practical (c.f. 24a, 28, 31).)

NOW simply translate all of the above ideas from the First Converter of a superhet to that of a Direct Conversion Rx, and you have just the same situation. The only difference is that output is at a.f. rather than at i.f.

But if you use a noisy mixer, you'll get low sensitivity. Use a nonlinear mixer and you'll get nasty crosstalk from any really strong signal. Use the conventional r.f. stage, and have a good chance of making the crossmod even worse (c.f. Refs 10, 21). I mention this only because someone has actually suggested it (9).

2D)) <u>Some Other Uses for Direct Conv</u>.

Thus it may be seen that the benefits of DC arise principally from the use of better components and low-level signal processing, rather than from the fact of early detection.

It is the low noise and high linearity of the mixer which allows elimination of the r.f. stage, while retaining good S/N and immunity from crosstalk.

And it is the a.f. stages which provide the gain formerly furnished at i.f., but the requirement still remains for low amplifier noise and for good selectivity filters.

The obvious question arises: If this can all be done with a well-designed Direct Converter, and if the same principles apply, then why not with a well-designed Superhet? It can indeed, and to excellent advantage -- as we shall discuss later.

The simple "Homodyne" (non-synchronous) form of DC has acquired much popularity because it proves a simple way to receive SSB-suppressed-carrier (or CW) signals. It has received a substantial amount of attention in the past two years, principally in <u>QST</u> (18-20, 22), <u>Ham Radio</u> (14, 16d), <u>Radio Communication</u> (pretty solidly throughout 1969-1971), etc (9, 11, etc).

Let us consider a few which seem particularly worth mentioning:

((1)) Doug DeMaw, W1CER, has been publishing a lot of good material on receiver design in general, and DC systems in particular (18, 21b, 22) in <u>QST</u> from 1969 to the present; indeed the whole subject of DC was brought to the attention of the amateur community in the 1968 article in <u>QST</u>, November, "Direct Conversion, a Neglected Technique". What a hornet's nest they stirred up!

An interesting variation on the theme was described in Ref. 22 with a Direct Conversion Converter: A DC (i.e., product mixer) detector modulates the bias on a crystal oscillator, amplitude-modulating it, and allowing it to drive an ordinary automobile radio as i.f.; the latter provides no selectivity. It does seem an elaborate way to get a lot of a.f. gain, but it is simple if you already have a radio available -- this matter of "simplicity" can be stretched.....?

An interesting idea is brought up: a super-regenerative detector is simply a Direct Conversion detector, of antique vintage! But in my experience, without an r.f. amplifier its broad as a barn -- and it radiates; some <u>Ham Radio</u> articles last year or so showed how to reduce the radiation by diode damp ing, but the super regen is still broad, and I'm surprised to see it appear in <u>QST</u> nowadays.

((2)) The same W1CER has been presiding over a series of articles beginning with May 1969 to Sept 1970 in <u>QST</u>, featuring DC receiver design coupled with high quality QRP transmitter design (18, 20). <u>QST</u> seems to have been the leader in good design; look up the back issues

of QST in any big library; if your library doesn't have it, it can be obtained anywhere in Australia on interlibrary loan (and likely similar in N.Z.).

((3)) Ed Noll, W3FQJ, has been giving DC and Phase-Locked Loops a thorough basic and applied going-over in Ham Radio (Ref. 16) in recent months, and probably continuing. This is also a MUST item for anyone interested in this subject. If you don't subscribe to HR you ought to -- considering the remarkably low subs rate we can still (?) obtain through EEB.

((4)) Various current items of more or less conventional nature have appeared e.g., in Break-In (9), CQ (11), QST (20), and in Ham Radio (14), not to mention the general coverage afforded such matters by G3VA (Ref. 24b).

((5)) "Resurrecting a Granddaddy" (Re 25) presents the simplest possible DC: A Crystal Set! But as we mentioned on p. 34, for the modern understanding of DC we must use a heterodyne process, which rules out the envelope detector.

On the other hand, one must admit that this is an odd one: This crystal consists of a Zincite (ZnO) crystal with a stell wire catswhisker -- and the author claims that it regenerates and amplifies! ((No! -- RAJR))((Oh? Its supported in a Letter in QST, Sept. 1971, p. 49 -- RLG)). So it could indeed qualify as a DC, I suppose. But I don't see how it could possibly work. Anyone know? ((It can't without a source of external power! -- RAJR)).

((6)) Various references have been supplied by readers, to relevant articles in Wireless World which it seems publishes a lot of sophisticated information. I don't have this first-hand; WW is one of the few magazines I don't receive; one has to draw the line somewhere.

That information from readers will be presented here, but a little later.

3) SYNCHRONOUS DETECTION
(E.g., fig. 3a, herewith improved a bit)

3A)) The System

At the risk of repeating ourselves, and for the sake of the readers who have expressed bewilderment on this subject, we maintain that S.D. does and mut synchronise the local oscillator with the received signal -- whether or not its carrier is transmitted! This is done easily with AM or FM, while DSB requires a bit more circuitry to regenerate the (non-transmitted) carrier from the sidebands! (Ref. 28, p. 88; details Ref. 31).

In fig. 3a, the d.c. portion of the output of PM-2 is selected by the Low-pass Filter, and this voltage forces the Voltage Controlled Oscillator (i.e., the "Reactance Modulator" + "Osc") to lock with the signal. The a.c. portion of the output of PM-2 is selected by the a.f. filter and gives demodulated FM directly.

For AM, PM-1 is necessary, and gives demodulated audio directly when signal is mixed with the output from the VCO. The phase-shifter is necessary to make everything come out right, and the a.f. filter filters out both d.c. and r.f., leaving only lovely audio.

Again, it is important to realise that such use of Synchrony is Synchronous Detection, whether its input is at i.f. (e.g., Refs 15, 27-31) or at r.f. (viz., so-called conventional Direct Conversion).

When Synch. Detection occurs at the Front End of the Rx, you can call it "Synchrodyne", a form of DC. When Detection is non-synchronous you can call it "Homodyne". Both use product mixing.

Thus, if the local oscillator has no obvious feedback control of frequency, it is properly Homodyne, not Synchrodyne. If an article doesn't say, you can usually assume "Direct Conversion" means "Homodyne", with no oscillator synch.*

We're definitely running out of room for this subject for this issue. Next time: Another Introduction to some real meanings of the Phase-Locked Loop (fig. 3a within the dotted lines), a word about "Exalted Carrier Reception", which does happen to be relevant; and a summary of Homodyne DC with a brief comparison with superheterodyne technology. And in the subsequent issue, some surprising consequences of a good use for the PLL. After that, a survey of good Superhet Receiver Technology -- if I have the strength!

We should like here to express much appreciation for quite a lot of useful information supplied by Jim, W1DTY, usually arriving in time to require extensive revision just as we were going to press!

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* But note that a local oscillator may pull to lock in with an AM (or incompletely suppressed SB) signal, and therefore synchonises even though no obvious loop is involved. Thus, synch. with no obvious cause -- RAJR.

RAJR ADDENDUM TO DIRECT CONVERSION ARTICLE:

THE USES OF TUNED R.F. STAGES

Classically an R.F. stage has had two principal functions: To improve S/N at the mixer, and to improve signal selectivity.

As our knowledge and requirements become more exacting, we are able to design mixers which are more sensitive and more linear, and to obtain good selectivity at high i.f. (so avoiding images). It would appear that the R.F. stage has become unnecessary.

Yet no mixer is so linear that it will take unlimited abuse from interference be unwanted adjacent signals ("QRM"), and semiconductors are particularly offensive in this regard.

A given number of variable tuned circuits will give substantially more selectivity when separated by R.F. Stages. Thus, a TRF stage having no net gain will reduce X-Mod in the mixer -- assuming no X-Mod in the R.F. Amplifier (and that is another story indeed).

The gain of an R.F. stage can be reduced by variable coupling (phasing -- not merely separating the coils), or (more conveniently) by input attenuators. But NOT by bias applied to grid(s). The latter increases noise.

Yes, the ordinary "RF Gain" control introduces noise. That's one reason why you run it "wide open" for weak signals. That this leads to crossmodulation in mixer or I.F. stages, motivates us to use more linear amplifiers. That a "wide open" r.f. gain control lead to unpleasant effects on a.m. from adjacent s.s.b.s.c. signals, impelled the use of product detectors at the end of the i.f. stages. Ordinary "BFOs" just could not put out enough carrier (Refs 29-31).

In conclusion, the Tuned R.F. stage will generally reduce X-Mod if an input attentuator (say) is adjusted to produce the same mixer input (assuming no R.F. Stage X-Mod). This is a consequence of improved filtering of unwanted signals by the R.F. Amp circuitry, compared to the use of the same number of tuned circuits without the R.F. Amp.

The use of an R.F. stage is thus seen to be an advantage, if properly used, and its present disappearance from the front ends of receivers is mostly a matter of convenience, principally to Industry.

Why?

a) We no longer need the gain to overcome mixer noise.
b) Mixer sensitivity is now comparable with galactic noise. Why go further?
c) R.F. stages cost money.
d) New-design mixers have sufficient dynamic range (as defined above) to be much better than the older circuits (though they are NOT perfect.

Therefore there is apparently no need for the R.F. Amp. But one day (c. 2000AD??) when 3kc (or less) spacing throughout the HF bands is law, we might need R.F. Stages in order to pick up any weak signals. The direction of the design of such sophisticated TRF's is a very interesting one -- but that's another story....

DIRECT CONVERSION REFERENCE LIST -- with comments
-- Continued from the April one, p. 41.(RLG)

This item is presented as a Labour of Love for those souls who appreciate such things, and with apologies for those who regard them as a waste of good space.

There are several references we have not included, either because there has to be a limit, or because they are more relevant to the discussion of PLLs, to come. Some relevant material on that has appeared in the famous "Deltahet" series in Electronics Australia, available from the usual sources (or Box 2728 GPO Sydney 2001, for $).

Application notes on PLLs and related subjects are also freely available from Signetics and from Motorola -- if you live in America. Here, try writing on good Letterhead to Technico Div of Pye (e.g. in Melbourne) for Signetics information (and ICs); and to Motorola, Sydney if you are big enough to get a reply.

Transistorised in 1971

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8) Amateur Radio, May 1968: "Improving the signal-to-noise ratio of receivers (that incorporate the use of 6BE6 mixers" by J. Jones, VK2ZET/2, p. 12. -- Uses cathode coupled 6J6 with ENR = 2K compared to 250KΩ of the 6BE6! Also covered in Refs 27, 29, etc etc.

9)a) Break-In, May 1971: "An Experimental Direct Conversion Receiver" by F. Johnson, ZL2AMJ -- With an MPF102 in front end, module osc and af; similar to Ref 14 here. Contains a pretty good REFERENCE LIST on this subject, mostly referring to QST and to Radio Communications.

b)The Milliwatt, Aug. 1970: "A simple Direct Conversion Receiver for 7Mc" by V. S. Buccicone W9IIL. -- Uses Balanced Mixer and if you replace those horrid 1N34As by 1N23s or (preferably!) by Hot carrier diodes (Ref. 13 here) this will probably be a nice design.

10a) CQ, Jan and Feb 1970: "Receiver Signal Handling Capabilities" by W.M. Scherer, W2AEF-- What causes strong-signal overload, crossmod, and how to measure it. FB. See also several other good receiver articles in 1970 CQ's.

b) Aug 1971: "Analytical approach to mixer spurious evaluation" by J. Perolo, PY1PE1C.-- More of same, mathematical treatment.

11) CQ, May 1971: "What to do with an old converter" by R.E. Baird, W7CSD. -- Run it into a Direct Converter to get rapid output. Has the advantage that the converter front-end gets rid of audio images.

12) Ham Radio, March 1968: "Double Balanced Mixers" by J. Fisk, W1DTY. -- A thorough and practical treatment of IC Ring Modulators. They consist of input and output transformers and the usual diode ring, all potted. Can be applied to sideband generation, converters, detectors, modulators, or spectrum generators. This was the first issue of the magazine so may be unavailable from HR, but so many copies of that issshave been given out you're sure to find someone with one loose (or see the library). Maybe this issue will be included in HR's someday-anthology??? CQ and 73 have had several anthologies, and so why not HR too (and EEB!). See also Ref. 26 here

13)a) Ham Radio, Oct 1969: "Hot-Carrier Diode Converter for 2 Meters" by G. Van der Haagen, K8CJU.-- How and why these improved point-contact

diodes make better mixers; c.f. Ref 28 here. NOTE: A new relatively inexpensive line is made by Hewlett-Packard, and is available in Australia; see EEB Advertisement page.

13b) HR, Oct. 1969: "A practical discussion of product detector operation, including a new high performance product detector using hot-carrier diodes" ((Wot a title!)) by M. Goldstein, VE3GFN. (See also Ref. 2 or 28, p.80)

13c) HR, Oct. 1969: "Hot-carrier diode noise blanker" by R. W. Campbell, W4KAE. -- The use of these very linear, low threshold, low noise diodes in a Noise Blanker which Blanks without crossmodulating -- a nasty problem not commonly lentioned by authors of Noise Blanker designs. It even improves the S/N.

-- See also: IC Noise Blanker in HR 5/69.
-- And: A fairly nice valve equivalent in 73, 4/70, or Electr. Aust. 8/69.

→ See also: Amateur Radio Dec. 1971, p. 3-6

13d) Radio Communication, Jan 1970, p. 25, "Technical Topics" by Pat Hawker, G3VA. This sums up the situation of the use of hot carrier diodes. In a rather interesting review of a Marconi high performance receiver, G3VA in TT of Feb 1970 suggests that "If you are going to use semiconductors in the front end of a receiver rather than, for instance, a beam deflection tube, then (the combination of FET linear amplifier and hot-carrier diode bridge mixer) is probably the most linear system so far, unless you are prepared to tackle the complications of the paramp up-converter" (which is described in Ref 28 here). The Marconi design allows reception of a 100μV signal without excessive crossmod from a 180mV signal 15kc away -- and this without use of an antenna attenuator.

14) Ham Radio, Oct. 1970: "The Sideband Minituner" by R. Littlefield, K1BQT/6. -- A DC Receiver, simple HEP 802 common gate mixer, audio module.

15) Ham Radio, Sept 1971: "Multimode I.F. System", by R. Factor, WA2IKL. -- Another lovely application of the Signetics NE560 PLL (for others see Refs 5, 6), allowing it to be used at output of the i.f. stages. Of course this allows the advantage of mechanical filter selectivity, giving far better shape factor than a typical simple audio filter used at the output of direct conversion systems. Gives superior detection of AM, FM, and SSB; with an improved audio compressor as AGC thrown in. Uses IC for Bal Mod Detector and IC for compressor (but you could build the latter easily from the usual lamp + LDR). This article also gives a note on the availability of the various ICs, which can be useful to us as well -- though for different reasons.
→ Signetics PLL ICs can be obtained from the Technico Division of Pye Industries P/L in Australia at prices actually comparable to American (plus tax of course). It can be a lot, but you get a lot of IC in a PLL!
↳ Late news: These have been reduced to about $12.

16a) Ham Radio, Aug 1971: "Integrated Circuits" by Ed Noll, W3FQJ. -- Being quite a compendium of state-of-art information on the latest practical balanced modulators, demodulators, and processors. Also a bit of his usual good oil on antennas -- hmmm, trying to do a G3VA? See also 16e, below.

b) Sept 1971: "Phase Locked Loops" by W3FQJ. -- Simple theory and practice, and notes on a new 75w transistor for Class B lin. An excellent Reference LIST in included on these subjects, including some items to be ment. here.

Note that this is the same Ed Noll who produced the worthwhile series of books published by Sams, e.g. FET Principles and Practice (Reviewed in HR on 2/69, p. 71), QRP Solid State Projects (Reviewed recently in EEB etc), and several books on antennas (Reviewed in EEB).

16c) HR, Oct 1971: "Experiments with Phase-Locked Loops" by same author. -- Just that. Want to play with them? Read this.

d) Nov 1971: "Direct Conversion Receivers", same author. -- Good general practical summary. Includes Homodynes, product detectors of various sorts, but no PLLs (for that see 16b,c, etc). A very good additional REFERENCE LIST includes a variety of items from recent Radio Communications, QST, and -- EEB!

e) Sept 1970: "An Integrated-circuit Balanced Modulator" by K8QWR. -- Describes the Motorola MC1596G used as a balanced modulator, a.m. modulator, a.m. detector, product detector, mixer, or frequency doubler. Consists of a dual differential amplifier.. Seve ral practical circuits are shown, and a block showing a receiver with no i.f. gain but sensitivity better than 0.1μV for 10db S+N/N. It uses an IC as r.f., balanced mixer, product detector, and a.f. power stage. I suppose the next step is one IC containing the lot; just connect antenna and loudspeaker and you have made your own radio.....?

17) Ham Radio, Oct 1971: "CW Processor" by D. E. Hildreth, W6NRW. -- A curious circuit which turns CW into DSBSC, then recombines that with the CW to get FM. Has considerable advantages of better signal/noise ratio , etc.

18a) QST, May 1969: "Direct Conversion 80-10 Rx" by D. DeMaw, W1CER. DC with a CA3028A IC mix. "A 0.3μV CW signal can be detected easily..." Uses pre-detector converters for bands < 80M.

b) June 1969: "QRP 80-40 CW Transmitter" same author -- to go with the above. Gives some 1.7w from a 2N2102 in a really careful design. There are a lot of QRP transmitters published but they tend to turn out poor signals unless severely troubleshot (which doesn't always occur) This one claims to be immune from such grief, and should be a model as a guide to design.

c) March 1970: "Packaged QRP for 3.5 and 7MHz", same author -- a and b in one package.

d) Aug 1970: "Once more with QRP", ditto. -- adds a VFO and a Dual Gate Protected MOSFET (40673) at the front end of the DC Receiver.

e) Sept 1970: "QRP Console", ditto -- SWR Meter and antenna coupler cum loudspeaker.

19) QST, Sept 1969: "A Direct-conversion SSB Receiver", by R. S. Taylor, W1DAX. -- Uses phase shifted outputs from two balanced mixers to allow selection of either sideband of an SSB signal. See also Refs 16d and 30 here.

20) QST, Aug 1970: "A Complete solid-state portable for 40 meters" by Melvin Leibowitz, W3KET -- A DC CW Tx using a CA3028A IC as Product Mix for Rx and paralleled 2N2102s as 3W final for Tx.

21) QST, Sept 1970: "A Solid-state contest Rx", by G. Addis, W2NH. -- Ordinary single-conversion superhet but good design; DG MOSFETs.

-- ENOUGH!!! MORE NEXT MONTH .....

THE CONTINUING SAGA CALLED "NOVICE LICENSING"

-- by M. Knott, VK7ZMK, Reprinted from the Bulletin of the Tasmanian Division (Southern Branch) W.I.A., October 1971.

((EEB Editor's Note: Please communicate your opinions on this matter to your local Branch of the Wireless Institute, not us; we've got enuf...))

Council wants to discover your feelings towards the Novice Licensing Proposal... The Specific Proposals submitted to Federal Executive by the Novice Licensing Investigation Committee are listed here below:

THE PROPOSALS

1) A theory Examination of lower standard than the present AOCP theory, but adequate to test topics related to the types of equipment that would comprise a Novice Transmitting Station.

2) Regulation Examination same as for AOCP Cand.

3) A Morse Code test at a speed of 5 wpm.

4) Frequencies to be crystal controlled.

5) Power limit to be 10 watts d.c. input.

6) Permitted to use CW only.

7) Age limit to be same as for AOCP Candidates.

8) Licence issued on the basis of limited tenure. Suggested to be one year only.

9) That the PMG be asked to introduce a special range of callsigns, e.g. VK7NAA - VK7NZZ.

10) That applicants for Novice Licences should be required to submit character reference to reduce the possibility of irresponsible persons gaining transmitting privileges ((Ho ho, how about doing the same for standard AOCP Licence?? -- RLG)).

11) That considerations be given to allocating sub-bands in existing Amateur bands and that the following frequencies be the BASIS FOR FURTHER CONSIDERATION: a) Segment of the 1800-1860kHz band; b) 3505-3525; 7010-7050; None in 14MHz; 21,030-21,150; 28,040-28,200; None on VHF.

IN SUPPORT OF THE PROPOSAL:

1) Existing agencies which the W.I.A. operates to increase the number of licensed Amateurs have not succeeded in building them to a level expected by comparison with other, similar countries ((NZ??)).

2) The drop-out rate from AOCP courses and YRCS training is high, 75%. AOCP is too long-term a goal to be compatible with family and job commitments. Novice licencing, it is suggested, would serve to retain interest and be an "in-service training" for full AOCP qualification.

3) Also, of course, it is a way by which an AOLCP holder can increase his CW proficiency.

4) Young, technically-minded people have so many interests available (nowadays) that Amateur Radio is fighting a losing battle for their interests.

IN OPPOSITION TO THE PROPOSAL:

1) A solution to a problem which is far bigger than the W.I.A.; It could mean ammendments to the Posts and Telegraph Act to accomodate Novice Lic.

2) Difficult to see what Novice Licensing would achieve with the licensing proposals; could only require, say, 3.7 - 3.9 MHz of the 80M band for Novice use.

3) Novices would not have experience to be aware of remedies for TVI and BCI, which:-

4) Lowers existing high standard of VK operating.

5) Finally it would tend to reduce all the present Amateur Radio Licencees to HAM status (I hate this word "HAM" and wish it could be removed from the Amateur's Dictionary -- WIA Ed) ((Amen -- EEB Ed.)).

The Novice Investigation Committee is still actively seeking suggestions and have produced quite a pile of "paper". Among other suggestions are: alternative name (e.g., Restricted, Provisional, Instructional), a trial period, alternative membership status and changes in Examination Style (to Objective). The basic idea is, however, as detailed above.

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((An interesting exchange for which we won't take room appeared in Sept and Oct issues of the Bulletin of the Northern Zones, W.I.A./VK7. Complaint by VK7AK was no band room, and lowered standards. Reply by VK7ZFO maintained theory standard high already, and that we need a more flexible attitude toward innovations, and "much more reasoned argument"....
((In QST, Sept. 1971, p. 74 ARRL quotes a letter from the American Federal Communications Commission sent to a manufacturer of variable crystal oscillator units. The FCC approves the equipment as limited to 80 and 40M Novice Class portions of the bands, "and each transmitter produced shall carry on the chassis the warning forbidding unauthorized tampering with the unit." NOTE, however, Item No. (2) of the abovementioned PROPOSALs and that VK exams are generally higher calibre than those U.S. Novices are given. __ -- RLG))

MUSINGS OF A GOOD FATHER ON A BAD DAY -- S. Pidd

((Condensed from W6SD Carrier, QSP QRM/WA5CKJ, and further condensed herein, with apologies. -- RLG))

There is nothing sadder than a childless couple. It breaks one's heart to see them stretched out relaxing around swimming pools in Florida, all suntanned and miserable on the decks of their boats, or trotting off to Europe like lonesome fools.

Its an empty life. They don't fight over the children's discipline. They don't blame each other for the child's nauseous characteristics. They miss all the fun of doing without things for their child's sake.

They go along in their own dull way, doing what they want and liking each other. Its a pathetic picture.

Everyone should have the wonderful experience and happy memories of sleepless nights, coughing spells, debts..... (etc.)

The real fulfilment comes as the child grows like a little acorn into a real nut....

How dismally vacant is the peaceful home without the constant problems that make a well-rounded life and an early breakdown, the tender discussions when the report card reveals the progeny to be one step below half-wit, the close-knit end-of-the-day reunion with all the joyful happenings related like well placed blows to the temple.

.... The childless couple live in a vacuum. They fill their lonely days with golf, vacation trips, dinner dates, civic affairs, tranquility, leisure and money. This is a terrifying emptiness, but they are too comfortable to know it.

You just have to look at them to see what the years have done. He is boyish, rested and unlined. She is slim, well-groomed and youthful. It isn't natural. If they had kids they would look like the rest of us, tired, gray, wrinkled and sagging. In other words, normal

(-- ARNS Exchange)

"Me seemes the world is runne quite out of square, from the first point of his appointed sourse;
And being once amisse growes daily wourse and wourse."
— Edmund Spenser . . .

Let us leave all That behind and examine a bit more closely an important new development in electronics:

HOT CARRIER DIODES: A few additional References

These diodes were mentioned in our State/of/Art article this month as available in Australia, and of special value for detection by mixing. Their local availability is described on p. 62 of the September EEB. Now how about pulling your finger out of the dam and letting ideas & experiments gush forth? Must it all be done abroad?

In addition to the Australian Reference added at the last moment to p. 101 here there are a few more I have uncovered, for which room was not available; please make note on p. 101 that they are here. Namely:

a) "Hot Carrier Diode Mixer/Converter for 2M", by W. Ress, WA6NCT, 73, April 1970. Rather along the lines of the December 1971 AR article, with discussion of H.C. Diodes, and a description of how to wind the input and output Toroids feeding the balanced diode ring.

b) "Broadband Double-Balanced Modulator" by W. Ress (the same!), Ham Radio, March 1970. A H.C.D. mixer which covers 200kHz to 250MHz, requires relatively high L.O. injection, but has high isolation, wide dynamic range (& all that that implies, as per our article), and good NF.

c)"RF Power Measurement with Hot Carrier Diodes", and "Wide-Range FR Milliwattmeters Using H·C.D.s", by F. C. Jones, W6AJF, 73, Sept and Oct 1971, respectively. These two articles devote a total of 7 pages to describe a very simple r.f. detector with various input attenuators allowing a forward biased H.C.D. to measure voltage (therefore power) across a resistor in various ranges from 0.05mW to 10W; an attenuating potentiometer feeding a nulled meter allows a wide range of readings, but it could be done as easily by reading the meter directly. Very useful for following output of QRPP rigs, L.O. output level, etc.

HOT CARRIER DIODES: Function (Ref: H.P. Appl Note 907)

The H.C.D. is comparable to a point-contact diode in frequency, and better in uniformity, reproducibility, & reliability. This is achieved by a rectifying metal junction, with e.g. N-type silicon in an epitaxial configuration (see RCA Transistor Manual etc for these terms). Particularly important is the superior purity of the crystal, improved surface cleaning and passivation.

Unlike the PN junction diode, the H.C. Diode is based on majority carrier conduction, and in normal operation shows nearly no storage of minority carriers. This results in more efficient rectification at high frequencies.

In addition to this freedom from charge storage drag, the H.C.D. gives extremely low noise figure, and very fast switching in high frequency (e.g. 10GHz or more) applications. It has been used in computers, mixers, detectors, and rectifiers into the microwave region.

In mixer use, conversion efficiency is high, with conversion loss of only some 2-3 db, and furthermore the diodes are relatively uncritical of drive from the Local Oscillator (to be compared with transistor requirements, in the discussion of Rx linearity, below). With a reasonably linear response, these characteristics show why H.C.D. have been popular in Direct Conversion systems...

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Another View (G3VA in "Amat. Radio Tech." III, p. 67):

"Hot carrier diodes also appear to offer considerable possibilities for h.f. mixers. Such devices, also known as Schottky-barrier diodes, are planar versions of the conventional point contact microwave mixer diode. When a semiconductor surface is in contact with certain metal films, what is called a Schottky-barrier junction is formed and only carriers at high energy level (i.e. "hot carriers") are able to cross the barrier.

"Minority carrier storage is virtually eliminated, making for superior performance to more conventional point-contact or p-n junction diodes at high frequency..."
((Further details in ART III, p. 80, 81, 87 and in numerous followup articles in monthly "Tech. Topics" in Rad. Comm.))

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HOT CARRIER DIODES: Technical

These are diodes with about 35 PIV, and a reverse conduction curve considerably sharper than that of the 1N21G silicon point-contact silicon diode equivalent; this would give it somewhat higher rectification efficiency and higher front/back ratio, as described here on p. 104.

The forward conduction knee is of the order of 220 mV

at 100 microamperes, which is about twice as high as the junction drop of the 1N21G, and comparable to germanium junction diodes generally. As mentioned above, linearity of forward conduction is better than normal point-contact but worse than special microwave diodes.

To work efficiently, the H.C.D. should work into quite a low impedance load; output impedance is of the order of a few hundred ohms, and in mixer application depends on the level of Local Oscillator injection — e.g., falling to some 40 ohms with L.O. input of 10mW. Normally the diode mixer would be driven with some 4mW of osc. Inj.

The zero-voltage junction capacitance is about 0.1pf at the high frequency end, 0.9pf at the low frequency end. Frequency limit does not seem to be specified, but Application Note 923 by H.P. deals with the applications of the device as a Video Detector in the 2-16Gc range, so it ought to be good at least that far (with suitably plumbing). The diode shows Resistive at 11Gc and reactive at other frequencies!

HOT CARRIER DIODES: R.A.J.R. Comment

One of the matters which interests amateurs particularly, is the linearity with which these diodes will mix signals, for reasons outlined in our article in this issue. At least this is the reputation the diodes have achieved. But in fact a comparison of the forward conduction characteristic with that of a good silicon microwave diode (e.g. 1N21G) shows that the latter has, in fact a better curve than, e.g. the HP2702 for which data is immediately at hand.

It is evident, therefore, that the Hot-Carrier Diode linearity is not necessarily better than the silicon point contact diode (though better than the germanium equivalent), BUT the silicon item is:

a) Very expensive, and
b) Limited in shelf life, i.e. its reliability decreases substantially with time.

If you have a 1N21, or similar, obtained from surplus sources, you will want to compare its performance with the H.C. diode; it might be better, or worse, and it will age — which the H.C. diode will not.

Aside from the fact that the H.C. diode has quite a bit higher PIV (e.g. 35V) than the point contact silicon diode (e.g. 5V), its principal advantage is, therefore, its low cost and its reliability — while giving substantially better conversion linearity than a conventional germanium point contact diode.

Additionally, WA6NCT points out in the Reference mentioned here on p. 103,

"Although nearly any high-conductance diode will give adequate performance in a diode ring, many characteristics of the hot-carrier diode make it the ideal choice. To achieve electrical balance in the mixer for example, the diodes in the ring should have closely matched transfer characteristics — this is inherent in the fabrication of hot-carrier diodes.

"For lowest mixer conversion loss, the ring diodes should have no forward resistance when conducting, and infinite resistance when turned off. The front-to-back ratio (of the HPA2800 hot-carrier diode is 2000M, compared to 480M for the 1N645 high-conductance silicon, or 5k for the 1N98 point-contact germanium diode.)

"For efficient operation on the very-high and microwave frequencies, the mixer diodes should feature extremely fast switching speeds and contribute very little noise to the circuit. These requirements are best met by hot-carrier diodes."

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THE BRITISH STATE-OF-THE-ART (RLG)

You may have noticed that the Literature reported here has been heavy in favour of American publications. Aside from the natural facundity of the American amateur literature, this has been due to the fact that as yet I don't receive Wireless World, and because I have not been receiving RSGB's Radio Communication for some time. Now it has finally arrived, and I have made good use of some fine receiver material in these articles, not to mention Pat Hawker's remarkable monthly column in Rad. Comm., "Technical Topics" — a thorough Literature Review in itself (My ownly problem is that I tend to file TT under one or another subject, so tend to lose it for the others. Thus I make good use of G3VA's "Amateur Radio Techniques" which files all relevant items under subject headings.)

Through TT, this one magazine is your gateway to the main amateur literature of the civilised world (mostly Anglo-Saxon, of course...). In the rest of the magazine there appear relatively few articles, but generally of

LATE POSTSCRIPT: For Synchrodynes etc, see Wireless World, July Aug & Sept 1971....

high calibre. Rad. Comm. should be available widely from Wireless Institute or NZART branches, and from other libraries. If not, ask them why not!

(In North America, Rad. Comm. is available through Comtec, Book Division, Box 592, Amherst, New Hamp. 03031.)

Microwave Diodes and Receiver Front End Linearity

In the August 1971 issue of Rad. Comm., G3ONL presents a lucid article by the above title, investigating briefly but cogently the main characteristics of the following diodes: Junction, Point Contact, Varactor, Tunnel, Hot-carrier, PIN, IMPATT, and Gunn Oscillator. It is a relatively painless way to absorb essential points of the contribution of these items to the New Technology. (See also: Rad. Comm, 4/71, p. 271; also 73, 6/69, p.4+)

In that same issue," Technical Topics" examines the problem of linearity in receiver front ends (a favourite subject therein), and the usual problem of obtaining wide dynamic range (as discussed on p. 97-98 here). Pat Hawker repeats Peter Martin's dictum that it is a rare semiconductor that can perform as well as a good valve, and there are none that can do better on an overall basis for receiver front ends (Peter Martin published a very fine series of articles on practical receiver design in Rad. Comm., March-June 1971 — our Reference No. 24a, next month).

But the State of the Art gallops convulsively along, and the latest answer to front-end linearity is to make real the old joke about using something like a 4-125A valve as r.f. stage; that would cope linearly with reasonably strong r.f. signals!

So in fact, sophisticated receiver manufacturers are now doing just that in semiconductor equivalents: using r.f. power transistors or power FETs as r.f. or mixer (note, again, that it is now the Engineer who leads new developments, rarely the Amateur).

Using the power FET, CP640 with peak drain current of 1.2A (that's amperes!), 40mA avg, Comdel have been able to achieve 2.5db NF, 8-9db gain, 0.5-60MHz, and dynamic range 140db or better!! Compare this with one of the better valves for much the same gain-bandwidth product, the 7758 (Mullard E810F): NF = 6db, and dynamic range = 100db. In our Ref. 24a, Martin specifies the NF of a balanced hot-carrier diode mixer typically at 8db.

More about this matter of valves vs semicons later...

Mixer Linearity— more.

As we have discussed in this EEB, the matter of linearity is crucial in mixers, probably even more than in r.f. stages — particularly as r.f. stages go out of fashion (c.f. RAJR on p. 100 here).

In this vein, Pat Hawker makes further poignant observations in the January 1970 TT. He refers to the Ham Radio articles in Oct 1969 (Ref. 13 here), pointing out particularly the relevance of VE3GFN's H.C. Product detector driven by square rather than sine wave L.O., but

"An appreciably stiffer technical level is 'Distortion Phenomena in a Switching Transistor Mixer" by Dr. J.G. Gardiner & D.C. Surana (Proc. IEE, 11/69)... which stresses the severely practical point.. that improvement in the linearity of a bipolar transistor mixer can be obtained by increasing the local-oscillator drive level; this also increases the conversion gain."

This is a consequence of the very small time such an overdriving signal spends in the exponential response region. The result is an appreciable increase in dynamic range (viz., lower crossmod & intermod) when the L.O. drive exceeds some 500mV.

On the other hand, even better dynamic range is obtained, with lower oscillator power requirement when dual-FETs (note, not same as dual gate FET) are used as balanced (i.e., push pull) mixer. So, is the transistor-at-any price enthusiast so wise?

Valves are better??

Mentioned above was the observation that a power FET seemingly gave performance superior to a good valve having the same gain-bandwidth product. But these matters have more points than a porcupine (see Rad. Comm., Feb 1970, p. 92), and a 100db dynamic range for the valve is quite satisfactory for all normal purposes, particularly if you consider that the valve is easier to use, not to mention immunity to extreme r.f. overload, temperature effects, etc. Semiconductors have their place, but not necessarily indiscriminately.

(PTO)

As reported in the January 1970 TT, GM3IAA reports that the Frame Grid EF183/6F25 (= 6EH7) makes a superior r.f. stage — although Rod Reynolds points out that the 6BY7 (= EF85) is better; its Equiv. Noise Res. is somewhat higher (e.g. 1500 ohms) but its dynamic range is far better, with a broad grid characteristic and superior AGC.

GM3IAA also asserts that the 6F24 frame-grid pentode makes by far the best mixer. Again, however, there is evidence that beam deflection valves are even better, as discussed in this EEB.

But the take-home lesson of this matter is that however you look at it, for the sacrifice of a bit of trouble with voltages, a valve can still give good or superior results for a given application -- and as transistors become better, so do valves! See RAJR on p. 40, April EEB.

In Part IV of his lovely receiver-design/construction article in the June 1971 Rad. Comm. (as mentioned on the previous page, here), Martin (G3PDM) states:

"Although a wide variety of integrated circuits is now available for high performance communications equipment, the results achieved in some circuits with valves can be superior in several respects. To summarise, these are:
a) Lower cross-modulation and intermodulation,
b) Greater dynamic range,
c) Lower noise modulation,
d) Lower noise in oscillators, and
e(Better agc performance.

"Semiconductor devices have advantages too, but many of these are not strictly relevant to amateur work. The experimenter is not normally concerned with small size, high reliability or low power consumption.

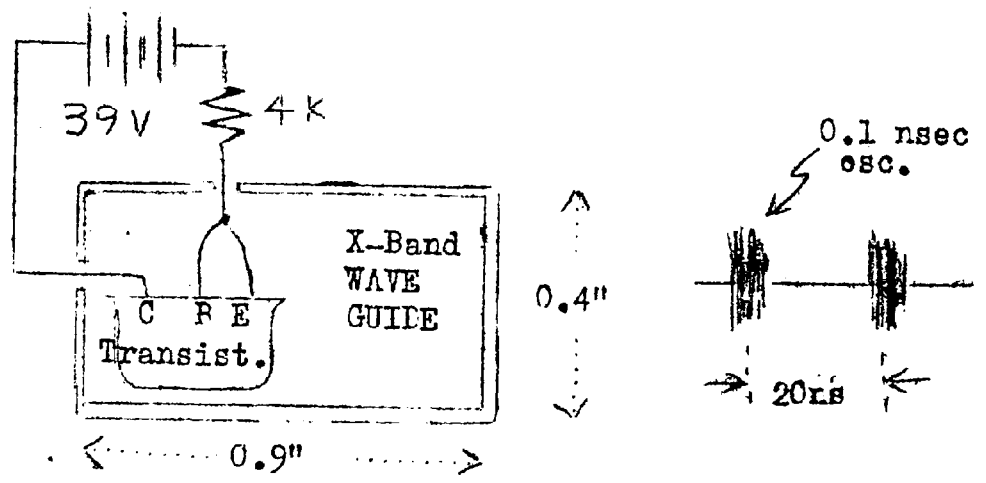
" "The real attraction of semiconductor circuits to the amateur is the high circuit complexity achievable at low cost, and the compatibility of construction methods with the home environment.

"It is hoped that this article will cause experimenters to look back for a moment and count their losses in the race through the silicon slice age."

I'm not certain about experimenters in Britain, but here there is a tendency to build equipment as small as possible and to reduce power consumption to the barest minimum, however difficult this makes construction, and in spite of a variety of difficulties resulting (e.g. problems with isolation). We tend to use transistors "because they are there", and this leads, amongst much else, to a plethora of problems in getting reasonable quantities of r.f. into the air when valves would perform better and easier.

AVALANCHE TRANSISTORS, II (c.f. October Editorial)

Digging back into the files I found an interesting item by Vilmur & Shii, "Avalanching Transistors" in Electronics" (USA) of October 25, 1963. Here's an interesting and impressive experiment for you to try:



The wave shown at the right is what we expect should come from this arrangement. The relaxation oscillation should be determined by stray capacitance, and should be typically in the range 25-50MHz; the excited oscillation will be in the 10,000 Megacycle range! And this from a quite ordinary 2N965 or any good ordinary switching transistor, germanium or silicon.

Use shorting plungers (very tightly fitting) spaced at some convenient multiple of about 3cm, place a mixer diode (e.g. Hot-Carrier, etc) at a suitable location in the waveguide and connect it to a receiver which can receive the 50MHz signal. Tune the plunders for maximum output and measure the distance between them to determine the wavelength (therefore frequency) of oscillation -- though Rod tells me that the conversion between them will not be the usual one, because of the different group velocity of waves propagating in a waveguide, compared to free space.

You could simply insert the end of the mixer diode in the waveguide, perhaps with a sliding top, but the surfaces of the top must make exceedingly smooth contact with the waveguide. Rather better coupling for this experiment will be found in the article "Waveguide Directional Coumplers" by G3RPE in Rad. Comm. Sept 1971. His series "Microwaves - 1000MHz and up" frequently contains this kind of information, and is recommended to all who are curious about the technology of SHF.

thora of problems in getting reasonable quantities of r.f. into the air when valves would perform better and easier, and where plenty of space and power is available.

The set of articles, "Plagiarize and Hybridize" by Peter Martin has been prepared by RSGB as a separate reprint. I think it likely that this item will be available to the public, and I am making enquiries about it. I'll let you know next time.

ICs Forever??

In reference to this challenge to semiconductors-forever enthusiasts, and relevant to our Integrated Circuit Squaretable, this EEB, Peter Lumb (G3IRM) in recent correspondence reasserts his p. 109 argument that Britons are not unanimous on this point:

"In reference to ICs, you are fighting a losing battle you know. There will soon be more ICs than transistors, and then what will you do? Seriously though, they do save time and usually do the job better than discrete components. What, for example, could be easier than using a uA723 as a regulator in a receiver; it does the job admirably, takes little time to fix, costs no more than discrete components and takes up less space."

(I've been trying to extract from him his design for a transistorised CRO — and there is a good use for transistors, except perhaps in the input stage, but he says: "All the details are on scraps of paper and I am not sure they haven't been modified. I think I would virtually have to pull the thing to pieces to write an article."

(I think one of these days I'm going to have to write an article, "how to experiment", outlining among other things, how to take and keep relevant data whilst experimenting....)

Certainly there are numerous semicon and IC receivers (and the rest) appearing in the international literature to demonstrate that Peter's point of view is at least popular. That noteworthy results have been achieved with IC Phase-Lock Loop systems (latest in Tech. Topics of Sept 1971), and with ICs in audio filters (ibid, Aug 71), and in transceivers and high performance AGC generators (Rad. Comm., Sept 1971), etc. -- does lend some validity to this platform. And in Rad. Comm. March 1970 (p. 161) G3VA summarises the situation with respect to the availability and characteristics of Plessy linear ICs for communications.

Let commonsense rule: use a semicon or IC where it can do a better job (for whatever reason), and only then.

EXPLOSIONS RISK (From QTC, Amateur Radio News, Radio Communication, November 1970):

"Mercury wetted reed relays used in some telegraph and other equipment have a metal jacket over a pressurised glass capsule. The jacket protects against injury in event of the capsule breaking. Do not be tempted to remove this outer jacket. Two men recently had lucky escapes in trying -- the capsules exploded."

((Also described is a very interesting Educational Electronic Experiments booklet published by Mullard — available from Elcoma Division (formerly Mullard) of Philips in Australia))

EDITORIAL, II

We now move on to less technical matters.

Arranging Magazine Articles Logically

In reference to my comment in the October issue, p.81, concerning the desirability of the big magazines separating their articles by filler material or adverts to allow easy filing, I noted whilst extracting material from CQ magazine, that CQ does in fact just that — paying for it merely by inserting the tail-end of articles toward the end of the magazine. Although the latter does produce some difficulties when two desirable tail-ends are placed together, it is a step in the right direction, and Dick Ross, the Editor of CQ is to be commended for this effort.

When I conquer some of our photography problems (which should be soon) I think I'll be able to place Letters and such on the obverse side of major EEB articles, thereby accomplishing the desired separation, allowing you to file EEB articles by subjects in manilla folders... If you have an overwhelming urge to keep a set of EEBs intact you could of course, have two subscriptions.... hi.

Comment on Novice Licensing (c.f. p. 102)

The CW-only mode of operating does sound like a good idea to promote further operation in this valuable mode; once the Novices attain their AOCP, they may become disgusted with the gabble and return to CW, "the last refuge of the competent" in this chromium-plated age.

A good way out of the present misgivings about lower standards etc, could well be to adopt a five-year trial period for the whole programme, as some people have proposed. At the end of that time it ought to be evident whether the programme will be of continuing value to the Amateur Service.

Why then, the thousands of words of heated debate on

months worth of photos had just been completed. Sod also probably had a hand in impelling the manufacturer to specify the wrong developer for his high contrast film.

Sod's Law is like Murphy's ("If Something can go Wrong, it will"), but where Murphy is often in a light vein (a wire cut to length will always be too short, etc), Sod's is in dead earnest (the finger your foolproof sander cuts off will always be the one you write with.)

Murphy would dictate that I write to the Manufacturer and he will confirm my discovery, pointing out that we ought to have written to him sooner. Sod would state that if I write to the Australian agents they will refer me to the American principals — and the Americans won't reply. Its a new business technique which saves firms much paper work and secretarial expense. If you don't receive a reply after 4 or 5 months, the answer was negative.

"Jesus here we are again"

This title, taken from the extraordinary Christmas Editorial in The Australian newspaper reminds us amidst the prospering throngs and tinned carols that there may be something special happening at this time of year.

In defiance of the tradition that EEB is inevitably late, let me be the first to wish you all a Merry Christmas (1972) and a Satisfying and Creative New Year (1973). Or as young Katherine has put it in, "Who Gave us Christmas":

There is foolishness
There is fighting
There is hate
The Devil gave us all this, but wait;
Don't forget Jesus Christ who gave us Christmas,
Who suffered all the pain just for us.
Oh! Let us throw the Devil in the pot,
And Rejoice for Jesus Christ
And Rejoice for Jesus Christ.

And Happy Hanukah and Novum Godom too.

The Post Master General's Establishment

Contrary to what some people think, I have nothing against the Post Office. They must obviously raise prices like the rest of us as the cost of goods and labour goes up — and up. But one might wish that they would not disguise a neat profit by a fictitious loss; and perhaps They might give thought to the possibility that printed communications have a rather unique value in a democratic society.

But we've been through all that before, and books still go for the same postage as scrap metal. I can see the day coming when it will cost as much to post a book as the book costs new!

But one learns to live with it, to certify any mail one really depends on (but oh the cost of certification — and registration to foreign locations goes UP and UP), and to send a telegram if one needs speed (but only the URGENT rate, please), or a package by private carrier (as discussed in the September EEB).

Even this breaks down, alas. I have sent many telegrams within and out of Australia, and there have been several times when the messages arrived garbled. For the most part I have lived with this, content at least that the main portions got through unscathed.

But some months ago I sent a couple of overseas telegrams which were important, and they were both badly garbled. I had had enough of this and wrote an appropriate note to the PMG.

They replied full of sweetness and light, saying they were investigating it.

They're still investigating. It must be fearfully difficult.

"Those that much covet are with gain so fond
That what they have not, that which they possess
They scatter and unloose it from their bond,
And so, by hoping more, they have but less;
Or, gaining more, the profit of excess
Is but to surfeit, and such griefs sustain
That they prove bankrupt in this poor-rich gain."
-- W. Shakespeare ("The Rape of Lucrece")

This & That

Would you good people please stop treating EEB like an ordinary magazine on one hand, or as an Encyclopaedia on the other? I may gather up transmitters in one issue, Reviews and Letters in another, Power Supplies or Ignitions or

State of the Ark or Whatever.... That's merely the way the ball bounces.

So, please stop asking us to present "a varied assortment of short items in each issue". We present what we have and what you send us. EEB is not necessarily designed to entertain you, but me — hi. If you like an issue, read it through to reinforce your prejudices. If you don't like it, read it through, (a) to learn something new, or (b) to see how the other half lives.

One kind of criticism I do appreciate: If you find a section of EEB becoming banal, let us know. I don't mind being academic or intense or controversial or anxious, but I don't want to be dead.

There'll be enough time for that later.

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There are still a few binders for 1970 issues available. Anyone need one to keep loose issues together? They are very pretty, and will cost you only three 7c stamps now, postpaid. If you're cunning, you'll get one for your 1971 issues and another for 1972 issues, and merely do a bit of minor surgery on the date shown on the spine. Its an opportunity because this item is now being sold below cost. To bind issues, you merely run a thin needle through the staples, and tie them loosely together with white thread. Then apply some white wood glue liberally to both the tied edges and to the inside of the cover spine, and put both together (avoiding glue spillover); store vertically with spine down until dry. But you'd best wait until we have made the Annual Index available, likely in Feb.

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When/if you renew, please show any amateur or SWL call letters after your name. We are going to start putting them on address plates now, because one day we'll try an immense Australiawide promotional posting (when I get some money), and we'll need to avoid duplication.

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For those of you who are interested in such things, we'll be having some material on transistorised transmitters coming up. There will be some discussion in December, of Ed Noll's "Solid State QRP Projects", and probably in February a fair bit of technical material organised around content from The Milliwatt (c.f. EEB p. 54).

Interest in transistorised transmitters has been immense, to judge from its content in the periodical literature, but I'm pleased to note that to a certain extent this seems to be changing in favour rather of low-power transmitting for its own sake, and a healthy reawakening of the need for improvement of efficiency and the general standard of technical operating.

To review the Literature in these fields is a heartbreaking exercise in time and complexity, and about all I'm going to be able to do is list main titles just to show what are the trends, and whence; commonly I prefer to present Reference Lists with numersou comments to make them significant to readers who do not have access to mags.

To those of you who are not involved in radio amateur activities, I extend a warm welcome to investigate them. Whether you spend time nattering to your neighbour on the air, or to a chap a half a world away, or whether you use your interests to explore a world of experimental diversity, amateur radio has much to offer in interest and fellowship. You'll want to ignore the various carpings I have been making on amateur matters; they stem only from high idealism and a desire to keep standards high.

For further information, do contact The Wireless Institute of Australia, Federal Executive, P.O. Box 67, East Melbourne, Vic. 3002.

AROUND THE AIRWAVES — J. Van Staveren (VK7JV)

Items selectod from the Geoff Watts News Sheet, as described in the September EEB, and from personal experience (*) There isn't much to take from the British sheet this month; most of it is not applicable to Australian conditions. For example there is plenty of news about African stations, but we can't work Africa, so why worry?

ANTARTICA; WBØCUM/KC4: Gary, QRV from Byrd Station; QSL to KØYKJ. (*): Col, VKØJV (home call VK7KW) leaving early January for Casey; as well as H.F., Col will have or have access to gear to work the Australis (2M to 70cm) and the AMSAT (2M to 10M) translators. QSL via VK7JV.

CAMEROUN; TJ1AW: His new QSL Manager is K4MPE.

GUATEMALA; TG9YN: Operator is ex-YA1BW. QSL via DL8DF.

LOS MONJES; 4MØLM: QSL via YV1LA.

NEPAL; 9N1JK: QSL via DJ9KR.
9N1MM: Father Moran, QRV 21.325 SSB Saturdays 1000

PORTUGESE TIMOR; CR8AI: Luiz. Heard 21.290 SSB 1055h; QSL to WA6AHF.

SAO TOME; CR5XX: Operators were CR6XX and CR6NN, SSB; QSL to W3HUP. CW; QSL to CR6GA.

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((Continued from column at left))

AN INTEGRATED-CIRCUIT SQUARETABLE

Nasty Integrated Circuits?

I wish to warn you of a nasty fact, namely that low signal-type integrated circuits are very likely never to work.

These devices are small, efficient, and expensive. For example, the LM372 IF amp and detector IC is very fragile. I was using one off an unearthed DC regulated power supply. As soon as I earthed it, it blew up.

The next unit lasted a bit longer -- 2 days. Even so, the signal/noise ratio was not the best.

While experimenting I left it turned on (accidentally) and a piece of solder shorted out two of the pins. Surprisingly enough I shorted out two other pins and it worked again.

With these sort of failures (even though they were brought about by carelessness) I cannot justify their widespread use in "home-grown" equipment, especially since the price is quite high.

Even though these ICs may look harmless, the best place that I can see for them is in digital wristwatches, computers, and such, where people can't get their hands on them!

-- W. Rannard, Oatley, N.S.W.

ICs, Pro and Con

... As for ICs, I have designed production equipment, both with and without them. The only reason I used them was because the Manager wanted them. In any event, consider:

Reasons for:

1) Production design is sometimes simplified, in that instead of having to account for tolerances of components you only have tolerances on a complete circuit. However, they usually don't replace enough (for the same price) to make this worthwhile.

2) It can sometimes be cheaper -- but never for the same performance!

3) Advertising gimmick.

Reasons against:

1) Usually dearer, particularly for one-off. If you have any sort of junk-box, change "usually" to "always".

2) Performance is usually poorer than an equivalent discrete. The classic example is the audio amplifier. Compare distortion, efficiency of the IC-10, SL403, and others, with an equivalent discrete. Part of this stems from the high cost of PNPs on the chip. It may improve, but so will discretes.

3) I personally find that they tend to "cramp my style"; design tends to be limited to the IC used-. I think others will back me up on this.

I have already won one bet on this: I built a discrete amp, with the same specs as the Philips 1W (TAA300) amplifier that (a certain Magazine) has been plugging. Mine cost half, and the current drain was a lot less too.

Of course they do have uses. Digital ICs are an obvious choice, since a discrete design tends to be iterative anyway; thermal tracking also tends to be better if you have two transistors on the one chip. But these are only special uses, rather than general ones...

-- C. Pitcher, Clifton Hill, Vic.

Quote without Comment

"On recovery, it was found that the voltage regulator was faulty. The fault was traced to an IC. The package was again returned to Melbourne and the voltage regulator was changed and a much simpler design, using a 15V zener and a 2N3055, was installed. No further problems were had with this circuit for any of the remaining flights."

(From "Australis Oscar Baloon Report", by G.N. Long, VK3YDB, Amateur Radio, 7/71)

Rationalising Integrated Circuits?

If you read the "Electronics and Communications" page of The Australian, you may have noticed an article on ICs some months back. Sort of a general survey of the business here, with many comparisons to America.

All three Australian manufacturers complained of the large-scale price-cutting war in America, and expressed hopes that local manufacturers would have the "good sense" not to let a "similar situation develop" here. Well...

What I wonder is: how much of the semiconductor manufacture is really done here? Why protect the manufacturer by duties and the like, when he has no prospect of winning exports overseas; why make the local equipment manufacturer, who is in the export race, pay for it?

One thing I would like to see: a return to sensible circuit diagrams for ICs. Half these IC circuits are worthless, in that they do not show how the device works. If, for example, you look for a moment at p. 41, fig. 6 of the June 1970 issue of E,A, you will see what I mean. There is a diagram for a divider decade.

A mate of mine showed it to me and asked how it worked. I explained how the Feedforward Self-gating Whatever was meant to work, and suggested he make up a Truth Table. He tried to, I tried to. Eventually we got it. The point was, we had to assume which items were the J and K terminals, Q and $\bar{Q}$, etc, because they are not mentioned there. I took this up with (some authorities) and was told that this was a LOGIC DIAGRAM, and was only meant to show how the circuit worked. Besides, the wiring diagram was underneath, and I could find the pin numbers of the ICs from that, presumably solving all my problems....

The point is, if you see a circuit diagram you should be able to wire it up, using ANY sort of active device; i.e. input and output, reset, and the like should be marked just the same way that C, B, and E of a transistor are marked (sic) in a circuit. I suppose it has a lot to do with the commercials: why build and think, when you can buy, pretend you are building, and not think at all?

-- C. Pitcher, Clifton Hill, Vic.

Use ICs when Best Suited!

Both in the EEB and in other periodicals I read about those horrible devices, ICs. As far as I am concerned I am interested in achieving a goal. If a tube is best for the job, fine; if a transistor is best for the job, fine; and, if an IC is best for the job -- well that is fine also.

For instance, the Motorola MC-1596 is a balanced modulator which has a dynamic range of 90db; yes, that is 90db! (See: "An Integrated-Circuit Balanced Modulator", Ham Radio, Sept.70) Just try and match that ANY other way.

I build to get results and most of my circuits from now on that need a balanced modulator or mixer will use that IC if I can fit it in.

As far as a concern for a lack of rigour in the design is concerned; forget it, there is still quite a bit of design ability required.

-- F. Merritt, VE7AFJ, Parksville, B.C. Canada

Problems with the MC-1550G

If you have read the articles in 1970 issues of Amateur Radio concerning the Solid State Transceiver, it is possible that you may have considered the circuitry involved.

For instance, consider the April 1969 issue of AR. It gives the circuitry of the transmitter mixer circuit employing a Motorola MC 1550G IC as a mixer, followed by a 2N3564 as emitter follower. The output of the Injection Mixer is applied to Pin 1 and the 9.0MHz SSB signal to Pin 10.

Of course the output should be at the required signal frequency, but unfortunately the amount of output I have been getting is virtually nil, certainly not enough to be able to use to drive the subsequent stages.

I have checked the circuit of the IC as supplied by Motorola and to me the way it is used in the mixer circuit could well be 100%, but as the results are far from that I have become a little dubious.

Would you be prepared to make a suggestion??

-- C. Jenkins, VK4QJ, Roma, Qld.

How to Test a Cross IC

In reference to the above enquiry, there are cases where the rejection rate of some ICs can be appallingly high. It is, therefore, finitely possible that OM Jenkins simply got a cross IC. The way to test this would be:

1) To try another IC, statistically more likely to be good, or:

2) To replace the IC with a reasonable discrete circuit. One of conventional design would ordinarily use appreciably fewer transistors than inside the IC, because of the inefficient use commonly made of IC components.

Correspondents who have made such substitutions have reported that they have, for only a modest amount of work, obtained results of superior performance, both in regard to efficiency, current drain, immunity from transients, and ease of trouble-shooting. I do not at all intend this to be interpreted as an "anti-IC" bias; ICs certainly have their uses, and I have occasion to be involved with a large number of them to good purpose. They have their definite advantages of flexibility and compactness -- and even price! -- but they must be considered with all honesty, and that includes the problems which can arise from their use.

To continue with the matter of what to do with a crook-appearing IC, in any circuit (other than complex feedback loops) the only way to check performance is simply to go through and check it out. One does this with a GDO, wavemeter, and VTVM or HF CRO. The signal at L26 might be expected to produce appreciable voltage at the centre of the operating range in this particular application. The signal at Pin 10 of the Black Beast would be expected not to be appreciably less than the setting on the pot indicates, though this depends on loading by the BB. A separate signal of the appropriate frequency could be applied independently to L27, and the performance of that Xfr and amplifier checked by the usual methods.

IF the signals going into the Black Box are at a satisfactory level, and if the remainder of the circuit is functioning logically, the only remaining fault is in the BB -- unless you have a fualty bypass or resistor which only shows up when feeding the BB! For this, the discrete circuit test is the only sure one, where you can get INSIDE of the circuit to find out what is happening.

I suspect that a lot of the technique of using and troubleshooting ICs is going to involve having handy replacement units to "plug in" (so to speak!), particularly as their complexity increases. When you have 95% of a receiver stuck inside of a BB, however, even this should become more obvious: you feed signal into the antenna, the audio comes out weak or distorted, so obviously you merely replace the BB. You have become an Experimenter of the Electronics Age. This kind of Progress does exercise RLG and others, but it can be of some value to Engineers, whose primary job is to get something to WORK, and the sooner the better.

-- Staff

The Servicing-ICs Joke

Following up the above suggestions, I have no idea why this IC didn't mix. I am able only to conclude that the... things are produced with an inbuilt failure rate that would make any valve manufacturer blush...

In this particular case every voltage measured quite OK when compared to functioning units, and when another IC was indeed fitted it worked alright. As I recall, the number of ICs that don't work as well as they should is far too high.

In regard to replacement of the IC by a discrete circuit, subsequently I tried it using a 2N3819 instead, with only a slight change in circuitry and it worked just as well in all cases and in some it worked a darned sight better....

My feelings about ICs can only be coloured by my experiences. I've had far too many fail even when used well and truly within their ratings. I refer now not merely to gear I've made myself, but that used commercially... It includes Japanese as well as Australian.

I have no doubt at all that for space saving ICs are on their own, but only to an insignificant degree when compared to the use of suitably-organised discrete components. In the final analysis, the saving in space makes any subsequent servicing (either on one's own gear or as a normal repair job) so much more difficult, its far from funny.

I'll mention one particular instance... The equipment is made by .... which sells normally at about the $400 mark... (tech. details)... The particular set didn't work as a radio set at all and the trouble was found to be in the IC..(details).. The job of trouble shooting is far more complicated than a set using transistors and the impossibility of maintaining a stock of the... things makes prompt servicing a joke.

From the point of view of one's own gear, if an IC fails the replacement cost is far more than would be the case if it used discrete transistors, and usually the time involved is also far greater.

Taken allround, even though one will have to accept the introduction of the things, I do believe they are a real advantage for the equipment manufacturer to achieve a higher profit on the article in the first place, but there the advantage ends...

-- Cliff Jenkins (loc cit.)

In Defence of Integrated Circuits!

I'm still satisfied with what I get for my subscription, although I cannot agree with all you say. For one thing, integrated circuits are the greatest boon ever to the amateur constructor who has limited time available. They are still a boon even if he hasn't!

Take for example the frequency meter I have just completed. It has the equivalent of about 900 transistors, numerous diodes and resistors, and most of these are included in neat little eight-legged animals ready to hook up on a board.

With so many circuits all identical no one but a complete jove would build them all from discrete components. Or again, I am well on the way to completing an SSB Transceiver for 14MHz, which again consists mainly of ICs:

FUNCTION	RX	FUNCTION	TX
RF	3N140	Mic	SL630, SL201
Mix	3N140	B.M.	CA3018
VFO	40468	C.O.	2N2926
Buffer	CA3005	I.F.(9MHz)	2N706
I.F.(9MHz)	CA3023 x 2	B.M.	CA3018
P.D.	CA3002	VFO	40468
Audio	SL630	Buffer	CA3005
AVC	SL620,µA709	Driver	>>>To be decided.
C.O.	2N2926	P.A.	

There are, of course, a few other transistors and diodes for switching purposes.

The balance that can be achieved with ICs is far easier to achieve than with tiodes or transistors, as the individual units are so well balanced to start with -- in fact, no capacitative balance is needed.

The VFO stability (checked against my frequency meter) is superb, and the isolation provided by the CA3005 cannot be beaten. From no-load to full-load on the VFO there is no measurable shift in frequency.

The AVC amplifier was specially designed by Plessy as an AVC stage for SSB receivers, and gives just the characteristic required, except that from my point of view it is upside down for driving the IF. That is why the µA709 is included -- to isolate and invert the signal.

The range of AVC can be set in this stage. For example you can have AVC for 6V with maximum signal, and -6V with minimum signal -- or anywhere between. The actual output from mine is 5V with no signal, which gives maximum gain in the IF stage and 0.5V with S9+++ signals actually gives a negative gain in the IF stage.

As you see the whole thing can be inverted depending on whether positive-going or negative-going AVC is needed by the controlled stages.

Take again the microphone amplifier. Two small units provide more than enough gain even from low output microphones. Outboard components are negligible and the second stage can be preset to just the gain required for the usual microphones. It even has its own built-in muting circuit.

Provided the constructor obtains books like the RCA Manual, Motorola Manual, or specific data sheets he will find that ICs are far simpler to use than discrete components. But he must be careful and know what he is doing, or it can be costly. The first two ICs in my frequency meter cost over £12. You can't afford mistakes there.

-- P. Lumb, 22 Hervey Road, Bury Saint Edmunds, Suffolk, England, U.K.

((I have furnished Peter's address here, in event of anyone desiring to contact him further about design matters of this kind. We are willing to keep an open mind about these matters when they are presented intelligently. The above letters represent a good sample of good material we have received on the subject. We have omitted only the comments of an American correspondent who was "turned off" by our "Anti-IC Policy", but who did not turn himself on for our benefit. And also our LJY has had quite a lot of experience with ICs, but we shall hear from him in some specific articles; he shows that they can be cranky beasts, and very critical with respect to power supply, but that they can be got to work. ICs evidently need their own Insights and a different kind of electronics technology. -- RLG))

↳ See: "Using ICs", Technical Topics, G3VA in Radio Communication, Apr 1971, p. 260

CIRCA 1980? -- Staff

We are pleased to introduce the 7100Hz. This is a versatile Module, specifically engineered for the Avid Experimenter, a Marvel in Miniature. It posszesses 52 terminals which allow a vast number of functions, e.g. 150W transmitter (AM, FM, CW, SSB, RTTY, etc), 50 watt ultralinear HIFI, baby minder, calculating machine, all purpose communications receiver, power converter, tape deck, and much more! You need only plug it into the 240V (or 115V or 6V) supply, connect antenna, loudspeaker or model railroad, and the world of Electronics is yours for the asking.

((There follows a mass of technical detail, but of special interest is:)) The 7100Hz is Scientifically Formulated to be completely foolproof... In event of error, the Experimenter will find only that the wrong function has been selected -- but it will ALWAYS work! This, then, ushers in a new Era in Electronics Experimentation ((etc etc)).

The 7100Hz is an Inperplated Snicket, so simple even a child or housewife can operate it, and is available in ten stunning colours -- and for only 50c (plus tax)..... to give you satisfaction undreamed of in the days before Interplated Snickets...

((Editor's Note: We regret that we appear to have mislaid an article using sixteen of these Interplated Snickets, but will be replaced by an article on the Design and Construction of High Quality Condensers-- as a followup from the treatment given in QST, April 1971, p. 87. We are proud to present this radical concept, and assure you that it represents a new trend: the construction of components no longer available commercially))

(EEB Feb. 1972)

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LETTER: Where is Sandy Bay??

Thanks bunches for sending me a copy of Electronics Australia. I have found it very interesting. There must be quite a bit of interest in building down under. I notice that many parts are competitively priced when compared to Canada. Lots of practical articles and approaches.

I have been able to purchase a large detailed map of Australia and I cannot find Sandy Bay, Tasmania. Question: Does that cast creditability on your existence???

-- F. Merritt, VE7AFJ, Parksville, Canada.

((That's nothing, a lot of maps don't even show Tasmania -- which is an accomplishment, considering that Tassie is about the size of Newfoundland. S.B. is a cozy suburb of the Metropolis of Hobart, featuring a good University, much Long Hair, many Little Boxes cum bourgeoisie, and Beach Pollution. Even at the End of the World: Progress! -- Ed.))

OBJECTS AND REQUIREMENTS OF AN AMATEUR RADIO HANDBOOK, Part I -- R. H. Ferris (VK7ZDF) -- and a brief discussion of the RADIO HANDBOOK, 18th Edition by W. I. Orr (Editors and Engineers/Sams, U.S.A., $US13.50).

-- "Completely updated edition of the famous communications book that is the electronics industry standard for engineers, technicians, and advanced amateurs. Explains in authoritative detail how to design and build all types of radio communications equipment. Includes SSB design and equipment, RTTY circuits, latest semiconductor circuits, ICs, and special circuitry."

((From an advertisement in 73 Mag.))

Why?

Because of some discussion about this book between members of EEB staff we have been forced to investigate the whole questionof the coverage of technical book reviews.

The Problem

Writing a book review for publication, especially of a recognised text or "Handbook" is a matter of no mean consequence. Not only do the final comments, presumably written from a position of some authority and experience, serve to inform prospective purchasers of its contents, but the comments act as a feedback to the author. The latter may give the author some measure of the success of the book in achieving its aims, and allows correction and modification where necessary in future editions.

Aside from these responsibilities, the task is also a difficult one insofar as deciding what the book should ultimately be, and what should go into it. Only then is it possible to make an objectiye criticism and produce commentary of real value to reader and author. If one can achieve this goal, these parties may fairly judge the volume in question, and compare it with similar works.

Basic Aims

For instance, one may consider the fairly mechanical points of binding, paper, print, layout, organisation of chapters and within chapters, page and section identification and indexing, and all other matters which pertain to the general use of the book and its readability.

Further, one must consider the less tangible points of

1) The sort of market and type of individual the book is trying to satisfy;

2) Within this context, the quality, quantity and depth of the material, and the (academic) level at which it is presented;

3) The policy toward the reader, whether to satisfy his ego in providing merely the things he wants to see, to educate the reader, or to provide him with a great tome of facts for reference only.

As an illustration of these last points we recall respectively the editions a few years ago, of the ARRL Handbook, the RSGB Handbook, and the Radiotron Designers Handbook, viewed in context of the Radio Amateur.

The need to consider carefully such a book in the framework of all of these points was highlighted recently when we received two conflicting reviews of the "Radio Handbook" (18th Ed.) from reviewers of personally similar inclinations. Subsequent investigation revealed that neither could be considered "wrong" but that the difference arose because the material had been considered from different angles and different standards, and that these values again differed significantly from those employed in previous Handbook Reviews published in EEB.

Hence, after much soul-searching we have come up with the notions mentioned above, describing broadly the way in which we intend to do the job now and in the future. This should give us a guideline to producing good, consistent Reviews, to let you know what we are about, and why.

With all this in mind, we now set down our ideas on what we expect the presently-considered book to contain.

The Market

While the old "Radio" Handbook was produced for benefit of the home-grown experimenter, today's product is undoubtedly intended for the Radio Amateur. In his modern environment, this individual is no longer prepared to wait 40 years or so until personal experience and resulting knowledge produces deep feelings of satisfaction from successful construction and use of radio equipment.

Rather, he expects more immediate, concrete results, and continuously so, Indeed, such an identity is now possible because of advances in science, engineering, education, and communication of information.

This Radio Amateur is also a bit lazier, finding it easy in his growing affluence to purchase, rather than nut-out and construct, gear of a standard able to satisfy his needs. This would seem to indicate a need deliberately to encourage a real and practical interest in the gear he uses.

Certainly one cannot deny the rights of those people who prefer only to talk on the air, rather than construct and experiment with equipment. But a continuing emphasis on the "appliance operator" level can only carry the Radio Amateur into a soul-less activity destructive of individual creativity.

The Material

In view of the Market, the contents of a Handbook must ultimately include equipment of a reasonably sophisticated nature, together with theory explaining the why, how, and wherefore.

Hence, in its totality, the theoretical text must lead the reader from a level of simple electronics to the necessarily more complex one, in a clear and concise manner.

The practical material must develop logically, and must be tied clearly to theory. It is not sufficient simply to include whole "suitable constructional articles". To treat either aspect satisfactorily the one must be demonstrated systematically and explicitly by the other. In this regard, the present organisation of the "Radio Handbook" is less than ideal.

The theory required need not always be highly mathematical. But it is only reasonable to include some maths -- as necessary. Because electronics is engineering, it is simpler to explain it in the language of engineering: mathematics.

Mr. Orr has included some maths, but has largely been relegated to first and last chapters, with little obvious application between. On the other hand, why does he waste a dozen pages in "Radio Mathematics and Calculations", describing Primary School arithmetic? The space would better be devoted to using equations to explain (even briefly) the design parameters of the various pretty circuits portrayed in this book. If this requires a little more space, it can surely be taken from some of the nuts-and-bolts descriptions which adorn the text; One chapter on layout design and philosophy should surely cover the majority of such requirements.

The Whole Cloth

We see no real value either to the individual or to the hobby of a volume which aims to entertain or flatter the reader; yet this approach is a common one in American texts. In any event this aspect is already more than adequately covered by periodical literature available to Radio Amateurs.

A Handbook should not be merely a source of reference for knowledge of transitory type, used only as the occasion arises. Instead, it should attempt to educate, covering in reasonable depth the backbone of the subject. The book should begin at a fundamental (but not trivial) level, and develop to a standard as required by the present "state of the art". In so doing, it is necessary to avoid temptation to concentrate on particular topics (e.g. Sideband) which are, after all, covered better by texts specialising in them.

Again, this unbalance is a failing common to virtually all of the texts presently available to the Amateur.

A Handbook should include such tables, graphs, formulae, and other factual information as are used frequently; these arise naturally out of the text, though in some instances they would be more conveniently grouped together in a suitable Appendix, as Mr. Orr has done in his last chapter. This is a good compromise between ARRL's burying stuff in the text, and RSGB's publishing it in another book (e.g. the Radio Data Reference Book, reviewed in the 1969 EEB).

Thus, the complete Handbook would be equipped with a good balance of theory, examples, and data.

The Orr Radio Handbook, 18th Edition

How, then, does this Handbook measure up to these various criteria? If we consider the amateur experimenter for whom a good handbook should be designed, this volume has achieved a very mixed success.

Here, the coverage of both the theoretical and practical aspects is patchy, with some very good articles, generally on more sophisticated topics (e.g., see Note 1), some excessively protracted but unproductive discussions (Note 2), and practically no consideration given to the intermediate level (Note 3). The integration of semiconductors is also quite inadequate, although an attempt is made in the

Receivers chapter, wherein are found some "state of the art" designs (but Note 11).

Whereas some sections are very instructional (Note 4), there is also a considerable quantity of window-dressing and deadwood (Note 5). Coordination between theory and practice is largely nonexistent in either direction, and the (dis-)organisation of topics on both the large and small scale is confusing, and greatly detracts from the usefulness of the book (Note 6).

The number of technically inferior circuits presented (e.g. Notes 7-11) is surprising, considering the Handbook's background and reputation. In spite of this the author is greatly to be commended for his serious attempts to treat some subjects on a sensible level of engineering -- where they are both practical and informative (Note 12). But such attempts are less frequent than one would expect in view of the aims set out above.

Generally, then, this is certainly no book on which one could develop a sound education in electronics communications, but rather a second text -- to be called on for additional information, particularly with respect to more advanced topics (Note 13).

How come?

Why this critical view of a book which has been noted over its many editions for its greater depth and usefulness, compared say, to the ARRL?

The answer is that the book has remained essentially the same (with only minor changes, really*), whilst the electronics field has advanced immensely in recent years. The fact seems unfortunately evident that the job of managing the organisation of a modern Amateur Handbook is too big for one person to handle, no matter how talented he may be.

For inspiration for this we may look to the RSGB Handbook, and although I should admit that it has its own limitations in view of the abovementioned aims, it is a group effort, and a compilation of discussions by specialists. The result is a competent treatment; if the RSGB book lacks the latest circuits and transistor types, it tends to make up for it in the depth of the theoretical and experimental treatment.

A Constructive Approach

The very question of how to organise such a group effort, is in itself a considerable subject, but at least the prerequisites will be treated by Rod Reynolds in these pages next month.

We believe that such discussions have a place in EEB, because they will help readers more effectively to recognise good books when they see them (and such a large number of electronics books are now being printed!), and to use the books more effectively when they read them.

NOTES (referred to above) on 18th Edit.:

1) e.g., Ch. 7, "RF Power Amplifiers", one of the best chapters in the book.

2) e.g., "Receivers" chapter, or Antennas. Where in the 127 pages of the Antenna chapters is an applied quantitative discussion of impedance?

3) Where is a small transmitter or simple receiver? Beginners don't need such things any more? Daddy buys it for them for Christmas?

4) e.g., "Vacuum Tube Amplifiers"; there is even something about feedback -- but where does he use it explicitly in his constructionals?

5) Sideband transceivers, ad nauseam, even into the Mobile Chapter. Or consider RF Feedback Ch.

6) RF Feedback is not used in his fancy RF amplifiers. And detailed network calculations in an early chapter are not correlated with the constructional material.

The general picture shows a crying need for a thorough revision of the organisation of all chapters in this book -- and incidentally to resurrect the Index, which has been mutilated.

7) p. 793, the regulated power supply with appreciable resistance in series with the Zener!

8) p. 24, the transistorised oscillator with the transistor biased purely by leakage. Would it work with a modern type of transistor?

9) p. 805, an FET amplifier supposed to be linear with a couple of µA drain current, not to mention the low stability factor of the ckt.

10) p. 596, magnificent: an envelope detector used for SSB; where is the Product Detector described in his Theory chapters? In another circuit following, but why present any inferior material?... And the valve lineup in the receiver of this rig: 12BA6, 12BE6, etc, belongs in the arc (see Hawker "Radio Amateur Techniques" Receivers chapter, etc etc), as does that of the nearly identical circuit on p. 604, etc. And this, after his treatment of linearity and cross modulation in Receivers Ch.

→ P.T.T. p.114

*The larger and blacker print of this Edition is a decided improvement over several previous ones; it couldn't have been worse. And semiconductors have been introduced -- in spots. And other material is included, but the main impression is that of very little change of the vast majority of material from previous Editions.

HOW TO REALLY COMMUNICATE -- D. Morgan (K6DDO/W9AIW)

True Communication?

There is a lot of talk on the bands these days, but very little true communication. Some years ago I seriously looked into the matter. I had got tired of chasing every new country and island all night to collect all the worked-alls. With thousands of DX QSLs and most of the really difficult awards in hand I realised I had hardly ever really communicated much of anything.

My contacts resembled one computer talking to another:

R GD OM 599 LA NAME DAVE 73 SK ....
OK DAVE 599 MOSCOW NAME BORIS 73 OM SK.

Yes I got good reports, the name of the op, rig, antenna, etc, and occasionally even the weather. But it seemed an awful lot like a robot to sit and make mechanical contacts like this. Well, once a Russian engineer near Moscow got me into an hour ragchew on 20 CW. You know that was a lot of fun and I didn't even mind losing a dozen contacts in the WAE DX contest to hear what he had to say.

Varieties of Communication

I do love to work contests and the thrill of working stations at 60 or 90 or 140 QSOs an hour. But I wouldn't want to do it all the time.

There are many varieties of communication possible. The real amateur will try them all. He will try CW and SSB and TV and RTTY. He will work every band, locals and DX, TV sets and even cuss at himself once in a while (off the air of course).

Maybe he will get the impression or hollow feeling he still hasn't learned to communicate. What can you do about this? Well, find something worth talking about beside the usual old hackneyed subjects of the rig, the weather, the band and radio. Why not Afghan stamps, antelope raising for fun, playing the guitar or trips you have taken?

What to Communicate

Tell the amateur at a distance, phone or CW, what your area is like, what kind of trees, the types of houses, how many people live there, the altitude, flowers in bloom, agricultural crops, main products, your work, cars that are popular, the local sports, etc. ((And you'll learn a lot about your own area! -- Ed.))

I have thousands of DX friends and have been in countless DX shacks as well as shacks all over the USA and find it amazing how little people actually know about life in each other's states and countries.

One of my good Australian friends was interested in the fact that I had eucalyptus trees in my yard in California just as he did and I wanted to know when they were introduced to Australia. Actually they were brought to California from Australia and we finally got it straight and had a good laugh over it.

I can guarantee an interesting discussion if you try to tell a W1 who never left New England and never saw a Eucalyptus tree what one looks like. And in case you dwellers of snowbound lands in winter want to explain something that a Californian would never see, tell him how you carry a little plastic scraper around in your car during the winter to take ice or snow off the windshield. I brought one of these from the East Coast to California and it is considered a real curiosity!

There was a bright sunny day that I climbed my tower and took photos in various directions of the everyday sights below. I went over to Europe and the amateurs were much impressed by the palm trees. They thought palm trees only grew in jungles and certainly not in W6 land. What you take for granted is often of great interest to a fellow even a thousand miles away.

Yes, there is actually a great deal to communicate to your brother amateur. The things which seem so simple and obvious to you are just not a part of life in other areas. Normal business hours are vastly different even a few hundred miles apart in the USA. Check this in your own area.

Ask a DX amateur what time he eats his meals and what he calls them. Get the recipe for some of his foods and see if your YF can cook them. Nearly every country has a different schedule. Find out which countries are tea countries and which are coffee countries. In which countries do adults drink milk? How many amateurs can get along nicely without refrigerators still?

Domestically this applies too. Find out about fishing and hunting in each state. What kind of fish can be caught and when. Where are good places to go on vacations? This discussion could be endless. What sort of surplus stores are there in your friend's city. Might

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they have the odd part you are looking for?

Putting the Packrat to Good Use

The American ((and Australian)) amateur is a packrat. He collects parts, bottles, screws, bent pins, old magazines and can't understand why the YF can't get a broom in edgewise. Now use all this extra stuff to communicate.

Send a little something to each of your contacts -- or do you actually think you'll ever get around to using that stuff? On the customs form write "Junk, no value", or "books" (no duty on books). You can get it out of the house and either make a friend or at least arouse his curiosity considerably*.

This will be most effective in communicating with DX amateurs in relatively undeveloped countries (Works fine in the USA too, but the danger is that he will send you something even bigger than what you got rid of!). They are usually short of parts compared to us. One of the best things we can do is to keep mailing our "junk" to them until they have more parts. Mr. American ((and Australian)) Amateur still doesn't realise how hard a job it is to get an amateur rig on the air in many places abroad -- and even in some of the most industrialised countries....

Send Literature

But don't only send tubes and condensers and switches. Your magazines and road maps and photos are very popular abroad. If you don't save your glossy travel, holiday, or sports magazines, mail them off rather than throwing them away. Take a bunch of photographs of you your house and your city. Mail these off to your buddies. I can assure you they will be interested and impressed.

Find out what the other amateur collects or does as a sport or hobby. Send him literature of a comparable nature. When vacation time rolls around visit some amateurs you have worked, and you can really do a lot of communicating -- there's nothing like an eyeball QSO. I have found amateurs only a hundred miles away very glad to meet visitors. This is especially true of beginners; they can really get excited over a visitor.

Truly amateur radio gives us the mechanical setup to do a lot of communicating. Few have learned to use it effectively. Try a few of these ideas and see what happens.

CQCQCQCQCQCQCQC

You could even use a continuous tape cartridge to call CQ Bassoon Players, CQ Deer Hunters, CQ Numismaticists (coin collectors), CQ Bass Fishermen, CQ Rockhounds, CQ Mountain Dwellers, CQ Soap Carvers --- or whatever you can dream up.

Now you don't need a continuous tape cartridge to call CQ for you. This is only if you pick some very obscure subject you want to discuss such as the length of ants' legs (maybe aunts' legs would be more interesting?)*. Its possible that if you called CQ Bagpipe Players that one might answer. There are many possibilities.

Devise some unusual and interesting subject you want to communicate about. Call CQ. Get a good QSO going. Who knows what might happen? Really enjoy yourself!

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* You'd also earn the undying gratitude of the YF - after the first shock of unbelief.... Uh, yes, Alice. -- RLG

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* Its only a pun in Americanese, Dave. Hi. -- Ed.

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RADIO HANDBOOK (continued from p. 112)

11) p. 636, fine MOSFET RF for AGC, but the mixer should also use a Dual Gate unit for which it is uniquely suited.

12) e.g. "R.F. Power Amplifiers".

13) The Terman-Woodyard Amp (which has also been included without significant alteration for the past 30 years or so -- but which no longer appears to grace the index; or the I.F. Noise Blanker (which the Radio Handbook pioneered for Amateurs, but which is now conventional, with a number of improved designs current.)

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WHAT NOT TO DO ?

((Herewith we initiate a series based on contributions from readers. If you have any to add, send them in; they will appear annonymously, of course. -- Ed.))

I built an elaborate multimeter, transistorised, of course, and ordered a beautiful sensitive meter for it. Stuck it on, no joy. Checked everything through six times, including transistors. Eventually discovered I had forgotten to take off the shorting spring they place across the terminals in transit. ((I've done the same with an FET)) RLG

LETTER: More uses for Scythe Stones!

In EEB of February 1971 you published an article on the use of a Scythe (not Sythe!) Stone to regulate high power.

You might be interested to know that such non-linear resistors made from silicon carbide whetstones depend on the interesting statistical behaviour of n semiconductor diodes hitched in random series-parallel, where n is a number of the order of 10^5 or 10^6 -- an n large enough to give truly statistical random effects.

In such a randomly connected series-parallel arrangement, no one tiny semiconductor diode has more than a minute bias voltage across it -- and because of their random orientation in the network, there are as many conducting in one direction as in the other, so the thing works on AC very nicely.

The net result is that each individual diode has so small a voltage across it that it is operating way way down on the toe of its response curve, very near the cross-over point of zero-voltage , relative to forward vs back resistance.

Any ordinary semiconductor diode, operated near the zero point, has a very nonlinear response; connecting n of them in series-parallel produces a resistor that does not follow Ohm's Law; instead of E = IR it follows something like $E = I^XR$. By adjusting the ratio of SiC crystals to binder, the stuff can be composed to follow a neat square law, third power, fourth, fifth or even a ninth-power curve! I note from your February article that the natural stuff appears to follow approximately a third-order relationship. But this can be improved on for serious use.

The General Electric Company manufactures such units under the name of "Thyristor", and uses some really big ones on high-tension power lines as lightning arrestors. If lightening hits the power line, the Thyristor effect effectively shorts the voltage peak induced in the line to ground. But to the normal 220kV power on the line it appears (thanks to the exponential effect) as a very high resistance passing only a few milliamperes to earth. Those Thyristors are exceedingly rugged, since SiC has a very high melting point.

I've been using a piece of the stuff in my audio pre-amp for modulation compression; it doesn't square-wave clip the speech waves, as a Zener would. It wort of puts a rubber ceiling on the audio peaks that eases them to a stop rather than slamming them into a rigid wall at the top (which would produce harmonics which would then have to be filtered!).

The old ARC-5 transmitters used in B29 bombers during WWII used a hunk of SiC across the AF modulator output for the same purpose -- its cushiony effect on the audio peaks. It decreased the tendency to generate high-voltage transient peaks that a straight clipping diode would have caused. Remember that the voltage on a transformer winding is proportional to dI/dt, the rate of change of current. A clipping circuit can produce an excessively high rate of change, and hence a very high transient voltage. You can puncture good insulation that way!

-- J. W. Campbell, Mountainside, New Jersey.

COMMENT by R.A.J.R., and an interesting note on the uses of selenium transient suppressors:

((Readers who may be confused by the apparent conflict between use of "Thyristor" for a silicon-carbide transient regulator, and a silicon controlled rectifier -- may rest at ease. The British first called SCRs "thyristors", and the term has gradually given way to calling them Silicon Controlled Rectifiers; now that Mullard has been taken over by Philips, one presumes that the transformation of nomenclature will be complete. In the meantime the Americans took "thyristor" to describe the device mentioned above, causing some confusion. In fact, there is no functional connection between the two, name notwithstanding.

((In these times, special selenium rectifiers are used for lightning suppression on EHT mains lines. They are also available in lower power versions for ordinary transient suppression, manufactured by Int. Rect. Corp, STC/ITT, etc. Selenium turns on less sharply than does the silicon carbide, but also generates less noise; on EHT transmission systems that noise can show up as high frequency transients -- which generate their own problems.

((On the other hand, one hears of experimenters trying to duplicate these devices by using ordinary selenium rectifiers back-to-back across the a.c. mains. As often as not, they come to grief, because the simple rectifiers tend to arc over at the edges before they are able to conduct significant currents in the reverse direction. To appreciate this one needs only to look at the characteristics curves of the commercial selenium transient suppressors (e.g., Thyrectors, made by G.E.,* presumably to replace the old Thyristors!), which show that appreciable reverse current does not flow until some 60 - 100V appears across the diode in the reverse direction, PER PLATE! Ordinary seleniums, rated at some 18V working, per plate, will usually arc over long before that.

((It should also be noted that Siemens manufacture a gas-filled transient-suppressing device, which has the advantage that it is considerably less costly than the "Klip-Sels" (Int. Rect. Corp.), "Thyrectors" (G.E.), or "Saf-T-Stacs" (STC), but for a really large mains transient the gas-filled suppressor is likely to burn out and must be replaced fortwith.... But the special selenium devices can also perish when lightning strikes...))

*See APPLICATION NOTE 200.5 xxxxxxxxxxxxxxxx

LETTER: State-of-Art Electronics (and beer!)

The reason I subscribe to the EEB is that on theaverage one issue out of eight or nine is a masterpiece (i.e., more than worth the year's sub.). The question is: do you know which ones? I have the odd feeling that the production of these gems is quite accidental.

May I now make a plea for fewer beer, good coffee, apple drink and soap recipes? Surely your average (sic) reader has more transistors to play with than sheepskins to tan or warts to cure.

These few articles aside, with congratulations to you on your State-of-the-art presentation of commonsense electronics.

-- D. J. Barrett, St. Ives, N.S.W.

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SIGNIFICANT NEWS REPORT (5/10/71):

Using photocells linked with a Computer, American Scientists have just discovered that goldfish rarely swim straight for longer than three seconds and have a cruising speed of 1.5 mph.

AVAILABILITY OF STANDARD FREQUENCIES IN AUSTRALIA -- Staff

RLG: The following quotation from the American publication, Collector and Emitter (July 1971) raises an interesting question why such a scheme cannot be instituted in Australia:

> "A work-connected visit to the National Bureau of Standards Laboratories at Boulder, Colorado, was the highlight of June activity for W5KE. While there it was learned that the NBS may sometime transmit special frequency and time code information between frames on network television broadcasts. If this comes to pass, ingenious amateurs may pick a 1 MHz phase locking signal off their TV sets, divide and/or multiply it to have precise frequency standards at very low cost. We haven't seen everything yet, fellows." -- W5KE, E. W. Foster

RAJR:

This is not practical in Australia, because we have already filled up most of the space available between TV frames. The fact is, however, that it is hardly worth the bother to do this in the first instance.

We have already an excellent 7.5 MHz signal standard from Lyndhurst, N.S.W. This signal suffers far less phase distortion at reasonable distance from receivers than would a signal received from a TV station.

Furthermore the fact is that the accuracy of the marker on the TV signal would have to be dependent on synchronisation from Lyndhurst in the first instance. And the transmission of that signal would be subject to phase distortion as well. In consideration of the considerable distances involved in Australia, the amateur's best source of accurate signal for synchronisation would still be the one at 7.5MHz. A typical application of this was the "Crystal Checker and Frequency Comparator for VHF" by I. N. Kallam in the April 1970 issue of EEB.

PHONETIC PHUN ((QSP Yellow Thunder ARC))
((Amateur Radio News Service Bulletin, December 1970))

Gaze over this and see how your own call comes out:

Average	Arrogant	Aardvark
Boring	Big	Bullmoose
Clumsy	Cheerful	Clod
Daring	Dreamy	Dumbdumb
Eager	Exciting	Earthworm
Fastidious	Fascinating	Flutterblast
Grouchy	Gorgeous	Gnat
Happy	Handsome	Hippy
Irksome	Ignorant	Idealist
Jolly	Joyful	Jumbuck
Kooky	Knowledgable	Kook
Lovely	Looney	Lamebrain
Mighty	Motherly	Mistake
Naughty	Normal	Nudnick
Odiferous	Ornery	Operator
Putrid	Purple	Pincher
Quick	Quiet	Quack
Raunchy	Regular	Ripper
Sweet	Suave	Sender
Toughful	Terrible	Tonguetwister
Uniform	Ugly	Unicorn
Vast	Ventilated	Ventricle
Warm	Wicked	Whacker
Xtra	Xrayed	Xylophone
Young	Yellow	Yankee
Zippy	Zappy	Zookeeper

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AN INFORMAL ELECTRONICS EXPERIMENTERS BULLETIN

DECEMBER 1971 VOL. 7, No. 7 P. 117

Man has too much in common
to be separated
by political blocks
or racial barriers....

whatever splits up mankind
is artificial and can be
tolerated or ignored -

whereas

whatever unites mankind
is real
and profound.

THOR HEYERDAHL
(via amateur radio)

-- QUOTED BY: WORLDRADIO,
Amateur Radio's Newspaper; see p.123.

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COMING:
Interplated Snickett, High impedance with low Z transistors, Condenser construction, Null Point Detector, Good Tr. Voltmeter, Proximity Detectors, Handbook Design, Etc.

CW RECEPTION WITHOUT PAIN -- K. M. Kelly (VK4MJ) (ex VK7LL))

During recent months the writer has been experimenting with Radio Teletype systems ("RTTY"), and has been working with various demodulators, with interesting results. Modern techniques result in an amazing amount of copy of RTTY signals in the presence of noise, in some cases with signals that are difficult or impossible even to hear on the loudspeaker.

One day in an idle moment I hooked the thing onto a normal code (CW) signal, and instead of working the teletype machine, I connected the output to an audio oscillator. The result was a nice audio tone, with no hash or other noises on it to irritate the ears, and there was a complete absence of fatigue in listening to it.

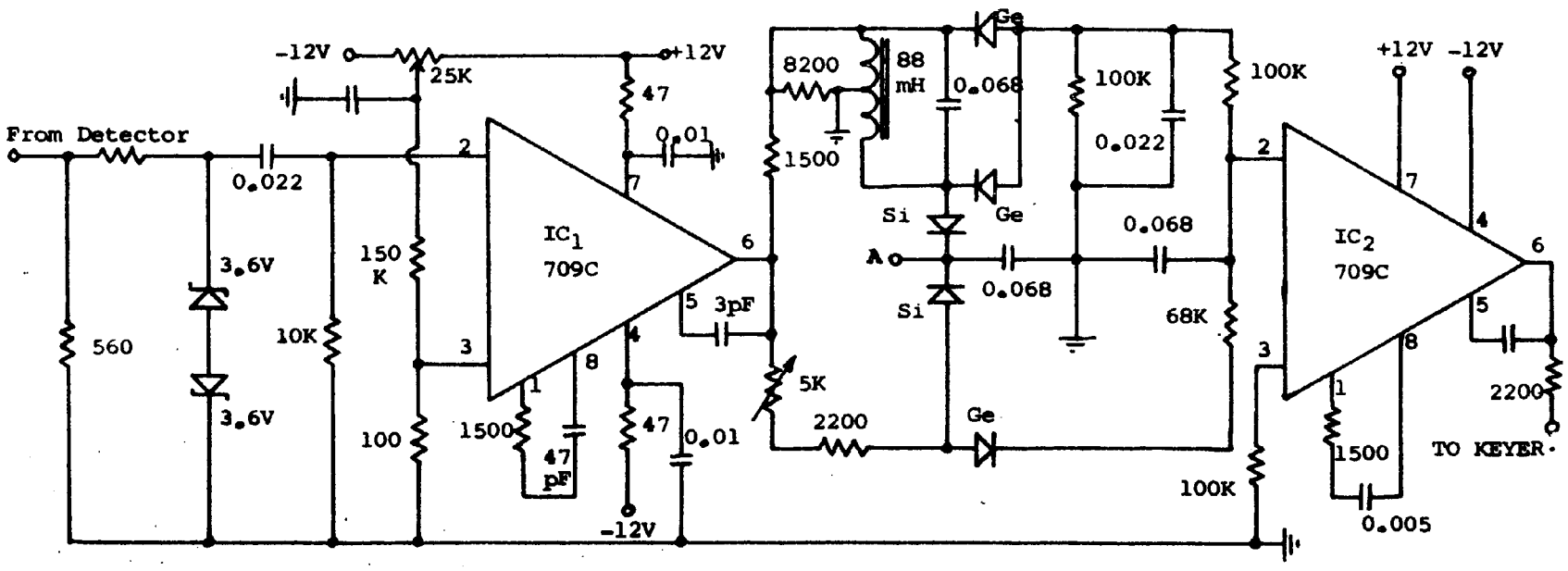
For those who would like to try this, I reproduce part of the circuit as relevant, which was published in the RTTY Journal for May 1970, by Irv Hoff, W6FFC. Audio from the receiver's detector is fed into the input, and the two zeners are to protect the first IC in case of excessive audio input from the receiver. The first 709C is a limiter, which gives about 90db of limiting!

The coil in the detector-filter stage is an 88 mH telephone coil, but a coil can be made with a Vinkor, or a TV width coil can also be pressed into service; however the toroid one is best, and the 88 mH items are widely available from surplus merchants. Whatever coil is used it should be tuned to the range of 1000 - 1300 Hz, not critical, and the audio from the receiver should be tuned to that frequency, e.g. 1200 Hz.

The second IC, also a 709C, is the slicer stage, and this works the keyer stage which keys the audio oscillator; this keyer can conveniently be a simple emitter follower whose emitter furnishes some +11 V to supply the audio osc pwr, whose collector goes to the +12 V rail, and whose base is shunted by a diode and fed from the output of IC_2 ((Ed Note: this last sentence is obviously to save us a bit of draughting, but if you don't know what an emitter follower is you obviously won't be building such a unit in the first instance...) Any audio oscillator will do which will work from 12 V or less.

To adjust the beast when finished, put a voltmeter on pin 6 of the limiter IC and adjust for zero volts with no input signal; the 25K pot does the adjusting. Then put a meter between point "A" and earth, and adjust the 5K pot for an equal voltage deflection with no signal, or with a signal properly tuned as input. If the morse sounds inverted in the audio osc, reverse the germanium diodes. Happy listening.

I think I ought to add to that article the low-pass filter. This is in my demodulator, after the discriminator-detector, and is a low pass filter at about 100 cycles or less, which of course must help a great deal in the immunity from noise. The latest is to use an IC low pass filter which is quite simple. You will find it in the excellent article by Irv Hoff in an issue of Ham Radio last year -- the ST-6 RTTY Demodulator.



A PRACTICAL DWELL METER -- D.J. Beck (VK5)

I have built the system shown in fig 1, and have found it most useful for my car. I'm not certain where it came from; I got it from a friend who got it from a friend, etc. I acknowledge full credit to the Inventor, but this way the circuit will get wide publicity through EEB.

The meter used was an "ex-disposals" 3" 1mA FSD scaled 0-100, graduated every 10 major divisions and every 2 units on the minor ones. I did not alter this scale, but used it to indicate DWELL PERCENTAGE.

Most commercial units are scaled to indicate cam angle in degrees with separate scales for 4, 6 and 8 cyls, e.g. 10^{o} to 50^{o} for 6 cyl engines.

Cam angle in degrees can readily be converted to Dwell %, for example:

DWELL ANGLE x No. of Cyl/360 x 100, and for 6 cyl, = 36^{o} x 6/360 x 100 = 60%.

It follows that a percentage scale is applicable to any number of cylinders.

Why bother with a Dwell Meter? It allows a much better tune up of the timing, and makes the points last longer than when the latter are adjusted with a feeler gauge. Points wear unevenly and the gauge cannot possibly measure the resultant gap accurately.

Setting the points with a feeler gg will not take into account wear or run-out of the cam, bearing wear, or wear in the vacuum advance mechanism. The Dwell Meter allows a dynamic test of actual engine performance.

The Dwell Meter is used with the engine running, and the condition of the distributor as a whole can be "explored" under varying conditions of load, speed and vacuum advance.

In evidence of this, some American cars are fitted with WINDOW distributors to allow the points to be set with the engine running.

At first sight the fitting of a CD Ign unit would render a Dwell Meter obsolete, but this is not so, because variation in dwell can affect timing, which is obviously undesirable.

My own car, a Toyota Crown, is very sensitive to Dwell setting, and errors can result in up to 3 mpg loss of economy.

Normally one says "I will clean and reset my points", but if you have a Dwell Meter it takes very little time to check and see whether it really is necessary to 'touch' the points.

To Use

Close switch, adjust P_1 to give FSD calibration. Connect across points, and run engine to read Dwell% on the meter. Set the points to give 60% for 4 cyl, 60-70% for 6 cyl engine.

Using an Ohmmeter as Dwell Meter (RLG)

If you look closely at fig. 1 you will see that it looks suspeciously like an ohmmeter. In fact an ohmmeter can be used for this kind of application, and the circuit of fig. 2 is relevant. Like that of fig. 1, its origin is apocryphal, and I too give credit to whoever invented it (notice how useful inventions tend to keep the details but lose the inventor? I wonder why).

The only item added is the diode and condenser, but perhaps it could be wise to add also Mr. Beck's r.f. filtering C and L.

The ohmmeter is used on the medium ohms range, and suitably zeroed. If polarities are correct, Dwell % is read from a 0-100 scale on the meter, and treated as discussed above. If polarity is wrong, the meter will read off-scale, so there won't be any doubt about it!

Incidentally, from fig. 2 you can see how to connect the circuit of fig. 1 to the car. Also, I might add that it could be a good idea to see what cam angle is recommended for a given car, apply the formula, and adjust points spacing to suit.

XXXXXXXXXXXXXXXXXXXXXXXXX

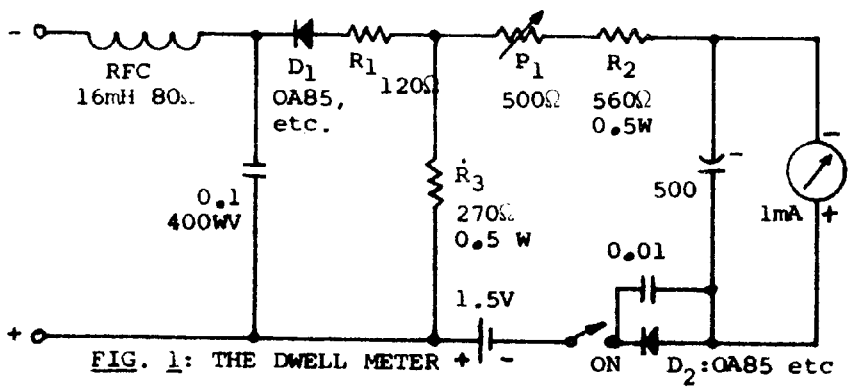


FIG. 1: THE DWELL METER

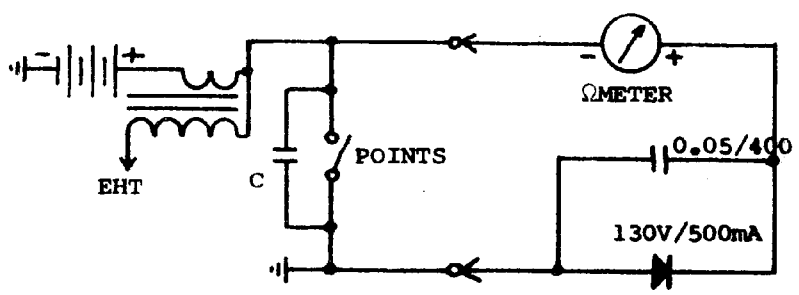


FIG. 2: VOM USED AS DWELL METER. Set VOM on high or medium ohms range. See text.

ADDENDUM -- R. A. J. Reynolds (Asst Ed)

For a Capacitative Discharge Ignition system there is little to be gained by having an accurate adjustment of Dwell. For CD it is quite normal practice to reduce dwell considerably, e.g. to 5 thou. on some distributors. Furthermore, this dwell now becomes quite uncritical (in most distributors) so why bother to adjust it critically?

The meaning of "dwell" is the time needed to allow the maximum current into the coil at maximum revs. Obviously this is not relevant for CD.

Further, I fail to see how dwell adjustment assists timing. One adjusts the points first, then the distributor spark timing. Timing can be adjusted by setting the idling (or a fixed) speed to the manufacturer's specifications using a standard timing light. Better, however, it is worthwhile fitting a vacuum gauge on the intake manifold (NOT on the vacuum line to the distributor!), adjusting the distributor position (i.e. timing) for maximum vacuum -- and then retarding the spark to decrease the vacuum by 1" Hg gauge.

The same meter can also be used to set idling mixture accurately: adjust for maximum vacuum. AND the same vacuum gauge can be used to monitor engine performance and petrol economy; run to keep vacuum high.

Obviously therefore, a vacuum gauge is a far more useful machine than is a dwell meter!

XXXXXXXXXXXXXXXXX Anyone have any other opinions? —T

Elephant Stew

Take one large elephant. Kill, clean and cut into small cubes. This will take about two months. Put in a large kettle and simmer over kerosene heat at 405 degrees (F) for 14 weeks. Make gravy to cover. This will feed 3,685 people. If more meat is needed, add two rabbits. But use only if necessary, as few people care for hare in their stew.
(ARNS Bull., QSP "Soldier", U.S. Army)

XXXXXXXXXXXXXXXXXXX

WHAT NOT TO DO?

110V device was run from 240V by putting a bobbin of resistance wire in series. But the bobbin got too hot. What to do? Simple, connect another bobbin in parallel with the original one. Result: Bobbins kept beautifully cool, the 110V device burn out!

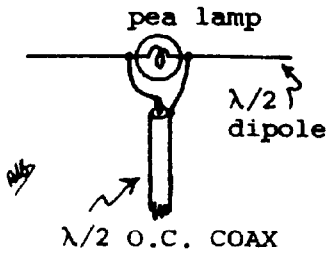
Quote without comment

"If humanity cannot work the miracle of personality over technology, Vietnam will be dwarfed by the final holocaust. Life in the biological sense might continue past that apocalypse, but would become worthless, indeed unendurable for human beings -- who would no longer be human."
-- Arnold Toynbee ("Experiences")

"If we defile life by killing or dominating each other we rob it of all value." --A. Szent-Gyorgi

LETTER: UHF Frequency Indicator

In order to determine whether a varactor transmitter output was on 432 or 576 Megs I made up two of the devices shown here at the right, one at each frequency. With this held close to a λ/4 wire in the Tx coax output socket, I found it easy to tune up for maximum output on either of the frequencies in question. I thought the idea might be helpful for other UHF experimenters.



-- T. Bellm, VK5ZDY, Stirling East, S.A.

Quote without comment

"The other day I got a letter from a W2 who had written to a well-known antenna manufacturer and asked if it was all right to use a transmatch in the line feeding the beam. The manufacturer wrote back and said absolutely not because using the transmatch could cause the traps in the beam to burn out! Good Grief! I guess the manufacturer is afraid that someone might get some power into the antenna, hah."
-- L. Mc Coy, W1ICP, in Collector/Emitter,7/71

STICKY TRANSFORMER CORES

((QSP Bandspread; QSPP ARNS Bulletin 4/70))

When was the last time you aligned your receiver and found one of the IFs was stuck and you were unable to move the tuning slug? Here's an idea that may help.

The usual reason for core sticking is wax from the coil form or intentional sealing of the core with wax.

Get an Allen wrench or a metal tuning tool that fits snugly inside the core. Hold the tip of a solder gun against the (metal) wrench until it gets hot enough to melt the wax, then with a long-nose pair of pliers, carefully turn the wrench. Remember not to get the wrench too warm, or you may burn up the coil former

WRONG FREQUENCY ((QSP, QST, Sept 1971)) (P. 89)

A friend of mine at the office came up to me several weeks ago and asked what he could do about a ham who was coming in on his stereo tape deck. He said it didn't bother him at first but after about thirty minutes of this he got pretty mad. I asked him if he knew who the ham was and he gave me the fellow's call letters. I then asked if the ham lived pretty close and had he been notified. My friend said, "I tried to tell him to stop messing up my stereo. I picked up both microphones and called him, but he never did answer."/K. Lambert, WA5EOG.

LETTER: Transistors in Output Transformerless Amps.

I like the new EEB ("whatever that is"). It is more informative about things electronic, and I liked especially the series on power supplies and OTL amplifiers in 1970. I liked the old EEB (pre 1970) too, because it told a lot about what was going on in the radio and allied world with reviews of books, magazines, and manufacturers.

In the articles about OTL amplifiers, you mentioned that with high ambient temperatures the output can become distorted.

About a year ago I built an amplifier with computer board transistors using a Mullard circuit (AC127, OC810, OC81, AC127) which is very similar to the Fairchild circuit. I used it to improve the output of a battery tape recorder, and it used to run for 2 or 3 hours at a time, and used to give out a very sweet sound all the time even though the output pair (034 and 083) got quite hot to touch, and the ambient temperature is 75° to 80°F at night here.

When I saw that the OC81 will dissipate twice the power of the AC127 (the original design output pair) I replaced the 034 with 2SB77, an output transistor from a wrecked Jap portable radio with no noticeable difference.

I then found by accident that if I bypassed the input transistor (063) and then fed the input straight to the driver transistor, no noticeable loss of sound occurred. So I removed the first stage and put the feedback resistor to the driver base; it stayed like that until the motor broke down and the whole lot was reduced to spare parts. The amplifier always sounded quite good, much better than the original using transformers, which seemed to blur the sound.

I also built the Fairchild 3W circuit when it came out in "Coryra", only using cheap silicon transistors. I did indeed have the trouble you described with the original Fairchild circuit (EEB May 1970), so it would appear that the Mullard (or Philips) circuit is inherently better. At the time I blamed the use of different transistors but I have now built the Maddever-modified circuit using the same transistors, and it sounds good.....

I wholeheartedly support the letter of J.E. Anderson, EEB Aug 1970 about cycles vs Hertz. I am a chemist using metric units in a Forestry Department using Superfeet and the like. The amt of time spent by me and other people converting from one set of units to another would make anyone with only an even passing interest in efficiency, weep. As Mr. Anderson says, there is no sweat involved converting Hertz to CPS, but the principle is important.

-- K. A. Garbutt, Boroko, T.P.N.G.

((In reference to not noticing any difference in output power when merely plugging one set of transistors in in place of another, see the important "DESIGN NOTE BY RAJR" at the bottom of p. 93 of the July 1970 issue.
((This matter of what we do include in EEB does seem to run in cycles (if you'll pardon that expression). Sometimes we'll have a run of reviews, as in fact at present, sometimes not, but remember that not everyone likes that sort of thing -- viz the letter by K.T. Andrew in this issue. In any event, note that when we make Reference Lists at the end of some articles we try to include in them as much information as possible.

((I loathe Hertzes, but as I ~~have~~ shall mention~~ed~~ in my "Sacred Cows" article on S.I. Units, I suppose we'll next year (late 72) are stuck with them. Its OK for you Chemical Engineers, but we Chemistry Lecturers are the ones who have to fight and interpret the Textbooks to a generation of students who already find modern life reasonably confusing. -- RLG))

LETTER: Never mind, mate!

I appreciate the magazine, the new format helps a lot; having a pretty book to read makes the material more interesting.

I read most of the practical circuits, the theory often gets read, but I hate "IMPORTANT DESIGN NOTES" by RAJR, e.g., p. 93, 1970. I know most of them so they can't be too important (sic).

I've got four initials in my name too, but I'm too bashful to use them. Furthermore I don't collect cars for a hobby, and if I did they would be average, not impressive.

-- L. N. Smith, Lileah, Tasmania

((Notice how cunningly I put these ~~two~~ three letters together! I've always admired Editors who could do that. -- Leo))

LETTER: Buy your own computer

I have just received your MAPRIL issue, and for awhile I couldn't make up my mind whether the article "Make your own Computer" was a leg-pull; shades of Larson E. Rapp in the April QST's etc.

I decided in the end that it must be serious because nobody would go to that trouble (and use so much of your valuable space) for a gag.

The small circular slide rule is very handy but I would not like to think that anyone in Australia has to make their own somewhat inferior article in order to have one.

Such a slide rule is available in Sydney (at least) from Paul's (Merchants) P/L, 314 Pitt St., Sydney 2000, complete with a neat plastic cover, for 95 cents (over the counter).

It is known as a "concise" No. 28N, of about 4" diameter, Japanese made of a very durable white plastic material, complete with cursor. The outer dial carries the "D" scale and the inner dial is recessed flush into the outer, and carries "C", "Cl", "A", and "K" scales. I think there is even a small instruction book which goes with it. A bigger 6" version is available, but costs about $3.40.. I have no connection with Paul's but I presume they would post one to anyone interested enough to send enough money.

I enjoy your magazine, including the non-electronic trivia, but would like to see a greater bias towards specific projects and less towards theory. I thought the book reviews in the current issue a bit much of a good thing.

-- K. T. Andrew, Ryde, N.S.W.

((The "Original Size" offered for 10c in the April EEB is 6" diameter -- Ed.))

P.S. Having gone to so much trouble, couldn't you do better than "a rough calculation to know where to put the decimal point"? -- K.T.A.

((...?? How else does one use a sliderule? --Ed))

Use for Potato Peels

Add the peels to well seasoned steak marinated in garlic, wine, and onions. Roast peels suitably in this mixture, add garden-fresh peas, home-cooked bread, and serve with a smile.

PUZZLE (Oct 1971) SOLVED

In a simple (?) circuit of two series resistors we showed that since

(1): $P_T = P_1 + P_2$, then

(2): $(E_1 + E_2)^2/(R_1 + R_2) = \frac{(E_1)^2}{R_1} + \frac{(E_2)^2}{R_2}$

(3): $\frac{(E_1)^2 + (E_2)^2}{R_1 + R_2} + \frac{2E_1E_2}{R_1+R_2} =$ "

and we asked you to prove it. We received several replies where the correspondent couldn't see what was the PROBLEM: we had proven it ourselves, hadn't we? To those souls we humbly apologise, and forge on to the other solutions presented, some locally:

A) Rod AJR worked out a solution having a dozen steps and a final identity which proved the point without reference to the original equation; and he didn't use a single differential equation in the process! For this noble effort we reward him with the privilege of indefinite perusal of all interesting EEB Manuscripts, and all others too which I don't understand.

B) Rarrie R, our tame mathematician said "so wots the problem?" To him as a Reward goes the task of editing all EEB Reviews to ensure that they don't land me in gaol.

C) One of our Subscribers didn't solve it at all, but he earns a Subscription anyhow for his noble efforts in solving the last-mentioned problem one time when Barrie overlooked it...

D) Richard HF commented in the same vein as BR, in consequence of which he earns the privilege of building for us any one of the brilliant designs he has muttered about during the past half-dozen years.

E) P. J. Griffin of Roseberry NSW and
F) David Hainsworth of St.lucia QLD sent answers at about the same time, which were simpler than Rod's, and achieved the desired results. A sub. goes to both.

Abbreviating a bit, PJG worked on the LHS of Eqn (3), rearranging to obtain

(4) $\frac{E_1^2 + E_1E_2}{R_1 + R_2} + \frac{E_2^2 + E_1E_2}{R_1 + R_2}$ so,

(5) $E_1 \frac{(E_1 + E_2)}{R_1 + R_2} + E_2 \frac{(E_1 + E2)}{R_1 + R_2}$

Now, since

(6) $I_1 = I_2$, then $\frac{E_1}{R_1} = \frac{E_2}{R_2}$ from which follows solutions for E_1 or E_2 in terms of the rest. Using this to substitute for E_2 inside the brackets of the LHS of (5), and for E_1 in the RHS of (5), and cancelling $(R_1 + R_2)$ etc,

(7) $\frac{E_1(E_1)}{R_1} + \frac{E_2(E_2)}{R_2}$ = RHS of (3), Q.E.D.

On the other hand, DH substituted E_1 from (6) directly into (2), simplified, substituted E_2 again from (6) into the result, and came up with the RHS of (2) directly. Good show men!

As for me, I think I'll avoid this kind of Puzz. for awhile. After a day full of such contributions from students I don't want to have to come home to it in EEB as well!

AUSTRALIAN STANDARD FREQUENCY/TIME SIGNALS

One of the chaps who commented on the triviality of the Puzzle, at the left, was John D. Cummin, of Frankston East,Victoria, who sends us the following useful correction and general information:

"On p. 116 of the November EEB, RAJR refers to the APO Standard Frequency and Time Signal Service as eminating from Lyndhurst, NSW on 7.5 MHz. For your information, Lyndhurst is in Victoria, in fact only a few miles away from my home. Transmission is on the following schedule:

UTC (GMT)	AEST	A. Summer T.	kHz
0945-2130	1945-0730	2045-0830	4,500
2245-2230	0845-0830	0945-0930	7,500
2145-0930	0745-1930	0845-2030	12,000

Details are given on p. 18, E.A., May 1970, updated on p. 23, E.A., Jan 1972."

XXXXXXXXXXXXXXXXXXXXXXXXX

LETTER: J-FET Circuit Loading, and Problems of Coil Design.

One point I have noticed when using transistors and JFETs in receiver r.f. circuits, is that while the base of the transistor or gate of the JFET is not connected to the top of the tuned circuit, one can obtain a mighty dip on the G.D.O. when checking frequencies, but as soon as the base or gate is connected, this dip diminishes tremendously in magnitude, as a result of the finite resistance shunting the tuned circuits.

The bipolar transistor does have a low input imedance, so would be expected to load a tuned circuit unless tapped down, but the JFET is supposed to be a high impedance device. I cannot help wondering how great an improvement in the overall Q of the coil would result from using a valve or IGFET in the circuit?

On another subject, nowhere have I been able to find a discussion on coil design using the Neosid formers or the ferrite toroid coils used by E.A. in some of their designs.

I wrote to E.A. a while back on this subject, but they replied that their Neosid and toroid coils were designed in the lab, and that design was complex and involved many parameters.

Both the RSGB and ARRL Handbooks give some discussion on designing coils, but these are for large diameter formers (min about 1/2") in general. It angers me to see in their circuits that coil details are for the most part given in terms of manufacturer's part numbers.

-- Eric Gauja, Merrylands, N. S. W.

((Simplest way to get around the problem of coil design is experimental: Wind a reasonable number of turns, measure the inductance, and rewind to suit, assuming that inductance varies approximately as the square of the number of turns. If final result is too far off, it can be corrected again either by the N^2 approximation or by the N^n relation found empirically; if you find something useful about this please let us know, specifying the core used, etc.--Ed))

WORLDRADIO: International Communications Report. (An exchange of correspondence)

Worldradio Magazine
2509 Donner Way, Sacramento,
California 95818, U.S.A.

18/5/71

Dear Sirs,

We have received a copy of your publicity sheet entitled "Amateur Radio Service". It appear that yet another amateur radio magazine is about to grace the American scene. One presumes that the other magazines will now devote themselves entirely to technical matters and leave the human interest material to you.

We should appreciate receiving a copy.

Yours sincerely,
R.L. Gunther, VK7RG

The Editor
Worldradio Magazine
(Etc)

18/8/71

Dear OM,

Thank you for sending the first issue of your publication. I have found it to be a remarkably positive expression of the positive side of radio amateur operation.

Ours is primarily a technical publication, but I have often attacked the lip-service amateurs give to experimentation whilst they devote most of their effort to operating commercial equipment.

Your activity shows that there may be another side to the coin: amateurs may indeed contribute to the benefit of the community and to their own creative endeavours as a result of operating goals rather than of technological expertise. Live and learn.

I commend your positive approach, and urge that you maintain your resolve to avoid amateur politics -- a difficult task...

Yours sincerely, RLG
(etc)

Mr. R. L. Gunther, VK7RG
P.O. Box 177, Sandy Bay,
Tasmania 7005, Australia

23 Aug 1971

Dear OM,

Thanks for the subscription to Worldradio and the nice words regarding such....

I was in Australia -- Sydney -- Townsville -- Port Moresby -- Lae -- Rabaul -- two years ago and had the grandest time. Went to Ewasse with Fred Hargesheimer, VK9FH (center spread, issue No. 1 Worldradio). I was saving my pennies so I could go back someday and then I started this paper and that pretty well took care of that for some time to come.

I found your remarks about the publication very well thought out and they captured the essence of what we are trying to accomplish.

Yes, you could certainly help by telling your readers about us. At this state and stage of our existence and development we can use every bit of help we can get... We are interested primarily in public service, humanitarian actions and international friendship.

We would be happy to send a free sample copy to anyone who might be interested...

73, Armond M. Noble, WB6AUH

EEB Ed. Note:

Worldradio is printed on inexpensive paper, small newspaper size, and features a definitely international outlook. It is published every three weeks, and describes its subscribers as "participants".

Worldradio's policies are well summarised by the quotation from Thor Heyerdahl which appears on EEB's front cover this month. My own view is slightly more cynical, but I admire such idealism greatly.

Another reflection of their attitude is indicated by a quotation from A.W. Clausen in their issue of Aug 9, 1971:

"A time of transition and ferment is an opportunity -- an opportunity to revitalize the multitude of ways we conduct our affairs, an opportunity to ponder the quality of life, that we may proceed responsibly toward whatever destiny we aspire for ourselves and our children. How our generation confronts the issues of this new decade no doubt will decide -- or dictate -- the path we travel for the remainder of this century."

Well, perhaps so, or at least so say many of the contemporary social philosophers, but you see, the main point of this is to show that this radio amateur magazine is not only idealistic, but also practically idealistic. Over again the point is made that mass media tend to stress the bizarre and overlook the constructive aspect of life. These people present constructive operator's amateur radio as a challenge to humanity and to the survival of amateur radio. Amazing. Send your $US6.00 and try them out.

STATE OF THE RECEIVING ART, IV -- RLG,etc

-- Direct Conversion: An interesting fad, used here as an excuse for re-examining some important parameters in Front End (and other) Receiver design : R.F. Stages, Linearity, Audio Selectivity, and Phasing (and other) Detectors.

"Give me a firm place to stand,
and I will move the earth."
-- Archimedes

Introduction

In Ref 16f, Ed Noll says:

"The foreboding opinion that integrated circuits will stop amateur experimentation and stymie ingenuity is unfounded. In fact, so much reliability and versatility have been built into these devices that there appear to be an infinite number of external circuits and systems yet to be tried. Each amateur can look forward to a lifetime of fun and experimentation with solid-state devices and systems; the integrated circuit is just an extension of the solid-state science of packing active devices into ever smaller spaces. Diodes, transistors and resistors are the primary components used... although a limited number may include an occasional capacitor or coil..."

Perhaps so, and ICs have another advantage: they can stimulate interest in certain types of circuits which were not popular with valves because of their "obvious complexity". About this tender subject we shall be having more to say.

Certainly the day has now arrived when an entire receiver can be made with ICs, whether superhet or direct conversion (Ref. 34a).

The Difficulty of Shifting the Earth

I am living to regret my decision to look into "a few" aspects of modern receiver design. It has delayed EEB unduly for the past 6 months, because I can't both write and publish a magazine. And it has probably been the cause of our having lost some 150 out of 250 renewals due these past four or five months. It may gain us international recognition, but it does tend to offend readers who want to see in EEB circuits of rain gauges to tell you when it is raining.

Well, that select band of you who remain with us, follow this tale into communications. It has some interesting byways, and will eventually lead to a conclusion I modestly predict to be earth-shaking (if everyone read EEB.).

Innovations, new -- and old

The Literature is being flooded with Direct Conversion (DC) and Synchronous systems: Refs 8b-e, 14-20, 22-24b, 26e, 28, 29c, 33, 34a-l -- and don't overlook the 1968 QST article which started much of this (described in 28, p. 81).

I have a distinct feeling of "Future Shock" as so ably defined by Alvin Toffler (35). Surely some of those references must be available to you if you are interested in the subject, particularly 8b, 16, 17c, 24b, and 28; if your local State Library or branch of the WIA or NZART does not subscribe to all the major English-language technical magazines, insist that they do so.

In any event, don't depend on it to appear in EEB. EEB is a romp through electronics, not into it!

Our Place

My place in all of this is not (necessarily) to repeat the good oil from the Literature, but rather,

1) To clarify (?) some definitions,
2) To show that Direct Conversion (DC) can be (phase-) synchronous or not,
3) To show that it works best when it works linearly (as what doesn't?),
4) To inject some commonsense (or rather, "commonse" into well-understood (?) subjects like R.F. Amplifiers, Mixers, and the rest, and

Superheterodyne Receiver Design

5) To point out that the same high technology applied to superhets as to D-C will yield even better results -- and NOT necessarily more complicated for the same performance; both Murphy and Gibbs demand this.

A lot of good literature on superhet receiver design of contemporary sort has appeared in the past couple of years in CQ (10ab, 11b), Ham Radio (15+,16h,17+), QST (21-23), Rad. Comm (24a, 28, etcetc), 73 (26bgh), and Wireless World (34a-l,b, etcetc).

For the most part, though, like the electrical system of automobiles, "today's receiver still uses the same principles developed back in the dark ages when the (Establishment) vehemently objected to the use of the 'new' superheterodyne." (26h) And with rather good reason, the scope of which will become evident as we delve further into the problems and advantages of Direct Conversion, the Alternative.

Those "same principles" have received quite a lot of grafting, including various front-end refinements to improve linearity, sensitivity, and stability; and

→ P.129

"The job of satire is to strip off the air of comfortable illusion with which are drab lives are covered; the way I see it, our job is to put it back again!" — Flanders and Swann (BBC)

HELP

The flood of correspondence which resulted from the final appearance of the Sept-Nov issues was appalling. It was the last straw in a steadily worsening administrative mess which has been accumulating at EEB. I have resolved to have orders handled promptly, and to publish the magazine not so impossibly late, by:

(1) Reorganising my files, an immense job, and not yet finished.
(2) Taking a moratorium (if you'll pardon the expression) on writing technical articles of elaborate sort; I can't both write AND publish this publication!
(3) Engaging the services of a proper Secretary.

Of these, point 3 is probably the most important; the job had got just too big for Graham Johnson, who also has his own life to lead. So Brenda Ford, who lives near me, is willing to take on the job, and is doing a good work of it. At the rate things are going, we shall soon have posted out all bound volumes and back issues requested, and the 1971 volume will be bound and ready for distribution. It will cost the same as the 1970 one: $2.55, etc. (See back pg)

Illusions and Commonse: (We lie halfway between Satire and F&S ?)

A correspondent writes:

"What did you think of the 'Automatic Radiotelegraph Translator and Transcriber' in the November 1971 Ham Radio? Wonder how many of them would be made; quite a few in the U.S.A. I reckon..."

Well, I thought about that article and about similar ones appearing in 73 and QST during the past year(and particularly late 71 and early 72), and I dashed off a longish article on "Means and Ends in Amateur Radio; where are we going?" — being a compendium of some previous and some new RLG thoughts. You've read much of that here, so I sent the M/S to a prominent technical magazine in the Yankee Nation, to which a number of you subscribe. If it doesn't get printed there I'll have to send it to the U.K. where the need is less, but not negligible.

One of the many things I discussed in that article was the question of the uses for technical developments, and whether technical progress necessarily makes the kind of world we would prefer. Perhaps relevant was a point brought up by several EEB correspondents (not included in the article directly), that we ought to publish "more technical material and leave the philosophy for the philosophers". But I have been under the impression that the Literature is choked with technical articles in rich variety. And what has been the net result?

Are technical items worth having just "because they are there?" Does not much of our sick society concern itself with producing marvelous systems with unmarvelous consequences? Beer recipes notwithstanding (what better use for short spaces?), we have attempted to look at human values in electronics. We say that it deesn't necessarily have value to build a gauge to tell you when the sun is shining, or a transmitter to put our more signal. We would have you ask yourself whether a stronger signal is necessarily a better one, or whether time might better be spent out in the sun rather than in making a gadget to chart it...? — Of course if you DO need a sun-gauge, then do build it...

Plundering Avalanche Transistors etc.

Its virtually certain that you'll get better results in the November avalanche transistor experiment (p.106) if you adjust the plungers for optimum response, rather than the plunders. Can't win 'em all.

Talking about microwaves, in the January 1972 Radio Communication is an article, "Microwave Transistors", by P.B. Brodribb; for those with back copies of 73 the June 1969 issue has "New Ways of Generating Microwave Power", and in the Electronic Engineer of Nov 1968 a nice piece, "Microwaves are going solid". Closer to home, (CONTINUED, p. 127 —)

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GIVE AWAY: User Handbook WS 62 (with circuit); User Handbook WS 122 Mk. 2 & AMP plus all circuits. Both 1955 Army issue. Will post free to first come first serve. Also, can anyone assist me with a circuit for RF Generator suitable for ultrasonic cleaning? B. R. Williams (Precision Watch Repairs), 284 Rocky Point Rd, Kogarah, NSW 2217.

= =

WANTED: One copy of EEB, Feb. 1971. Bruce Bonamy, Box 161, The Union, University of Sydney, NSW 2006. ((Ed. Note: Several other people are wanting this copy, so perhaps B.B. can be of service to them if he receives more than one offer. The Bound Volume for 1971 should be available soon.))((I said it should be!))

= =

COMPUTER BOARDS FOR SALE: 10c per transistor, post free. Transistors are high quality germanium, low leakage, medium gain; other parts may include diodes, resistors, capacitors of various kinds. These boards have been described extensively in our regular Computer Board Notes, a copy of which can be provided for an additional 20c. We make about 3 to 4c per transistor, which goes toward paying for our Equipment. You get the merchandise more quickly (and simply) than when ordering overseas -- and you can also specify whether you want PNP or NPN, while they last. For quantity ordering, order directly from overseas yourself, as described in the Computer Board Notes. Order from: EEB, Computer Boards, Box 177, Sandy Bay, Tasmania 7005. Australia and New Zealand only.

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FOR SALE: High Quality Automatic Coil Winding Machines. 1) Model Q, for coils up to 6½" dia to 6" long. Standard model, with Clutch-Countershaft, Reel Carrier, Service and Operating Manuals, some spares. FOB - U.K., delivery approx 8 weeks from order. $400. $ extra for 12" carriage, $120 for 15" carriage. If required this machine can be fitted with a double end drive for winding flexible strips for volume controls, etc, or the parts may be supplied at any future time when they can be easily fitted by the operator. This is, of course, an extra. The machine can be supplied with magnetically clutched ½ motor & predetermining counter in place of or additional to foot-operated clutch at extra cost. The machine is substantially built, and ball bearings are fitted where requisite. It consumes very little power, a ¼H.P. motor being ample, and although designed for power drive a driving handle is supplied by which the machine can be worked quite comfortably in an emergency.

2) Semi-automatic hand driven coil winding machine, Model A for coils up to 5" diameter and 5" long. For the repair shop, where an elaborate and expensive machine could hardly be a profitable proposition, our type A machine is ideal. For those wishing to commence manufacturing with moderate capital, it offers an inexpensive means of equipping a small winding department. Ten feeds are possible, from 450 to 86 per inch, and further ranges are possible. The principal range provides feeds suitable for most gauges of wire and of any covering between 47 and 24 gauge. Standard machine with reset counter but without Double-end Drive fitments: $200 FOB - U.K. Approx 8 weeks delivery.

These fine machines are manufactured by the ETA Tool Co of Leicester. Established in 1914 they were among the first builders of coiling machines for the radio industry in the world. They have never deviated from the quality standards of those early times and continue to supply numerous government establishments. Every machine is hand-fitted and finished to ensure exact tolerances -- and thus accuracy. Old-fashioned methods of contruction have been followed, and [illegible]

fitted and finished to ensure exact tolerances -- and thus accuracy. Old-fashioned methods of contruction have been followed, and relative to size ETA machines are heavy, robust and very durable. Every part is replaceable (and available); these machines do not wear out. There are few coiling machines so versatile and simple to operate. They are backed by service within Australia, and users are assured of competent advice on any unusual winding tasks they might encounter.

SOLE AUSTRALIAN SALES & SERVICE REPRESENTATIVE: ADTRON A'ASIA, 30 KORONG ST., SOUTHPORT, QLD 4215.

EDITORIAL (Continued from p. 125)

Electronics Australia is featuring "Using IMPATT Diodes at Microwaves" in the first two issues or so of 1972. As background, of course, it would be difficult to better EA's "Fundamentals of Solid State" now available as a book or "Home Study Course" which will probably be likewise after finishing the periodical presentation.

Goodness, there is no lack of information on any phase of electronics; just lack of time to study it!

Are Experimenters Human (too)?

John Andersen's ideas (Nov EEB) as well as Armond Noble's (Worldradio) and a recent AR Editorial ("Leonardo da Vinci is a Silent Key") have started me thinking — a painful process. Perhaps I'm wrong to embrace experimentation so onesidedly. After all, that is merely my preference. But the good folk in Worldradio show that there can be much value in amateur radio operation for its own sake, and for creative experience. Although this is attenuated somewhat by 3rd-party traffic restrictions here, the principal idea may still obtain.

I am willing, therefore, to acquire some flexibility, and to solicit articles and discussions from contributors who wish to show that electronics can have value beyond Ohm's Law. After all, I'm a prime example of the Prime Frustration that comes from being an experimenter. I can investigate this and that, but don't really have time to build much communication equipment. The result: I'm never on the air... If I swallowed my pride I could get on the airwaves as time allowed, using commercial equipment. And perhaps not become corrupted thereby...

What do you think? As John Andersen says, lets have a forum on this subject.

"Nuisance from a Transmitter"

In the Feb 1972 Radio Communication (U.K.) is a tale which bears a moral for us. Although the British Post Office had informed a TVI Complaintant to put his own TV set in order, the London Financial Times had advised him to bring lawsuit against a radio amateur.

When the Radio Society of Great Britain read this they dashed off wildly in the direction of the Times, and I reckon that newspaper lived to regret their mistaken advice! RSGB point out dryly that

"This is tantamount to saying that if a person buys a television set which receives two programmes at the same time the purchaser can force the interfering TV station to close down -- clearly a ludicrous situation, but the logic is inescapable".

Quite relevant for Australia dna New Zealand is the Society's conclusion; one needs merely to substitute the word "Institute" or "Association" for "Society":

"('The moral) is that members should do something about any case of interference which comes to their notice, and should seek the Society's help if they are unable to solve the problem. It does not help the individual or the amateur cause simply to say 'I don't operate during TV hrs in case I cause TVI' or to succumb to social blackmail on the grounds that 10 viewers with poor equipment are numerically stronger than one amateur complying with the terms of his licence.

"If the amateur concerned in this case is not a member of the Society then he is on his own in fighting any attempt to serve an injunction on him, but more than this, by being alone he is doing the amateur movement a great disservice, and calling down on his head a decision which may be to the detriment of us all. If you know of a non-member TELL HIM HE CANNOT AFFORD TO STAY OUTSIDE (J.W.S.)"

The case is relevant not only for legal advice and moral support, but in a number of other ways. Membership in the WIA or NZART (preferably both!) brings an interesting technical magazine each month (and on time), the offer of fellowship from other people who meet together with similar interests, QSL and EX services, regular classes to help beginners improve their knowledge of electronics (and if they desire, to work toward their AOCP licence), and the availability of inexpensive components equipment and books.

Fees for membership have risen, it is true, as all else in these perilous days, but they are well worth it. By joining the Institute/Association you do yourself a favour, and you strengthen the cause of amateur radio (and therefore of experimenter electronics in general!)here

and therefore in the world; VK and ZL have as much voting power as W and VE.

Membership is open to all people interested in electronics; you need not be a radio amateur. The cost is equivalent to a single night out at a good play for the whole family (or half the family on the Mainland?). Write: Federal Manager, WIA, P.O. Box 67, East Melbourne, Vic. 3002; or The Secretary, NZART, P.O. Box 1733, Christchurch. They will direct you to the relevant Division of the group.

Amateur Radio is the monthly magazine published by the WIA and Break-In by the NZART. Coverage is mostly on communications subjects, and what a wealth of interest lies there in. EEB contributors are encouraged to send us a block diagram and explanation of their pet projects, but to save the big presentation for AR, or BI. EEB is a voice for experimenters, but these magazines must be a voice for Australasia (or Zealaustralia ?).

THIS & THAT

We are informed by AWV that RCA's "Ham Tips" has been discontinued, "with considerable regret and much nostalgia". "This action was decided upoh because of the reduced need for a Radio Amateur publication featuring construction-type articles". Sign of the times?

"It was also recognized that there are a number of excellent periodicals in publication that serve this need very adequately". Non sequitur? But RCA say that they will continue to contribute articles to the various "well-known" periodicals, and I might add they also do a fine job through their various publications (handled here too, by AWV and local technical bookdealers): Transistor and Tube Manuals, Hobby Circuits Manual, Silicon Power Circuits Manual, and much else (e.g. a wide variety of fine Application Notes, available from AWV by request on company letterhead).

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G2BVN of RSGB writes that there will be a new edition of Amateur Radio Techniques, that famous collection of state-of-art circuits by Pat Hawker, G3VA. It will be a 256 page volume (Edition III was 208 pgs), and will be available around the end of May 1972. It will be available in Australia from Wireless Institute Branches, as usual, and from NZART in New Zealand; also from technical bookshops at a rather higher price.

Roy says: "Due to very great pressure of work, G3VA has not had the time to carry out all the revision work that he would like, so that some of your previous comments regarding the format may stil apply!"

Oh well, never mind, that book would be a gem if printed in white ink on blotter paper.

"AROUND THE AIRWAVES" will be resumed here next month under a new title, under the leadership of Greg Johnston, VK7KJ.

IMPROVED CW RECEPTION

In this issue Ken Kelly's RTTY-derived triggered oscillator is one more refinement on a method that has been around for some time, allowing more reliable CW reception. Hoff's system seems to bear the improvement that it is unusually sensitive to signal in the presence of noise.

The Signal Feed-through Technique

The problem with most such systems is that they do not allow you to hear the original signal which keyed the oscillator. That this is undesirable is well described by D. Wherry, W6EUH who proposed an improvement in the Dec 62 issue of 73:

> "Those of you who may have tried this device can attest to the utterly helpless feeling you experienced when the oscillator ceased to trigger and you were confronted by a deep silence, with no way of knowing if your contact had drifted up, down, or just faded away." !

The answer he provided was simply to select a small portion of the actual input audio from the detector, and mix it with the output from the triggered oscillator. This gives the operator the "feel" of the signal, and restores human control over human destiny. The original circuit used valves, but semicons would be simple enough, and the circuit details are obvious if you know what an audio mixer is.

High Sensitivity through Pulse Detection

A cunning and fundamental improvement of this method (of triggering an audio oscillator from signal) seems to have got buried back in the June 1947 QST: "A New Noise-reducing System for CW Reception", by D. L. Hings, VE7BH. It works by an ingenious system of "pulse detection" which uses the noise energy to turn the audio oscillator off! The audio is amplified considerably, limited heavily, and then rectified to produce a d.c. signal to key the oscillator off (through Schmitt or other means). What makes this system so effective is the fact that (CONT. NEXT MONTH...)

sophisticated selectivity systems, noise blankers, balanced modulator-type r.f. and a.f. mixers, frequency synthesizers, phase locking, threshold-sensitive detection, audio filters and phase-cancellation, and a massive infusion of semiconductors -- not always a benefit.

In any event, please note that (contrary to my Nov 71 Editorial hopes), Peter Martin's fine "Plagiarise and Hybridize" receiver design article (24a) will not be available generally from RSGB as a reprint.

You will, therefore, need to dig up Radio Communication in a Library or from friends or somewhere. You might even entertain the idea of joining the RSGB (and so receive Rad. Comm.). Aside from their interesting technical magazine (which contains a first rate review of the technical Literature each month), RSGB also provide various services for the DXer, and the mag contains many valuable advertisements for gear and parts available from the U.K.

Interested parties should write for further details to:

The Radio Society of Great Britain
35 Doughty Street, London W.C. 1.

The Question of Nomenclature

Radio-Electronics magazine features a column headed "Technical Topics", presumably under the reasonable assumption that most Americans don't read the British Literature.... Never mind.

This (Ref 33) is one of a series of articles on the current literature subject of Phase Locked Loops ("PLL"), and it is interesting even though it seems only to have heard of AM.

The author points out that "Synchrodyne" obtains its local carrier from the Phase-locked Oscillator, while the "Homodyne" obtains the local carrier from the incoming carrier directly, i.e. true exalted carrier reception.

There is some obvious conflict of terminology going in the literature. I prefer the use of "exalted carrier" to describe systems which either amplify the carrier separately or which use it to generate a synthetic carrier, as in Macario's triggered astable (28); in the light of a recent development (17c) the definition may have to be broadened to include all kinds of carrier-regeneration systems. On the other hand, "homodyne" can be reserved to describe non-synchronous product detection; what else are we to call it?

The popular term, "product detection" is misleading, because as we have pointed out here, such detection can be phase synchronous or not; it was such nonesense that got me into this subject in the first instance (via misunderstandings with my Asst. Eds.).

"Simple Direct Conversion" isn't a spectacularly descriptive alternative either, because it can get quite complicated if properly manipulated. I do disagree with Pat Hawker's choice of that term (24b-1) because of that and because of the various ambiguities which were dissected in the April 1971 EEB article.

On the other hand, Pat's (G3VA) suggestion is good, that we call "two phase" that conversion system which phases out the signals on one side of the carrier. But I disagree emphatically that this is to be restricted to Direct Conversions alone, since the system can be and has been used at the end of numerous I.F. stages (16d, 19a, 31+) -- not to mention the fact that there are at least three types of two-phase systems (31+).

Direct Conversion Revisited

I'm going to contradict my plans of p. 99, and save a further discussion of truly phase-synchronous detection for another time, because it will fit together more logically -- and believe it or not, there are other important matters in receiver design than phase-locking, useful as that may be at times.

One small advantage of not doing things on time, is the increased insight you obtain from thinking about them.

Here I/we shall reexamine some dimensions of Direct Conversion, logically in the order: RF, Mixer, and AF. Most of this comes from my own thinking and reading, with an occasional insight from Dick or Rod -- but I'm afraid to show them the whole M/S, or this wouldn't get done till Christmas.

THE R.F. STAGE REVISITED

In Refs 19b and 29c, De Maw says that a DC Receiver can receive not only SSB and CW, but also AM if zero-beat is exact. Since the product detectors used in this instance were non-locked, I'll bet that the tuning is facilitated by oscillator "pul- * ling" from the signal carrier, and this is in fact done deliberately in Ref. 33 (see also analogous technique though disguised, in Ref. 3!).

De Maw also points out that the oscillator can radiate into the antenna system*

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* Dick Ferris points out that this is also a good argument for using a buffer stage between local oscillator and mixer. Yet it is a procedure rarely adopted in any but the most expensive receiver designs.

if the detector is not well balanced (another good argument for using a well-balanced modulator as product detector), but in any event it can be reduced by use of an R.F. Stage.

R.F. Stage? Didn't we discard that device last month? Maybe.

Are R.F. Stages Necessary?

Rod's and my discussion of this last month is well summarised by Noll in 16d:

"The usual direct-conversion receiver includes no R.F. Stage. None is required when the product detector itself has a very low noise level. Selectivity is determined by the output audio filter. Any R.F. Stage ahead of the product detector has a marginal influenceon the overall selectivity. An overpowering local station may give some trouble..."

Yet in 16g he adds to his PLL detector (of 16b) an FET r.f. preamplifier, specifically to "improve sensitivity" and by implication to select against strong local adjacent frequency stations. Howcum?

Tradeoffs: Sensitivity vs selectivity

If you will return to p. 100 here you will see that Rod does not shun an R.F. Stage altogether, and it is "seen to be an advantage, if properly used". Such use introduces no significant noise and does not worsen crossmodulation.

In return, a properly-designed R.F. Stage can increase front-end sensitivity, reduce adjacent channel interference (QRM), reduce oscillator radiation into the antenna, and provide a convenient way to apply Automatic Gain Control (AGC).

It appears that Noll is using an R.F. Stage for most of these reasons, because when using an IC PLL, there is a certain minimum signal needed at the input to trigger the thing to proper phase-synchony (16c). This calls for a certain amount of signal at the front end, and if not enough comes down the spout, it has to be strengthened; if it gets too strong you can have trouble too, and this is a problem which has to be watched particularly when an IC PLL is used at the end of an i.f. amplifier chain.

If, on the other hand, sensitivity is increased by pre-mixer amplification, this will tend to increase the strength of interfering signals as well, unless selectivity is increased proportionately; if you need more selectivity against adjacent channel QRM you'll have to keep the extra tuned circuits and reduce gain. One thing has to be "traded-off" against the other.

An example of an R.F. Stage to increase sensitivity is given in Ref 14e, where a DGMOSFET improves front end sensitivity of a Direct Converter from 1µV to 0.1µV. Aside from the fact that atmospheric noise might vitiate the value of such increased sensitivity, the circuit does add two tuned circuits, and this is right and proper in terms of the above-mentioned trade-off.

Ref. 21b-3 uses THREE tuned circuits in a low-gain valved r.f. stage, for really impressive front end selectivity ahead of a good superhetrodyne design.

To Reduce Noise

The other place extra r.f. amplfication is useful is where the mixer is not quiet; remember that a low-noise front end was one of Rod's prerequisites for dispensing with the R.F. An example of this seems to be found in Ref. 13e, where G3EJF finds that "the addition of a grounded-gate R.F. Stage using a 2N3819 FET added greatly to the sensitivity of the receiver without degrading its cross-modulation performance". His detector was described in Ref 28, and the improvement in sig/noise ratio from his adding the R.F. Stage is presumably due to his use of noisy surplus germanium doides, and possibly an inadequate antenna. Hot carrier diodes do have their uses, see? (c.f. Nov. EEB Editorial).

I'm not picking on G3EJF, but only showing that where an r.f. stage is found necessary, its probably making up for a defect elsewhere, either in sensitivity or selectivity.

What is to be emphasized here is the fact that modern techniques give superior performance only when they follow modern technology and use modern components scrupulously. It rather reminds me of people who build pretty voltage regulators and then bung a great electrolytic in the middle of them to reduce ripple. It works, certainly, but only because the regulator isn't regulating properly in the first instance (and if it was regulating before you put in the condenser it is even less likely to regulate afterwards!).

An RF Stage to improve selectivity and therefore to reduce crossmodulation...

In the same vein, the presence of a strong adjacent signal can cause cross modulation unless the detector (e.g. mixer) is very linear over a sufficiently wide dynamic range of inputs. If it isn't one can indeed improve matters with a doubly-tuned input, and even more by putting an R.F. stage between the input tuning circuits (EEB p. 100).

If, now, it is necessary to use the R.F. Stage to get enough minimum signal to drive a PLL, say, extra tuned circuits are going to be needed to keep QRM from riding in on that extra r.f. gain. For this reason the grounded gate R.F. Stage of 13e with two tuned circuits is better than the common source one of 16g with only one. Additionally, a common-source stage requires neutralisation unless only one tuned circuit is used.

If you do find an r.f. stage necessary primarily for selectivity, an r.f. Q-multiplier may help instead, even in DC receivers. In DC Rx, a strong signal can beat with the SECOND HARMONIC of the L.O. of the product detector, and that gives you "images" with a vengeance. For example strong Peoples Propaganda stations on 40M riding in on weak Peoples Amateur stations on 80M! In that case, pre-detector front end selectivity is essential, and increased front-end Q can prove useful. (Ref. 11b, 34b, 1968 EEBs, 14b)

R.F. Stage to give AGC

One reason often advanced for using an R.F. Stage is that it allows a convenient method for introducing Automatic Gain Control. This is indeed done in Ref. 24b-1 and 34a-1 via audio derived AGC, but remember that this tends to worsen S/N ratio, so should incorporate an offset delay, to avoid any effect on weak signals. It also tends to reduce R.F. Stage linearity which can be improved by various means, e.g. controlled degeneration -- or the easy way: do it inside an IC! (34a-1)

AGC can be facilitated by controlling an audio stage as well (24b-1, 34a-1), but this, of course, isn't much use at the front end.

Beware, therefore, of sweeping statements that r.f. amplifiers can improve receiver "sensitivity". Perhaps they may (true "sensitivity" includes S/N), but if so there is always a price to pay.

In DC sets (and the rest) the best policy is to avoid it by using a very low noise, linear, dynamic mixer (e.g. a good beam deflection valve), and get all gain at a.f. -- making sure that no a.c. gets into the receiver from the 50cps mains (e.g. through filaments!; 13e).

A Commonse Approach

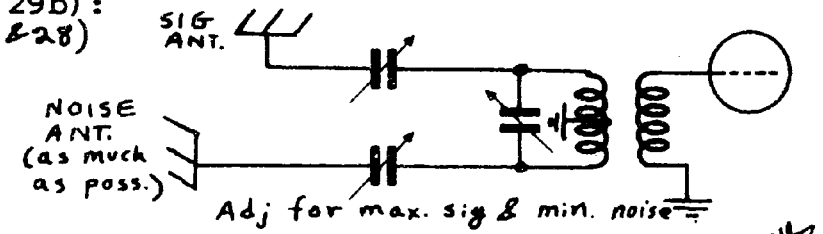
Clearly there remains room for clear thinking in this popular subject, though one must admit that the situation can get complicated.

An R.F. Stage can reduce the amount of 2nd harmonic signal coming through (as above), but the same thing can be achieved by ensuring that the L.O. puts out a good sine wave in the first instance, thus avoiding the various compromoses involved in R.F. Stages.

On the other hand, such a harmonic-free L.O. is vitiated if the mixer itself distorts its signal, and produces a harmonic which beats with the 7Mc signal. The elimination of the R.F. stage therefore, requires not merely low noise subsequent stages, but a pure L.O., preferably a buffer between osc and mixer, and a good linear mixer; more about the latter soon.

It can be seen, therefore, that an R.F. Stage can hide poor design of stages which follow it, but it imposes its own problems: noise and overload.

If, on the other hand, you live far from any powerful transmitters, the arguments about QRM may be largely irrelevant. If, as a correspondent points out, power-line noise if fierce, its not going to matter a lot what kind of mixer you use, and ingenuity and patience could better be devoted to methods for phasing out the QRN before it gets into the set (e.g. as described in older editions of Ref. 29b):

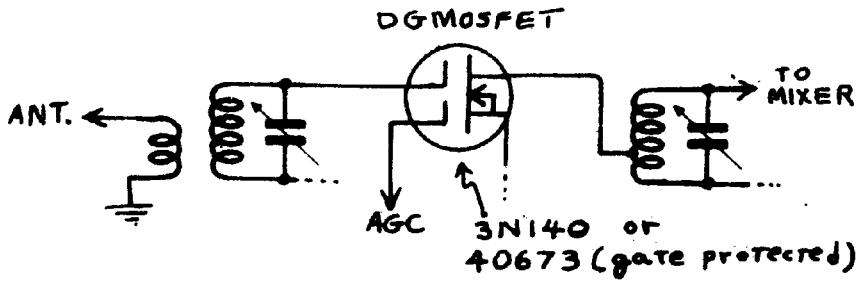


A Postscript by Rich. Ferris

If you must use one of those ICs at the front end you may have to take account of the fact that, with few exceptions, ICs incorporate bipolar transistors, well known for their lack of linearity.

If this produces a low dynamic range, there is no alternative than to have excellent front-end selectivity. If this is accompanied by an amplifier as well, and if the rest of the receiver has a sufficiently low Noise Factor, additional r.f. gain merely contributes overload to subsequent stages. If then, the r.f. stage is wanted primarily for selectivity its gain should be reduced (without adding appreciable noise).

It is simple enough to reduce the gain of an r.f. stage, merely by tapping down on the output tuned circuit:



By this means the gain can be reduced to any level you wish, and AGC to a Dual Gate MOSFET gives another -40db on top of that!

Furthermore, why all this talk about a grounded gate to avoid neutralisation? A dual-gate MOSFET with good circuit geometry should not need any neutralisation -- see typical designs, Refs 15cde.

((Refs 21b (1/72) and 29c talk about neutralising their DGMOSFETs, but this is doubtless due to poor design geometry--RLG))

Blast, I've got pages and pages more of this, but we have to allow some room for other stuff in EEB. More next ~~month~~ April

REFERENCE LIST FOR SYNCHRODYNES ETC

As EEB readers may have noticed, our Reference Lists have been presented not merely as a set of bibliographies, but as an annotated discussion of relevant contact with each reference. This lends the list more value, not only for interest, but also in event of (a) The reference not being available to the reader, or (b) The question whether a given reference is worth pursuing for further de-detail.

This philosophy has been followed in the first 2 lists presented on this topic, in April and November 1971 EEBs. But this is getting out of hand. The literature on receivers is enormous, even that corner devoted to product mixing of various kinds, and only the past two years or so. Many readers are already impatient at the amount of space being devoted to modern receiving techniques, and many see little value in reference lists -- annotated or otherwise.

I shall therefore make a compromise in this instance. Herewith follows a rather condensed reference list, including only the bare bones of each reference, and covering both previous lists plus the current one.

For titles of articles, authors, and a fuller discussion of previous items, readers are referred to the April or Nov 71 EEBs. For a similar coverage of current material (indicated by *), you can send a self-addressed 4x9" envelope plus two loose 7c stamps (or equivalent stamps if DX). I do recommend this "Auxiliary List" to anyone sincerely interested in modern receiver technology and its implications.

In the following list, grouping has usually been by magazine, but sometimes by subject. Trsfrtd eho Readers who are discouraged by the vast scope of the periodical literature are referred at least to the quite good Handbook material in Refs. 27-32.

This material does not (yet) include the various Application Notes by Motorola, RCA, T.I., and Signetics. They are worthwhile indeed (when available to the Public), but deserve a separate and careful coverage on their own.

KEY:
AR = Amateur Radio (WIA)
BI = Break-In (NZART)
CQ = CQ Magazine (Cowan)
HR =(Ham) RADIO (Tenney)
MW = The Milliwatt (Journal of QRPP)
QST= QST (ARRL)
RE = Radio Electronics (USA)
RC = Radio Communication (RSGB)
73 = 73 Magazine (Bilious Green)
WW = Wireless World (UK)

AN = Application Notes
D-C= Direct Conversion
HCD= Hot Carrier Diodes
IC = Integrated Circuit
PLL= Phase Locked Loop
Rx = Receiver, receiving
Tx = Transmitter, transmitting
Tx/Rx = Transceiver

REFERENCES FOR SYNCHRODYNES ETC
(See above for further details)

April 1971 EEB:

1) Ferris and Reynolds.
2) A.R. Techniques III; full of good oil
3) HR 3/71: Phase Synchronised Osc.
4) HR 11/71: PLL functions
5) 73 10/70: PLL appl. with IC.
6) IEEE (Signetics AN): PLL in detail.
7) Pop. Electr.: 12/70; PLL for FM.

Nov 1971 EEB and current (*):

8a) AR 5/68: cath.coupled 6J6 mixer.
b)* AR 1-2/72: PLL and application to FM
c)* W.A. VHF News Bull. 2/71; 80M D-C Rx
d)* (Ibid): 10/71;Good outline D-C, PLL
e)* AR 2/72: PLL in FM repeaters, clever

9a) BI 5/71: D-C Rx plus Ref. List
b) MW 8/70: D-C Rx.

10a) CQ 1-2/70: X-Mod and measurements.
b) CQ 8/71: Math. treatment of same.
c)* CQ 12/71: Simpler bandpass filter design. See also 21c. and 2/72: Low pass design.

11a) CQ 5/71:Converter into D-C avoids a.f. impages, etc.
b)* CQ 6/69: Improved Beam-Deflection converter plus RF Q-Multiplier.
c)* CQ 12/71: TX DSB conversion, uses. See also 29A for numerous DSB ckts.

12) HR 3/68: Double balanced mixers, explored. C.F. 13,16ef,19b,26a,27-29a

13) HOT CARRIER DIODES. See also 26ac, 28
a) HR 10/69: HC Converter.
b) HR 10/69: HC Product detector.
c) HR 10/69: HC Noise blanker.
d) RC 1/70: HC Detectors, linearity.
e)* RC 11/70:Tx/Rx with D-C + FET R.F.
f)* AR 12/71: Use of HCD in converter.
g)* 73 4/70: More of same.
h)* HR 3/70: Broadband HCD Mixer.
i)* 73 9-10/71: HCD for power meas.
j)* H-P AN907:All about HCD. C.f. 28.

14a) HR 10/70: D-C Rx.
b)* HR 9/70: D-C CW Tx/Rx, and Problems.
c)* HR 6/71: "Ten-Tec" D-C Rx. Also reviewed in CQ (4/70), QST (8/71), and in 73 (4/71).
d)* HR 4/42: Improving the Ten Tec.
e)* 73 2/72: Improving Ten Tec Modules.

15a) HR 9/71: Multimode IF: PLL IC Detector (with note on availab. of IC)
b)* 73 3-5/70: Improved I.F.; c.f. 34a-1
c)* HR 8/68: 2M Converter, MOSFET not neutr.!
1/69: 220MHz, ditto.
12/71: 6M, ditto.

16a) HR 8/71: ICs, various.
b) HR 9/71: PLLs explored.
c) HR 10/71: PLL experiments.
d) HR 11/71: D-C explored, with Refs.
e) HR 9/70: MC1596G Bal. Mod. explored.
f)* HR 6/71: ICs as Bal. Mods, etc.
g)* HR 12/71: More PLL applications, etc
h)* HR 5/69: Vast uses for ICs!

17a) HR 10/71: Improved CW Detector syst
b)* HR 11/71: Improved CW (etc?) Rx.
c)* HR 3/72: The Reciprocating Detector, an advance in communications.
d)* HR 1/72: Threshold gate limiting for much improved CW reception.

18a) QST 5/69: D-C Rx: CA3028A IC; c.f.34a-2
b) QST 6/69: QRP Tx, well designed.
c) QST 3/70: Combines 18a + 18b.
d) QST 8/70: Improved; protected DGMOSFET
e) QST 9/70: Same, further improvements

19a) QST 9/69: D-C SSB Two-Phase Rx.
b)* QST 4/69: Solid State Product Detect's.

20) QST 8/70: D-C CW Tx using ICs.

21a) QST 9/70: Ordinary Rx, good design.
b)* QST 1970-1972: Several good front-end designs, e.g. 6/71, 1/72, 2/72.
c)* QST 9/71: Simple bandpass filter design. C.f. 10c, and QST 9/69,1/72, and RC 8/71 for more of same.
d)* QST 1/72: Human Ear as a.f. filter!
QST 2/72: Human ear at only 100Hz!

THE FOLLOWING ARE ALL NEW HERE (*):

22) QST 2/71: D-C modulates xtl osc:Rx!

23a) QST 1-4/71: Excellent series on FM Rx especially part III including PLL.
b) QST ca 1956: Primitive Exalted Carrier; see also EEB Nov 1968, p.111

24a) RC 3-6/71: Excellent Superhet Design
b) G3VA's Technical Topics, 1970-1972. Good coverage of Rx and other design and applications; see 28 for < 1970.
b-1) RC 11/70: D-C AGC, a.f. image solns
2) RC 12/70: Modern superhet design.
3) RC 2/71: PLL FM Detection.
4) RC 6/71: PLL AM Detection.
5) RC 8/71: Active a.f. filter, etc.
6) RC 9/71: PLL Rx expts with IC, S/N observations; digital modulators,+
7) RC 1/72: A penetrating study of Improvements (?) of the Art, and a cynical view of SSB operators....

25) 73 3/71: Oscillating Crystals (Followed up in QST 9/71, p. 49!).

26a) 73 1/71: Double bal. mixers; c.f. 12
b) 73 2/68: Hybrid Rx, fair design.
c) 73 3/69: Improved Ring Modulators.
d) 73 1/70: DSB Tx using Ref 26c meth.
e) 73 2/70: PLLs for Frequency Synthesis. See also QST 1/72, Refs 3 and 28 here. And for Phase Locked Wadley Loop VFO system see Ref 28, and Spectrum 11-12/68, and Radio Bulletin (VK3) 1-2/72.
f) 73 12/71: VHF DSB, with reasons.
g) 73 10/65: "That Unwanted Sideband".
h) 73 1/72: Balanced modulators and frequency synthesisers in superhets.

And for a variety of conventional Tx or Rx designs, some good, see the "73 Handbook", Vol. I: "Transistor Projects".

27) Amateur Radio Circuits Book (RSGB, 1968). Bal. Mixers + much else.

28) Amateur Radio Techniques III (RSGB), as in Ref. 2: Tx, Rx, etc. This book is the most valuable single reference work now available to the enquiring experimenter; new Ed. in '72.

29a) Radio Communication Handbook (RSGB, IV, 1968): Rx Design and the rest. A valuable basic reference.
b) Radio Handbook (E/E; Sams), by W.I. Orr. Good concise principles, but no mention of PLL after 17th Edit.
c) The Radio Amateurs Handbook (ARRL, 1971)

30) SSB for the Radio Amateur (ARRL). Rx ch. of interest, but previous editions were better in spots.

31a) SSB Techniques (CQ, 1954). Good fundamentals and many excellent applications. In spite of the enormous amt of literature subsequently, the basic ideas are much the same and indeed some good designs have been lost to view.
b) (New) Sideband Handbook (CQ, 1958): Same, revised, much better than ARRL's in numerous features, with excellent description of fully synchronous detection using only 8 valves (including diodes). But alas, now out of print.
c) GE Ham News, Vol II: 7-8/51 issue: "The Signal Slicer" by D.E. Norgaard, W2KUJ. A superior "two phase" asynchronous product detector, 4 valves.
d) GE Ham News Sideband Handbook (1961) More PLL using valves, selectable SB.

32) Solid State QRP Projects, by E. Noll (Sams): Mostly Tx, but note MC1596G etc may be used as DSB generator; cf.16.

33) RE 11/71: Intro to D-C, and a "PLL" which works by simple osc. pulling! Rather like that of Ref. 3. Hi.

34a-1) WW 7/71: Two IC-only Rx's.
2) QST 10/71: IC-only Rx's, more.
b) WW 12/71: Stable Q-Multiplier.

FOOTNOTE: SEE NEXT PAGE

35) Future Shock, by A. Toffler (Bodley Head, 1970); all about Ham Radio, etc. Essential reading for anyone deciding whether or not to have children. Hi.

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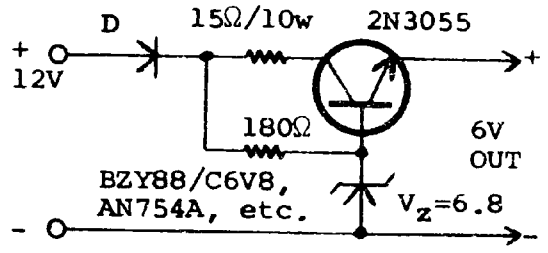
* (Footnote to previous page). It is a source of considerable disappointment that newer editions of these works have not been published in the past dozen years, since there is room for application of these fine designs to semicons, and not merely ICs. Refs 6,7,16h and the various Signetics and Motorola Appl. Notes give plenty of opportunity for it.

It is high time that someone brought out another good "New" Sideband Handbook written in the same practical style as the CQ or GE versions -- and not just SINGLE sideband, for cogent reasons which we shall discuss in these pages.

XXXXXXXXXXXXXXXXXX

LETTER: Converting 12V to 6V

The following device is a simple adapter for running Cassette Recorders or similar (6V) from the car power (12V):



This device will supply 6V at 400mA or so, the value of the collector resistor depending on the maximum output current limitation desired. The diode, D, in series with the +12V is to stop foolish people connecting the device around the wrong way. If, however, the output is shorted out, the device is protected, ie, the voltage across the transistor drops to a very low value, but the 15Ω resistor does tend to get very hot! if the short is left on for any length of time.

I put the device in a small Eddystone box and it seems to be performing quite well; if prolonged short-circuiting is contemplated it could be a good idea to drill ventilation holes in the box.

I used double-sided fibre glass printed circuit board, and used one side as the heat sink for the 2N3055, with the judicious application of "Thermeflow" heat-sinking compound; any silicone grease will suffice.

The 2N3055 is a real workhorse transistor, and is quite inexpensive.

I have been working on some amateur TV equipment and for EEB will write up a note on sources of supply, and pitfalls in camera construction. I will also be working on a CCIR 625 line 150 frame sync pulse generator; I'm not sure yet whether to use transistors (they are cheap) which would be involved, or to buy ICs and do it a lot simpler.

-- D. Thomas, Waramanga, A.C.T.

XXXXXXXXXXXXXXXX

LETTER: Uses for Voltage Dependent Resistors

Like you, I rather dislike the word HAM, and certainly think it suitable only for some of those jerks whose manners and intelligence appear to be about the same as those of the animal referred to. They have been a minority, but do seem to be on the increase.

I found very interesting the letter by J. W. Campbell in the November 1971 EEB, on the use of non-linear resistance for speech compression. I have recently commenced experiments along the lines he has indicated, but using the modern equivalent: Voltage Dependent Resistors. I have used VDRs for transient suppressors to protect silicon diodes in power supplies, and for audio compressor/clipper in an audio modulator.

It isn't really a clipper or a compressor, but seems to combine the best features of both methods and seemingly with few or none of the disadvantages such as having to use filters or have great complexity of circuitry.

Unfortunately there don't seem to be many VDRs about that could even vaguely be suitable for transistor circuitry, as most work on voltages in excess of the normal transistor circuit level. More suitable for valves.

As a matter of interest I can get about 10db of compression quite easily (or is it clipping?). VDRs in my opinion have been a simple device which seems to have been ignored for altogether too long.

-- Rod. D. Champness, Warragul, Vic.

((How about using the constant-current part of an FET as an LT VDR? V goes up, so does R. --Ed))

XXXXXXXXXXXXXXXXX

LETTER: Semiconductor CRO Article? ((Peter?))

Any chance of seeing in EEB in the near future a couple of articles on CROs using OP-ICs, and high voltage transistors for anode deflections?

-- T. Cengia, Poatina, Tasmania

LETTER: Double-balanced Hot Carrier Diodes?

I always receive EEB late, but I feel this is due to late publication rather than the Aust. P.O. ((doubtless, usually -- Ed.))

I would like to see some articles on the use of Double-balanced Hot Carrier Diode Mixers. ((so would we -- Ed.)). Jim Fisk in Ham Radio has covered a lot of ground on these. Even El. Aust. featured one in their Multi-band Rx in Jan/Feb '70 issues. The Rx is claimed to have an excellent sig/noise plus good IMD suppression...

-- K. R. French, Potts Point, N.S.W.

XXXXXXXXXXXXXXXXX

Forbidden fruit is responsible for many a bad jam (A/C, 12/70).

XXXXXXXXXXXXXXXXX

THE OWEN INDUCTANCE BRIDGE -- RAJR

We have received a few comments about my treatment of this fine and simple Inductance Bridge presented last September by Chris Pitcher, as below.

Mr. Pitcher has pointed out in elegant mathematice (which we need not reproduce here!) the good theoretical foundation on which my (admittedly) oversimplified derivation was based. He also pointed out that C-1 + Cv ought to cover the <u>whole</u> range of 0 - 10,000 pF, because very large values of loss resistance in L (viz, r_x) will require very low values of C-1 + Cv. Such a range can be achieved by suitable switching of C-1 values 0.001, two 0.002, and 0.005μF.

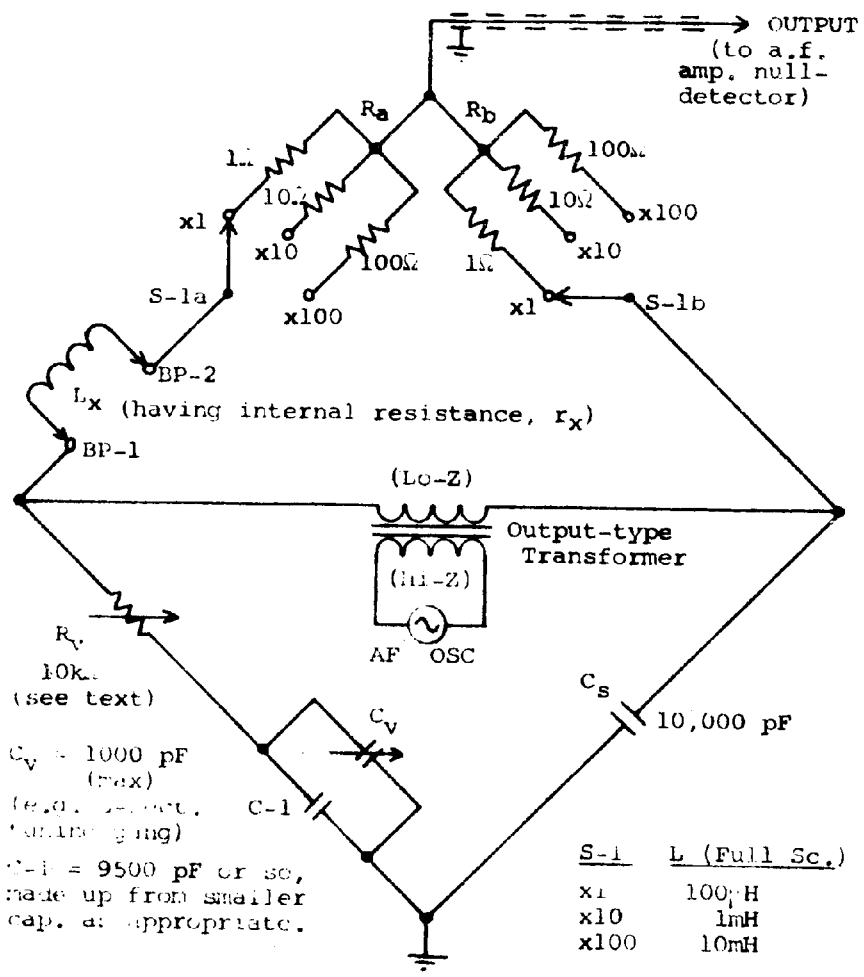
Dick Ferris has pointed out that the units must in fact be consistent, with which I must of course agree. In his pungent style he comments:

"Doesn't it strike against the core to say that 'the units are all wrong' as claimed?? The fact is that they're not. Using a bit of high school physics and resolving the appropriate (MKSA) units into dimensions, e.g. Mass, Length, Time, Charge:

Inductance = $M\ L^2 Q^{-2}$

Capacitance = $M^{-1}\ L^{-2}\ T^2\ Q^2$

Resistance = $M\ L^2\ T^{-1}\ Q^{-2}$



At Balance: $L = (R_v)(R_b)(C_s)$

and it is a simple ((sic)) matter to show that one Henry equals an Ohm-squared Farad, as implied by Rod's Eqn. 10. No, I didn't believe it at first either, but my faith in Science proved stronger."

Mr. Ferris also had numerous ideas on my maths, one of which was correct: Line (5) should have been A/B = D/F, and Line 7: C/A = E/D. Never mind, but in an attempt further to clean up my maths a bit, Mr. Ferris introduced a resistance, Rs, in series with Cs, with the rather inelegant consequence that the calculations for L and r_x now became dependent on frequency. He appears, therefore, to have invented a new type of bridge, which we might call a Ferris Wheel. To use said device one would need only a very stable oscillator to do the measurements, and a tame computer to help with the calculations. Never mind.

In its normal form, the Owen Bridge varies Cv as well as Rv to obtain balance. For r_x taken as small (e.g. = 0), Cv is adjusted is adjusted for null, as mentioned in the September article, and only Rv is needed to balance L. But for r_x not insignificant the picture is rather different.

The simple procedure presented by Pitcher can be broadened to include a reliable measurement of L even when it has high series loss resistance, r_x. (CP has given an example of a case where he measured the inductance of a 10Ω wirewound resistor, and accurately!).

In the new arrangement one avoids the step of adjusting Cv when BP-1 is shorted to BP-2, and instead one simply adjusts Rv and Cv simultaneously for minimum null. This has the result that

$$L_x = R_v R_b C_s, \text{ as before} \qquad (10)$$

but now we can calculate the value of

$$r_x = R_b \left(\frac{C_s}{C} - 1\right) \qquad (11)$$

where $C = C_1 + C_v$.

But this only applies if the resistance <u>shunting</u> L is not appreciable; this is not a trivial matter, and could be a problem for iron-cored inductances. In that case the null will not be zero. The existence of a non-zero null will

a) Tell you that r_p is significantly low (r_p is the effective parallel R)

b) It will affect the accuracy of eqn 10, and this will be worse as signal source frequency increases.

If you reduce frequency to overcome this, the output will go down, thus requiring

greater detector sensitivity (Murphy's Law). A compromise might perhaps be the choice of 1kHz for the oscillator, and to avoid measuring inductance of big iron core items. RLG says that he has a big article on that one subject for sometime.

The de Sauty Bridge

It should be of interest to note that a bridge similar to the Owen Bridge can be used to measure capacitance with the same elegant simplicity of calculated results. To save another drawing, it is as follows: Take the Owen Bridge, replace L_x with C_x and replace C_s by R_s; all else remains about the same.

Then, assuming r_p is large ($>>X_{C_x}$),

$$C_x = CR_s/R_b \quad \text{at null, and}$$

where Rv is nulled with Cv as before,

$$r_x = \left(\frac{RbRv}{R_s}\right) - R_a$$

where r_x is the series resistance of the unknown capacitor.

Unfortunately, however, r_x is rarely a problem in capacitors, rather it is r_p, the leakage resistance. Then, if r_p is appreciable the whole thing flies apart, and

$$C_x = \left(\frac{C}{R_b\ r_p}\right)(r_p R_s + R_a R_s - R_v R_b)$$

and

$$r_p = \frac{R_b}{w^2\ C\ C_x\ (R_a R_s - R_v R_b)}$$

where, as before,

$$C = C_1 + C_v. \text{ and } w = 2\pi f$$

The minimum null is determined as in the case of the bad inductance, and the two equations in two unknowns can be solved by standard algebraic techniques (or by the abovementioned Stable Osc plus tame computer, ahem.). Two dimensional calibration curves are feasible, but remember that as in the case of the lossy inductance, this system is now frequency-dependent, with similar conditions due to Murphy (higher freq gives lower effect of r_p but lower sensitivity, etc.).

In summary, one may say that it is possible to use these relatively simple reactance bridges to get good measurements with minimum trouble and good accuracy. For cases involving lossy inductances or capacitances, a good Wayne-Kerr Bridge is not necessary (but it helps).

xxxxxxxxxxxxxxxxxx

That all depends....

"I believe that no one should write as a journalist what he would not say as a gentleman..."

-- Don Copeland, W4CJI (ARNS Bull., 2/70)

xxxxxxxxxxxxxxxxxxxxxxx

LETTER: More on the LSG-11 (c.f. Nov. EEB)

Regarding the LSG-11 Signal Generator, I have not noticed anyone mention that it is wise to remove the a.c. input furnished, and replace with 3-wire input, earthing the case. Unless this is done it is possible to burn our the low resistance attenuator resistor.

-- E.O.K. Phillips, Buderim, Qld.

((ED. NOTE: Another article on this subject has also appeared, in Break-In (N.Z.), 12/71, titled, "Get more use from this popular instrument", by H. N. Wiggins, ZL2BFR. The modifications involved:
1)Fitting a higher ratio dial drive,
2)Addition of heterodyning facility, by connecting an AF transformer to the 12BH7 and running to a front panel socket for phones.
3)Reduction of output on "Low" by alteration of the output attenuator.
4)Addition of an external box containing switched 1K or 1000pF for various loads.))

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THE AUSTRALIAN EEB: Editor = R. Leo Gunther (VK7RG), Asst. Ed. and most draughting = Rod A. J. Reynolds (VK7ZAR), Assoc. Ed. = Rich H. Ferris (VK7ZDF), Associates = L. J. Yelland (Prahran), C. Pitcher (Northcote), R. S. Maddever (Geelong); Subscription Manager = Robert A. Walton, Secretary = Brenda Ford, Printer= Chris Wren (Advance Publicity Co; Hobart 341-817)....

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5: Scythe-stone Zener
6, 105: Avalanche diodes
11, 20, 23, 106, 124: ICs
14: Ceramic valves and beryllium: DANGER
18: Circuit-boarding simplified (Metal tape)
21: Phototransistors vs photomultipliers (L)
Wood vs plastics
Talc rock forms steatite!
23: Printed circuit rresist technique (L)*
24: Transistor power rating (Grandma's Test; L)*
26: FET Drawing Convention: VERY IMPORTANT!
42: Ge vs Silicon transistors (L)
55: MTOSFET availability (L)
Teflon non-dangers (L) (But dangerous if burned!)
71: Coil winding techniques (L)
Aluminium soldering (L)
81: UHF Semiconductors.
~~Sod's Law~~
106B: "Who Gave us Christmas"
PMG Again
106C: EEB Coverage (c.f. p. 35)
Binders & HOW TO BIND BOOKS
Please tell us your amateur or SWL call.
125: We have a Secretary now!
Means and Ends for technical developments
Microwave semiconductors
The uses of Appliance Operation; a favourable view!
"Nuisance from a Transmitter"
— a good word for the WIA and NZART
"Ham Tips" Discontinued
New Edition of Amateur Radio Techniques forthcoming.
Improved CW Reception: An evaluation and literature review (continued in the Feb 1972 issue).

HUMOUR, Dry & Wet
19, 21, 26, 30, 41, 47, 55, 65, 68, 76, 92, 120, 134.
102: Musings of a Good Father on a Bad Day.
106A: Sod's Law.
115: Significant News Report.
116: Phonetic Phun.

INSTRUMENTS
5: BC221 Conversion (L)
9: Diode PIV Tester*
21: FET as integrating photometer (L)
56, 135: Inductance Bridge, simple (p. 135 for maths corr.)*
57: Sig. Gen + RF Voltmeter as resonance indicator (L).
Fault finding (L)
Holliday GDO comment (c.f. EEB 8/70)
67: Zero (keying-) voltage oscillator*
74: Transistor voltage-rating tester*
75: Transistor gain tester, versatile*
87: Modulation monitor (L)*
88: Carrier level & modulation-indicating meter*
Overmodulation indicator*
89: Digital voltmeter design.
94: LSG-11 Signal generator problems (L)*
106: Avalanche transistor oscillator*
136: Capacitance Bridge, simple, accurate (c.f. p. 56 for similar arrangement, Inductance Bridge)*
120: UHF Frequency indicator (L)*

LETTERS (All: L)
3, 8: Importing Components (French/VK2, RLG)
3: Direct conversion
5: CD Ignitions (Schwinger/VK5)
BC221 Conversion. Electronics Aust and receivers....
16: Inflation etc; literature reviews (Gutsche/VK5).

(LETTERS, continued)
16: Value of EEB? (Kelly/VK4)
17: Importing diodes (Daview/VK4)
Automatic devices (VK5RI)
Exorbitant book prices (Harding/VK2)
20: Can amateur radio live (VK3ZMU)
Argument fo: › 2K = 2K2; ICs, Pro.
Optimism about electronics (Chaplin/VK4)
Value of Dwell Extenders
Value of EEB; Inflation (Johnstone/VK3)
21: Commonsense electronics (Campbell, W2ZGU):
— Phototransistors vs photomultipliers
FET as integrating photometer
wood vs plastics
Talc Rock into steatite!
Science Fiction.
23: The value of engineering opinion (Multz/VK3)
Printed Circuit Resist Technique (Yelland/VK3)*
Intelligent evaluation of EEB (Nagle/VK2)
IC Staggers On... (VK2AKB)
24: Receiver Design (Pitcher/VK3)
Transistor power rating, a la Grandma*
31: Improved Beer (G3UGD)*
42: RSGB vs ARRL Handbooks; Ge vs Si Transistors (VK4ZCS)
54: Commercial gear vs amateurs (VK3UG)
Radio noise detection (see also "Noise", 2/72)
55: "I feel pretty bloody angry" (Bonamy/VK2)
Practical EEB; home-made camera (Young/VK2)
More months in the year (Morgan/VK4)
Availability of MTOSFETS (Young/VK2); Teflon non-dangers; but note that it is dangerous if burned!
Power supply theory & practice (Hill/VK6)
57: Sig Gen + RFVM as resonance indicator (Smith/VK7)*
Fault finding in equipment.
Comment on Holliday's GDO (Ref EEB 8/70)
Compliments to EEB (Martin/VK2)
66: Publishing, Electr. Aust. and Experimenters (Peth/ZL1)
70: Converter Construction (Beinke/VK5)*
Baluns vs coaxial feed to dipoles (VK7AFJ)
71: Coil winding & its problems (but see Adverts, 2/72).
Soldering aluminium (Mc Kenzie/ZL2)
76: Cancelled subscription. Can't win 'em all.
77: Cure for literary diarrhoea (Yelland/VK3)
85: State of the art in VE: RTTY, valve frone ends (VE7AFJ)
87: A modulation monitor etc (Campbell, W2ZGU)*
Science Fiction: John Campbell, obituary.
94, 136: LSG-11 Sig Gen problems (Beckett/VK6; Phillips/VK4)
94: ICs, Pro. Component availability in VK (VK3ZVT)
109: Where is Sandy Bay? (VK7AFJ). Component avail. in VE

(MISCELLANEOUS, continued :)
Miscellaneous
3, 17: Importing equipment (L)
66: EEB Circulation (it hasn't yet reached 1000)
21,87: Science Fiction & John Campbell
24, 38, 136: NZART now handles EEB subscriptions.
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PHILOSOPHIES
Values
49: Dry Humour: keep away from Australian subjects...?
61: Appliance operators.
61, 79: Crisis in the State of the Art.
16, 17, 20, 63, 64, 66: Inflation and Devaluation (L;Ed.)
123: Worldradio philosophies
125: Means vs ends (Ed)
Love
76: Government Expenditor.
95, 106C: EEB: Take it or....
106B: "Who Gave us Christmas"
117: The community of Mankind!
Technology
66: Publishing, experimenters, and El. Aust.(L)
19: The worth of ham radio
11, 79: The worship of technology.
77, 106B: PMG Efficiency (?)
96: INTEGRATED CIRCUIT SQUARETABLE. (= discussion)
113: How to Really Communicate*
121: Cycles/sec vs Hertzes.
Etc.
31: The average reader...
47: Psychokinetics...??
120: Personality vs technology
136: Journalists vs Gentlemen
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POWER SUPPLIES
5: Scythe-stone Zener;
6: Avalanche diode uses*
27, 58: SCR-Regulated power supply.*
114: Selenium transient suppressors.
134: Converting 12V to 6V*
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PUZZLES
1, 67: Voltageless keying, and consequences.
86, 122: Mathematical (?) puzzle.
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RECEIVING
3: Direct conversion (L)
11: State of the Art (Pt. I): PLL, ICs, Direct Conv, SWR, etc
24: Receiver design (L)
32: State of Art (II): Mixers, PLL, D-Convers., Superhets...

94, 136: LSG-11 Sig Gen problems (Beckett/VK6; Phillips/VK4)
94: ICs, Pro. Component availability in VK (VK3ZVT)
109: Where is Sandy Bay? (VK7AFJ). Component avail. in VE.
115: More uses for Scythe Stones (Mod. Compress.)(W2ZGU)
State of art electronics in EEB (Barrett/W2)
120: UHF Frequency Indicator (VK5ZDY)
121: Transistors in Xfrmerless output amps (Garbutt/VK9)
"Important Design Notes" criticism (Smith/VK7)
Circular slide rule criticism (Andrew/VK2)
122: J-FET circuit loading, coil design problems (Gauja/VK2)
134: Converting 12V to 6V (Thomas/VK2); Amateur TV
Hams vs amateurs (VK3UG); VDRs for speech compression.
Semiconductor CRO? (Cengia/VK7) (see EEB 4/72)
Double balanced H.C. Diode mixers (French/VK2)

= whew! =

LITERATURE: Lists, reviews & discussions

5: Electronics Australia and receivers (L)
16, 35, 63: Reference Lists and Reviews, dissected.(cf 106C)
41: Synchrodynes, Direct Conversion references 1-7.
47: Transmission Line matching.
71: Soldering aluminium.
81: How to be an amateur (Ed)
UHF Semiconductors (Ed)
81, 106: Filing Literature for USE (Ed)
98: Receiver (and Transmitter) Design.
101: Direct Conversion and Rx Design References 8 - 21a.
104: British State of the Art, reviewed.
132: Direct Conversion & Rx Design References: Comprehensive
((NB: New edition of Ref. 30 received; no difference/Rx))

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MISCELLANEOUS (See also: Philosophies)

Technical:
14: DANGER from ceramic valves!
17: Model train track conversion
18: Metal tape for circuit boards, easy.
28: Circular Slide Rule* (Note: Kits for this no longer avail)
43, 61, 84, 106C: AROUND THE AIRWAVES (DX)
71: Aluminium soldering* (L)
77: Radiation Hazards at Microwaves
86, 105: Valves vs semiconductors
106: Explosions RISK from mercury-reed relays!
116; 122: Availability of standard frequencies in Australia.
114, 120: What NOT to do...?

Literary
26, 78, 88, 95: SWOOP (Elise White)
61: Availabiltiy of U-235? (Ed)
94: Publishing & magazines.
116: Phonetic Phun
106C: How to bind books; very practical.
125:"Ham Tips" discontinued.

24: Receiver design (L)
32: State of Art (II): Mixers, PLL, D-Convers., Superhets...
38: Phase Locked Loops (Ed)
70: Converter construction (L)*
85: RTTY, and valves in Receiver front ends (L)
96: State of Art (III): Mixers, linearity, HCDiodes, etc.
100: The uses (and abuses) of Tuned R.F. Stages.
103: Hot Carrier Diodes, uses in mixers.
104: The British state of the receiving art.
105: Front-end linearity: High Power approach! Valves, etc.
106: ICs forever?
118: CW Reception Adapter (originally RTTY)*
120: Freeing sticky transformer cores.*
122: Standard frequency/time signals in Australia (c.f.116)
124: State of Art (IV): D-C vs Superhet, RF Stages, Noise...
(This series will be continued in April 1972)
125: Improving CW Reception: State of Art (More in 2/72)

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RECIPIES, etc — for the Brave
24: Honey Mead, Cure for chapped hands.
31: Beer, improved (but refrigeration settles best!)
41: Chocolate mint biscuits; Filet of Foal...
47: Eliminating baldness
54: Radio Noise Detection (L)
55: To cure itch./ 76: Creme de Menthe A L'Antique ++++
94: Brandy Hair Tonic/ 95 Unique Weed Killer, for unique....
120: Elephant stew./ 121: Use for potato peels.

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REVIEWS (Specific items)
11: Australian Tape Recorder Society
15: 73 Vertical, Beam, & Triangle Antennas (NOLL)
22: Basic Electronics (ELECTRONICS AUSTRALIA)
10, 125: AMATEUR RADIO TECHNIQUES, III (HAWKER, RSGB), IV
31: Amateur Radio News Service Bulletin (more later)
37: A. R. Techniques (III) ordering information (new WIA)
43: Orr Radio Handbook, 18th. Ed.
Electronics Today, final Review.
44: Shrader & Weick: Electrical Fundamentals books.
42, 69: ARRL Handbook (c.f. EEB Feb, April 1972)
54: Motive, obituary; The MILLIWATT (WEISS)
66: Zero Beat/ Australia
78: Motorola Semiconductor Data Book, revisited.
95: Transistor Ignition Systems Handbook (Ward)
110: Objects & Requirements of an A. R. Handbook (e.g. ORR's)
129: Radio Communication (Radio Society of Great Britain).

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TRANSMITTING

4: Nice Phase-modulated 2W 2M transmitter*
11: State of the art: Neutralisation or no?

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My word that's a lot of typing in a year!