THE AUSTRALIAN EEB

AN INFORMAL ELECTRONICS
EXPERIMENTERS BULLETIN

Editorial Office:
P.O. Box 177
Sandy Bay, 7005
Tasmania,
Australia.

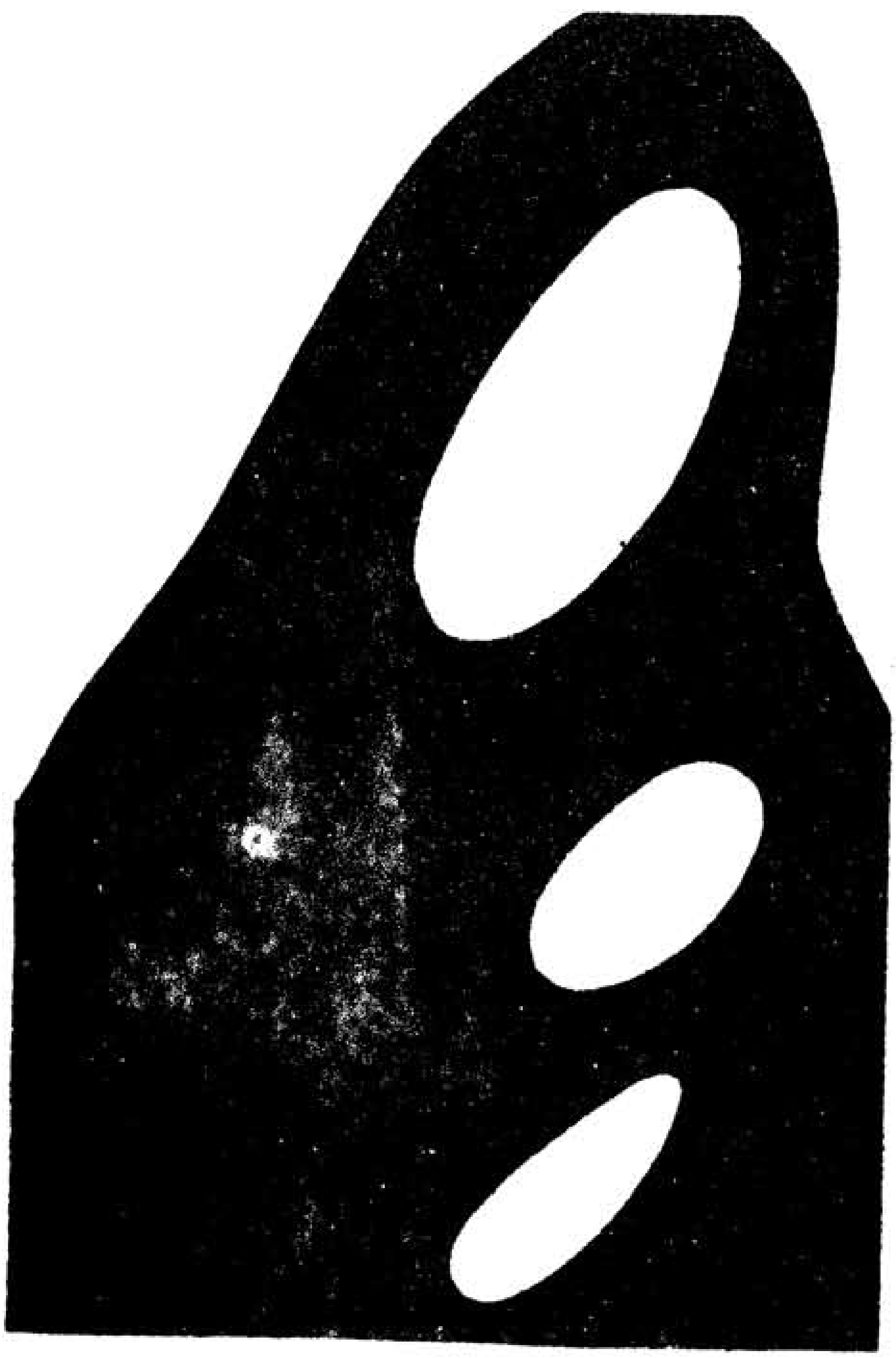
20c per copy

Australia and N.Z. :

1 yr.	2 yrs.	3 yrs.
$1.00	1.75	2.25

Foreign: 80% higher

Frapnuary 1969 Vol. 5, No. 1



-- JAN SMITH

CONTENT:

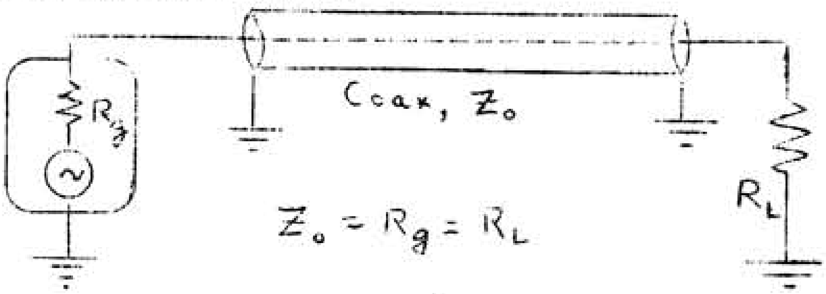
A COAXIAL LINE FEEDER DILEMMA
-- Balanced vs Unbalanced Feeder Lines

-- L. J. Smith [VK6LJ]

Among the many technical problems which beset me in my hobby of amateur radio, is one for which I have never heard a truly convincing answer, and which invariably causes strong arguments! The problem is this:

A dipole is a balanced antenna, i.e., it is symmetrical about its feed point. It should be fed, therefore, with a balanced feeder. To feed it with coaxial cable is "A Bad Thing." My question, why is coax-feed such a "Bad Thing?"

The argument against coax-feed is that current flows in the outer screening, causing radiation when coax is connected to a balanced load. Fair enough. What, however, is a "balanced" or "unbalanced" load? The usual diagram showing a generator, the feeder and load appears thus:



If the generator resistance, R_g is equal to the load resistance, R_L which is equal to the characteristic impedance of the coaxial feeder, Z_o, then all of the power generated by the generator is dissipated in load, R_L [assuming a lossless line, of course]. Again fair enough. This can be demonstrated easily by a transmitter having an output impedance of 70Ω, a length of 70Ω coaxial cable, an SWR meter, and a 70Ω dummy load. BUT -- is that dummy load balanced or unbalanced? It doesn't appear to matter! Therefore, provided that the dipole presents a 70Ω resistance to the coaxial feeder then all of the power, it would seem, will be dissipated in the antenna.

Since we have found that the load need only be equal to the coax feeder impedance, what next? Well, the argument goes, the antenna by radiating power will induce voltages back into the feeder. True. If a balanced feeder is used, then the induced voltages cancel because both feeder wires pick up the same voltage. Again true. On the other hand, with coax-feed the induced voltage occurs, we assume, only in the outer screening, and very little in the inner wire, so that radiation must occur, since cancellation can not.

What purpose, then, am I serving by inserting a balun device in the "eye" of the antenna, and feeding with coax? The antenna will still induce voltages into the coax below the balun and cause feeder radiation. It transpires, therefore, that if the antenna is fed with coax, even if the balun device is 100% efficient [which it most certainly will not be], then feeder radiation is unavoidable!

Only if the antenna is mounted on a metal tubular mast with the coax-feeder running inside to shield it from radiation from the antenna, will feeder radiation be eliminated. But now the mast radiates it instead. At this point the technical boys turn purple and start becoming violent.

Finally, it still appears to me that if almost any antenna is fed with coaxial cable right up to its "eye" irrespective of any balun device being used, feeder radiation will occur. Further, that feeder radiation occurs, and the average amateur [in blissful ignorance?] does not notice it at all in practice. The only antennas likely to be least affected are the sleeve dipole, and to a greater extent its cousin the ground plane. To feed a dipole or its variants like the Yagi array etc, balanced feeder must be used when within 1/2 wavelength or so of the antenna if feeder radiation is to be reduced to an insignificant amount.

Can anyone show me how my answer to the problem, and the conclusions I draw might be wrong?

[[How about it, gang? -- Ed.]]

TRANSISTORISED TRANSMITTERS, Part VII

PART VII-A -- RLG

Bowing to popular opinion, I take this opportunity to keep [relatively] quiet for a change, and to present some practical transmitter circuits, rather than lengthy sermons on Stability. I must, however, refer you to the following very good references on the subject, to be read thoroughly by any serious experimenter:

1] 'Silicon Power Circuits Manual' published by RCA. This contains all of the distilled wisdom of their Engineers, if it has not already appeared in their other gem: 'Transistor Manual' Either of these may be obtained from Oklahoma, as detailed on p. 110 of the 1968 EEB, for about $US2.20, post paid, or rather more from Melbourne bookshops -- probably available too from AWV/RCA here. Together with much practical design, RCA investigates at length the criteria for Stability of transistor amplifiers, and very practical steps to maintain it. Coupling and loading criteria are also covered, with relatively simple charts and graphs.

2] G3VA's 'Amateur Radio Techniques' [or 'Technical Topics'], reviewed in the Oct/Nov 1968 EEB, and his monthly column in Radio Communication [ex- RSGB Bulletin]. Practical circuits and some background are sensibly presented.

3] 'Amateur Radio Circuits Book,' reviewed in the Aug. 1968 EEB.

4] In addition, the 1968 &9 periodical literature is bulging with transistor transmitters design hints, and many practical circuits. In addition to the fine coverage by our Amateur Radio and Break-In, particularly good material is obtained from QST, Ham Radio, and 73. CQ and Wireless World have some too. I hereby resist the temptation to present a long list of references from these works, but if you are interested, you will be well rewarded by consulting them, from friends or from libraries of the WIA or NZART. It is hopeless for most individuals to subscribe to everything, but why not get together with your friends, and subscribe to one each, and circulate the magazines when they arrive?

I must note that the circuits to be presented here do not necessarily posses ideal characteristics; they share only one strange property: they work! I do admit that this exalted state may be obtained in many instances without elaborate precautions, but sometimes it may not, as some correspondents have verified.

If you do run into instability [e.g., parasitic oscillations, unexplainably low output and hot transistors for reasonable drive, unaccountable distortion on modulation peaks, outright oscillation of amplifiers, or unaccountable failure of one transistor after another even though d.c. voltages and drive appear to be right], you might try a few of the more important remedies; one might think that precaution would be easier than cure, particularly for printed board layouts:

1] Bypass large [e.g., 0.01-0.1μF] condensers with small ones [e.g., 0.001μF] of good r.f. quality [feedthrough best, avoid paper types], and conversely. Ceramic disc types are good, but keep leads short. In addition, d.c. bypassing or heavy decoupling with electrolytics across the power supply will reduce other types of transients, particularly for mobile installations.

2] Use ferite filtering elements in supply leads, and in base or emitter circuits.

3] Keep all transistor leads as short as practical, particularly the emitter lead of a common-emitter stage. Where an emitter resistor is used, it should be bypassed quite effectively [See Footnote, EEB, July 1968, p. 70]. Deliberate non-bypassing of an emitter resistor is another matter, into which I shall not delve here.

4] RF chokes, when used, should be poor quality, namely lossy. Use wirewound resistors of suitable value -- I'm not joking. Use tuned circuits to avoid this difficulty. It must be noted, however, that a suitably designed L- or T-network for interstage coupling will generally give better power transfer than an inductive link, or in any event it is easier to adjust for optimum match; matching with transistor circuits is considerably more critical than with valve ones.

The small RF chokes found on computer boards have the desirably lossy characteristic, if a suitable value is found, but beware: Their high resistance can cause difficulties if inserted in a collector circuit carrying appreciable current. If you do use a choke, it ought to have an impedance no greater than ten times that of the circuit it is shunting.

5] Keep input and output circuits reasonably separated; run a shield directly across the transistor socket between base and collector [for common emitter], and earth it suitably. Avoid magnetic coupling of input and output. Return all bypass elements to a common point in each stage. Toroids have less external field, and reduce the shielding problem considerably, although they are somewhat less efficient.

6] Output tuned circuits should have sufficient Q; use large wire, and large C.

7] Use transistors with more frequency and voltage rating than needed, but better results may be obtained if the transistor has an f_T not $>$ 10 times the operating frequency; this reduces tendency to low-frequency parasitic oscillations, which are the main types plaguing transistor circuits.

8] When all is presumably well, check the circuit in operation, with an absorption wavemeter [e.g., diode, coil, meter] to attempt to detect undesirable frequencies of operation, both lower and higher than the operating frequency. This is desirable as a wise precaution in any event, preferably under reduced voltage and drive. Remember that if you do not apply drive to a Class C transistor, it will have no output; several protective circuits use this property to reduce drive immediately if the VSWR rises excessively in the output [See Silicon Power Manual, A.R. Techniques].

Even with normal collector voltage applied, you can still check an amplifier by applying reduced r.f. drive; if instability is evident, or if excessive inductive collector load impedance is present, you can detect it without sacrificing the transistor.

9] For AM collector modulation, best results will be obtained if the final is tuned up when double the collector supply voltage is applied [without modulation!] -- briefly to avoid overheating the transistor; the reason for this is the fact that a transistor acts like a voltage variable condenser, and presents a capacitance to the output tank which depends on collector voltage. Therefore, optimum tuning will be different for modulation peaks than for troughs! An alternative method is to tune without modulation, then retune for maximum output under full modulation; the correct adjustment will be slightly on the low frequency side, because collector capacitance decreases as collector voltage increases. f_T is also affected [c.f. EEB, Dec. 1967]; unfortunately this causes an input Z mismatch, so somewhat higher driving power is required for a properly adjusted collector modulated power amplifier [and modulated driver].

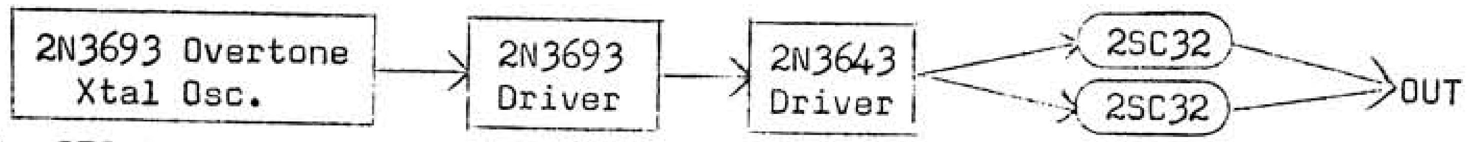
10] Keep drive below BVebo level.

I shall have more, much more to say about all of this in due course, never fear. I am, by the way, quite disappointed that no one rose to the occasion of summarising the article on Transistor Parameters to make it more generally understandable, as requested on p. 50 of the May 1968 EEB. This is really a pity. What say?

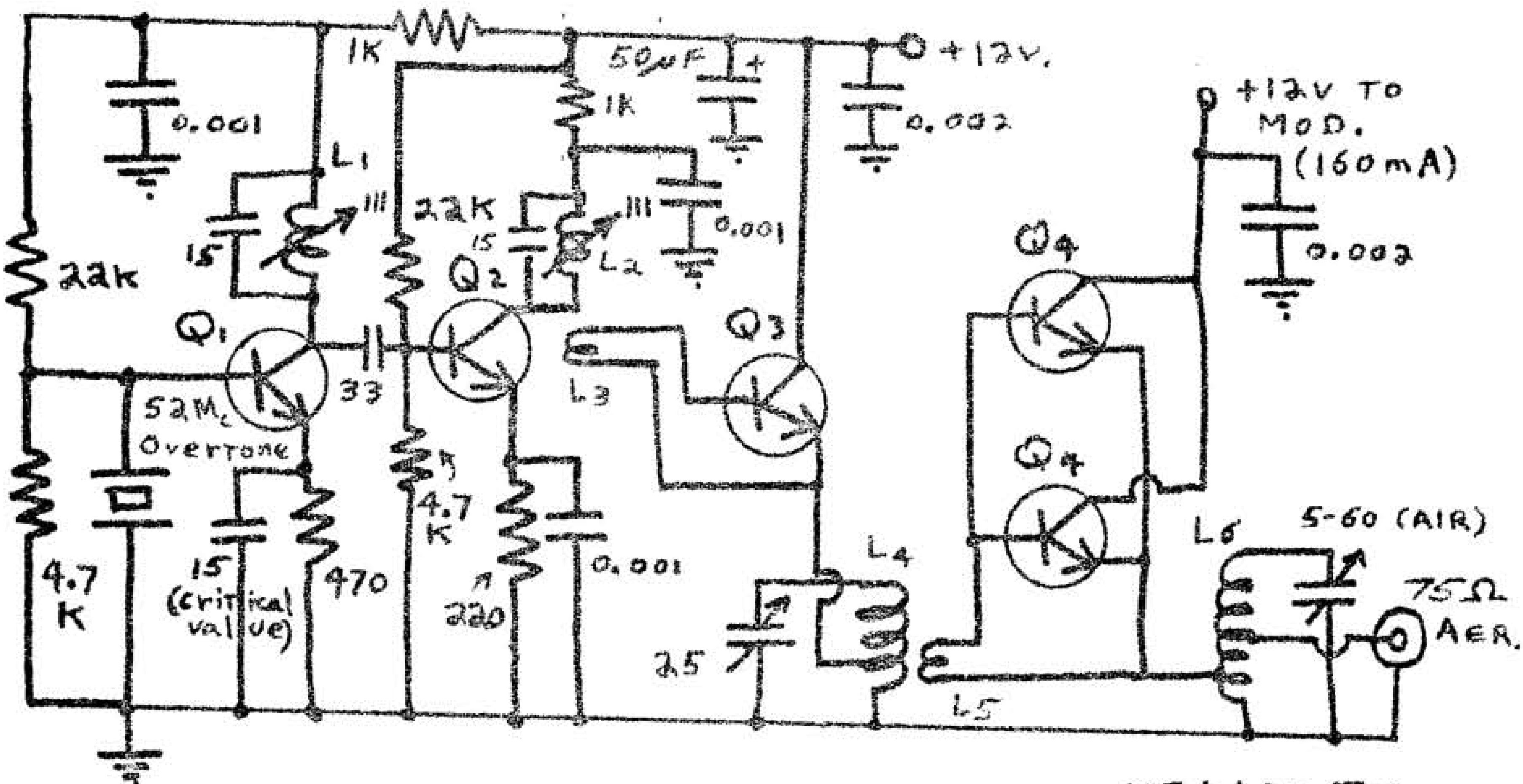
>>>>>>>>>>>>>>>>>>>>

PART VII-B: A two-watt Six-metre QRP Transistorised Transmitter. -- K.M. Kelly [VK7LL]

This unit uses the excellent S.T.C. type 2SC32, which has good performance, and very modest cost [in the dollar and a half range]. I use two of these on 12V at 52Mc with an input of 2 watts, in the following configuration:



The STC transistors are fitted with the "cogwheel" type heat sinks, which allow 50% more power rating in free air, and probably twice more when bolted down to a suitable heat absorbing surfact. In the above application, with the transistors in air they get only warm. The schematic diagram for this transmitter is as follows:



KELLY TX.

L_1, L_2, and L_4 are toroids or air wound with 24 gauge to resonate at the overtone frequency. L_2 can be about 7T on 1/2 in. dia. air, with L_3 one or two turns, as appropriate for drive. Likewise for L_5. The tap on L_4 can be adjusted to suit drive; start with centre tap. Better coupling can be obtained by using a tap on L_4 to feed the base of Q4, but it is less easy to adjust drive than when using a like. L_6 is 6-7T No. 14 wire on 1/2 in. air dia., with tap about 1T up; adjust the latter to suit impedance of antenna used. Drive is adjusted as necessary to obtain desired input. With final loaded, collector current would be about 160mA. For a note on driving power requirements, see EEB, August 1967, p. 104.

The books tell you that paralleled final transistors should either be well matched, or the bases fed separately to ensure equal collector currents, but no difficulty was encountered in this instance.

Q_1 and Q_2 can be Fairchild 2N3693 or 2N3643 or equivalent. Q_3 is 2N3643 or 2N3642. Q_4 is a pair of STC 2SC32 transistors. So far, all the silicon transistors I have tried have stood the treatments I have given them, but a couple of AFY19 germanium types bit the dust. The latter, however, were rated at fairly low voltage, and this was probably relevant. For two transistors having the same voltage rating, the germanium one should be more robust to transients. In the present case, the output transistors were able to stand up to severe mismatch, probably because actual

BVces was higher than specified by STC*. [Ed note: Consider also possibility of Fairchild AY6102 at 3W P_c, or suitable Mullard item; see EEB, 1968, p. 117 and refs.]

The modulator was a single ended 2N301 [equivalent OC26, etc], consisting of the transformer and output transistor of an Astor car radio. If more modulation is required, add the collector voltage line of the drivers to the modulated line via a tap on the modulation transformer, or [better] use the ingenious two-diode system described on p. 95 of 'Transistor Transmitters for the Radio Amateur' by Don Stoner [Sams, publ.] [[Oh yes, that's a good book too, add it to the list on p. 3 here --RLG]] but note the error in their figure, concerning consistency of connections to the modulated stages [see EEB, Dec. 1967, p. 170 for details; the book has several other minor errors which I shall discuss here eventually -- RLG]. [Also appears in Mullards 'Practical Planar;' EEB p. 117]

The construction was on a printed circuit board, each stage was shielded, and all leads were very short, which undoubtedly contributed to the Stability which so exercises the EEB Editor.

Transistor Characteristics

For reference in utilising alternative transistors with suitable characteristics, the transistors mentioned have the following brief characteristics:

Tr	P_c	Derating [25^oC case]	BV_{cbo}*	BV_{ceo}*	f_T	V_{sat}	At	C_{ob} [10V]	P_o	PG	At
2N3642	700mW	7mW/^{o}C.	> 60V	> 45V	>250Mc	0.35	500mA	<8pF	600mW	8db	30Mc.
2N3643			60	30						9db	
2N3693	500mW	5mW/^{o}C	45	45	200	--	--	3.5	--	32db	11Mc.
2SC32	1.5W	12.5mW/^{o}C	60	25	125	0.55	30mA	7	>600?	19db	30Mc.

A Practical Matter

Leo talks a lot about problems, but I'm afraid that a lot of the literature available blinds me with science. I find it quicker to " try it and see." [[Ed. note: it helps considerably if you are blessed with the natural intuition with which Ken avoids difficulties]]

<<<<<<<<<<<<<<<<<<<<<<<<<

PART VII-C: A 200mW 6 Metre Transmitter -- W. Henry [VK7WH]

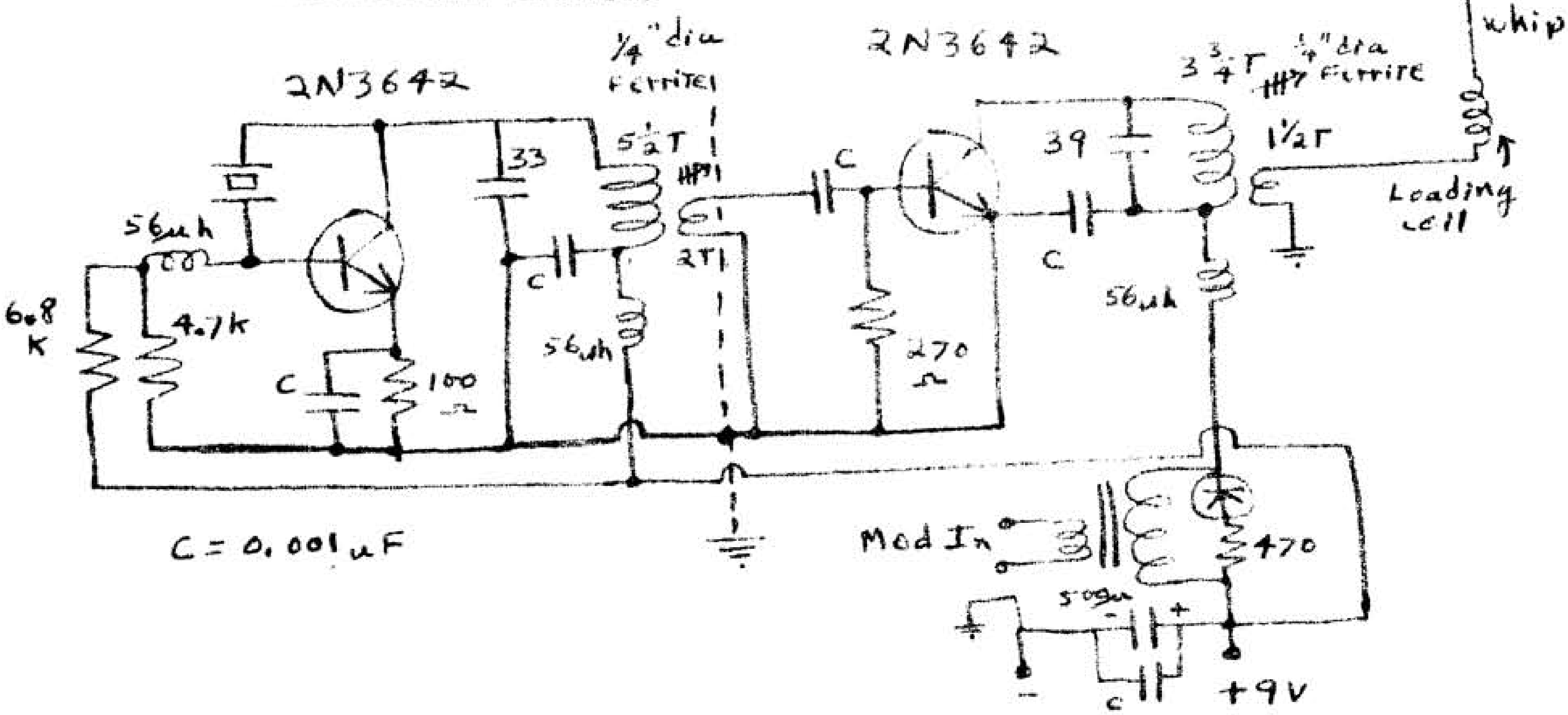
The circuit on p. 7 uses a 2N3642 in an overtone oscillator on 53Mc driving a common emitter final 2N3642 with a conventional tank circuit wound with heavy gauge wire, having low L/C ratio, and with the antenna very tightly coupled. The coils were wound on 1/4" Neosid 50Mc standard Ferite VHF cores.

The best driving condition was found to use the simple configuration shown in the base circuit of the final amplifier; a small amount of reverse bias is developed by the self-bias action of the 270Ω resistor and C [= 0.001μF]. This improves efficiency, and drive is not enough to drive the base into the BV_{ebo} region. No emitter resistor was used! The driving link had to be very tightly coupled.

The 2N3642 seems to have great possibilities as an amplifier up to 52Mc [or more] for low power applications. I am also using one in the final of a 6 Metre Walkie-talkie which runs 200mW input from a 9V supply. Experimentation shows that this is about the maximum possible input obtainable from this supply voltage. If you seek more power, an increase of supply to 12V increases the input to 500mW, and one transistor operated quite happily on 18V at 1.8W input for about 5 minutes or so without getting to the 'ouch' point [[But if you modulate it at this voltage you

*Ed. Note: Actual breakdown voltages are usually considerably higher; measure them.

200Mw 6 Metre Transmitter by VK7WH:



better have the final well tuned and well matched! -- Ed.]]

I should point out that the voltage of the driver stage [the oscillator] was also increased along with the final, increasing drive as necessary. At 18V supply, modulation could be a problem. BV_{cbo} is theoretically 60V, but actual breakdown voltage of some units tested as high as 90V, which undoubtedly explains the ability of this transistor to withstand these voltages.

A heat sink was not used in this particular installation, though it might seem advisable, particularly if ambient temperature is high, or input power is increased. The 2N3642 has a size close to the standard 'TO-5' case, and a simple heat sink could consist of a strip of sheet metal bent [on a separate former!] to the right diameter, and kept in place with a metal thread. Or one of those clever 'cog wheel' type heat sinks could be used. They appear sometimes on computer circuit boards, or are available from STC, as described above by Ken Kelly. I ought to emphasize, however, that there is little point in fitting a heat sink unless the transistor gets too hot [say, to sizzle water].

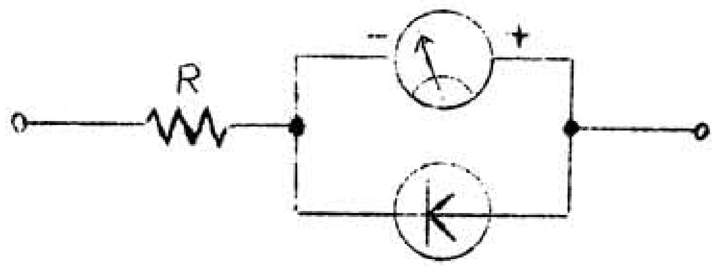
In summary, I might say that this unit is extremely stable. Two versions were built, one on matrix board, the other on printed board, and both worked first up. Hand capacity effect is negligible, owing to low circuit impedances.

DIODE PROTECTION??

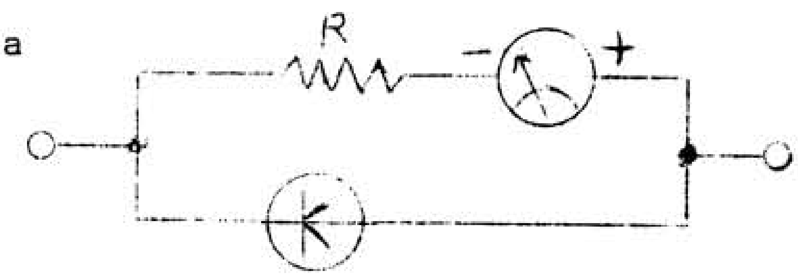
It might be well to point out to Electronics Australia authors and others, that the point of diode protection is to protect meter movements -- not diodes. A few months ago that magazine featured a transistor tester [of reasonable though limited design] in which the 'diode protection' was arranged thus:

[PTO]

[Diode Protection??]



The resistance was part of the meter-protection circuit, according to the authors, but it was not. Diode-protected meter circuits work by virtue of the sharp voltage threshold of conduction of a forward-biased diode. Without taking up space here to draw the typical forward characteristic curve, you know that a diode does not start to conduct until the forward voltage across it exceeds some threshold value, which is about 300mV for silicon, but which varies from one diode to another. If the diode is connected across a meter movement, increased current through the meter will produce a greater voltage drop across it, and when the voltage exceeds the diode threshold, the diode will conduct the current rather than the meter, protecting the latter from burnout -- although the needle may be bent. The effectiveness of this protection may be increased considerably by placing a resistor in series with the meter, in this manner:



Now the voltage across the diode is greater for a given meter current, and the diode conducts sooner, protecting the meter for even modest currents, and even reduces the tendency to meter needle bending. In practice, one merely runs full-scale current through the meter, and increases R until the meter reads perhaps 1% low at FSD [or just barely discernible, if you prefer]. At this setting, full protection is afforded for overloads exceeding about 1.5 x FSD, up to truly prodigeous overloads. A higher current-rated diode will protect somewhat more efficiently at very high overlaods. Without the resistor, the protection does not start until about 3 x FSD, and does not become really effective until 4 x to 5 x FSD, according to my own experiments.

Obviously this extra resistor is not practical in already calibrated multimeters, because it would affect the current scales, but it is quite a good idea in new equipment -- if correctly placed, and adjusted to optimum value for a given meter and diode. I might also note that silicon diodes are more effective in this application than are germanium ones, because the threshold of germanium is more sloppy -- more likely to affect calibration at low currents.

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LETTER TO EDITOR

Heat Sinks

It is possible to use aluminium building channel as a cheap source of heat sinks. It comes in different dimensions, with long and short legs, and in thicknesses from 1/8" to 3/8". At 90c a pound, it is considerably cheaper than the commercial variety, and works well. Three reasonable heat sinks can be cut out of a length weighing one pound. On the other hand, it is possible even to economise on commercial heat sinks. If you buy the biggest size, e.g. 8", you can cut it in three pieces, with a considerable improvement in cost.

-- G. van Leuven, Naracoorte, S.A.

[[If a heat sink is made of shiny material, it helps considerably to darken it. This can be done easily by smearing it evenly with black 'Texta-color' or 'Dry Ink' or equivalent acetate-base marking pen. Ordinary enamel paint should be avoided; it holds the heat... In 'Hints and Kinks' of QST, Sept. 1966, p. 85 is described several useful ideas along this line. They mention the old but useful idea of bending a strip of metal about a drill one size smaller than the transistor; it can be used to hold the transistor down to a chassis or larger heat sink. The QST article [by W1CER] also mentions the building channel, with the interesting variation than channels of different widths can be bolted together, to form the equivalent of 'fins' from the bent-up edges; the greater centre thickness is also beneficial -- Ed.]]

Review: RADIO DATA REFERENCE BOOK, Second Edition

-- Compiled by G. R. Jessop, G6JP [RSGB, 1967], Stg 12/6 + about 2/6 post.

Like the AR Circuits Book [EEB, August 1968], this is a marvelous compendium of useful information, and also without a Table of Contents. I find this maddening, and if this were not such a good book, I shouldn't mention it. But it is a good book indeed, as you will gather from the Table of Contents we provide herewith. Obtain the book from your local WIA or NZART, or direct from RSGB as described in the Oct. 1968 EEB. If you don't want to tear your EEB to pieces, send an SAE for extra page copy.

[The index is very good, comprehensive, nearly good enough to do without Table of Contents, but the above list will help considerably to find your way through this most remarkably useful book]

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CAVEAT EMPTOR ["Empty barrels make the most noise"]!

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A NEW USE FOR CW

The Oct. 1968 Auto-Call described a novel idea by Norman E. Elsas: It seems that 75% of blind persons find it impractical to learn Braille. So you need only substitute the Morse Code! It can be punched out on any typewriter using just two keys, and more rapidly than Braille. The typewriter embosses the paper so that the code symbols can be read by touch; you start at the bottom of the page with the typewriter set on the 'stencil' position, and work up the page. It can also be done with a hard pencil. VK7ZZ says that the deepness of the impression is more important than the spacing, so you will want to use a thin card, and press quite heavily; but allow spacing between letters, and ample between words. They say that a seven year old child, sighted or blind can learn the code in a few hours, and this system would allow blind people to communicate easily with sighted ones. Sounds like a lovely idea.

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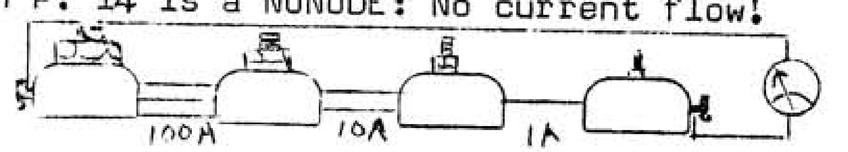
EDITORIAL -- RLG

Frapnuary Issue! EEB never publishes in January, but to squeeze this one in we have invented a new month: Frapnuary. Also solves the problem of not enough months in a year. By the way, the symbol over the 'Postage Paid' on P. 14 is a NONODE: No current flow!

Erratum: I'll bet you couldn't find 'Fig. 3' in last month's article on Meter Shunts; it was well hidden, wasn't it, but here it is again:



COMBINATION SHUNT

By the way, if you have difficulty obtaining resistance wire, it can be ordered from Post Radio Supplies, 33 Bourne Gardens, London, E.4. But first try J. Muntz, 12 Voumard St., S. Oakleigh 3167 for local information.

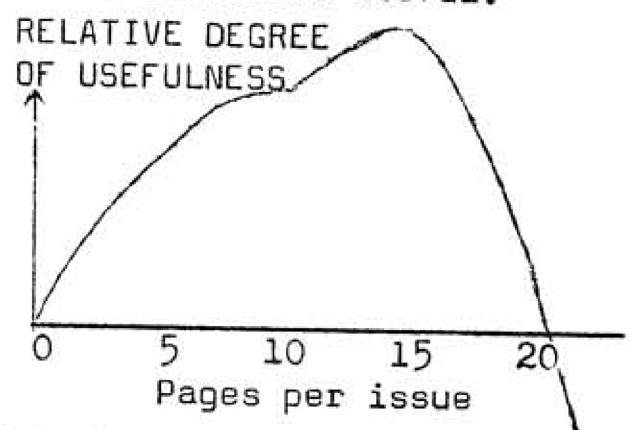
EEB's Quinquennial ["Five-year labour"]: Five years, heavens. We seem to be established in the electronics world, because we are receiving some nice articles, and some thought provoking letters. I won't take up space here listing them, but if you renew [promptly] I don't think you'll be disappointed. I might mention that I like the kind of thinking shown by the Antenna Feedline Dilemma in this issue. I don't think the author is right, though his argument sounds convincing, but what matters is that this kind of thinking is occurring, and we are pleased that EEB can be a voice for it. More, please.

EEB goes Bimonthly: I have rewritten this paragraph five times, but I think that the only thing that need be said is that eleven issues per year is simply too much demand on precious spare time. A bonus for publishing six or eight copies per year will be a budget more in accord with reality; with capital investments and various postages, it is really remarkable how much it takes to finance a magazine. But --- I have some misgivings. Even at the three year rate, 9-12c per issue is a lot to pay for a casual romp through electronics. Therefore, if you are a financially-embarrassed student, you can subscribe for 75c per year if you wish; but if so, send P.O's, not cheques.

An incidental benefit will be the fact that EEB will not add excessively to the terrible deluge of printed matter that lands in your postbox. I think that a monthly schedule is too often for most magazines, and several publications have shown agreement with this by going bimonthly. Wouldn't it be nice if Electronics Australia would?

The size of EEB: In the same vein, how big should a magazine be to be READ? We get all kinds of queries which show that EEB doesn't get read very closely, even by those who would have most to profit by it. Or I'll make an outrageous statement which goes unchallenged. Yet, we get frequent letters complimenting us on EEB, and exhorting us to keep up the Good Work. Y'know what all this means? It means that EEB is highly admirable, and bloody useless. Now, don't get me wrong; I enjoy this work. It makes me feel creative, useful, fulfilled, but I like to think it is sometimes useful.

I have noticed that the effectiveness of EEB decreases in proportion to its size, in the approximate manner shown in the graph at the right. I have tried this several times, the most recent being the bloated Oct/Nov and Dec. 1968 issues. The conclusion is quite inescapable: When EEB gets larger than a size which can be perused casually with interest, it gets thumbed-through in the same way as the big slicks, and then tossed into the bookshelf as another admirable trophy. For this reason alone we shall keep the size of 1969 issues down to 14 pages or less, even at the price of breaking up articles. Better to publish an extra inbetween month [groan] of smaller size.... Obviously I have to condense Editorials; this one started out as four pages.



EEB Staggers into 1969: Last month I mentioned that not was as simple as it once appeared on the addressing scene. Addressograph has decided that our quantity is not sufficient to qualify for the reasonable embossing price. This was a rotten blow, because we had changed over our whole addressing to this marvelous system, but since embossing machines cost about $700, there seems nothing to do for it. So -- its back to gummed labels, but with a difference, in which Editors of sister publications may be interested. We shall put the Addressograph plates to good use. Each has room for a little metal tab which shows the month of renewal. This allows alphabetical filing, but allows plates to be pulled for renewals. Well, we shall simply print up the addresses on gummed paper as before, but file the gummed labels with each plate, sticking one of the labels to the plate for identification. This will keep much of the versatility of the previous system, and gummed labels are cheap. Alphabetical filing is really necessary; cross-reference systems can drive you crazy when the mailing list gets to 500, which it is now approaching. And renewals and new subs will, for various reasons, often have various renewal months on a given page. Myomy.

<u>The Australian Experimenter Again</u>: Last month you will recall that we announced the unfortunate demise of Clive Witchell's magazine by that title. It appears that it has now been ressurected, owing to a flood of sympathetic reader response. I have not always had favourable comments about <u>TAE</u>, but Clive is quite correct in asserting, albeit bitterly, that small magazines have more important things to do than criticise each other. On the other hand, constructive technical criticism benefits everyone. We always welcome letters of that sort which can be published, and we trust that Clive does too. His reborn magazine is now priced at a reasonable level, 10c per copy including post, and contains the usual interesting material for beginners, with emphasis on review of basic physical principles. His principal advertiser is 'Bernards Radio Books,' and I have found those books to be very good indeed. A sample copy of <u>TAE</u> can undoubtedly be obtained by a SAE to 2 Ethel St., Moorabbin, Victoria 3189.

<u>Around the Shop</u>: As the December renewals and subscriptions came in, I was amused to see that the big promotion involved in sending extra December issues out resulted in about ten new subs. That means that they cost us only about $3 per subscriber. I do value your subscriptions, but what did the other 440 of you do with the extra copy? It is difficult for me to believe that anyone could resist such a temptation as the December issue, which was particularly attractive [by no great coincidence].

The advertiser on p. 119 last year who wanted EEB's got a response with an offer for a Vol II for about $3.50. Whatever you may think about such things, I must admit that it is flattering to the ego. Vol I doesn't seem to be available at any price. Far be it from me to suggest that <u>EEB</u> makes a good Investment [at least], but........

Many thanks to the chap who had the consideration to return an extra back cover which was included accidentally with his, and which was addressed to someone else. He ensured that the other's copy was delivered promptly, and saved us a complaint.

<u>XYL?</u>: A renewal ended with the comment, 'I am only the XYL'! My word, I wish I could train mine that well. Never mind, but that term 'XYL' must go. I have deep doubts that there exists a female on God's Green Earth who is willing to admit that she is no longer young. Shall we adopt the term gaining popularity abroad, 'YF'? It can be interpreted as 'wife' or 'young female' as you please. I am, of course, referring to CW. For phone and for writing, the use of CW abbreviations is absurd, as VK3ACH has pointed out cogently in the Oct/Nov <u>EEB</u>. I guess now I'll have to set a good example.

▯ ▯ ▯ ▯ ▯ ▯ ▯ ▯ ▯ ▯ ▯

" Unless one is a genius, it is best to aim at being intelligible." -- Sir A.H. Hawkins

▯ ▯ ▯ ▯ ▯ ▯ ▯ ▯ ▯ ▯ ▯

<u>LETTER</u> [Reprinted, in part, from <u>73</u>, April 1967, p. 116]

... But gentlemen, this is the beginning of our end. Technical advancements made today and tomorrow will further transport us from technical leaders to meek followers, beginning to learn.

It all started in the days when AM was in vogue. Hamdom decided it needed something bigger, better, and newer. HAIL, the birth of S.S.B. Industry has spent billions in research, redesign, and promotion for us, only to do it all over again for solid state.

We, of simple hamdom, wonder what is in store for us? 1966 has come, departed, and its memory is gone with the countless millions of ham dollars. Now we are blessed with Super Colinears, 2000 watt PEP linears, Solid State [$1500.00] Receivers, Single Side Band, Moon Bounce, Scatter, Monolithic Circuits, Maser, Laser, etc. In summation I have but three questions:

1] When will ham radio, as we know it today, perish?
2] If it does not perish, whom and of what wealth will it be available to?
3] What shall we write as an Epitaph?

-- James A. Kohlman, WA9TJT, Chicago, Illinois.

THE AUSTRALIAN EEB

AN INFORMAL ELECTRONICS
EXPERIMENTERS BULLETIN

Editorial Office:
P.O. Box 177
Sandy Bay, 7005
Tasmania,
Australia.

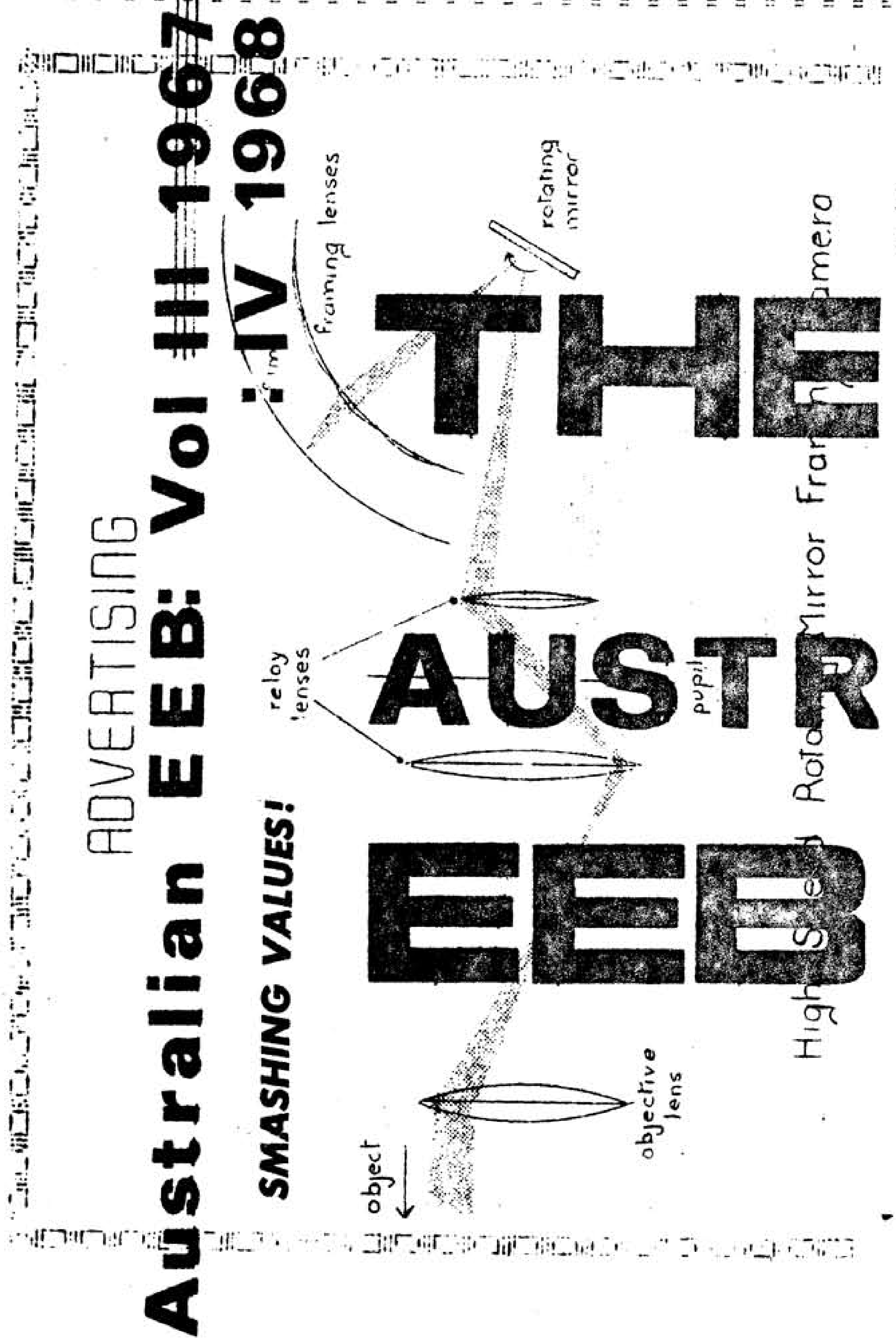
20c per copy

Australia and N.Z. :

1 yr.	2 yrs.	3 yrs.
$1.00	1.75	2.25

Foreign: 80% higher

February 1969 Vol. 5, No. 2



CONTENT:

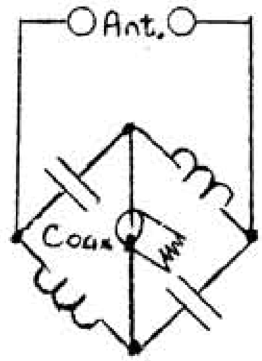
[[Next Likely Issue: April]]

-- I. EADIE
& RLG

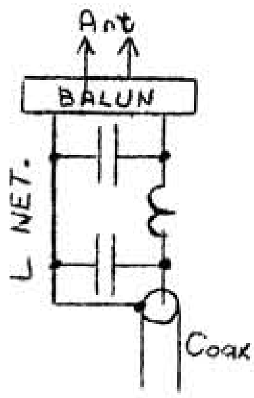
A COAXIAL LINE FEEDER DILEMMA. Part 11 -- R. A. J. Reynolds [VK7ZAR]
-- A Reply

Last month, L. J. Smith proposed an interesting problem concerning balanced and coaxial lines. In the meantime, three interesting articles have appeared which are relevant to this subject :

1] 'Wide-band Bridge Baluns,' by Bill Orr, W6SAI, Ham Radio, Dec. 1968, p. 28. This describes a very useful device, a balun which uses condensers and coils in a bridge which permits broad-band matching of 50Ω cable to an astonishing range of load impedances. But this appears to require that the antenna be resonant, i.e. present a strictly resistive load to the coax line. Since few antennas are very well tuned, it can be of interest to consider :



2] 'An Impedance-Matching Method -- Combining the Balun and L-Network,' by Robert Leo, K7KOK, QST, Dec. 1968, p. 24. Here the balun feeds a simple impedance-matching network which cancels out reactance from the antenna, so that the coax sees a resonant termination even though the antenna may be seriously detuned; saves space, since a much shorter, therefore capacitative, antenna can be used.



I note that Bill Orr's network [Ref. 1] is simply a symmetrical π-net, or two L-networks back-to-back. It is quite conceivable, therefore, that the bridge system could be used simultaneously for balun and for impedance-matching purposes. Calculation of values beforehand would be impractical, but cut-and-try adjustment could be tedious too, because of the necessity of varying both L and C to maintain both balance and match. So the system of Ref. 2 makes this more convenient.

3] 'Is a Balun Required?' by Lewis G. Mc Coy, W1ICP, QST, Dec. 1968, p. 28. This gets down to the point, and the one asked by Mr. Smith: What do we accomplish by using a symmetrical transformer [a balun] to match a balanced antenna to an unbalanced line, since the antenna will still induce voltage in the coax below the balun, according to Mr. Smith, causing feeder radiation.

The point may well be illustrated by reference to Fig. 1:

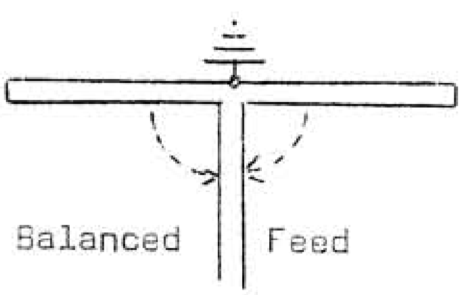


Fig. 1a.

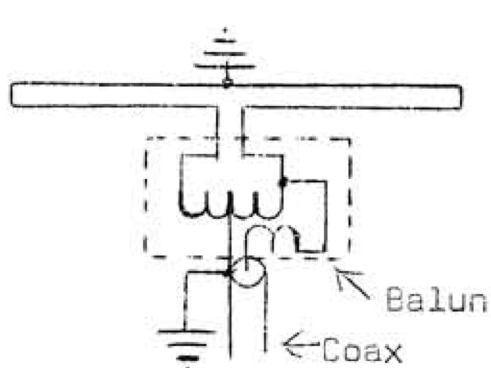


Fig. 1b.

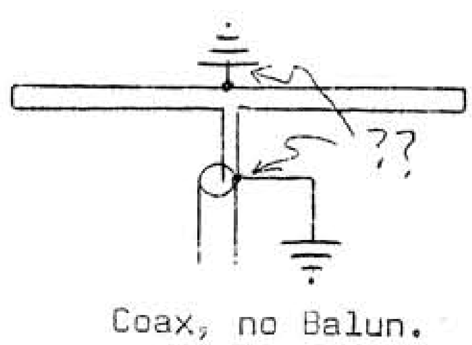


Fig. 1c.

In Fig. 1a, a balanced feeder feeds a balanced antenna; I show the Folded Dipole type to illustrated the point that the centre of the antenna is effectively at earth potential, whether or not it is so connected. Fig. 1b shows an unbalanced feeder matched by a balun to the balanced antenna. Fig. 1c indicates an Unbalanced feeder connected to a balanced antenna, and the obvious dilemma it proposes; this will be discussed in this article.

Mr. Smith makes the point that in Fig 1a radiation induced by the antenna [dotted lines] cancels out in the feeder, but the radiation induced in system 1b does not, since the outer braid of the coax now has no parallel wire to produce a signal of opposite phase. Therefore how is Fig 1b any improvement over Fig 1c?

The answer might be that it is not necessarily an improvement, but as Mr Mc Coy points out in the QST article, this may depend on your specific requirements. If it is essential to avoid feeder line ration, Fig. 1b is essential. Let us see why.

Parallel Balanced Lines

A balanced line is one with two parallel conductors of the same size and shape. At any point on the line, the voltages on the two conductors are equal but of opposite phase with respect to earth. Therefore the fields produced by each conductor cancel out, and no radiation occurs; the energy is 'piped' up to the antenna itself, and radiated from it because the phases up there reinforce rather than cancel.

If a signal is coupled back from the antenna to the line, the fields no longer cancel, and the line can radiate; that is why one should bring the line away from the antenna at right angles for at least one-quarter wavelength.

Although an ordinary doublet-type antenna has no physical connection of the 'centre tap' to earth, the analogous system of the folded dipole shown in Fig 1a shows that the earth potential is always present at the centre, whether or not it is physically so connected; the mere nature of the line and its near 'equal capacity to earth' will provide the connection. This is important here.

Coaxial Unbalanced Lines.

In this case, and with correct impedance termination, the outer conductor is at earth potential throughout its length. This can be justified [but not really explained] by observing that it is not unusual to earth the outer conductor of a coaxial feed at several points along its length. The r.f. travels on the inner conductor, and the inside of the outer one; the outside of the outer one is at earth potential! -- or ought to be. Obviously no radiation occurs under this condition.

Feeding the Folded Dipole

Now consider the folded dipole fed by each of these feeders. In the case of the twin line, Fig. 1a, no problems exist. The 'centre tap of the dipole is at earth potential either physically, or by capacitative effects, and the voltages on the feeder have the right phase relationships, as explained above.

If, however, a single coaxial line is used as in Fig. 1c, something like a short circuit will appear on one side of the dipole, as suggested by "??", with obvious consequences. Let us consider this short circuit more closely.

That Short Circuit!

It is not simple. I mean, nobody would short the outer conductor to the mid-point of the dipole, and the antenna refuses to believe it too. So it forces a strange resolution. To appreciate this, consider the overall picture. In Fig. 2

where the ' normal' situation exists, all of the energy [neglecting line losses] is poured 'up the spout' and is localised at the antenna.

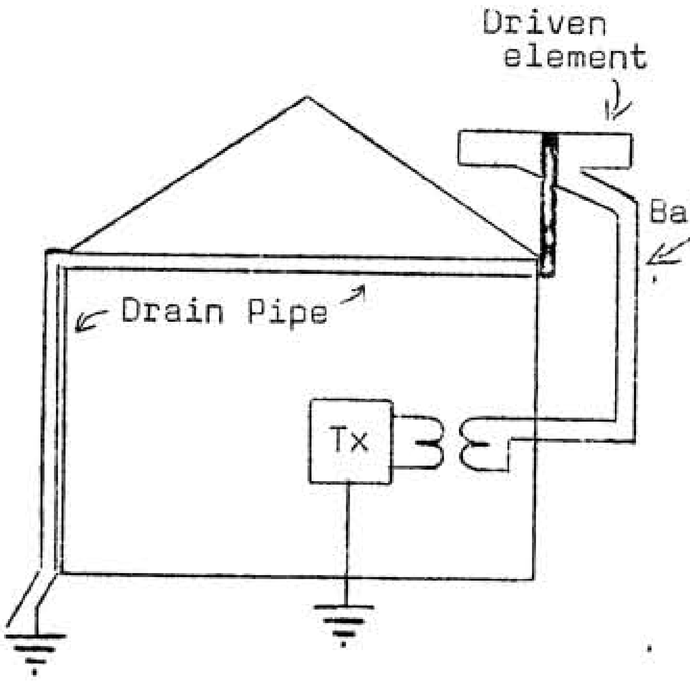


Fig. 2
Folded Dipole as per Fig 1a.

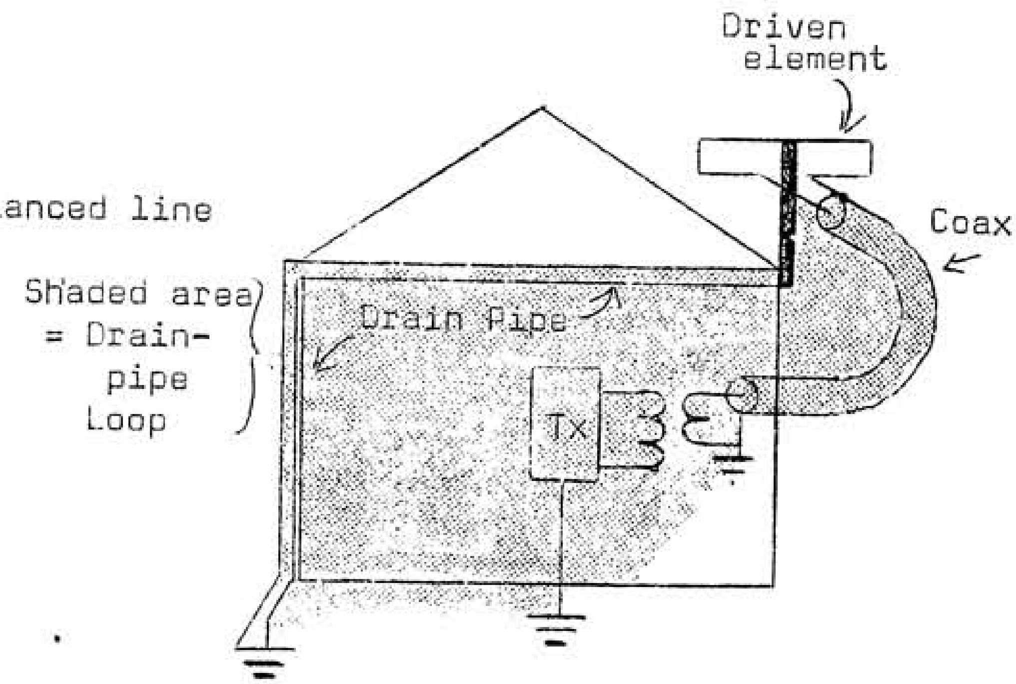
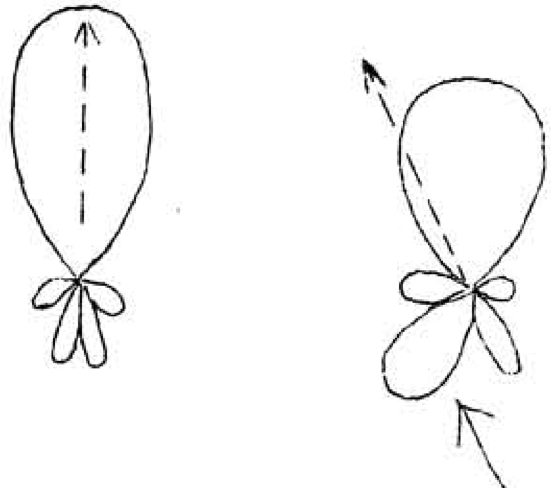


Fig. 3
Folded Dipole as per Fig 1c.

In Fig. 3, however, the impossibility of a shorted antenna asserts itself. The middle of the antenna is forced to be part of a loop formed by the mast, drain pipe, earth, and say the coax [this is an approximation, of course]. Due to the loop thus provided, the energy delivered is localised in the area enclosed by the loop. This is probably a lossy inductive circuit, and power radiation at low Q will occur from everything, and maybe even from the dipole as well!

Even if an appreciable amount of power is delivered to the dipole, it will upset the radiation pattern considerably; whether or not this is important for your system will depend on whether directivity is important. An ordinary dipole at H.F. is not very directive unless it is at least one-quarter wavelength above real earth, so the system of Fig. 1c might not upset its nonexistent pattern; on the other hand, that r.f. floating around your drainpipe is not very high up in the air, and does not improve DX. In addition, it is likely to cause TVI. The consequences for any kind of really directional antenna are obvious. [Fig. 4, e.g.]



"Normal" "Drain-pipe lobe"
Fig. 4
Distortion of Antenna pattern by induced parasitic loop.

So back to the Balun!

Which brings us back to Figs 1b and 2. The purpose of the balun is not so much to reduce the induced voltage, but to provide the correct phase relationships with respect to earth, which in turn suppress the effect of the loop.

The distortion of the pattern [e.g. Fig 4] by the array of Fig. 3 is caused by the loop acting as a driven element, of which the coax is only a part.

Note that this is not the same effect as parasitic radiation due to nearby fences for example, although the actual magnitude of the effects may be similar if the earth loop is not good. Note too that this earth loop does not have to be wholly resistive; the distributed capacitance between antenna and earth is sufficient to start the loop.

When a balun is inserted, this driven loop disappears, and so does the 'induced' voltage on the coax -- if it is lead away at right angles to the antenna. If the coax is not so led away at least one-quarter wave, then Mr. Smith's induced potentials will indeed appear, though for rather different reasons than he postulates. This is undesirable if feeder radiation is to be minimised [for reasons described above], but it may be reduced by the perpendicular geometry, because the phases of potentials induced by each side of the antenna cancel out.

As the QST article points out, however, if the coax is a resonant length, radiation from it could be very difficult to suppress, with any geometry [but assuming the use of a balun]. The cure is simple: use a GDO to make sure that it is not a resonant length; this cannot be done by calculation, because earth is involved, and that isn't necessarily located where you stand on the ground.

The Ground Plane

The point made by Mr. Smith about radiation from a ground plane, for example, is analogous. The 'plane' of the ground plane provides a virtual earth, which is a reflecting surface. A 'virtual' dipole then appears in equal and opposite position to that of the driven element, and in no way affects or is affected by the feeder line -- for much the same reason than an image in a mirror does not affect anything behind the mirror!

Editor's Note: Antennas notwithstanding, I was pleased to see a Letter to Editor of Radio Communication [RSGB] recently, from L.J. Smith, VK6LJ [ex G3HJF], who after crowing about the virtues of SSB says: "For myself, sir, the wheel is beginning to turn full circle. Having worked the world on s.s.b. with a minute commercial transceiver I find greater satisfaction now in operating in a manner which hitherto I have been shamefully incompetent-- C.W.!" Good on you, OM!

αααααααααααααααααααααααααααααααααααααααααααααααααααααααααααααααααααααααααααααα

1-Watt TRANSISTORISED TRANSMITTER -- Jim Fisk [W1DTY] [[Diagram on p. 20]]

This little rig grew out of some experiments with Vackar and Seiler oscillators [See EEB, December 1968, p. 134, particularly Ref. No. 2]. After all the publicity by Pat Hawker in Technical Topics, and a recent article in one of the electronic engineering magazines, I thought it was time to get these circuits into amateur hands.

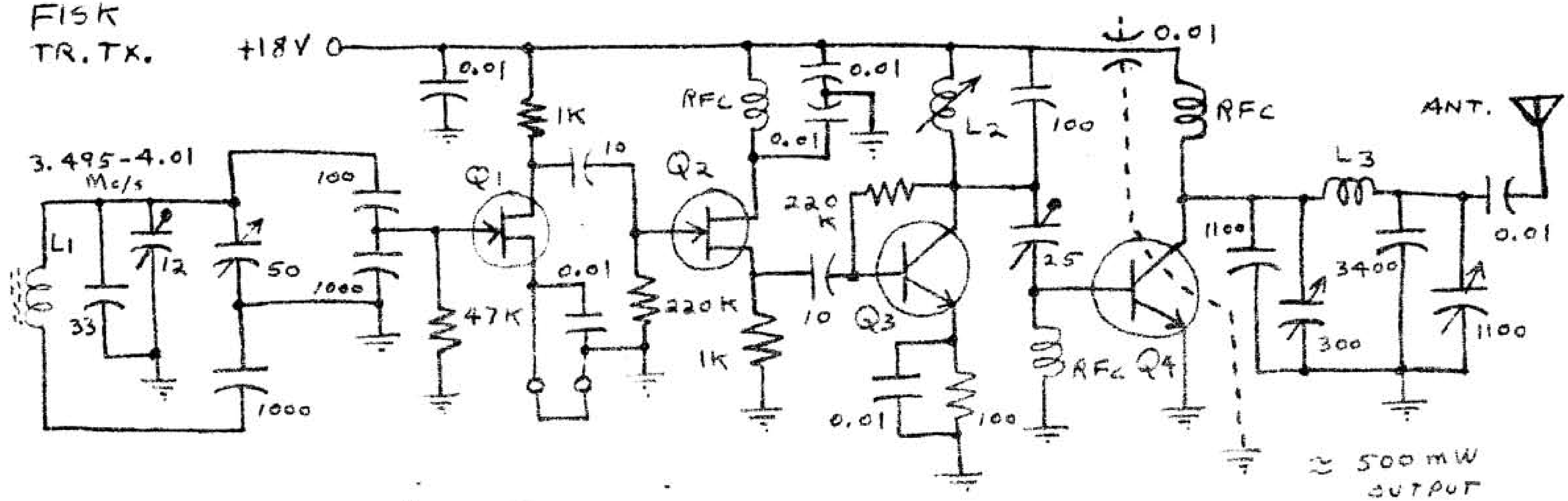
The stability of the Vackar and Seiler oscillators was almost unbelievable, really. A typical Fisk breadboard, with parts laying all over, wired together with No. 22, the ferrite-core inductor dangling from the variable condenser, etc -- drifted when I thumped it, or from close hand capacity, but when keyed, there was absolutely no drift. A properly constructed assembly, of course, worked even better. When the power supply was changed from 22V to 9V, drift was only several-hundred cycles. Remarkable.

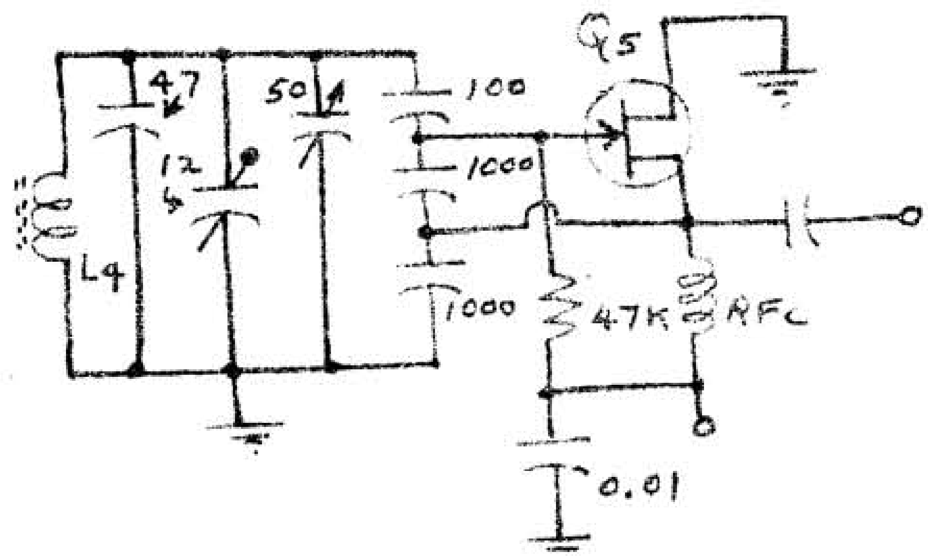
I added an FET Buffer, a 2N706 driver, and a 2N697 1-watt amplifier, and the result is the circuit shown on the next page. Best DX [80M] is 50 miles so far. All T9 reports, some T9X.

Q1 is the Vackar circuit, Q5 the alternative Seiler one, as you please. Drift was nil with both. Vackar output only varied about 0.9db over the range of 3.5 to 4.0Mc*, while the Seiler varied about 2db. But that's still pretty insignificant.

The Motorola FET's can be obtained from Cannon Electric [58 Cluden St., Brighton East, Victoria, 3187]. If they don't have the other transistors, Fairchild equivalents are shown. Any transistors should work in these positions if they are rated for several hundred mW and at least 50Mc f_T.

* None of that Hertz stuff here -- heh! heh! -- RLG

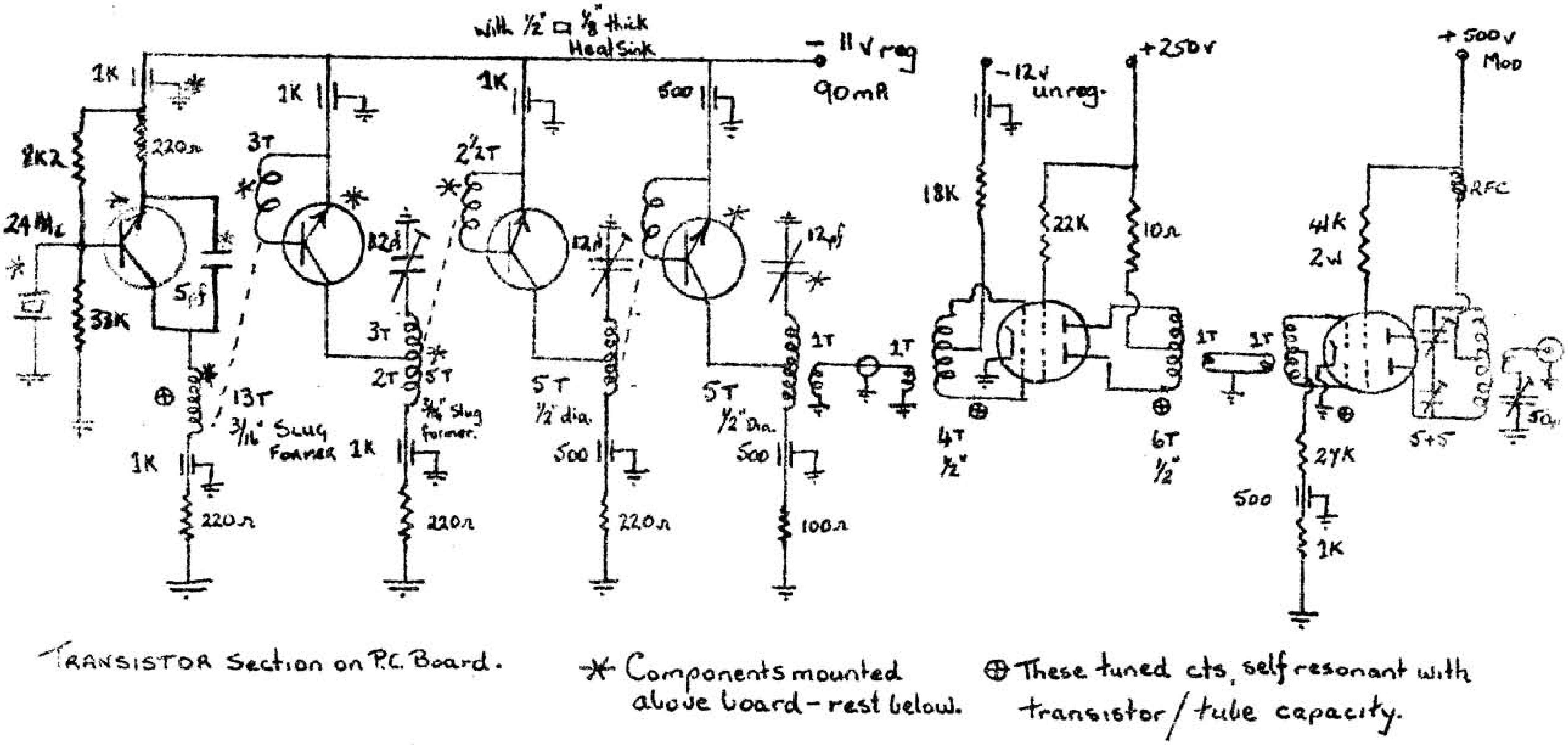




Q_1 = MPF102 (Motorola FET) Vackar Oscillator
Q_2 = MPF105 " Buffer
Q_3 = 2N706, 2N3567, etc. Driver
Q_4 = 2N697, 2N3642, etc. Final (with heat sink)
Q_5 = MPF102 (Motorola FET) Seiler Oscillator (see text)

L_1 = 48T No. 30 on ½" Ferrite core (Amidon T-50-2; Amidon used to be Ami-tron)
L_2 = 9-16uH (J.W. Miller 4506)((Wind your own on variable Ferrite Core, and check with GDO — RLG))
L_3 = 7¼T 1"dia, 16 tpi (B&W 3015 or Air Dux 816T)
L_4 = 44T No. 30 on ½" Ferrite Core (Amidon T-50-2)

<u>QRP TRANSISTORISED</u> <u>TRANSMITTER</u> -- Jim Fisk, W1DTY



A WELLINGTON GROUP's MOBILE TRANSMITTER

Sent in by Ted ZL2TAX

This is the mobile used by ZL2TGC, which is similar in concept to ZL2TCU's one. Neils (ZL2TGC) transmitter was designed mainly by ZL2TDW, with ZL2TGC, 2TFJ, 2TDW and 2TAX doing the construction with a little help from EDAC in places.

Incidentally the whole unit mounts in a standard 19" x 3½" rack space 14" deep. The transistor driver bears a strong resemblace to most of the walkie Tx circuits in the Wellinton area -- since Tom ZL2TDW has built most of them.

REPRINTED FROM "SPECTRUM" (N.Z.) July 1968

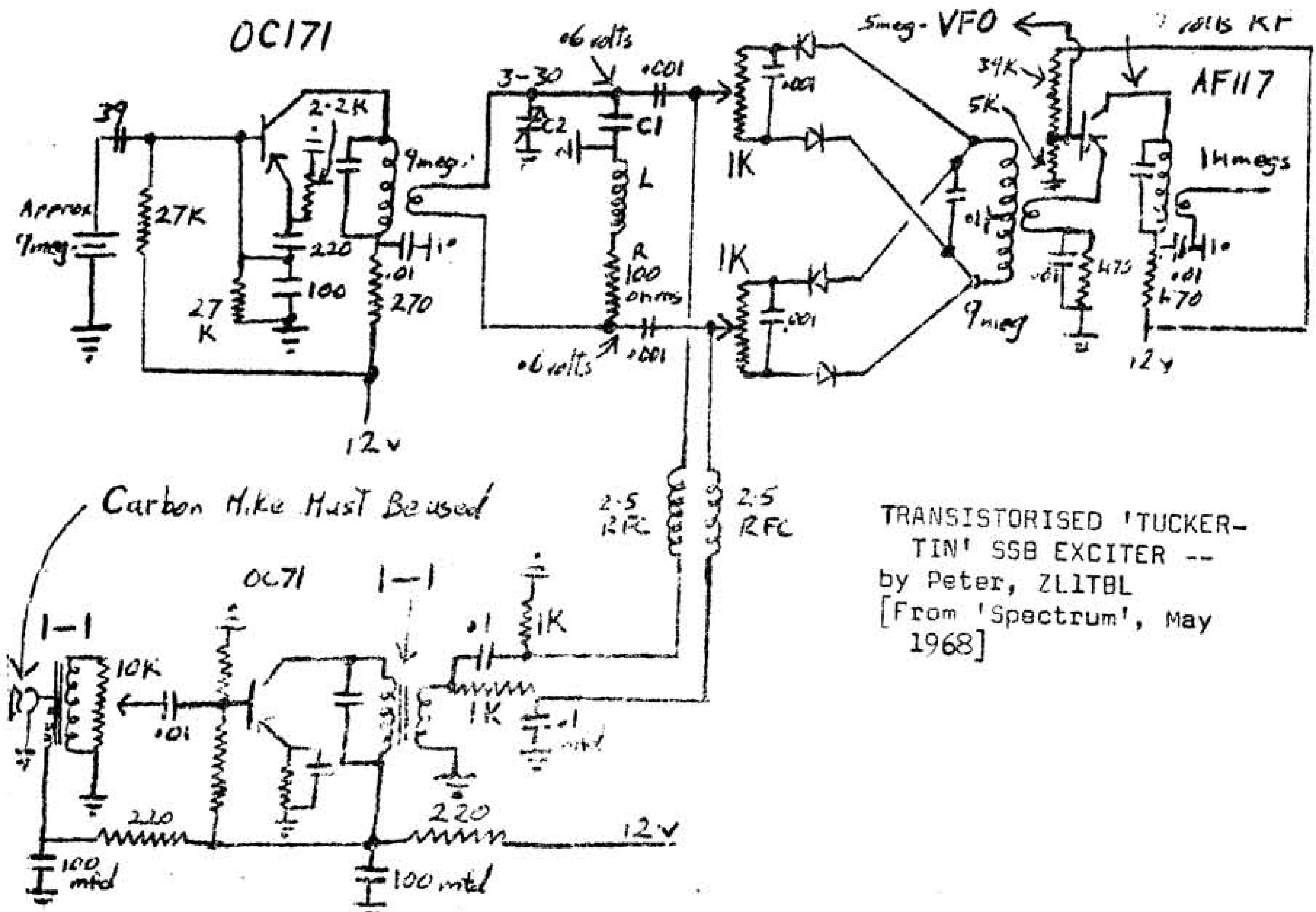
TRANSISTORISED TUCKER-TIN SSB EXCITER -- by Peter Uren [ZL1TBL]

[[Reprinted from Spectrum [N.Z.], May 1968. This is the transistorised version of the renowned circuit which was described in the March and April 1968 EEB! The following text has been condensed slightly, for reasons of space:]]

The valved equivalent of this circuit appeared originally in the August 1961 issue of Break-In. I have had this set working on 2M with very good reports, and signal strength about two S-points more on SSB than on AM using the same power. The exciter runs on approx. 13.7Mc, beating with 130.5Mc signal for 144Mc output.

This is a cheap and easy circuit to get going when you have no CRO to tune it. The 5Mc VFO used for this rig was the one drawn up by ZL1TFF in last year's News Letter. It turned out to be rock stable, and I was pleased with it.

[[EEB Note: The arrow pointing to the output r.f. tank says "2 volts RF"]]



TRANSISTORISED 'TUCKER-TIN' SSB EXCITER -- by Peter, ZL1TBL [From 'Spectrum', May 1968]

RF Phase Shift Network.

3-4megs	390 C.1.	12 t (L)	on 3/8" Slug	27Swg wire.
8-9megs	200 " "	9 t	on ¼" slug	18 Swg.
13-14megs		6 t	on ¼" slug	" "

Inductance of L is not critical. C2 is used to adjust so that the output on both channels is the same voltage using an RF probe and VTVM.

If other Freqencies are used change C1 accordingly so that the value of C1. with C2. give even voltages on both outputs.

REVIEW -- by the Editor

" Transistor Transmitters for the Amateur," by D. Stoner, W6TNS [Sams]

This book is such an obvious classic, that anyone interested in this subject will obtain it or already has it. Therefore, I confine myself to some corrections:

Nothing is perfect, and this otherwise excellent book has a few errors:

P. 15, middle: Should read: "For example, a transistor with an f_T of 60 would have a current gain of 2 at 30mc..." etc. Power gain is a different matter, and is essentially current gain times voltage gain; it has a slope of 6-8db/octave, and ends in f_{max}, where PG = 0db, by definition. If maximum useful PG is taken at 10db, the maximum useful frequency will be about 1/3 to 1/2 f_{max}, with f_{max} usually somewhat higher than f_T. The actual limit will depend on isolation, neutralisation and unilateralisation, etc. See enclosed "Tr Parameters."

P. 18, Fig. 1-10. A base-leak is a poor way to limit drive, and can give trouble with base voltage ratings of planar types if drive is excessive. This subject is described in the Aug & Sept 1967 issues of The Australian EEB, which I happen to edit, and will be examined again in forthcoming installments of this series.

Similarly for peak voltage limiting via shunt diodes, In Fig. 1-10B: This is adequate only 1] if the diode has a relatively low shunting capacity at the RF used, and 2] the zener voltage of the back diode is less than the base-emitter breakdown voltage of the transistor. And one of the diodes is superfluous; it duplicates the forward conduction function of base-emitter junction. See the abovementioned 1967 issues of EEB.

P. 26, top. A zero-biased transistor amplifier is in Class C, not Class B. To put it into Class B [where it conducts during exactly half the driving cycle], you must forward-bias it. A minor point, but important. See Amateur Radio, Sept. 1967, p. 14; & EEB, ibid.

P. 28: If an RF voltmeter is calibrated for sine wave RMS, you can obtain a peak voltage measurement by multiplying scale calibrations by 1.4. His point about non-sinusoidal nature of RF output waveforms is well taken, particularly in reference to transistor stages if the Q of the output tank is insufficient [e.g. less than 10]; see EEB, July or Aug. 1968. In general, lamp loads have the disadvantage that the lamp impedance varies with power; this is discussed and an improved design is presented in the March 1968 issue of EEB.

P. 47: This is a neat idea. See also his P. 21 and 122. Ref: "The Common-base Oscillator and its Applications," in Break-In [N.Z.], March 1968. [B.I: Box 1733, Christchurch, N.Z.]

P. 95: Wrong polarities of the transistors. Either the buffer would have to be NPN, or the common cathode connection of D1, D2 would have to go to the emitter return of the buffer. "Leakthrough" is discussed in the 1967 EEB, December. Soon to be described: Neutralisation etc.

The above comments reflect merely my own perfectionism, and are only important in reference to the items discussed for P. 18 and 95. I'm sure that we make plenty of errors in publishing technical material, and we are grateful when you point them out.

If you build up anything, how about sending us a letter about it, hopefully with diagram. If you add a few words of explanation to the diagram, describe some operating conditions, and perhaps a few results [nothing fancy!], it will be, or can be made into an article, and you can earn a subscription to the EEB -- and gain some fame in Australia & Elsewhere. There is also nothing to prevent you from sending that article abroad subsequently, for Fun & Profit.

TEMPERATURE MEASUREMENT AND THERMISTOR LINEARITY. -- RLG

Several months ago [Sept] appeared an article on remote temperature measurement, using thermistors. The authors stated that the linearity was good enough to calibrate the meter directly in degrees. This may be good enough for photographic darkroom use, but in fact thermistors are not always particularly linear devices. The linearity also varies in amount and shape from one thermistor type to another, and over various temperature ranges. One must never assume that the meter reading of a balanced bridge thermistor system corresponds exactly to temperature, without calibrating it first at several temperatures. Whether deviation from ideality is tolerable, without detailed calibration, depends on your application.

Working conditions for thermistors.

I have found a thermistor balanced bridge thermometer to be a useful device, as long as it is calibrated adequately, and as long as the thermistor is not required to dissipate too much power. As the authors of the abovementioned article point out, the latter condition is adequately met if the thermistor dissipates less than about 0.25 mW, although this figure could be reduced if the thermistor is to be used in air rather than in liquid; 0.05mW would be safer. The power dissipation of the thermistor may be calculated easily by $P = I^2 R$, where I is the current through the thermistor, and R is its resistance at a given temperature [R depends on type of thermistor, and on temperature]. For a given temperature range, power dissipation in the thermistor can be reduced only by reducing the power supply voltage, or by increasing meter sensitivity. The cheapest way of accomplishing the latter is to use a simple d.c. meter amplifier, e.g. of the sort using 2N4250's described in these pages last year.

Incidentally, in reference to that Maddever Transistorised Voltmeter [EEB, October 1967; Ham Radio, April, July 1968], if a more sensitive meter movement than 1mA is used, quiescent current may be reduced considerably by increasing emitter resistors until it saturates at about 2 x FSD, and varying the feedback resistors to maintain sensitivity. Lets see you do that with Integrated Circuits!

Another method of measuring temperature

While I am talking about temperature masurement, I might mention the rather curious technique used by K6EAW to measure temperature, as described in the Feb. 1967 issue of 73. He measure the temperature of a transformer winding by the rise in the resistance! Namely, $-\Delta T \doteq 255\ [R_h/R_c - 1]$, where R_h is resistance when hot, and R_c when cold. Answer comes out in degrees, Centigrade. It works both ways: you can measure the temperature of a space by putting a transformer in it, and you can tell how hot a given transformer gets with a given current through it. This can be quite useful in determining actual maximum current and power ratings, particularly for unmarked units; an ordinary transformer [or choke] ought not to get warmer than about 100°C [boiling point of water], but I think that this reckons without that awful plastic tape they are using nowadays between windings. To measure temperature rise in a given enclosure [e.g. a VFO], you can merely use a small transistor interstage transformer.

You can also use germanium diodes or transistors as temperature-sensors, but of course they won't be very linear, and you may have some trouble with calibration if they are heated excessively [e.g. over 80°C].

Further Information on thermistors and applications may be found in easily-digested form in 'The Thermistor', by C. Klinert, WB6BIH, 73, Nov. 1968, p.78. It also shows a graph which indicated unequivocally the nonlinear property of thermistor resistance with temperature.

IMPROVING RECEIVER FRONT ENDS -- a Review Note.

Quite relevant to our series on this subject is an interesting article: "Finding true Receiver Sensitivity," By J.J. Schultz, W2EEY/1, CQ, 11/66, p.43.

He makes the profound observation that "A stated sensitivity only has meaning when both the output signal noise ratio and bandwidth are stated." And follows with an interesting discussion on the intelligent use of r.f. preamplifiers.

Improving Sensitivity.

A considerable improvement in Noise Figure can be obtained from a 'medium grade' receiver by using a low-noise preamplifier. Such a receiver might be one with sensitivity 1μV for 10db S/N [3kc, 50Ω], but negligible improvement would be expected for sensitivity already of the order of 1μV for 20db S/N [3kc, 50Ω]. In the best condition he described, sensitivity was increased to 1μV for 30db S/N [4kc, 50Ω]! Although one might think it better to improve the S/N of the receiver itself, as we have described, a tuned preamp can provide discrimination against adjacent signals.

Up to a Point.

On the other hand, does not this begin to be silly, since the antenna resistance noise itself is the final limiter of sensitivity? One good point made in the CQ article involves the use of the preamplifier at the antenna; this has the substantial advantage that it minimises pickup of noise by the transmission line, although this ought not to be a great problem with a properly designed feeder.

Given the assumption of adequate sensitivity, we have seen that a real problem can arise from apparently intractable adjacent-channel interference giving rise to cross modulation. Barrie Robinson [VK7ZJR] is preparing another article in this series for us, in which he attacks the problem by refined tuned-circuit methods. And the Assistant Editor has a note on a cross-modulation problem which cannot be solved by any refinements of receiver design!

Improving Intelligibility.

On p. 113 of the Oct/Nov article on 'Receivers and Unwanted Signals' I raised the obvious point that all sensitivity, selectivity, and linear detection methods in the world will avail nothing if you can't understand what the other chap is saying! I can't help being impressed by the profundity of this point. I finally ran across the original article in which this point was drawn to my attention, and I herewith give credit for it:

" The Frequency Response Argument -- A New Approach," by J. L. Tonne, W5SUC, 73, Sept. 1962, p. 68.

In the abovementioned article by W5SUC, the point is well made that the people who write the various Handbooks may perhaps deal with rather more ideal conditions of transmitting and receiving than we do. For really good practical results, he shows that you do NOT want to eliminate low frequency response in the transmitter, but rather to boost the high frequencies transmitted at the rate of about 12db/octave [i.e. two cascaded RC filters], but with a sharp cutoff above 3kc or 3.5kc, for obvious reasons.

He gives some practical details, not the least of which is a suggestion to keep distortion low in the transmitted audio! Contrary to what you may have read, this 'makes for higher intelligibility and also uses less spectrum.'

The Good Oil See Radio Communication, Feb. 1968, p. 100-101 for real commonsense for Rx design.

TRANSISTORISED CRYSTAL CALIBRATORS
-- The Square Wave Crystal Oscillator Revisited.

Error

An error was made in the circuit of the Square wave crystal oscillator circuit shown on p. 98 of the EEB for September, 1968. The connection between the crystal and the trimming condenser was unintentional, for it grounds the circuit at a point where neither positive nor negative power can be grounded. If this is attempted, a blocking condenser should be included, or the connection omitted, which was the suggestion of a largé manufacturer of such crystal oscillators. [[Ed. Note: Please look up that article, now, and make the correction.]]

The Problem

When the correct circuit was tried, multivibrator oscillation was obtained with any of a bag full of cal ibrator crystals. In fact, the oscillation was not controlled by the crystal at all! This problem has been encountered widely when transistors are used with calibrator crystals designed for valve oscillators.

Integrated circuits such as the Fairchild μL914 Dual Gate, and the Motorola MC724P Quad gate, priced at or below $US1.08* are convenient when numerous transistors are required in a circuit. In the Gate, there are two or more transistors connected together except at the base. Two of the gates, therefore, can be used in a multivibrator, leaving the other two transistors unused. The trend in multivibrator oscillator circuit design, therefore, is to put these others to use. An Article [Ref. 1] shows in detail how this is done, combining a crystal oscillator with a square-wave generator. Unfortunately, however, it did not oscillate with my crystals, either. [[But see footnote, next page here -- Ed]]

The Solution

At this desperate stage, having gone through some ten circuits with transistors and IC's, I invested $2 in a printed circuit board, crystal socket, 1000pF condenser, two 10K 1/4W resistors, and a Fairchild μL914. The circuit is shown in Fig. 1.

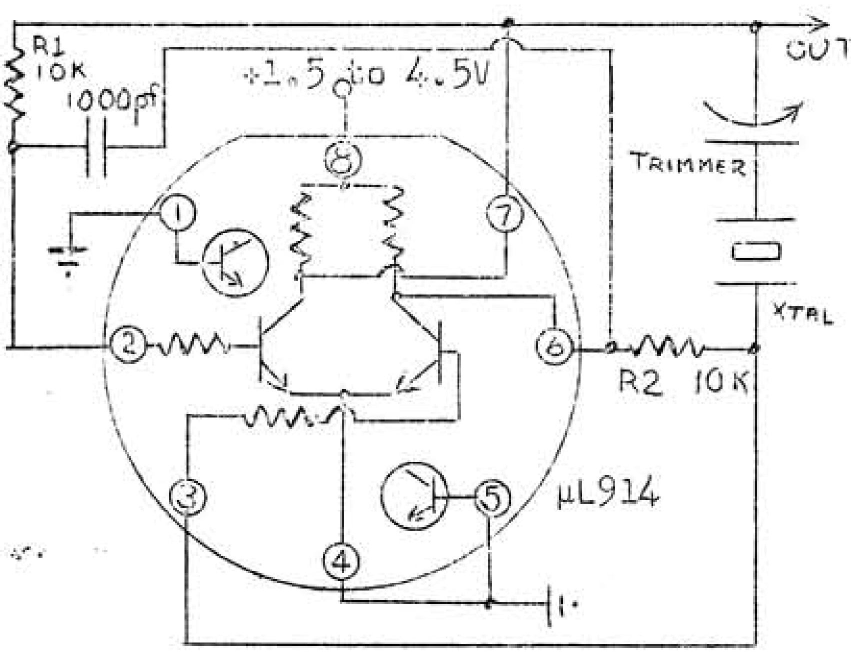


Fig. 1 : μL914 gates used as a square-wave crystal osc.

The odd thing about this extremely simple circuit was that it took off immediately with nearly every crystal in the bag from below 100kc to about 3Mc. With slight modification, it will cover 3-10Mc The unit came with a reprint of Reference 2, together with a reprint from some unspecified publication describing this this oscillator, explaining the operation as follows :

The Operation

The two independent gates are biased in their Class-A region using resistors R1 and R2. These two gates are cascaded with C1 to form a two-stage, RC-coupled r.f. amplifier. Feedback from output to input via the crystal produces the desired oscillation, in the form of a square

---

* Australian unit price for Fairchild μL914 = $0.80; and the MC724P = $1.17, [Motorola] and MC790P is $2.15. Equivalent Fairchild units are available. Add 25% to all prices if you pay sales tax.

wave very nearly equal to the crystal's series resonant frequency. In my unit, a plunger-type condenser in series with the crystal tunes a parallel-resonant type of crystal to the exact frequency.

[[A note by the Asst. Ed.: Another way of looking at it is to say that the binary rests in one condition, but due to the low Z of the crystal, a return path exists only at that frequency, so it flips over. The flip-flop flops when C_1 discharges via R_1. R_1 also stabilises the left-hand side of the binary. Theoretically it ought not to oscillate unless $[1/f] > 0.691R_1C_1$, but most obviously it does, up to 3Mc -- which makes it an even more remarkable circuit! On the other hand, I see no reason why you have to use an Integrated Circuit for this simple circuit, compared to a few readily-available components, except for a minor saving in space. How about someone trying this with computer board transistors, and letting us know the component values and performance?]]

25kc Calibrators

On the basis of this excellent behaviour of the 100kc calibrator, a new unit was built using this circuit with a Motorola MC724P Quad Gate [power supply taken from heater voltage], which was plugged into the crystal-calibrator valve socket in the Collins 75S-3 receiver. A Motorola MC790P dual JK Flip-flop* was added, to produce calibrator harmonics every 25kc in the HF bands. This is described in Reference 4. It is essentially a version of the divider described in QST [Ref. 3], but without requiring any change in the receiver's connections. Because of the squarewave output, there is no difficulty in driving the MC790P Flip-flop, and it is unnesessary to square up the wave or use a Schmitt Trigger.**

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References:

1] 'Build an I.C. Crystal Calibrator,' Radio Electronics, Feb. 1968, p. 32.
2] '30 Basic Projects,' Radio Electronics, Jan. 1968, p. 50.
3] 'A Divide-by-Four Frequency Divider for 100kc Calibrators,' E.H. Conklin, QST, November 1968, p. 26.
4] 'Calibrators and Counters -- How to use inexpensive integrated circuits for accurate frequency measuring equipment,' E.H. Conklin, Ham Radio, November 1968, p. 41.

See Also: [recent literature -- RLG]

'Integrated Circuit Frequency Counter,' by W. Votipka, 73, Nov. 1968, p.20-27.
'Digital Frequency Counter,' by B. Kelley, Ham Radio, Dec. 1968, p. 8-26.
'Crystal controlled Frequency Dividing Calibrators,' by R. Davis, Coryra, December 1968, p. 1. [This circuit is particularly interesting, because instead of using a muliplicity of transistors in logic circuitry, it simply uses a stable signal to syncronise oscillators cascaded at submultiples of 5]
'Heterodyne 1000-100-10kc Frequency Substandard,' by Dr. F. Foit and T. Von Drushka, ZL2BEV, Break-in, Dec. 1968, p.331 [Another ingenious circuit. Although it uses valves, it interestingly starts with 1Mc crystal, beats that with tuned 900kc which is fed back to give accurate 100kc, etc, with analogous for 10kc output. 'As long as the Q of the coils is at least 30, you can absolutely rely on it to pick the correct harmonic.' Now that's real engineering!]
'Frequency Meter, Trigger, Divider, Tachometer,' by C.L. Mills, Electronics Australia, October, 1968, p. 85 [uses µL914's and µL923].

* A JK Flip-flop is a binary which is controlled by a set or reset process, or coincidental pulses on both input leads. -- RAJR.

** Note, however, that it is possible to obtain 10kc as well as 100kc marker signals from the µL914 square-wave crystal oscillator directly, by a slight modification of the circuitry. Details may be found in Electronics [U.S.] for December 11, 1967; or in 'Technical Topics', Radio Communication, Feb. 1968, p. 102. -- RLG.

Vanqui Lachrimae beero
['Invain doth laughter sweeten sorrow']

EDITORIAL -- RLG.

AMATEUR [sic] Radio?

I was appalled, utterly, by Kayla Bloom's Editorial in the December 73. It is a phenomenon of the Modern Age, and lends credence to the opinion that 'Amateur' Radio has not long to live. She defends the 'Appliance Operator' openly, and the commercial interests which encourage him -- really! Words fail me and you know that that is a rare occasion. But you might look at my Editorial for July 1968.

In that same issue of 73 appear two'nice article which help to smother the memory of that exacerable Editorial: A valved DSB rig with numerous design comments; see also Oct/Nov 1968 EEB. And a 'Zero Temperature-coeffecient JFET VFO'. By Grandma's test method, for those of you who don't have access to the article, merely vary V_g until a finger placed on the FET doesn't change frequency as a function of time.

Its the Count that Thoughts [Inscription on the side of a big Computer].

We are beginning to receive IC articles ourselves, and I find this annoying, for reasons which have been discussed in these pages. Yet, I am forced to recognise that this aspect of Progress has certain justifications.

I'd say that it is ordinarily not justified to use a simple linear IC when a modest array of transistors could suffice, not only on aesthetic grounds, but functional ones. As mentioned on p. 175 of the December 1967 EEB, superior performance may be obtained by suitable choice of separate components. On the other hand, we shall not refuse such articles, but we definitely insist that the circuit diagram be supplied for the insides of all IC's used. At least you then have a choice.

The other matter concerns digital circuitry, Les Yelland has a lovely-looking 24 hr digital read-out [neon numerals] clock, for which I begged an article when I was in Melbourne recently. But the circuitry involved either a few integrated circuits, or an incredible number of transistors. Although the latter might be financially practical with Computor Board transistors, I must admit that the work involved could be considerable. IC's would seem to be practical where nothing else will suffice, but are we not becoming a slave to method? As I point out in the addendum to the References of Bill Conklin's article on Calibrators, there are other methods which can be as good or better. At least you ought to have the choice. Thus :

Recently I bought a lovely antique clock in the local Mart. Goes Tick-Tock pleasantly, keeps much better time and goes exactly twenty times as long without winding, as our store-bought wind-up alarm clock. Look better too. Now, here's an idea, Les. How about designing us a neon-readout system using the clockworks only, of one of those Antiques, with the dial replaced by the neons? Real Progress! [Or maybe the numerals replaced by ordinary neons? Cheaper.]

Around the Shop.

Ummm, remember that article Ron Brown and I were doing on Computer transistors, to be published in AR? Uh, well, the final draft is right here, and by the time you read this, it will be in Ken Pincott's hands. The series will be well worth the wait.

Page One, last month was fiendishly difficult to print, but results were not too unpleasant. Honestly, but, I'm not trying to copy Ham Radio. After the issue had been typed, I realised there was no Table of Contents -- so it just Happened.

Should we use 'capacitor' rather than 'condenser'? I use the latter because that is what a lot of people actually say, but I'm open to suggestions. From your comments I seem to be on safe ground with kc instead of kilohertz. Anything else?
P.S. The true reason for the fashionable use of Hertz: See Electr. Aust, Dec. 1968, the article which deals with this subject, particularly the Editor's P.S. !

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JUST RECEIVED AT AUSTRALIAN ELECTRONICS, 32 Waterworks Rd, Dynnyrne, Tasmania, 7005: "FET, Principles, Experiments, and Projects," by E. M. Noll. This is the fine book covering highly practical theory and practice of these useful devices. Readable and useful; see comment in EEB, Oct/Nov, p. 109. Available for the interesting price of $4.95 [post paid]! 2

CHOICE TRANSISTORS from Custom Electronics, Box 1452-1, G.P.O., Adelaide, S.A., 5001. See Advert in EEB, 'Frapnuary' 1969, p. 11. Please note that the 2N3819 and 2N4250 are now 75c each. Also please note that the 2N3819 is not a MOS FET, but an N-channel Junction FET; for further details about its applications, send to EEB [not us] for their 'FET Packet' [[9c S.A.E., please -- Ed.]]. The following useful transistors are now available also from us; all are NPN Silicon, except 2N3645, which is PNP..:

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2N3645	0.7 W.	60	500mA	>100	150mA	>200	20mA	1.00
2N3646	0.5 W.	40	500mA	>30	30mA	>350	30mA	0.70
2N4122	0.5 W.	40	100mA	>150	10mA	>400	10mA	0.80
AY8103	6.0 W.	60	3 A.	>50	1 A.	>25Mc	200mA	1.80

Please add 15c for post and pack. [*Ed. Note: Actual voltage often much higher; test it]
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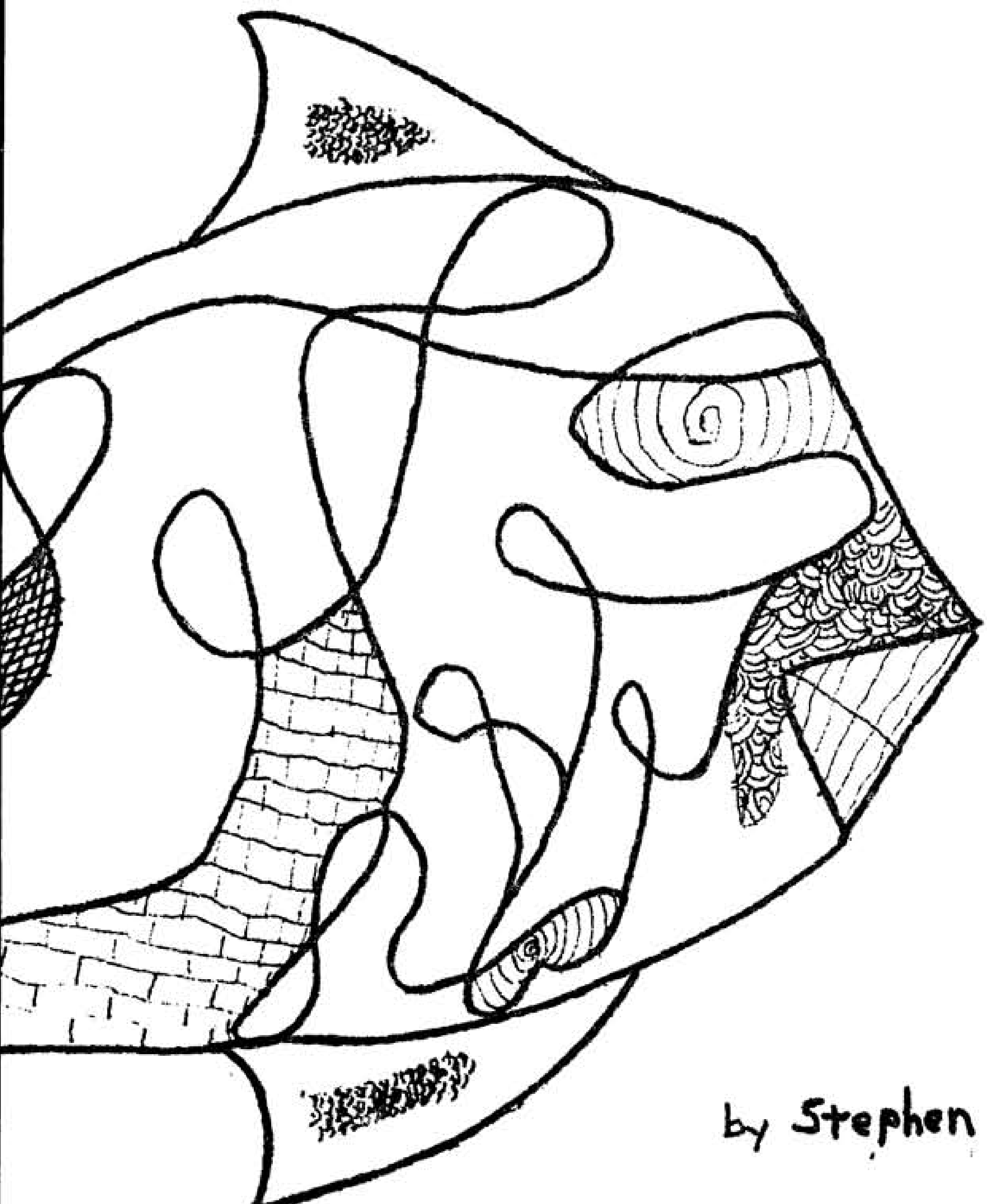
April 1969 Vol. 5, No. 3 P. 31

CONTENT:

No matter what it says please note that Vol. III is now $2.50, courtesy of PMG's Department. Vol. IV is still $2.00 via book rate.



by Stephen Gunther

NEXT ISSUE: Probably June. This one is big enough to keep you happy until then.

REVIEW: RADIO COMMUNICATIONS HANDBOOK, 4th Ed. [1968] --R.A.J. Reynolds, VK7ZAR
[Radio Soc. of Gt. Br., 35 Doughty St., London W.C.1]
Stg 63/- + 8/- PP [$A7.50 from local Divisions of W.I.A.; available in U.S.A. from Communications Technology Inc., Box 592, Amherst, N.H. 03031, U.S.A.]

In comparison with another Handbook I reviewed here a few months ago, it was a pleasure to read through the new one by R.S.G.B. It is in many ways suitable as a general reference text, though I have some criticisms too. The coverage of the book is wide, from a simple station, to an elaborate SSB affair with all Mod. Cons. and a teleprinter in the corner.

The high demand for the Third Edition exhausted all supplies in 1968, even though it went through four printings. If you did not obtain it, you will most certainly want to obtain the present one. Many of you will, however, have the previous Edition; in this review I confine myself principally to comparisons of the two Editions to convince you that this one is well worth obtaining as well.

In general, the Fourth Edition has been enlarged to cover all major fundamentals and advances in amateur subjects, as well as the finer points of what can only be called communications engineering. Although this entails some maths primarily of interest to the engineer, the majority of the treatment is readily understandable by the thoughtful radio experimenter.

The format of the new Edition is even more readable than the good-looking Third Edition, and in these days of cheap and shoddy standards the British once more show themselves the upholders of a good tradition.

Although I am a believer in that tradition, it can be overdone. It seems to me that there is here a certain tendency to retain old tried and trusted methods [e.g. valves] even when more modern ones [e.g. transistors] are obviously better. And yet... and yet, what is one to do? Valves have their important place in electronics, and so do transistors. Any compromise between them is certain to be unsatisfactory.

A few specific comments about changes in the Fourth Edition:

Ch. 1: Fundamentals. Broader coverage, including a new and valuable summary of constant-K and M-derived filters. This is an old but important subject, usually overlooked by Amateur publications; the Radio Handbook [E/E] is a noteworthy exception, and also covers the topic.

Ch. 3: Semiconductors. Enlarged to cover newer types of transistors, SCR's etc, with practical designs; very interesting. There are several transistorised audio circuits, but please note an unfortunate error in Fig. 3.18: a resistor has been omitted between the speaker load and base of the top transistor of the complementary pair; it should probably be about 620Ω, as appropriate for the currents shown. And in Fig. 3.29, the arrows on the FETs are backwards. We all make errors.

Ch. 4: Receivers. Brought up to date, and bearing a similarity, in places, to the receiver section of 'Amateur Radio Techniques,' by Pat Hawker of R.S.G.B. Theory section mostly valves, about 20% of practical material uses semiconductors; one might have expected more FET designs than found in this 1968 book.

Ch. 5: VHF Receivers. Adds a series of new and very interesting constructional projects, some employing nuvistors and FET's. Semiconductors are much better represented than in Ch. 4. This chapter is an outstanding feature of this Edition.

Ch. 6: HF Transmitters. This chapter has been rewritten, and covers the subject very well as far as valves are concerned. Transistor final theory is limited, as it covers only the simple cases. On the other hand, constructional details for several valve and a few transistor transmitters are excellent. Transistors also now appear occasionally in the following Ch. 7: VHF Transmitters, which is also excellent for constructional details.

Ch. 8: Keying and Break In. The coverage is complete, and contains much material previously unwritten, at least within one cover.

Ch. 9: Modulation Systems. Now includes a section on F.M., modified from Ch. 11 of the previous Edition. Nearly all valves.

Ch. 10: SSB. Although I don't want to encourage SSB, I have to admit that this completely rewritten and enlarged chapter is the best that I have ever seen, covering both theory and construction. Several very large fold-out diagrams are included.

Ch. 11: RTTY. This new chapter contains sufficient information to enable an Amateur to get on the air with RTTY, provided the equipment he has is in good condition. But such a manual can hardly be expected to give complete details on the maintenance of teletype machines, as this is a specialised job in itself, requiring much training and practice.

Ch. 12: Propagation. Notes on Scatter and Moon-bounce, and on the analysis of propagation reports are very good.

Ch. 13, 14: H.F. and VHF Aerials: Expanded for more detail.
Ch. 15: Noise. Same, and very good indeed, as before.

Ch. 16: Mobile. This chapter has been rewritten, but demonstrates the point I raised in the discussion on the previous page. One would expect that under 'Mobile Equipment' there would be a very large swing to miniaturisation and semiconductor practice, but this is not the case. Valves still appear to prevail, even as noise limiters and diode detectors. There is talk about vibrators. I can't help feeling that many of the 'new' articles were prepared before 1963 or thereabouts, particularly as early transistor types predominate. Certainly some of the early transistors and designs are adequate, but some of the modern ones are better, while being relatively inexpensive.

Ch. 17: Power Supplies. Re-arranged and much enlarged, with more design detail.

Ch. 18: Interference. Rearranged.

Ch. 19: Measurements. Among much else there is now a good, while still fairly simple, sweep generator [0-2Mc$\pm$ 0-60kc]. I have found this method to be the only reliable one for receiver alignment if first class performance is desired. This unit in particular, merits a little comment. It utilizes a reactance modulator combined with a fixed 5Mc oscillator to provide $\pm$ 0-60kc modulation of a 5Mc carrier which is mixed with a 5-7Mc VFO to give a calibrated fixed deviation over the variable carrier range 0-2Mc. Many variations on this design suggest themselves.

Ch. 22: Useful Data. WHERE IS IT? This excellent chapter has been omitted from this Edition. It has obviously been put into their 'Radio Data Reference Book' [c.f. EEB, Jan. 1969, p. 9] a magnificent book, but the omission of this useful section here was, in my opinion, annoying.

Although there is some heavy theory in this book, there is enough of it which is down to earth for the budding amateur. The words of Dr. Saxon in the Foreward describe the book well:

> The Handbook is not only invaluable to the Amateur; it is also an extremely useful part of the professional library, being particularly suitable as an introduction to the many varied aspects of radio communication, and the young aspiring communications engineer will find in this book much that is essential to provide a sound basis for his subject.

FASCINATING POSTSCRIPT: RLG has recently obtained a treasured possession, a Second Edition RSGB Radio Handbook; it makes absolutely fascinating reading. In 1943 the British were using crystal bandpass filters, discovered by ARRL in 1954 and Editors/Engineers in 1956. Reminds me of the situation with the marvelous Vackar Oscillator which the Europeans have been using for many years, and which the forward-looking yanks discovered in 1968; c.f. EEB, Dec. 1968, p. 134.

* * * * * * * * * * * * * *

[[Editor's Note: I am not wholly in accord with Rodney's opinion that any compromise between valves and transistors is certain to be unsatisfactory. Although transistors are not featured as prominently in this volume as one might wish, there is a tendency to use valves for functions for which they are most suitable, and transistors for theirs. This kind of conservatism is, as I have been pointing out, quite reasonable, and is particularly justified for transmitters of any/appreciable power -- as I shall discuss in a forthcoming article.* On the other hand, I must admit that the Mobile chapter could have profitably included more Solid State.

[[This raises the basic quandry: how is one to put all important things into one book, in this age of increasing knowledge. We have seen that in all Handbooks there is a tendency to omit important points [often fundamental ones] in order to get everything in one volume; and yet the Handbooks get larger and larger. Although it is certainly nice to have all facts at hand in one volume, is it a luxury we deserve in this age of Information Explosion? The reasonable answer would seem to be the publication of a separate volume, a 'Transistor Communications Handbook,' as done so successfully by Editors and Engineers in America, under the authorship of Stoner and Earnshaw [First Edition 1963, and still going strong !].

[[Perhaps the British have done just this in the publication of the separate volume 'Amateur Radio Techniques' [c.f. EEB, Oct/Nov 1968, p. 107], which presented a competent review of the best and latest techniques in communications design. It cannot, however, be an adequate substitute for a comprehensively organised text which progresses from basic theory to selected applications.

[[I wish to emphasize here that the above comments are suggestions to make a very good book better. The Fourth Edition of the Handbook is well worth obtaining, as it stands. In view of its popularity, I anticipate that it too will become scarce in time.]]

All Publications submitted by RSGB for review have been turned over to the Library of the Tasmanian Division of the Wireless Institute of Australia.

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LETTER [Received just before we went to Press in February]
-- About the Antenna Dilemma

Seeing my letter in the 'Frapnuary' EEB is a trifle embarrassing, because since writing it, my thoughts on this subject have progressed somewhat... I wish now I had left off the earth connection of the load end of the cable shown in the diagram; it would have made my point more logical... Subsequently, after much searching I have found a neat and conclusive explanation for unbalance currents on coax feeders.

-- L. J. Smith, VK6LJ, Morely, W.A.

[[No need for panic, OM. I consider it a privilege to receive constructive replies to the brash things I commit sometimes to print. In this instance, it has stimulated our Assistant Editor to a better description of antenna feeder theory than found in most texts. Mr. Smith continues this discussion on p. 41, here. -- Ed.]]

* That article will appear in Amateur Radio rather in EEB, and is entitled 'Common Sense and Instabilities in Transistorised Transmitters.' Watch for it !

EDITORIAL --- RLG

Only in EEB will you find us insulting Advertisers by loose translations of Caveat emptor. We can take that liberty because their stuff is so good and so cheap that it doesn't matter. But I am puzzled that we do not receive more [free] personal adverts. Don't you ever buy, sell, or exchange anything? Would you advertise more if we charged money? We will, if you insist. Hi.

The Australian Experimenter, mentioned in the January Editorial, seems to be well back on its feet, and looks to be useful for beginners. We appreciate very much the recent mention of EEB in its pages in Feb. 1969, along with kind words about Coryra. Amor Vincit Omnia. At one time I thought that it would be useful if our three casual publications were combined, but that would result in a very large issue, and as discussed in January, it would be impressive but unread.

Talking about January, is there anyone else who did not receive our January 1969 ['Frapnuary'] issue? I hope this will not be a repeat of the dreadful situation a few years ago when the PMG must have lost a bagful of mail. If you did not receive our Vol. 5 No. 1, please let us know, but please also include a 4x9'' SAE. It wasn't our fault, and mass replacements can get expansive.

I was startled to see my son Stephen's fish drawing on the front cover of the January 1969 issue of Auto-Call. The drawing was part of our Chrismas greetings, and half of it is reproduced in this month's EEB. Andy, the Editor, says: ''It was drawn by Stephen Gunther [age 9], and I am sure that some of these art experts could drool at the nuances depicted therein, coming forth with diverse explanations....Who knows, maybe we have a budding artist who will command kilobucks a print?''

In the same issue of Auto-Call was an interesting article, as usual, by W3AX describing piezoelectric elastomers. It seems that if you melt a thin layer of butyl rubber [or various other substances], and allow it to resolidify in an intense d.c. electrical field, it retains a permanent charge [like the classical 'electrets']. When electrical connection is made to the surfaces of the rubber [by silver paint, foil leads], it exhibits piezoelectric response [like a quartz crystal] up to 50kc. Amazing... The Editor of Auto-call, KØNL, can be heard on 14.230Mc weekdays at 1900 GMT, or 21.385Mc or 14.285Mc weekends.

In his Editorial for January he says: ''We've often pondered the invention of the transistor. Back before tubes when crystals were the only method of detecting, it is unreasonable to believe that someone didn't try two catwhiskers, perhaps more, on the same spot of galena, and at the same time applied voltage to same, and at the same time recognized a peculiar effect. Yet it appears to be true. But can you imagine what things would be like if transistors had been invented before tubes?'' When I was about 15 yrs old, the same thing occurred to me, and I tried very hard to invent the transistor. Andy should know that the reason it wasn't successful was that I didn't know what to look for. Just as well; I wouldn't have been in Australia now, and I like it here.

I have a few really nice spoofs for April issues, but with our bimonthly schedule, and with a remarkable number of articles now available, we are pushed for space, and I'll forgo the fun this year. Individual issues could be made larger, but as I mentioned in January, they wouldn't get read, so why bother? By the way, if you tell friends about EEB [and wontcha pleaz?], you might mention that there are likely about eight copies per year rather than six; this seems to make a difference. For financial purposes it ought to remain at six, but comes the end of the year when I have a bit more time, and the typewriter beckons -- and well, there you are.

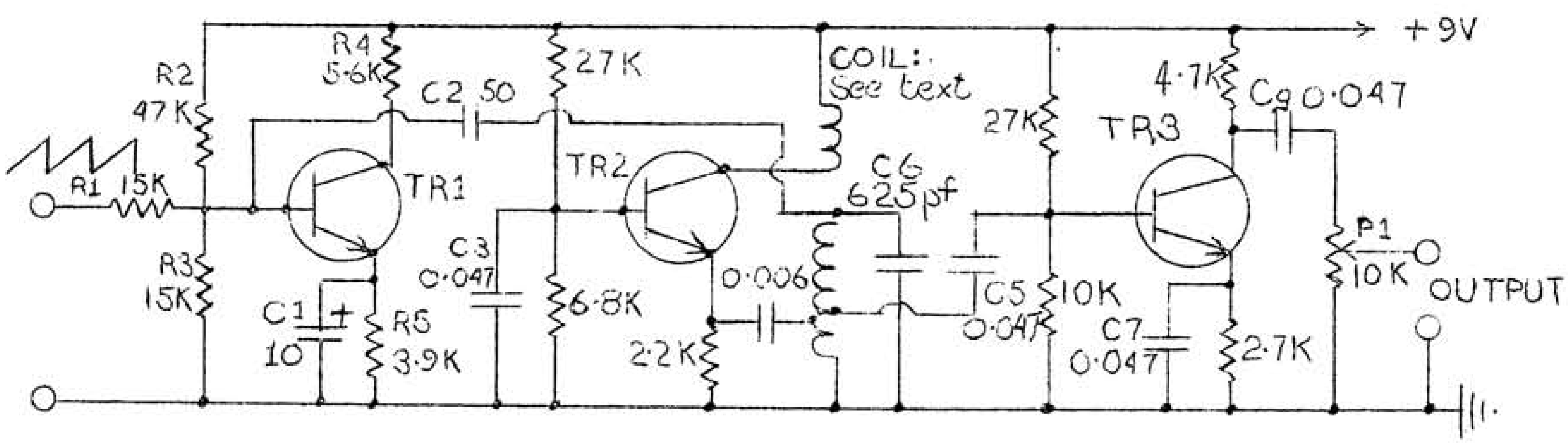
>>>>>><<<<<<

A LINEAR 455Kc SWEEP GENERATOR -- T. Cengia [VK7]

A signal generator with an automatic frequency sweep is very useful for any kind of alignment procedure, when used with a Cathode Ray Oscilloscope. You merely adjust tuned circuits for the desired shape of the bandpass, as seen on the CRO. This allows the optimum 'flat top' characteristics of which the circuit is capable, giving good voice quality with maximum attainable selectivity; the edges of the bandpass should be as square as possible.

Numerous designs for sweep generators have appeared in the Literature. The old ones used valves as reactance modulators, and they were good though somewhat complicated. More recently, designs have employed voltage variable condensers [varicaps]. These are simply specially constructed silicon diodes which are back-biased. Any diode will have a certain amount of capacitance when back biased, and the capacitance will decrease as the back bias is increased, owing to the broadening of the depletion layer. Ordinary diodes will work more or less well in this application, and an article on that subject will appear one day in the EEB. Special varicaps work better, with wider capacitance change for a given voltage, and higher Q. Any tendency for the diode to leak current when back biased, will degrade its Q, and therefore that of the tuned circuit across which it is connected. In addition to problems with Q, varicaps tend to show considerable nonlinearity of capacitance change with applied voltage.

The circuit shown below was derived from the Selected Semiconductor Circuits Handbook [Military Manual 215, p. 10-11] and has several advantages. It uses the Miller Effect of Tr1 to provide a capacitance which varies with the voltage applied at the input. This capacitance is approximately: $C = C_{be} + A_v[C_{ce}]$ where C_{be} is the capacitance from base to emitter, A_v is the voltage gain, and C_{ce} is the collector capacitance. If the gain is varied by modulating the base bias, C will vary, and in this circuit will couple its effect through C_2 to the oscillator, Tr2. This will change the oscillation frequency at the sweep rate.



The circuit is not component critical. It uses 083 computer board transistors and any miniature IF or oscillator transformer; the configuration of the oscillator can be altered to suit the coil available, according to standard practice. If transistors of opposite polarity are used [e.g. 033], of course the supply is merely reversed. If operation on a much higher frequency is required, it will be necessary to use transistors with a higher f_T, e.g. the TO-18 types found on the computer boards, or the modern planar types [e.g. AY1114]. The unit is small enough to fit inside an oscilloscope. Power can be robbed from any convenient point, making certain that it is reasonably well filtered. Total current drain is 2.5mA.

The linearity and bandwidth of this unit, compared with a valve counterpart, are excellent. With C_2 = 50pf, the deviation is about 15Kc for an input base current of about 20µA. With C_2 = 83pf, the deviation is 25Kc, and so forth. The coil used here was a Philips type off of the 199 transistor portable. The tank capacitor of 625pf came from a computer board. A different type of coil, such as a 455kc i.f. miniature type will need a tank condenser varying between 330pF and 220pF, and a smaller TR1 base condenser is likely.

The main reason for the amplifier is to isolate the oscillator from load variations. The prototype was built on a 3x2'' piece of veroboard. Mounting the components vertically will reduce the size considerably. It is necessary to shield the unit to avoid hum pickup. The oscillator is tuned with the sweep voltage actually applied to the input, or detuning of the mean frequency could occur. R_1 is not critical, and in this case merely functions to reduce loading by TR1 on the sawtooth amplifier used to drive it; any other method of isolation [e.g. emitter follower] could suffice, but if a coupling condenser is used at the input it must be large enough to prevent any distortion of the low frequency component of the sweep wave. In general it is most convenient to take the input sweep voltage from the same source of sawtooth wave as used for the sweep of the CRO.

An additional low-frequency oscillator may be used to mix the signal in TR3 [e.g. in the emitter] to obtain e.g. 10kc marker pips for more versatility in using the sweep system for receiver alignment.

QUICKIE SPECTRUM SWEEPER -- F.W. Rodey [Reviewed by EEB]
[A review of an article from Radio-Electronics, Jan 1968, p.73]

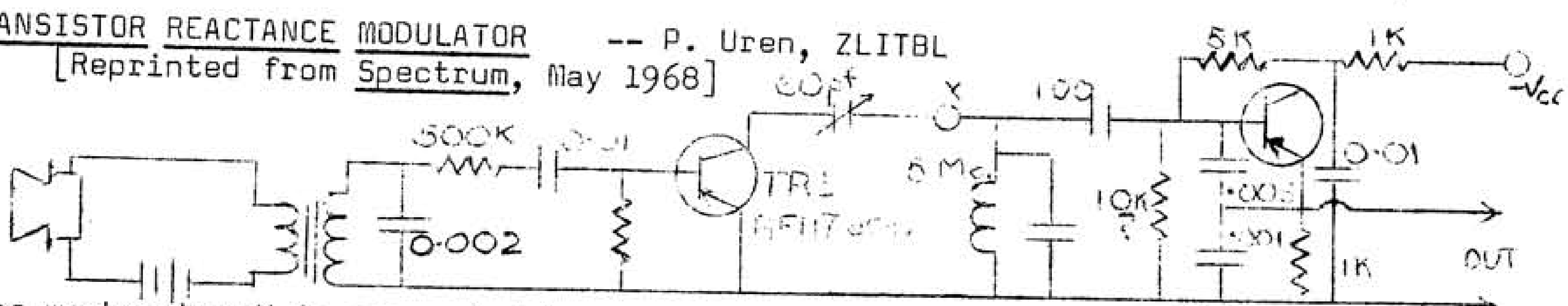
This interesting sweep generator uses an old phono motor modified as a saturable core reactance which controls the frequency of an oscillator. Very nice. A phono motor should be selected with a large diameter rotor [e.g. 1 inch], and the rotor itself is removed, as are the shorting rings from the pole pieces. A hole is drilled through the sides of the pole pieces, through the middle of the space vacated by the rotor, and parallel to the axis of the phono-motor's coil windings; clamp the pole pieces while drilling.

Through the hole insert an appropriate size rod of ferrite [e.g. 1/4'']. The oscillator coil is placed in the rotor space, and the ferrite rod is inserted through it, and through the other side of the pole piece. The coil is then used as the inductance in any kind of oscillator, as appropriate.

The phono-motor coil itself is fed with 6V d.c. from a simple power supply, in series with a 12.6V a.c. filament winding. The 12.6V transformer's primary is connected to a variac or high power pot. This variable voltage controls the sweep width, and the 6V d.c. bias determines the average inductance which is swept. With a bias voltage of 6V d.c., and a control voltage of 6V RMS, the sweep was ±25kc at a mean frequency of 1150kc.

As an interesting variation, Mr. Rodey used the sweep oscillator to replace the local oscillator in a receiver, to sweep its own i.f. spectrum automatically !

TRANSISTOR REACTANCE MODULATOR -- P. Uren, ZLITBL
[Reprinted from Spectrum, May 1968]



Also works when X is connected to crystal oscillator instead of VFO ! The only voltage on the collector of TR1 is rectified from oscillator voltage. This has been on NBFM, with good results. [[For further comments by ZLITBL on noise-free use of FM, see EEB, October 1968, p.108. Note that SSB is a form of AM, and subject to the same noise problems. SSB is nice if you use phase-lock detectors as does the PMG, but for high effectiveness and simplicity, FM beats all -- except CW]]

SIMULATED DUAL-GATE FIELD EFFECT TRANSISTORS! -- Rick Matthews, VK5ZFQ

Readers of the interesting EEB FET Packet* may be interested in the use of two single-gate FETs to simulate a dual-gate FET. This useful substitution allows us to obtain with triode FETs the advantages of high linearity, large signal-handling capability, low internal feedback, more efficient mixing, and small interaction between mixing signals -- possessed by the Tetrode FET. This can be useful because of the sometimes better availability of the more conventional triode ones. Two sigle-gate FETs in a series-cascode configuration can identically equal a dual-gate FET, provided they are of the correct type. This is quite unlike valve technology where no two triodes, however they are connected, can simulate a pentode.

It is, thus, possible to use two MPF102's in place of the versatile 3N140 with only only a few minor resistor-value changes. This in spite of the fact that the MPF102 is a junction FET, and the 3N140 is a MOSFET!

Application to improved AGC

I have extended this even farther, and have applied RCA's AGC circuit for the 3N140 to the one using two MPF102's instead [Fig. 1].

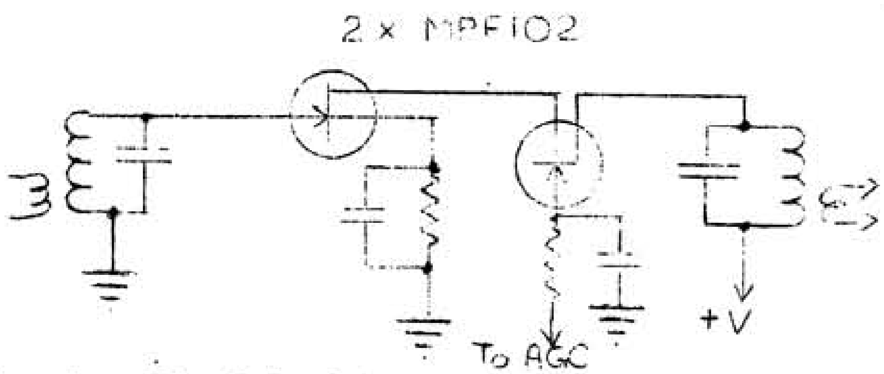


Fig. 1: Simulated tetrode AGC

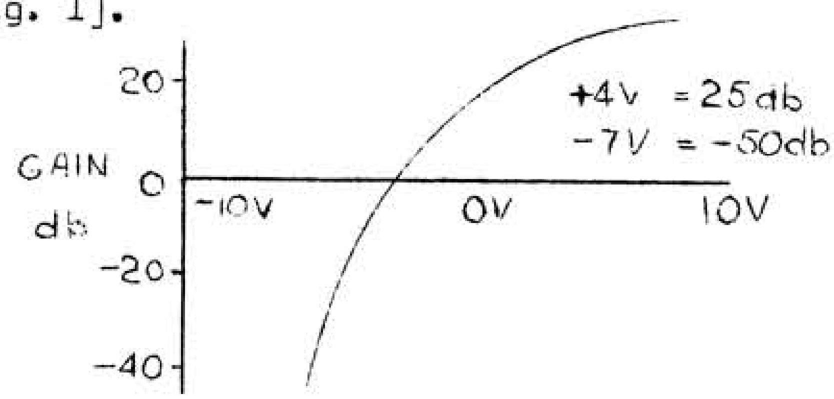
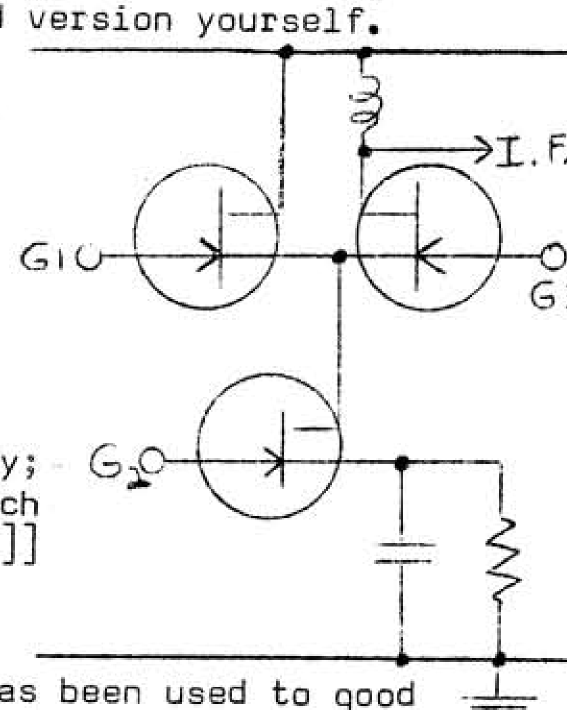


Fig. 2: RCA Data for Gate-2 AGC on 3N140

I hope that this information may have some value to you. It might be a good idea to obtain the 3N140 data sheet [AVW], to see a more detailed version yourself.



[[Editor's Note: By providing the FET Packet* to those interested in FET's, we have presented basic information to those interested in the subject, and we can proceed satisfactorily from that point. It must be mentioned, however, for the benefit of those who do not have the Packet, that Rick uses the new, unambiguous symbol for FET's. The arrow is pointing at the Source, and the other is the Drain. The arrow is, of course, the gate. Care must be used, because the N- channel FET is the one with the arrow pointing to the Source, the P-channel one with the arrow pointing away; this is opposite to ordinary ['bipolar'] transistors, so watch out, [because gate polarity is opposite to drain polarity].]]

Editorial comment on recent FET Literature [RLG]

This idea of using cascoded FET triodes is useful and has been used to good advantage in recent Literature. In the Jan 1969 Radio Communication, G3VA in his perpetually fascinating 'Technical Topics' describes a novel mixer using three triode FET's, as at the right. G1 goes to signal, G2 to local oscillator, and presumably G3 to AGC; it has very low noise, but needs a substantial signal.

* Available from EEB for a SAE, a largish envelope, e.g. 4 x 9". Please include a 9c stamp separately, do not put on envelope.

[[In the February 1969 Amateur Radio, VK3AFQ and VK3AKK continue their excellent series of articles on their Solid State Transceiver, [c.f. EEB Oct. 1968], with liberal use of FETs, both triode and tetrode. That months article also includes a most useful table on 'Locally Available VHF Field Effect Transistors,' showing type, price and characteristics. Although Freq vs NF and Gain are not shown for the 2N3819, MPF102, and TIS34, they must still be pretty adequate transistors because of their use on 2M [See: FET Packet]. I actually had the opportunity to see this Transceiver when I was in Melbourne recently, and was most impressed; I hope that when the series of articles is completed, AR will print a complete diagram of the whole device -- fold-out, if necessary !

In QST for Jan 1969, WA7FJC describes a lovely 50Mc Transceiver using the Simulated Tetrode configuration for r.f. and i.f. stages. The transmitter will be discussed in the article in AR mentioned in the Footnote on P. 34 here.

In Ham Radio, Feb. 1969 is an article by W1OOP which I can only describe as Magnificent: ''Converting a Vacuum-tube Receiver to Solid State,'' and lo and behold it is my favourite, BC348 ex-army receiver. It is a fine piece of metal, and lends itself well to numerous worthwhile modifications, but this is the Best. I have had thoughts for years about transistorising it, but have been too busy publishing this silly magazine. Now I'm glad I didn't. His BC348 has been converted to numerous FETs and bipolar [ordinary] transistors, with lots 3N140's. If you have one of these receivers, this article is a Must; if you don't it is a Must if you have any thoughts about converting your receiver to Solid State. See also 'Solid State Modules' discussed on p. 109 of the Oct 1968 EEB.

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PART VI: RECEIVER FRONT END DESIGN, revisited -- by the Editor [Continued from EEB/ Oct 1968]

-- A REVIEW: 'Hydrus -- a New H.F. Receiving Equipment, by P.L. Painter,' in Point to Point Telecommunications [Marconi], April 1968, p. 82.

This periodical is the Marconi equivalent, more or less, of Mullard's Technical Communications. Our Assist. Editor has drawn my attention to the above article in which a number of points are raised in reference to sophisticated design of receivers. The equipment described is quite complex, and we have room here only to discuss briefly the front-end design, and it is relevant to Rick's point mentioned above.

The receiver described [mostly with block diagrams] is a high stability unit covering 1.5Mc to 30Mc. ''Frequency steps of 1Mc and 0.1Mc are derived from a high-stability master oscillator, with the 0.1Mc steps covered by a free-running interpolating oscillator. Reception facilities are provided for telegraphy and telephony, in both single and dual-diversity roles, together with automatic frequency control and automatic gain control'' !

The following design considerations are considered important:

1] Highly selective circuits introduced between antenna and first stage, to reduce the effects of cross-modulation and intermodulation, consistent with Noise Figure.

2] Prior to the maximum selectivity point in the receiver, the signal level is kept as low as practicable.

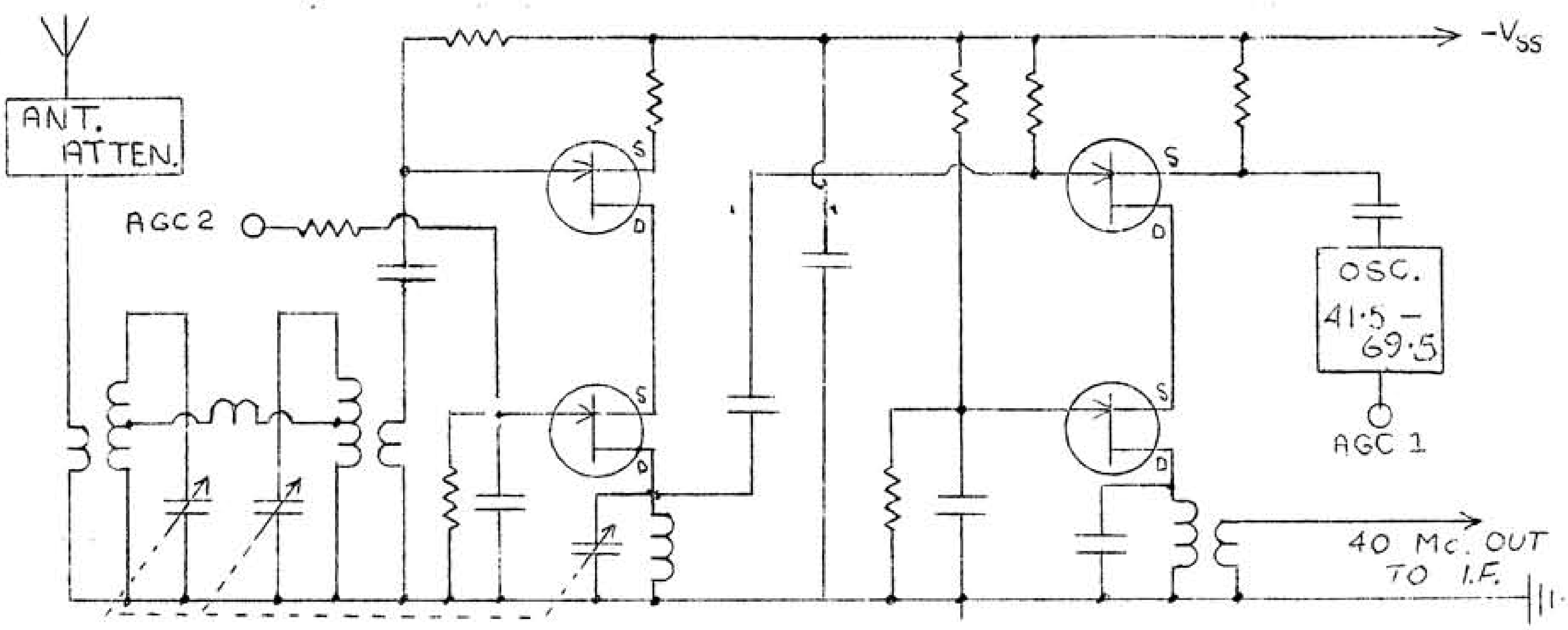
3] The first i.f. must be located outside the band of operation, and preferably should be a known clear frequency [[Recent designs in the periodical literature have solved the clear-frequency problem for i.f. by the use of a sharp front-end filter tuned to the i.f. frequency. --RLG]]

4] The number of frequency-changing processes should be kept to a minimum to reduce the risk of spurious responses [[This is now becoming a standard feature of receiver design, where multiple conversion is no longer necessary, because of the availability of very sharp crystal or mechanical filters at i.f.]]

5] The a.f.c. system should have sufficient 'hold in' range to compensate for the combined frequency drifts of the receiver and received signal.... But the bandwidth and time constant of the a.f.c. system must avoid loss of control from strong adjacent unwanted signals and prolonged fading of the pilot carrier...

6] The a.g.c. system should handle a wide range of input signals. It should be derived from the carrier or sideband signals. Time constant should be capable of adjustment, depending on type of modulation. Pedestal a.g.c.: See Radio Comm., 1/69, p. 26.

Now, there you have a succinct description of a number of principal points of contemporary receiver design. We shall be interested here in their thoughts on the receiver front end. The relevant simplified circuit is shown below:



Mr. Painter points out that the number of tuned circuits which can be inserted before the amplifier is a compromise between sensitivity and selectivity. If the Noise Figure of the amplifier can be made low [e.g. 2db], it is possible to add another 4db or so of noise in the tuned tanks, and obtain adequate front-end selectivity while still achieving satisfactory sensitivity. In the above circuit, the band-pass system produces an attenuation of 30db to 40db when 10% detuned. The combination of tanks and cascoded junction FET's results in NF of 4db to 7db, which is quite satisfactory up to 30Mc.

The FET's form the 'active' circuit. As we have discussed in EEB, FET's offer considerable advantages of linearity and sensitivity over conventional ['bipolar'] transistors. ''depending upon circuit configuration, improvements in cross-modulation performance of up to 20 db have been measured. Coincident with better signal handling, device noise figures of 2 db or less are realizable.'' Can we do as well with valves?

The cascode circuit shown for the front end of the 'Hydrus' receiver gives good isolation between input and output, and as VK5ZFQ points out, it provides the excellent AGC control of the tetrode FET [Via AGC_2].

'' The mixer circuit is biased to about half the 'pinch off' voltage of the FET for optimum conversion gain. The oscillator injection is fed across the resistance load in the source, at a peak-to-peak level equal to the 'pinch off' voltage. Automatic gain control is applied to the mixer by reducing the oscillator injection as the AGC_1 voltage increases. This has the advantage of increasing the maximum signal which may be applied to the gate, as the received signal at the antenna increases.''

The i.f. stage which follows this is fed by 'up-conversion' to 40Mc, which obviously solves all image problems. The Frequency-selection system is [Continued on P. 45]

ANTENNA FEEDLINE DILEMMA -- A FINAL WORD ! -- L.J. Smith, VK6LJ

Rod Reynolds has done well on this subject in his February Article in EEB. He sums things up fairly completely, and I have no profound objects aside from minor points. His explanation is certainly better than that given in the ARRL Handbook.

Since posing the problem of feeding a balanced antenna with coaxial feeder [EEB, Jan. 1969], I have come across the following explanation which may also prove of interest to you. It took much searching and many textbooks ignored or awkwardly skirted the subject. However, the following book did not, and it is very good: 'Services Textbook of Radio,' Vol. 5; 'Transmission and Propagation.' [HMSO].

Causes of Feeder Radiation from Coaxial Cables directly connected to Balanced Antennas

A coaxial antenna feeder carrying power to an antenna can be shown as Fig. 1a.

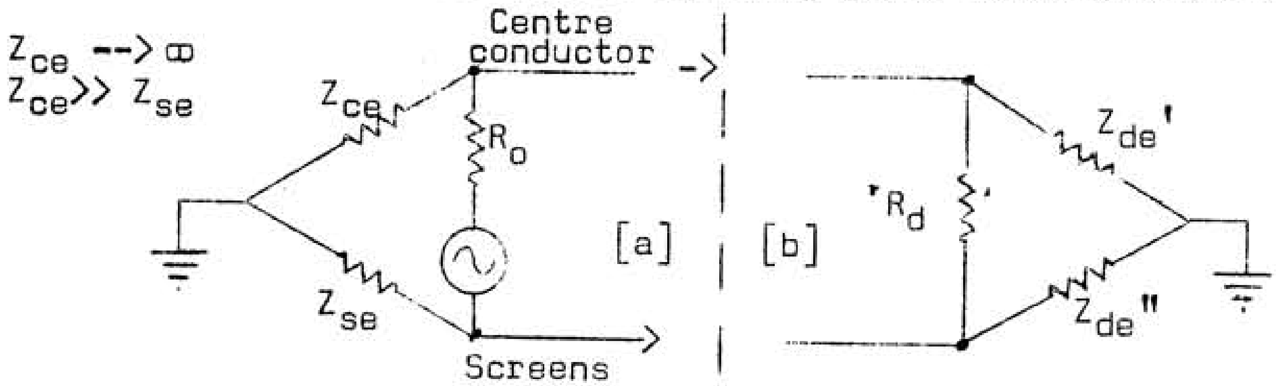


FIG. 1

It has a characteristic impedance R_o. In addition two impedances to earth: Z_{ce}, the impedance of the centre conductor to earth, and Z_{se}, the impedance of the outer screen to earth. In practice Z_{ce} is very high and Z_{se} is moderately low. Exact values would be very difficult to predict but the important thing is that they are certainly very different.

Now this feeder is connected to balanced dipole [fig. 1b]. The dipole has radiation resistance R_d and also two impedances to earth Z_{de}' and Z_{de}''. If the dipole is balanced to earth then $Z_{de}' = Z_{de}''$. Obviously then the generator will drive a current through R_d and also Z_{se} to earth and the Z_{de} impedances. [This is the ''Earth Loop'' mentioned by Mr. Reynolds in his article]. But since Z_{se} and Z_{de}' and Z_{de}'' could in practice be fairly high in value [greater than 300 ohms does not seem unreasonable], current flow on the outside of the coaxial feeder line would represent only a small part of the available power.

Incidentally in the ''Receive'' condition, noise voltages can be induced across Z_{se} and thence to the input of the cable.

The Balun

The solution in both cases is to insert a device in series with Z_{se} to raise its value nearly to that of Z_{ce} thus restoring symmetry and reducing the current through the earth loop. The ''Services Textbook'' goes on to describe various types of linear balun most of which seem to be of the short circuited quarter wave line type which can appear as a very high impedance in series with Z_{se} for a particular frequency. The impedance of a wideband toroidal balun may well be much lower.

That is the textbook explanation. But, in my view, there is one other factor which contributes to feeder radiation which is not mentioned in the above reference and that is proximity coupling between the antenna and its feeder.

Proximity Coupling

In Fig. 2 the feeder R_o is connected to the dipole Rd. However, impedances must exist between each half of the dipole and the opposite sides of the feeder. Coupling

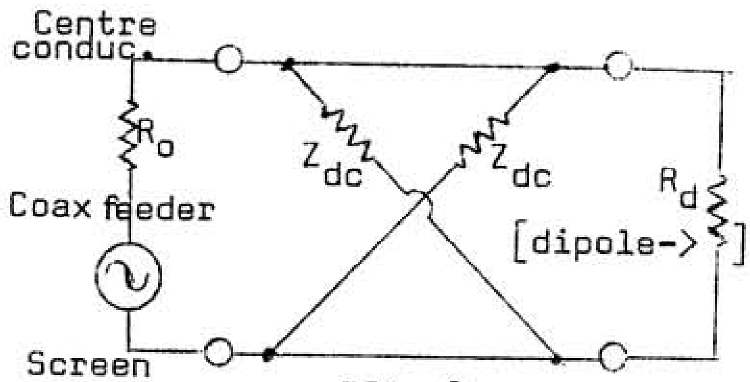


FIG. 2

between the centre conductor and opposite side of the dipole is likely to be small and therefore Z_{dc} will be high. However, Z_{ds} between the screening and the dipole, is likely to be low in systems where the coaxial feeder goes close to the antenna, whether a toroidal balun is used or not. Therefore, the generator will drive a current through R_d and Z_{ds}, which are in parallel. The only way to raise Z_{ds} is to remove the coaxial feeder as far as possible from the dipole. The quarter wave linear balun does this effectively. It is interesting to speculate how much power is likely to be dissipated in Z_{ds} if the antenna is a folded dipole fed with coaxial feeder through a 4 to 1 toroidal balun transformer ! Does the radiation resistance R_d rise in greater proportion than the increase in Z_{ds}?

Practical Points

So much for heady theory. What does all this lot matter in practice? - which is the question I asked originally. It is obvious that if the dipole is fed with Coaxial cable directly, that feeder radiation will occur and that this can be reduced by running the feeder at right angles to the antenna and increasing the impedance of the screen to earth. The best way is to use a linear balun it would seem. However, it is the author's personal experience that feeding with balanced line or coaxial cable doesn't make an ounce of difference in practice ! Its really all in the mind. Electromagnetic radiation at low frequencies is an almost uncontrollable phenomenon anyway so that feeder radiation does not seem to matter. Look at the number of operators who feed triband quads direct with coax. No-one can deny that they seem to work effectively.

For the record it is interesting to note that even matched balanced feeder lines still radiate some power. It is equivalent to an antenna of length equal to the feeder spacing but carrying twice the current. If there are standing waves on the line then the loss is that much greater.

A Note from the Asst. Ed.:

It is not 'all in the mind,' but I must admit that there is not always a practical difference found between the use of a balun, and its absence. Indeed, the sloppy back/front pattern of an array can sometimes be improved by a bit of asymmetry, but it is important here to realise that the absence of a balun can affect the pattern; that it can also be affected by numerous other factors is true, but additional.

A Note from the Ed:

I am very pleased with this exchange of views, but would like to point out that the Argument from Effectiveness has its dangers. When I was working a station 400 miles away, on 80M mobile, I drove into the garage, and the whip shorted out nicely to the earthed metal garage door. In reply to my query, the other chap said that my signal strength had gone down a bit. To my mind this does not prove that garage doors radiate power effectively, but that a remarkable amount of communication can be effected with minute amounts of r.f. So much the worse for the advocates of High Power and their prestige-building commercial stations...and antennas.

I do hope that these elevated articles are not driving EEB readership away.....

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QUOTE WITHOUT COMMENT [73, December 1968, p. 3]

"Ham radio is merely a sideline with most of our manufacturers, or they couldn't afford to stay in business... Just hope they stay with it, or you may have to drag out the soldering iron and go back to the easy building of AM equipment."

WHAT TO DO ABOUT THE PMG ['s Department] -- RLG

I should mention to overseas readers, the PMG's Department handles all the mail here, and a lot more too. I should say that it is the least satisfactory postal service in the world, but for the fact that recent developments in the U.K. and U.S.A. indicate that we are up, or perhaps I should say down, to world standards. It is probably a natural consequence of mechanisation, overpopulation, and decadence of technological society, but that is not a matter upon which I can comment at length in an electronics magazine. Here, I should like to make a few positive suggestions on squeezing the most reliability from the postal and other services. These ideas are the result of considerable experience, and I hope you find them useful; they probably apply abroad, too.

A. ADDRESSING

1. Take extra care to write addresses legibly; we see plenty of scrawled QTH's here, and if THRUSH CRESC. comes out TRASH CREEK, its not our fault, not the PMG's.
2. Always provide a return address on your envelope ! Our favourite tale is the time we received a Postal Order for $1.50, with a scrawled note asking for subscription. And that is all. Somewhere someone has gone away mad, because of forgetting, at least, to put a return address on his envelope.
3. Add the postcode to all addresses, even though you have to look it up. A recent advertisement in The Australian by Sydney Mail Exchange Supervisors said what we all knew, that that expensive Paper Shredder is inefficient and inaccurate -- but it is still a good idea in theory, and I favour it. The inefficiency in the Department is probably due, as the advertisement [and an article on p. 7 of The Australian for March 10, 1969] inferred, to people.

B. ENSURING RELIABILITY for letters

If you want a letter to go rapidly and reliably to destination,

1. Put it in a small rather than large envelope, if practical, but large is better if there are a lot of contents.
2. If it is bulgy, strengthen it with celotape in two directions.
3. Fragile items are best boxed, but if put in envelope, strengthen it, mark prominently HAND STAMP ONLY and FRAGILE and hope for the best.
4. At the P.O. fill out a 'CERTIFIED' sticker, and pay the man an extra 10c for the reliability which ought to be supplied for the first 5c.
5. If the letter contains anything with monetary value, REGISTER it, for 25c.
6. If you are really serious about the letter getting to its destination in a reasonable time, double the postage, and mark prominently: SPECIAL DESPATCH, AIR. Notice how in the PMG's Dept, as elsewhere, money talks, and the more the louder?
7. Post 'early in the day'. I fail to see how this can cut days off of the delay, but there you are.
8. If you work for the Geelong Chamber of Commerce, it might help to post your letters through them. In the abovementioned newspaper article was mentioned the fact that that august body had no difficulty with delivery of its letters.

If you follow the above instructions as appropriate, your mail should go through much more smoothly, and if it merely costs a lot more, well what doesn't nowadays? After all, ''The men who run the Post Office have been in it for years. They are well trained and know what they are doing. ''[The Australian, ibid.] Gosh that's comforting. I was beginning to worry.

C. ENSURING RELIABILITY for packets

This is rather more difficult, perhaps, than for letters, because there may be a wee bit more chance that your packet will be lost or delayed, than letters.

1. Follow scrupulously all suggestions under ADDRESSING, above.

2. CERTIFICATION [see Item B.4] is absolutely essential if you insist that the package arrive at all; it may also improve speed, but this is uncertain.

3. REGISTRATION is probably not necessary unless you are really concerned about monetary value, but unfortunately no Certification is available for overseas parcels, so they must be Registered to ensure that they arrive at all. This is important for overseas parcels [and parcels sent to you from overseas], because of the worsening quality of postal services abroad, too. We have had several unpleasant experiences which justify this caution.

4. If your parcel has any appreciable size or weight, particularly weight, it can be well worth taking it to F.H. Stephens, I.P.E.C., or equivalent reliable shipping/forwarding company. Delivery will certainly not be slower than by post, and in many instances it can be appreciably cheaper -- as well as being more reliable. You should always check on their rates before posting a heavy parcel; you may be pleasantly surprised. If the rates come out about the same, the shipping company is preferable to the Post. Anything is preferable to the Post. That includes, by the way, services within a city; you are likely to get faster and more reliable delivery if you use one of the city Delivery Services, than if you use the Post. It may even be cheaper. If you can be partners in a horse, cheaper still.

5. If you want your parcel to go in a hurry, you have a real problem. It may help to pay the extra 3c/oz for air mail, if the parcel is not too large, but this is not certain. The best method for packets of any appreciable size or weight is to send them by TAA or IPEC Air Cargo. Although the minimum-charge may make small packets expensive, the extra cost may be justified if delivery is urgent.

As an example, of many, we recently had been exchanging air mail correspondence with a party in Gosford, N.S.W. Ordinary well-addressed letters took 7 to 10 days each way. A heavy packet taken to TAA in the evening arrived in Gosford the next day. Air Cargo is also the best way to send fragile pieces of equipment; to entrust them to the mails is to court disaster.

D. REDUCING COST

This is the most difficult point of all, because there are few ways of reducing the exorbitant cost of postal services. Since the Money Changeover when the Government set us all a good example by raising postal prices appreciably, their prices have been increasing, and certainly they will continue to increase. It would appear that the postal services can be used well by those most able to pay for them; that's a good sound capitalistic practice. My, just think what we could charge you for EEB if you found it essential for your living, and we were allowed to charge anything we pleased.

In any event, we are stuck with it, and here are a few tips:

1. Purchase a cheap but reasonably accurate postal balance; best accuracy for money is obtained from the kind with two pans and a set of weights. This investment will pay for itself through the years, many times over.

2. Weigh all questionable letters, and if possible adjust them to fall within the weight for a given charge. Same for Packets. [Use larger weighing scale for parcels].

3. Notice that there exist brackets of charges. It costs you 21c to send a first class item weighing 5,6,7, or up to 8 oz, but 25c above 8oz and less than 12oz.

If you can adjust weight to fall within brackets, you can save. This applies to Letter Rate and to Other Articles rate under 1 lb.

4. Parcels over 1 lb. are something of a problem. There is no special rate anymore, for books or printed matter sent by parcel post in Australia, so you can find yourself paying incredible amounts [compared to previous] of postage. Here is one hint: Try to adjust your parcels so that they do not exceed 16 oz. A 25oz parcel sent to a 'Far Distant State' costs $$0.70 [plus 10c for that necessary Certification]. If you can break it up into a 15 oz plus 10 oz pair, it will cost only $0.38, $0.58 if Certified.

5. On the other hand if you send that 25 oz packet to England or Canada or U.S.A. or New Zealand, you can leave it intact, and it will cost you only $0.53 for the parcel rate.

If the packet is 18 oz, it costs $0.70 in Australia, $0.37 to any other place in the world....

If I send that 18 oz parcel to Melbourne by air, it costs $1.14; to Dunedin, N.Z., rather farther, it costs $1.08.

>*>*>*>*>*>*>*>*>*>*>*>*>*>*>

[Rx Front End Design -- Continued from P. 40]

not unlike that of the 'Deltahet.' ''The method of frequency synthesis is based upon the well-known drift-cancelling loop, which has the advantage that the loop may be integrated into the intermediate-frequency amplifier. The overall frequency-setting accuracy of the system is well within $\pm$ 200cps over the entire frequency range.''

We must now leave this amazing dual-diversity receiver, with its f.s.k. facilities, and the ability to receive each sideband independently. The latter facility allows two entirely independent programmes to be transmitted on one [non-existent] carrier, whilst using a carrier pilot or sideband pilot to control the AGC of each channel independently !

Postscript: Further design considerations from the October 1968 issue of the same magazine are discussed by G3VA in the January 1969 Radio Communications, and that three-transistor mixer on p. 38 here came from it. The r.f. amplifiers used minimum possible gain consistent with good S/N ratio, following the principles we have discussed in the EEB Receivers Series during the past year. G3VA also has another note on converting ordinary valve mixer stages to 7360 Beam Deflection types, much superior for cross modulation. I wonder how the 7360 compares with the 3N140?

See April 1969 issue of Ham Radio for good oil on Noise.

LETTERS

More on the Coax Feeder Dilemma

Reading your Frapnuary EEB I noticed the item by L. J. Smith, VK6LJ, on the Coax Line Feeder Dilemma. Perhaps the enclosed copy of a CQ article of a few years back will be of some value to him and/or other EEB readers.

EEB is looking more professional all the time. Watch out about that!

-- Dick Ross, K2MGA, Port Washington, L.I., N.Y., U.S.A.

[[EEB Ed. Note: The article is 'The Coaxial Line Balun' by C. Gilbert, K6GAX, CQ, Jan 1964, p. 49. The author presents the usual summary of theory and advantages of a balun, to reduce radiation losses caused by unbalanced line currents. He does bring up the useful point that the balun has an additional advantage of stabilising antenna impedance. If the r.f. is slightly lower in frequency than the resonant freq of the antenna, the capacitative reactance of the antenna is cancelled by a corresponding inductive reactance arising from the balun -- because after all, the balun is a tuned quarter wave line. If the applied frequency is too high, the converse happens; matching is improved simply by the presence of the balun. Very interesting. Thanks, Dick.]]

Hypodermics used for Prods

Discarded needles for hypodermic syringes make excellent prods for VOM's, etc. The thin prod can also reach short leads on a printed circuit board. It may be necessary to bend the tip, and sometimes to enclose part of the needle in a fine piece of PVC sleeving from hook-up wire, to prevent accidental contact... Another use for these needles [No. 18 is a good size] is to clear the holes of printed circuit boards after a component has been removed; the needle is pushed through the hole after applying heat to the solder. The needle is stainless steel, and solder will not adhere to it.

-- Fr. A. Turner, C.P., Vanimo, New Guinea.

[[NOTE: The hypodermic syringe is fearfully dangerous: grind the end flat first! -- Ed]]

Superbly Suppressed Bandwidth

Since no one else defends the Faith, it is up to me. Here are twelve good reasons for SSB:

1> Economy of Bandwidth in radio spectrum. 2> Reduction of QRM caused by unsightly carriers. 3> Lower receiver noise [because reduced bandwidth]. 4> Higher transmitter efficiency [trapezoidal modulation -- fooey]. 5> From the commercial point of view, ease of multichanneling telephone calls; from some places we use four channels on one transmission. 6> We use SSB on our cables, to conserve spectrum. 7> The PMG is having a sideband and carrier harvest; I imagine they've got at least 12 good reasons. 8-11> Quite obvious to anyone who takes a moment to think about it. 12> The Yanks won't work anyone with a 'coathanger' on.

-- J. Lilley, Bringelly, N.S.W.

[[See bottom, p. 37, this issue. John continues with several more entertaining pages describing interesting plans for transmitters and receivers, promised articles for us, opinions about various Handbooks and the state of the art, etc. We get a number of such letters, and I wish we could print it all, but not all of it hangs together well enough to make a proper technical Letter or article. But technical matters notwithstanding, I have made a number of excellent friends through this activity, and have had some marvelous technical and non-technical correspondences -- time permitting. --Ed]]

Good News? [[We have been receiving a number of letters expressing this opinion:]]

Congrats on your Jan and Feb issues. I was able to understand them! The articles on coax feeders and transistorised transmitters were fine. More Please!

D. Gilder, Box Hill South, Vic.

[[Y'know, sometimes I wonder. We'll publish an article telling about the causes and cures of transient overvoltages, or the general functioning of the highly practical Regenerative Switch configuration of transistors, or a series of notes showing that it is futile to increase r.f. gain if that only makes the noise louder -- and people will complain [obliquely] in letters that this is terribly heady stuff, and that they will rather stick with the conventional stuff they can understand. I suppose that that means good solid transmitters and power supplies, BUT we have a lot of that kind of material too every year; just look at any of our annual Table of Contents.

[[And then along comes something like this Coax Feeder Dilemma, which can hardly be classed as Light Reading, and yet we have got enthusiastic comments from Engineers and from various amateurs and Amateurs. It appears that the blend of Rodney's Brains and my typewriter go well together, but then why not as impressively in the Receivers Series -- which was highly practical, but did anyone read it?.. VK6LJ has tapped a deep well here.

[[Well, let the present issue be a typical example of our coverage. There is esoteric material [Coax Feeder], practical stuff [Sweep Generators], useful techniques [Cascoded FET's], comments on literature [Receivers, FET's], review of the important RSGB Handbook [giving more than the usual review platitudes], Letters, light humour [Editorial, Quotes], heavy humour [PMG], and Advertising. Owing to my comments, it is too fat this month, but who can accuse us of being onesided??? -- RLG]]

ADVERTISING

Please say you saw it in the EEB !

->PERSONAL ADVERTS FREE IF MODEST SIZE. COMMERCIALS 10c/ line, $1.50 half page, $2.00 full-page; can be spread over several issues. CAVEAT EMPTOR ['All that glitters is not sold']

->FET, PRINCIPLES, EXPERIMENTS, AND PROJECTS, by E.M. Noll, a fine book. FETs have all advantages of valves and transistors; they are readily available in Australia [EEB ads]. This useful book tells all about them, including even designs for QRP FET Transmitters ! $4.95 postpaid [see also FET Packet] from A.E., 32 Waterworks Road, Dynnyrne, Tas. 7005.

->ES+I ELECTRONICS have a Catalogue available, with the following items, nearly all of which are in stock:-

TO-1 transistor cooling clips: 8c each, minimum quantity of 5.
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TO-18 Radiator and TO5 heatsink adapter are a few cents dearer.
Silicon grease; 10 grams lasts a long, long time. 10g for 90c, Special Silicon Grease.
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2N3055 transistors; 1 off: $2.20; 2-4: $2.00; 5-9: $1.85; 10-50: $1.80.
Extra good value, absolutely unbeatable anywhere.
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Any order for these must go with a $2.00 min order for other items.
Power Supply Articles: Details in the Catalogue. No. 1: 6-9V, 500mA power supply [4 pages] - $0.50. No. 2: 2-40V, 1A supply [4 pages] - $1.00. No. 3: 0-62V, 3A supply [11 pages] - $1.50. These are all typed on foolscap, packed with information.
For further details on all of these items -- and for data sheets on the 2N3055 Power Transistor and the 1W zeners, please send for our big catalogue !

E S + I ELECTRONICS, 81 Prospect Rd, Summer Hill, N.S.W., 2130

->MORE KIT-SETS AUST. SPECIALS THIS MONTH:- PART PAK SPECIALS FOR YOUR PARTS BOXES.
5% tolerance resistors. Comprises 3 resistors of each value between 10Ω and 1 Meg.
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-> FOR SALE: Two Kriesler Magnavox Woofer Loudspeakers, 15" dia, 25W RMS ea. Cone resonance 35cps in free air. $70 the pair. P.G. Thompson, 15 Proctors Rd, Dynnyrne, Tas. 7005

-> WANTED: Older edition of ARRL Handbook, cheap. G.H. Thompson, same address [or Radio Hbk?]

THE AUSTRALIAN EEB

AN INFORMAL ELECTRONICS
EXPERIMENTERS BULLETIN

Editorial Office:
P.O. Box 177
Sandy Bay, 7005
Tasmania,
Australia.

20c per copy

Australia and N.Z. :

1 yr.	2 yrs.	3 yrs.
$1.00	1.75	2.25

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JUNE 1969 VOL. 5, No. 4 P. 49

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CONTENT:

NEXT ISSUE: July for sure. More about Mixer Performance, and a Picture Story about Unstable Resistors. This is an Extra issue, because we are being swamped by articles, hooray!

Wontcha please tell your friends about EEB?

THE ELECTRONIC ORGAN, Part I --- R. E. Dunk, [VK2]

Perhaps the most popular and versatile instrument to-day is the electronic organ, successor of the classical pipe organ. The variety of sounds and instruments imitated by it is only limited by the ingenuity of the designer and the selling price. All sizes are produced, from the small single keyboard unit to the 3 manual [keyboard] Theatre Organs, however, most organs have certain basic principles in common.

The organ must produce 48 to 84 audio frequency tones of similar waveform which can be switched on, by a set of keying contacts, to mixing and filtering networks, followed by a number of stages of amplification driving powerful hi-fi speakers.

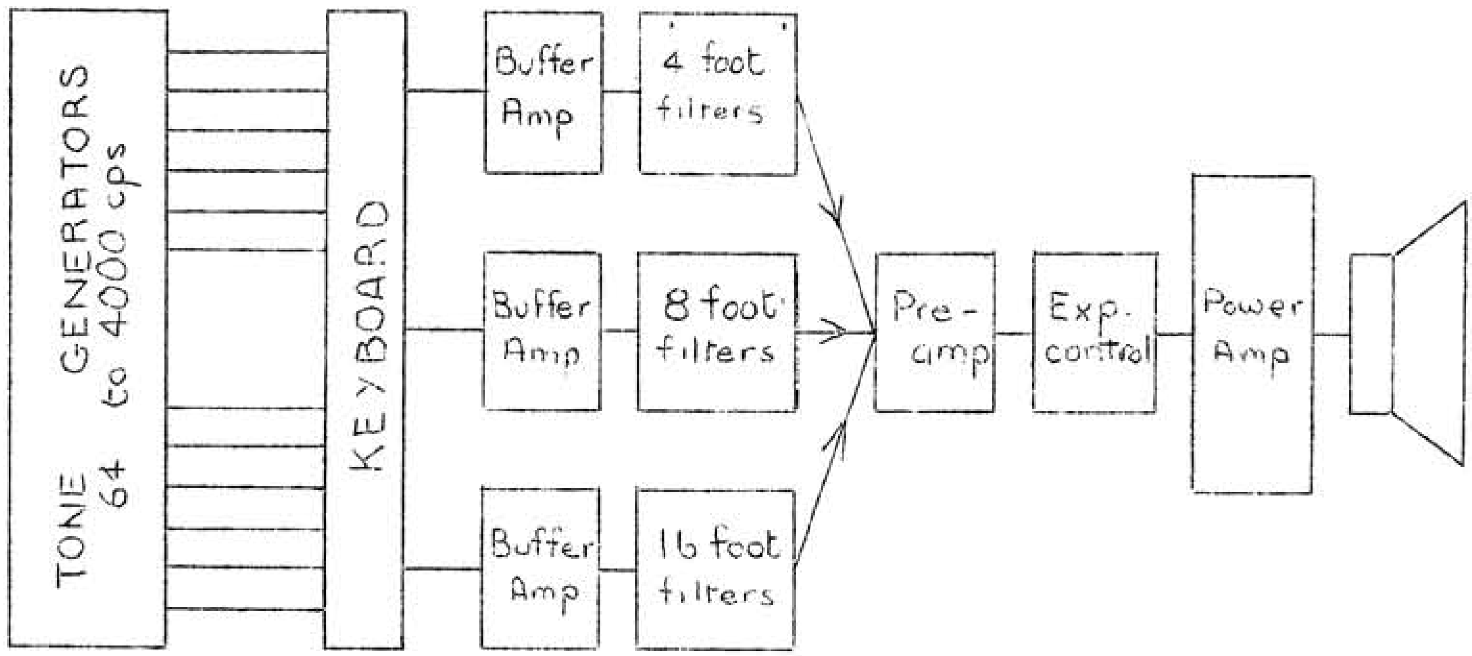


FIGURE I

Figure 1 shows the block diagram of a basic electronic organ. The tone generators in most organs follow one of two designs, either twelve tunable master oscillators, usually of L. C. Hartley type, for the top twelve notes, each followed by a string of bi-stable multivibrators each triggered by the one above and oscillating at half the frequency or, an individually tuned L-C oscillator for each tone.

Thomas, Lowrey, Schober and some other Electronic organs, use the master oscillator and divider system which is more economic to produce, makes the organ console lighter and is quicker to tune, however individual tuning and voicing as found in the classical pipe organ is impossible with this system and sounds that can be obtained from divider type organs appear quite acceptable to a good proportion of people but to others, quite hard and unreal. This stems from the fact that mathematically exact ratios within octave relationships [2:1] are not as pleasing to the human ear as slightly varying ratios which allow phase shift between tones of successive octaves. The "Gulbransen" organ is one which makes use of individual L. C. tone generators.

The keyboard contacts in different organs vary considerably, but usually short circuit the signals via isolating resistors or back biased diodes, until the key is pressed to sound the note. Three or sometimes more tones are controlled by each key, one for each footage group of stops, e.g. middle C key would operate tones C2, C3 and C4 on 16', 8' and 4' stop groups respectively.

The greatest scope for original design lies in the section following the keying contacts, i.e., the mixing and filtering networks to modify the tone generator output waveform and thus obtain the desired sound quality. All organ manufacturers use different circuits and principles here and all that can be said is that mixing is achieved via isolating diodes or resistors and filtering circuits consist of R-C and R-L-C networks in varying degrees of complexity.

The expression control generally takes the form of a foot pedal operating a potentiometer or a shutter past a light dependent resistor to virtually control output amplitude, either by loading down the signal to earth, or by the conventional volume control circuit.

Power amplifiers and speakers are usually chosen to suit the application, 15 watts for home use and 200 watts or more for theatre and church use.

Various sound effects can be incorporated in electronic organs, such as vibrato which frequency modulates the master oscillators at 5 to 10 C.P.S., tremolo which amplitude modulates the signal at 5 to 10 C.P.S. just before the power amplifier and the "Thomas" organ "Band Box", which simulates very realistically such percussive instruments as cymbals, bass and snare drums, bongos and castanet.

Just like cars, there are many makes and models of electronic organs and the various enthusiasts debate their advantages and disadvantages, and will probably do so for ever more.-- See interesting book: 'ABCs of Electronic Organis' by N.H. Crowhurst [Sams, U.S.A.]

* *

QUOTES WITHOUT COMMENT

... To me, our hobby provides the opportunity to serve, to build, to be prepared for emergencies, but most of all, to ragchew in a relaxed, friendly manner. Just between us, I don't give a damn if another ham is running a Swan, a Goose, or a Duck. It matters less whether his skywire is a Zepp or a Schlepp. If he is alive, alert and aware, he's the Joe I want to come by, and I resent some unprincipled idiot who suffers from controversy-phobia trying to keep us quiet! ...

-- J. C. Jacobson, WA3CQO [QST, Feb. 1969, p. 69, 'Correspondence']

... On several occasions when I was expressing my opposition to the Vietnam War in a QSO, someone has broken in on the frequency, chewed me out for my views, and refused to identify himself. I usually respond by inviting the breaker to join our discussion, but it doesn't work -- these guys won't give their calls.
... I think hams should use our means of communication for furthering understanding; and at the very least, everyone should let his fellow hams talk about whatever interests them.

-- F. H. Letton, K4RAD/6 [QST, Feb. 1969, 'Correspondence']

... But if we want to discuss the rights and wrongs of happenings at the United Nations, why Christianity is better [or worse] than Buddhism, or some clinical details, let us do so in his [or our] living room. Or in a bar. Not on the air ... But absolute freedon of speech can be as bad or worse than no freedom at all, and failure to question a radical application of its principles can lead to complete chaos and disintegration ... Freedom of speech does not include the right to offend a substantial segment of the population, domestic or world ... For example, there is no real measure of agreement today on what constitutes obscenity. The best thing to do is steer completely clear of sticky subjects ... The guy who insists on his right to absolute freedom of speech ... risks your status, and mine, by raising the basic question of whether amateur radio is really in the public interest.
And so we say hooray for all "unprincipled idiots" who, by reminding us of the unwritten law, help keep us away from heated discussion on politics, sex, and religion.

-- Unsigned Editorial, QST, Feb. 1969, p. 9

... Freedom is so basic and so natural to mankind that it cannot .. and must not .. be compromised, for to split the difference of an absolute human value is to forfeit humanity's opportunity to achieve self-improvement. [Cont'd. page 52]

... Freedom's challenge must, above all, be met at the individual level. A collective, concerned effort is impossible without personal cooperation. Free men enjoy many privileges .. but how many turn their backs on the consequent responsibilities?..
-- P. M. Elliott, WA3KTD, quoted in <u>Auto-Call</u>, Mar. 1969, p. 14

... I realize that a good many amateurs have a basic feeling that everything in ham radio should be entirely home made and that manufacturers are an unnecessary evil. Without our manufacturers I fear that much of ham radio would still be hung up in the Tri-Tet Crystal Oscillator days and running 200 watts to a 6L6.
-- W. Green, W2NSD/1, Publisher, <u>73</u>, Feb. 1969, p. 79.

... In the clothes we wear, the food we eat, the books we read, and the ideas we hold, there is a strong tendency toward conformity, toward sterotypy. To be original, or different, is felt to be 'dangerous'.

Why be concerned over this? If, as a people, we enjoy conformity rather than creativity, shall we not be permitted this choice? ... With scientific discovery and invention proceeding .. at the rate of geometric progression, a generally passive and culture-bound people cannot cope with the multiplying issues and problems ... Unless man can make new and original adaptations to his environment as rapidly as his science can change the environment, our culture will perish. Not only individual maladjustment and group tensions, but international annihilation will be the price we pay for a lack of creativity.
-- C. R. Rogers, in 'On Becoming a Person' [Houghton, Mifflin], p. 348

[[See also in next EEB: "Are Radio Amateurs Human?"]]

ARRL's reply in April wasn't very convincing

* *

THE SUPER WORMTURNER -- by D. Brown [VK2]

ΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩ

<u>EEB NOTE</u>: The Staff of the <u>EEB</u> assume no responsibility for the use of any equipment built from designs appearing in its pages, i.e., 'we guarantee nothing'. But please don't electrocute yourself anyhow!

ΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩΩ

The Super Wormturner is a sophisticated electronic device for applying electroneural stimulation to members of the phylum nematoda, although it can be used successfully with members of other phyla. See Fig. 1.

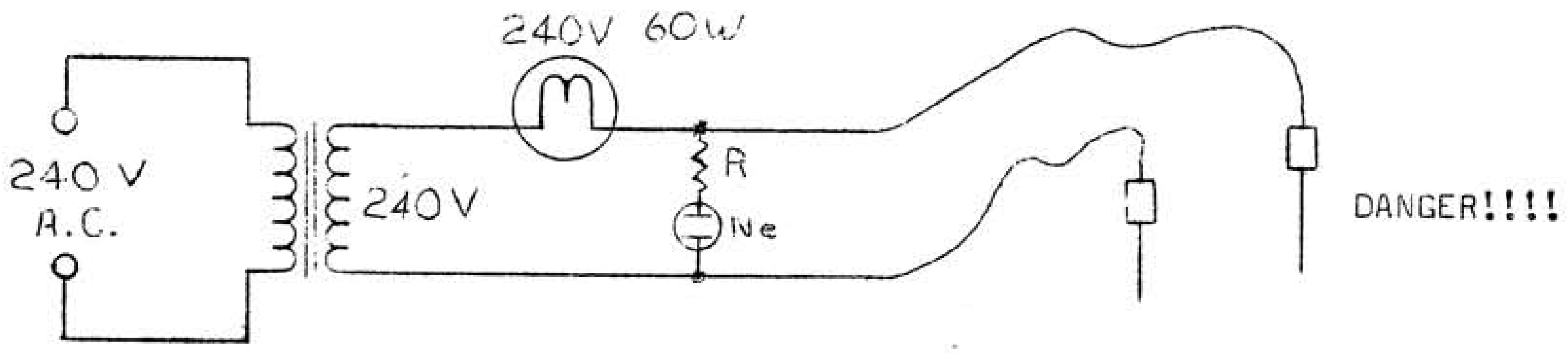


FIG. 1

The resistor R is adjusted so that the neon emits the required amount of light [typically about 500K]. The light bulb serves as a sort of EBC [Electronic Blunder Corrector], if the fool operator shorts the output, transformer or fuses shall not blow. Please ensure that you are not the cause of the short.

The probes must be well insulated unless you, and all the family, and your cat, are immune to electric shock. I constructed mine from bamboo and fencing wire [Fig. 2].

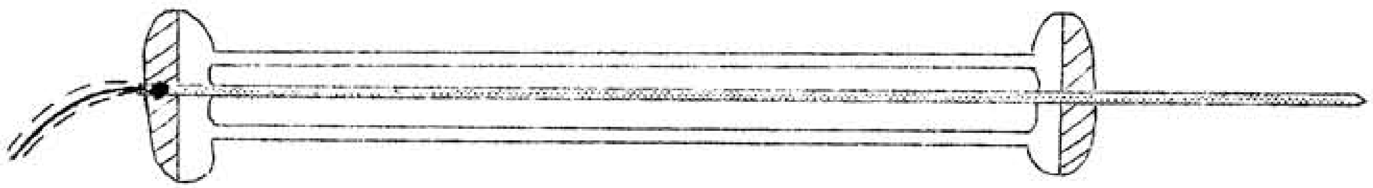


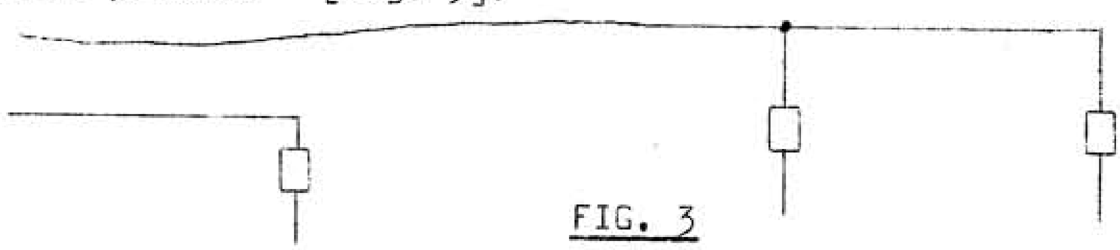
FIG. 2

The fencing wire is secured in the bamboo by means of epoxy resin, which also insulates the joint between the fencing wire and the power lead.

More sophisticated technicians may shudder at the thought of bamboo; plastic pipe would be more for them. It is important that these probes be well designed; a plastic cap, say from a felt marking pen or a detergent bottle, could serve as further protection for the soldered joints and reduce the amount of resin required. There is a considerable force exerted on the bamboo/wire joint during location of the probes; it is important that this joint be strong.

The length of live element on the probe will depend on how loose the soil is. The factors are - how strong the wire is, and how far the worms can wriggle. It is useless to stimulate worms four feet down if they can never reach the surface; besides, there may not be worms down that far. Thin wire will bend in hard ground; actually the wire should be as thick as is available.

The procedure is: choose a suitably wormy patch of soil. Take the probes, position them a suitable distance apart [it depends on how conductive the soil is : 2-10 ft. is usual]. Make sure the probes are buried up to the beginning of the handle to avoid risk of shock to anyone. Only now will the device be plugged in and switched on; if the lamp does not light, check the wires. If all systems go, sit back and wait for the worms. For a greater activated area, try two active probes. [Fig. 3].



DOUBLE DANGER!

FIG. 3

The system of Fig. 1 may be used as is, with effect, or one of the probes may be connected to the earth connection of the mains plug. The latter is more effective, but more hazardous to the operator - be warned. But I use the earthed system.

In that event, there basically three currents flowing as shown in Fig. 4.

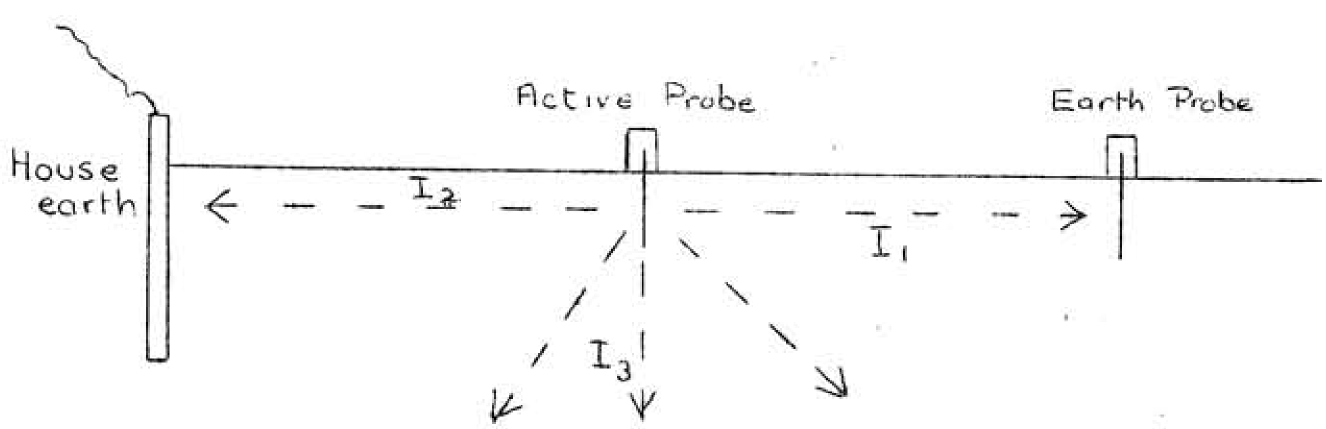


FIG. 4

So no matter which way a worm is aligned, there will be some current which, when resolved as per worm, has a component along the main nerve, and thus a voltage drop will always appear across the worm. Apparently the resulting convulsions drive it to the surface. This principle has been applied to such things as crabs and fish as well as worms. The Super Wormturner is truly a versatile instrument; only common sense is needed to make it a safe versatile instrument.

NOTE by EEB Editor: We recommend the transformer on general principles, but it won't prevent trouble; only care will do that. We also recommend that no power switch be installed: the unit should never be plugged in to the mains when not in active use. If the soil has been watered for a while before [!] applying power, it will be found that the yield of worms will be higher. David is correct in surmising that there may not be many worms four feet down, but I have had to dig for 1-2 ft. sometimes to find them. On the other hand, worms may always be found quite close to the surface on those occasions when you are spading the garden and have no intention of collecting worms.

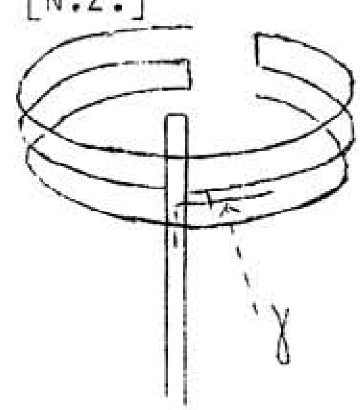
As you know, worms are useful as bait for fish, although for some reason the fish near Hobart at least, seem to prefer the meat of other fish. If you catch no fish, you can always eat the worms; I understand that they are delicious fried in butter.

* *

IMPROVED HALO ANTENNA FOR 2M -- By H.M. Allmand [ZL2TGZ]

[Reprinted from '3 Stacked 1-1/2 wavelength Halo' Spectrum, April 1969] [N.Z.]

The antenna is constructed as shown here at the right. No. 8 wire is used, 114 inches long, earthed in centre of the top and bottom loops. The mast itself is insulated. Spacing between loops: 3 inches. Gamma bar: 6 inches long, spaced 1 inch from centre loop.



This Halo is a considerable improvement over one using a single loop. Try it on your mobile!

Ed. Note: See also very interesting related item in "The Corkscrew-- a new type of polarized ant." by J.J. Schultz W2EEY/1, CQ April 1969, p. 56.

* *

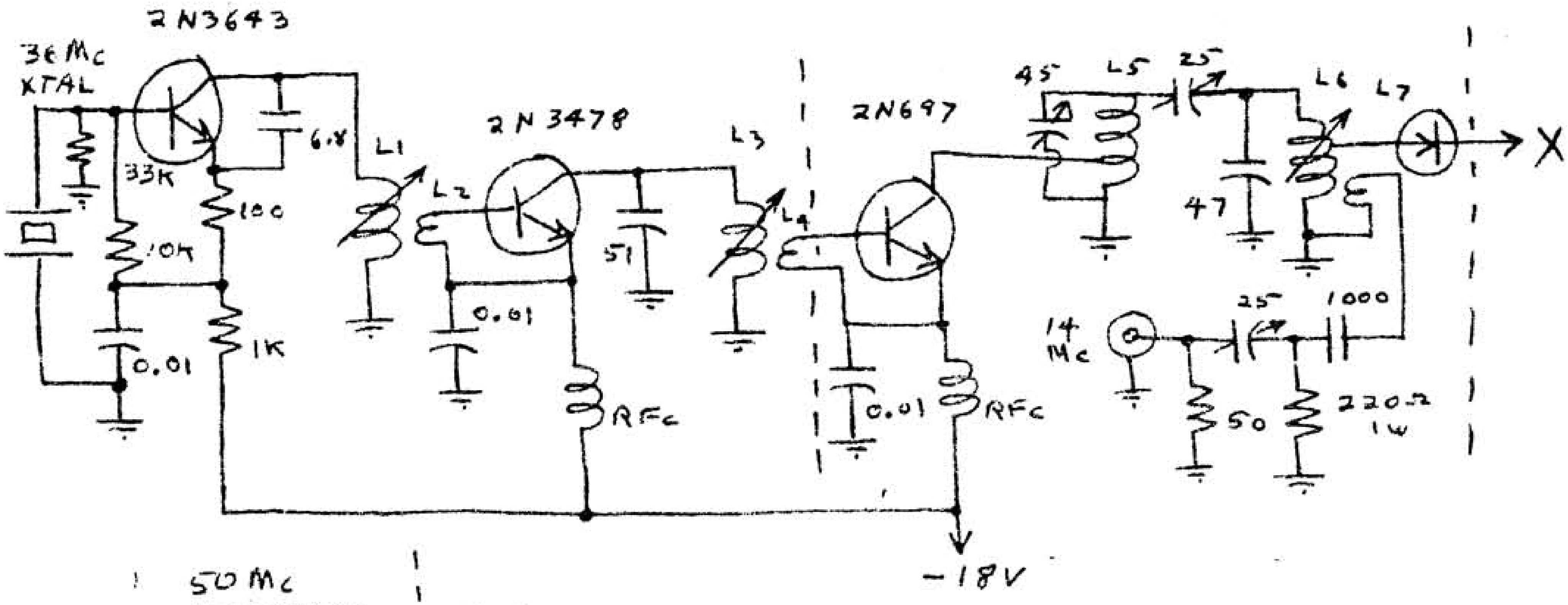
CORRECTIONS TO THE APRIL 1969 EEB:

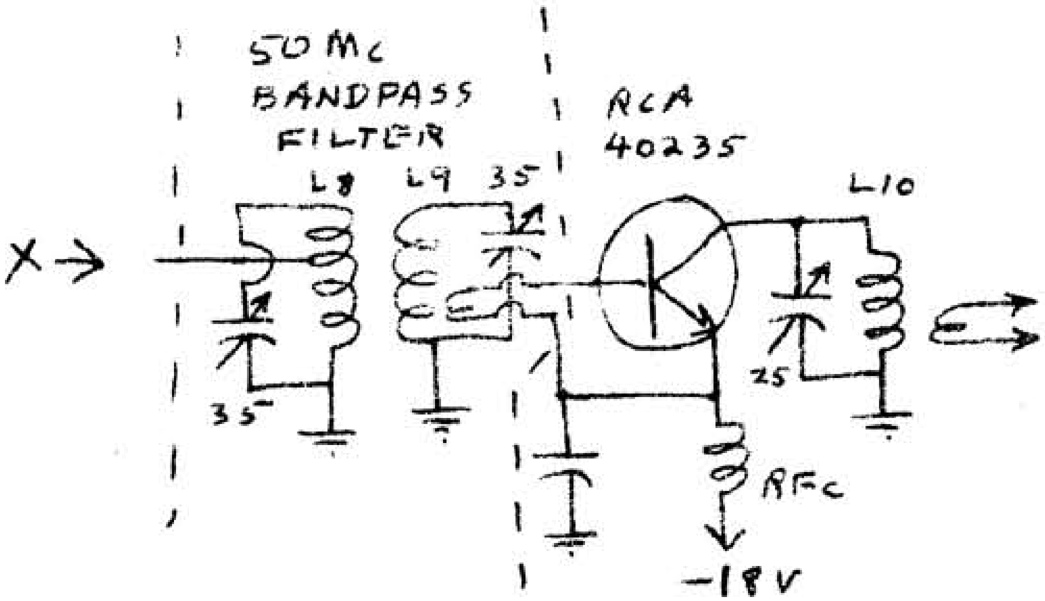
P. 36: In the diagram, the top of the coil next to C6 goes up to the top of C6, of course. P. 37: In the diagram, the collector of TR_2 goes to the junction of the 5K and 1K resistors. No, we don't know the value of the resistor in the base of TR_1; try different values [e.g. 10K] to see which gives most deviation with good linearity. P. 40: Diagram. The lead from AGC2 through resistor goes to the Gate of the lower FET, as well as to the paralleled R and C nearby. The values of components were not given in the original article, but can be calculated by simple use of Ohm's Law, analogous circuits, or experimental results. See EEB Grandma's Tests series of a few years ago.

* *

QUOTES WITHOUT.....

"Sad to say, however, in the strict scientific disciplines when objectivity is a requisite, there it is seldom met with; for a scholar equipped with a thorough first-hand acquaintance with his field, is a great rarity." -- Søren Kierkegaard.





L_1 = 7T No. 26, ½"dia, close spaced on slug-tuned former.
L_2 = 2T No. 26 on bottom of L_1
L_3 = 11T No. 26, ½"dia, close spaced on slug-tuned former.
L_4 = 2T on earth end of L_3
L_5 = 5T No. 16, airwound, ½"dia, ½" long, tap at 4T.
L_6 = 5T No. 26, ½"dia, close spaced on slug-tuned former.
L_7 = 2T No. 26 on earth end of L_6
L_8, L_9, L_{10} = 7T No. 16, ½"dia, air wound, ½" long, spaced on 7/8" centres. Diode tap at 4½ T.

A 50 Mc/s TRANSMITTING CONVERTER

-- Jim Fisk, W1DTY

TRANSVERTER ADDENDUM -- RLB

Our publication of a device used solely for SSB shows that we are not against SSB in principle, only in practice [Ref. EEB, Oct. 1968]. Transmitting converters are used to convert an SSB signal generated at one frequency, to an SSB signal at another. Frequency multiplication via Class C RF stages is not practical for SSB, because of their non-linear character. Details about the principles and practice of SSB are available from many books [e.g. Manuals by ARRL and CQ, and Hanbooks by RSGB, E/E, ARRL], and from the periodical literature [e.g. Ham Radio, March 1968, etc.].

Transistor Characteristics

For reference in utilising alternative transistors with suitable characteristics, the transistors mentioned in W1DTY's circuit have the following brief characteristics:

Tr	Pc[25°C case]	BVcbo	BVceo	f_T	V_{sat}	At	Cob [10V]	PG	At
2N3643	700mW [FC]	> 60V	> 30V	> 250Mc	0.35V	500mA	< 8pF	9db	30Mc
2N3478	200 [RCA]	30	15	750			1	12	200
2N697	600 [Motorola]	60		50	1.5	150	35		
40235	180 [RCA]	35		1200			0.5	30	216

As for all derived-mesa transistors, these have BV_{ebo} in the range 3V to 8V, so excess drive voltage must be avoided. As you may see from the wide range of voltage and frequency ratings of the above transistors, characteristics are not likely particularly critical as long as modern high frequency types are used. Obviously the output transistor must have good frequency capabilities, but anything with f_T > 400Mc would undoubtedly suffice for output at 50Mc.

Brief Bibliography

For reference, I might list here a few of the valve and transistor articles on transverters, from the periodical literature. I hasten to add that there are plenty more, but these are ones on which I can lay hands at the present time.

Amateur Radio, Dec. 1968, p. 6: A Transverter for 21 or 28Mc, A. Rechner, VK5EK. [807 mixer, two 6CN6 for 200W PEP final; plus valve converter for transceiver]

Break-In, Sept. 1967, p. 240: 144Mc SSB Transverter, J. Bicknell, ZL2CE. [12BY7A mixer from 14Mc, QQE06140 25W final; valve converter. Tuned line final]

Ham Radio, July 1968, p. 68: High level HF Transverter, by J. Stanley, K4ERO. [5763 converts 14Mc, 6146 final to 75-15M, versatile, P_o<200W. 6BE6 mixer for Rx]

Ham Radio, Sept. 1968, p. 22: Frequency Translation ... F. H. Belt. [Detailed principles, various heterodyne methods. Good]

Ham Radio, Dec. 1968, p.44: Medium Power 6M Transverter, K8DOC and K8EUR. [5763 converts from 14Mc, 4X150A gives 150W. Valve converter]

Ham Radio, April 1969, p. 8: Heterodyne Tx mixers for 6M and 2M. D. Bramer, K2ISP. [Two 5763 mixers/final from 7Mc, fed by toroid, cathode injection. 1W output] [6360 mixer/final from 50Mc; L/C Tank output. Printed ckts layouts for both]

QST, Sept. 1963, p. 28 2M Transverter, by E.P. Manly, W7LHL. [6360 final/mixer from 14Mc. Plus lots of articles subsequently. See also ARRL SSB Handbook]] e.g. 2/69, 3/69

RSGB Bulletin, June 1964: Introducing the VHF Transverter, T. P. Douglas, G3BA [QQV03-10 balanced mixer from 28Mc, medium power. Plus lots of articles → eg. 3/69 subsequently. See also RSGB Radio Communication Handbook; reviewed in EEB-4/69]

Radio Communication, Sept. 1968: Technical Topics, J. P. Hawker, G3VA. [ECH81 mixer from 3.5Mc, EL83 output on 14,21,28Mc; 5W. This subject and all others are covered frequently in Technical Topics every month, and very competently in their anthology: Amateur Radio Techniques; see review, EEB 10/68. The bound and monthly features are utterly fascinating].

73, Nov. 1965, p. 62: 6 Meter Transmitting Converter, J. Owings, KDAHD. [14Mc to 5763, 2E26 gives 10W. Plus more 73 articles, no more room left here]

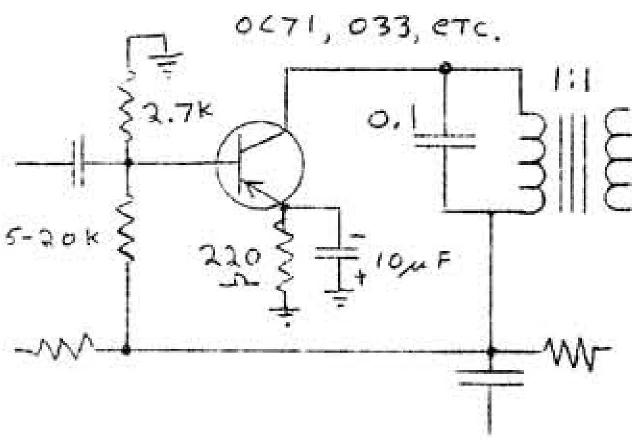
NOTE how rare are transistorised models? We are pleased to present W1DTY's.

".. But mere repugnance does not in itself account for effortless unbelief". -- A. Toynbee ['Civilisation on Trial']

EDITORIAL -- RLG

About the Transistorised Tucker-Tin SSB Exciter

Some questions have been asked about component values in the Modulator stage of that Exciter. If the Modulator works into 1-2KΩ, the Mullard Reference Manual of Tr. Ckts shows that you would expect this Z_o [remember the 1:1 XFR] with I_c = 3-5mA. Thus, using Grandma's Ohm-Law, typical values might be as shown in the figure at the right -->. Most reasonable would be to adjust R_2 for maximum audio with least distortion, for a given Xfr ratio; a different Xfr ratio would require different I_c; smaller I_c for more Z_{pri}, but of course this gives less P_{out} too.



About the Wellington Group Mobile Transmitter [EEB, Feb. 1969]

No specific transistors or valves were specified, but Grandma's Rule triumphs: Use what seems reasonable. Any transistors as long as they have f_T of a few hundred Mc and the right polarity; if PNP, just reverse supply. From the crystal frequency it is obvious that output is on 2M. For the driver and final valves, QQV02/6 gives about 5W, QQV03/10 [= 6360] about 10W, 832 gives 11W, or 75W from 829. Simple?

About the PMG

Almost in answer to my April article [although the latter was lying about in great piles on the floor at the time] the PMG has stated that if we want acceptable postal services we shall have to pay [even] more for them. Thus the first shot in the new increases, and the funeral feasts serve forth the wedding tables. 10c per letter? 25c by air? $3 to mail a small book to New South Wales? Surely this must become absurd eventually? Surely there must come a point where it will become profitable for private carriers to expand the scope of services described in the April EEB, to include virtually all mail for rapid reliable service? Strange ...

Postscript: I hear that Australia is selling the new automatic mail-shredding machines to America. This is magnificent!. It will help greatly to slow down the frenzied American Way of Life. We should make more such canny exports.

The International Literature

Very interesting to see how magazines change [yes, even EEB]. Presumably via competition, QST during the past few years has been upgrading technical material -- as indeed as their Handbook. RSGB gets Sylvia, and will never be the same again; also makes 'Technical Topics' a regular feature, thus buttering their bread thickly. Ham Radio becomes a highclass mag., elegant and sophisticated. 73's EEB-type approach continues, with human-interest features and odd and interesting experimental projects, not to mention its crusading Publisher; it may end up being the only really amateur experimenters magazine after the others have succombed to glitter and professionalism. CQ continues to improve the polish of its format [thus forcing the others to follow suit], with emphasis on antennas, beginners projects, special features and suchlike. Popular Electronics, on the other hand, has broadened out from the beginners etc., now with many excellent articles of high calibre, much like the British Radio Constructor. Radio Electronics and Electronics World have left us behind, with television, integrated circuits, and only a few worthwhile projects. And so forth. In a forthcoming EEB we shall present a list of brief details about a number of mags.

Professional Amateurs

In the January Ham Radio is an article on a saturable reactor to control inductance, but surely it is cheaper and better to make your own, as described in the April EEB [p. 37]. There is an increasing tendency to use store-bought components; when you read the literature of the big industrialised countries, don't be intimidated by their prepackaged gadgets; make your own. Its cheaper and more fun.

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LETTERS

Unwinding the Antenna Dilemma [Ref: VK7ZAR's article in February EEB]

Regarding Figure 1C of the February reply to the Co-ax Feeder Dilemma, while not many people would feed a folded dipole antenna with coaxial cable and ground the centre of the unbroken side of the antenna, the results would not be quite as horrendous as Mr. Reynolds implies. In fact, closely equivalent systems are used to feed some successful antennas.

Electrically, the shorted half of the half-wave antenna becomes effectively a single conductor. The other half of the antenna can then be thought of as being 'Gamma Matched' [with a long Gamma rod], or as half of a folded dipole. Now, if the shorted 'unfed' half of the antenna were bent at right angles to the fed half of the antenna, and if a few more quarter-wave conductors were connected to the grounded point and spaced radially in the vertical plane, a horizontally-polarised 'uni-pole' ground-plane antenna would be produced. The resulting antenna could then be rotated upright to become a conventional ground-plane antenna. [Andrews 'Uni-pole'].

If, however, the shorted half of the antenna were left in its original position, it would be incorrect to assume that it would not radiate [as implied in Fig. 3 of the February article]. Actually, being in the field generated by the fed half of the antenna, it would extract power from the field, and then re-radiate it, exactly as though the antenna were fed from a balanced line. Of course, the overall radiation pattern of the antenna will be distorted -- even if the antenna system is completely in the clear -- because part of the power fed into the one half of the antenna will be radiated in the process of developing the local field that excites the other half.

Of course, the pipes and other material under the fed half of the antenna will also affect the antenna radiation pattern -- as they would even if the antenna and feed system were perfectly balanced -- but not for the reasons stated. If the conditions were as implied by VK7ZAR, a simple solution to the problem might be simply to connect the inner conductor of the coaxial transmission line to the half of the antenna that was most in the clear. This is not a bad idea, incidentally, because it gives your previous transmitter r.f. energy a slightly better chance of being radiated into something besides your rain gutter and household electrical wiring.

-- H. Brier, W9EGQ, Gary Indiana

[[The case of the solidly shorted dipole was not considered in the February article. The impedance matching in this case, without modification to a correct gamma match, is bad and would cause large distortions of the radiation pattern, and a poor SWR on the feeder. The Z of the loop side is nominally 150Ω, that of the shorted side considered as an open dipole side is about 600Ω, and that of the feeder may be 50Ω to 75Ω? Yes, it would work, but just how well?
N.B.: The area within both sides of the folded dipole should be shaded in fig. 3 of the referred article. -- Asst. Ed.]]

Cont'd. Page 59

ADVERTISING

Please say you saw it in the EEB!

PERSONAL ADVERTS FREE IF MODEST SIZE. COMMERCIALS 10c/line, $1.50 half page, $2.00 full-page; can be spread over several issues. CAVEAT EMPTOR ["Don't let the wife know"]

- -

SILICON DIODES: Epoxy 1000 PIV/1.2 Amp, 24c ea. All units tested and guaranteed. Minimum order $5.00. All Australian and N.Z. orders Air Mail Postpaid. 10% off on orders over $US50. M. WEINSCHENKER, P.O. Box 353, Irwin, Pa. 15642, U.S.A.
[[Ed. Note: Australian rate of Duty + S.T. runs to about 95%, sometimes more; best is to order and wait and see. Since Customs procedures become considerably more complicated for orders over $US44.00, OM Weinschenker would probably give you the discount if you ordered $US48.89 worth. Also stocks higher currents, 88mH toroids, etc.]]

- -

FOR SALE: Two Kriesler Magnavox Woofer Loudspeakers, 15" dia, 25W RMS ea. Cone resonance 35cps in free air. $70 the pair. P. G. Thompson, 15 Proctors Rd, Dynnryne, Tas. 7005.
WANTED: Older edition of ARRL Handbook, cheap. G. H. Thompson, same address.

- -

SPECIAL CLEARANCE SALE from Australian Electronics, 32 Waterworks, Dynnryne, 7005.
U.S. Government books, large, heavy [alas!], well presented, numerous diagrams:
Basic Theory and Application of Transistors: $1.50 postpaid.
Theory and Use of Electronic Test Equipment: $1.00 postpaid.
Introduction to Electronics: $1.00 postpaid.
General Electric SCR Manual, 4th Edition, the big one with EVERYTHING: $3.00 postpaid.
Sams Book: Diode Circuits Handbook [very useful!]: $2.50.
101 Ways to Use VOM/VTVM: $2.40.
If you have seen our previous catalogues, you well know that these are bargains, even with our usually low prices. The sale is the result of the catastrophic lack of response recently to two large advertisements in a national magazine. We have not had such a bad response in our five years of business, and we are quite tired of selling books. These are magnificient books, and the prices are simply absurd, as you can verify by a visit to any bookshop. A vast proportion of the price is taken up by postage. You'd better get these before we get disgusted and give them away locally!

- -

ADDRESSOGRAPH PLATES: $2.00 per hundred, ideal for filing labies by month, even if you do not use the addressograph embossing. Greatly simplifies addressing. Addressograph Print-out machine can be made available for reconditioning costs of about $30, to enable your group to use full addressograph label facilities. Write c/- EEB.

- -

FOR SALE: Part-built Power Supply, 750-0-750V, 1A transformer, two heavy duty chokes, filament transformer 2 x 10V c.t., four oil filled 8µF HT filters, mounted on heavy duty chassis with panel. Needs only rectifiers. As is, where is, $40 ono.
.. Phone/CW Tx, 30W, 7Mc, 14Mc, built round Command VFO; requires 350V HT and 12V LT. $30ditto
TV Chassis, classic, no tuner. Best offer. 813 valves, reasonable offer.
WANTED: Complete Circuit, PALEC VCT. For any of the above, reply to VK3WW, 3 Maxwell St., Lalor Victoria 3075. Phone 465 2991, A.H.

- -

EEB wishes to apologise to the other chap who sent in a personal advertisement. It seems to have got mislaid whilst boxes were moved about for carpentry etc. If he will send it in again right away, we will try to do better this time!

- -

TRULY CHOICE TRANSISTORS from Custom Electronics, Box 1452-L, GPO, Adelaide, 5001.
2N3819: N-Channel; 'Very low noise from audio to UHF frequencies' [EEB packet]. Idds = 2-20mA, Igss = 2.0nA, Vgss = 25V, Yfs = 2.0-6.5mA/V, Ciss < 8pF .... $0.75 each

TRANSISTOR	TYPE	P_c	BVcbo	Ic[max]	h_{FE} at	Ic	f_T at	Ic	Comments	Price
2N3055	NPN Si.	115W	100V	15A.	150	4A.	200kc	1A	Lowest price!	$2.00
2N3643	NPN Si.	0.7W	60	500mA	>100	150mA	>250Mc	50mA	Lovely Class C.*	0.80
2N3645	PNP Si.	0.7	60	500mA	>100	150mA	>200	20mA	High fT at high Ic.	1.00
2N3646	NPN Si.	0.5	40	500mA	> 30	30mA	>350	30mA	Low Vsat, Ditto "	0.70
2N4122	NPN Si.	0.5	40	100mA	>150	10mA	>400	10mA	Lovely UHF	0.80
2N4250	PNP Si.	0.5	40	50mA	>250	10mA	> 50	10mA	Very low NF,*LINEAR	0.75
AY8103	NPN Si.	6.0W	60	3A.	> 50	1A.	> 25Mc	200mA	Med. Pwr. r.f., a.f.	1.80

Please add 15c for post and pack. Sorry, no South Australia sales possible.

[[Editors Note:*2N3643: See Tr Tx, Jan and Feb 1969 EEB's. It could be interesting to try the 2N3646 too? *2N4250: This is a most unusual transistor, very low a.f. noise, with virtually constant β from 1µA to 50mA! See EEB, June, July, Oct, Dec 1967]]
[[The 2N3055 would be excellent for transistorised ignitions and power supplies]]

HITSETS AUST.

-> BOX 176, P.O., DEE WHY, N.S.W. 2099 <-

A MESSAGE TO CUSTOMERS:

Over the past months we have had good support from our customers, which has enabled us to purchase in much bigger quantities from our Japanese and British suppliers. Because of this, we are placed in the fortunate position of being able to REDUCE prices on our polyester capacitors and 1/2W resistors. In addition, it will be of interest to clients to note our new quantity buying discounts.

We stock only new, first grade, high quality parts. We guarantee all components.

Our despatch department is capable of handling all orders efficiently. The staff are full qualified. All orders are packed with care, and despatched by return post.

Below are listed our new prices:

TRACON POLYESTER CAPACITORS; All 100V:

Capacity	1-9	10-99	>100	Capacity	1-9	10-99	>100	Capacity	1-9	10-99	>100
0.001µF	7c	6c	5.5c	0.01µF	7c	6c	5.5c	0.05µF	11c	9c	7.0c
0.0015	"	"	"	0.015	7c	6c	"	0.068	11c	9c	8.0c
0.0022	"	"	"	0.02	7c	6c	"	0.08	11c	9c	8.0c
0.003	"	"	"	0.022	8c	7c	"	0.1	12c	10c	8.5c
0.0033	"	"	"	0.03	9c	8c	"	0.15	15c	12c	9.0c
0.0047	"	"	"	0.033	9c	8c	"	0.22	16c	13c	9.5c
0.005	"	"	"	0.04	10c	8c	"	0.47	25c	20c	18.0c
0.0068	"	"	"	0.047	10c	8c	"				

CARBON FILM RESISTORS

Wattage	Tolerance	Range	1-99	>100
1/4 W	5%	1Ω to 6.8 Meg	4c ea.	3c ea.
1/2 W	5%	0.5Ω to 10 10 Megs	4c	3c
1 W	5%	5Ω to 1 Meg	7c	5.5c

Resistors may be ordered in mixed values.

Please Note: Our new price list is now available. It contains many new items, all of which will be advertised in EEB in due course. Or S.A.E. for full Catalogue.

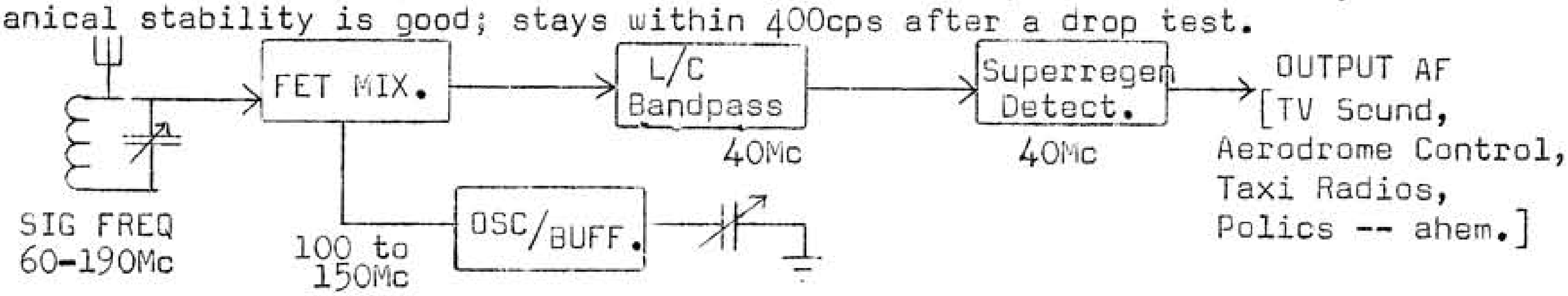
Please add 10c pack/post to all orders, owing to increased postal charges.

[[Readers who are reasonably convinced that Baluns have their uses, will be interested in the article 'Application of Broad-band Balun Transformers,' by R. H. Turrin, W2IMU, in QST, April 1969, p. 42. He uses ferite rings in various configurations; although he does not say exactly how broadband the improved baluns are, they are evidently considerably better than 3-30Mc.--Ed.]]

Random Thoughts on Receivers and Transmitters

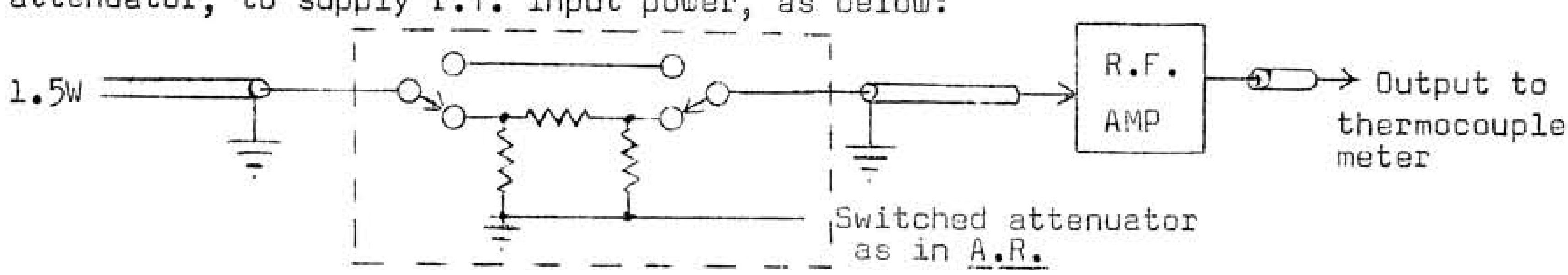
I have searched all the Sydney bookshops for good technical books but have found the standard of literature depressingly low -- mostly American paperbacks which trumpet their transistor gimmickry as if it were the latest thing from the research laboratories. It seems that beside odd publications from G.E. and Motorola etc., the only consistently good material comes from RSGB, whose publications only the W.I.A. stocks. [[Good reason for joining the W.I.A.!--Ed.]]

I am building a solid state version of EA's Fremodyne Four. So far I have a VFO built up using the chassis of a 522 test set; it covers 100-150Mc... Mechanical stability is good; stays within 400cps after a drop test.



I like your series on r.f. power transistorised amplifiers. I shall, however, be using at most, 3 or 4W d.c. input on 6M and 2M. The most I have measured so far is 300mW out at 50% efficience on 6M using one 2N3642 at 16V HT into a 100mA thermocouple meter and 50Ω resistor. I have experienced trouble with oscillation in the final, and also find that the previous stage needs to run appreciable power before the final will draw any collector current at all. Also, I am not sure how to neutralise these amplifiers. [[See my article forthcoming in Amateur Radio, entitled 'Common Sense and Instabilities in Transistorised Transmitters'. -- RLG]]

Although I have not tried it, I think a good setup for experimenting with coupling etc., would be to use a low power transmitter [e.g. 1-2W] feeding into an attenuator, to supply r.f. input power, as below:



The output of the transmitter is pure sinewave, and can be measured unambiguously, while π and T-section attenuators can be made fairly accurately. This means that one tunes the input tank for maximum output from the transistor, and the input power is then known very accurately even at levels as low as 5-10mW.

-- W. M. Holliday, VK2ZUP, Wahroonga, N.S.W. [January 1969]

* *

QUOTE WITHOUT COMMENT ['VHF r.f. Noise Suppression', A. E. Glazier, 73, 10/68]

"... It is also true that a narrow pass band in the i.f. section will help; however as most amateurs today are using commercial equipment, little can be done about this."

THE AUSTRALIAN EEB

AN INFORMAL ELECTRONICS
EXPERIMENTERS BULLETIN

Editorial Office:
P.O. Box 177
Sandy Bay, 7005
Tasmania,
Australia.

20c per copy

Australia and N.Z.:
1 yr. $1.00 | 2 yrs. 1.75 | 3 yrs. 2.25

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JULY 1969 VOL. 5, No. 5 P. 63

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Modifying Receivers

The virtues of the 7360 beam deflection valve for mixers and ssb balanced modulators continue to be reflected in amateur publications. Not many people might be inclined to dig into one of the Drake R4 series of receivers which have clearly proved a popular choice in Europe; but *DL-QTC* (November, 1968) carries a detailed discussion on changing the 6HS6 first mixer for a 7360 in order to further improve cross-modulation performance. The R4 series are double conversion (5645 and 50 kHz fixed i.f.) models with pre-mixer (heterodyne-type) hybrid valve/semiconductor first oscillator. The article also provides a table of cross-modulation characteristics, reported in other articles, for various valve and semiconductor front ends. In semiconductors, that given for the BF173 looks interesting. The table underlines the high performance of the 7360 compared with that of some well-known receivers and transceivers, and makes it look as though a change to a 7360 might be well worth the effort for anyone suffering from cross-modulation or blocking. It may be appropriate to remind readers that in 1960 RCA put out a useful leaflet on the 7360: *RCA Application Note AN-185* "Modulator and Converter circuits using the RCA-7360 beam deflection tube." (RCA Electronic Components, Harrison, NJ, 07029, USA).

How to be "without it"

Bill Matthews, G2CD, is stirred by the continued problem of TVI to interpose a long-felt plea that, despite the "with it" rush to ssb, the claims of fm and nbfm should not be lightly brushed aside. He notes that from a TVI viewpoint, ssb is still amplitude modulation . . . only rather more so. In the urge to squeeze out extra talk-power that is so often quite unnecessary, he questions the prevailing attitudes of many amateurs who would sooner be "with it" (on ssb) and off the air, than "without it" (on nbfm) and on the air. To be a follower of fashion is not always a wise choice.

There can be little doubt that a very good case can be made for much greater use of fm techniques—certainly on 21 and 28 MHz, and on the vhf bands. One suspects that if every ssb station suddenly began using nbfm, the overall communications efficiency would suffer far less than many ssb enthusiasts would be prepared to admit. Far more impressive might be the effect of such a change on TVI.

Without entering into the current controversy on ssb for the vhf bands, it might be worth noting that a letter in *Electronics* recently pointed out that it is a fallacy to believe that ssb would double the number of channels available to mobile business radio since "it is unfortunately beyond today's state of the art to confine the energy of an ssb signal to its own channel to the degree required in mobile radio systems." In other words, few ssb stations on vhf could hope to suppress the unwanted sidebands to anything like 90 dB.

PAT HAWKER, G3VA

RADIO COMMUNICATION JANUARY, 1969

CONTENT:

NEXT ISSUE: August. More Organs, FET-ised Rx, and MUCH MORE!

Quo Vadis?

If I might offer some humble criticism of EEB it is this: From the reader's angle it appears to have a rather uncertain sense of direction. For whom does it primarily aim to cater? The Radio Ham? The Experimenters, many of whom are bored silly by Ham Radio argot and topics? The Youngster who is in search of odds and ends of basic information to assist him in constructional projects?

Furthermore, in EEB you would disarm criticism by the statement that it is 'informal', and 'we guarantee nothing', etc, and you decorate its cover with a drawing by your Kiddy. You also hailed a booklet being flogged by a bloke .... at $1.25 as 'beautiful', although it claimed to tell readers how to design their own transformers. Figures for a 240V 50cps primary input were given, most of which seemed to have been pinched from some American source which had in mind a 110-117V 60 cycle primary; the substitution would be catastrophic.

In Electronics Australia you advertise GOOD books, DELICIOUS books, things are 'choice', and things are 'lovely'. Well, maybe, "Style est l'homme", but hell, Leo, you're a dead loss to the greengrocery business -- where you could lavish your vocabulary on tricking out a fruit stall. Many of those guys are of the 'We guarantee nothing' brigade too.

I always enjoy your little personal essays and asides, but most also wonder how a lot of your other readers react. Is it good to editorialise in a technical medium? I don't find masculine, responsible writing dull stuff. Electronics Australia, e.g., Neville Williams and his crew do an outstanding fine job of endeavouring to entertain and accurately inform readers.

In print you caper in a way that affects you to be a type of juvenile, irresponsible character -- which in fact you are very far from being. Why? Do you feel you have to 'be with it' to make EEB flourish?

-- A.

[[We don't cater to anyone. -- Editor]]

Transistorised Transmitters etc

Several excellent articles have appeared in QST and CQ during the past two years on transistorised transmitters [and Ham Radio and 73 ! -- Ed.]. While I agree, however, that solid state is a 'must' in the modern experimenter's work for low power transmission, I have found them sadly lacking in several respects. If you have f_T high enough to cover several bands, say 3.5, 7, and 14 Mc with reasonable efficiency on the highest frequency, then it is hard to tie them down on the lowest frequency -- or look at all of the trouble required to make them behave, as detailed in the 'Frapnuary' EEB.

On the other hand, small valves, power output types, give wonderful low power results down to 10M. My QRP on 21Mc uses a 6CL6 with about 3W input, driving a 2E26 QRO at about 10W. Both units have worked DX; the smaller one has got JA, W, VE, and ZL, while the 10 watts have given me over 20 countries. Nor is the receiver anything but a 3 tube T.R.F. with variations, using 6AK5, 6U8, and 6AQ5; antenna is a small helical whip.

I do have a solid state VFO. Having read through many of the available articles, and having ruined numerous 2N697's I still have an open mind, with a slight bias in favor of valves!

Many thanks indeed for your articles ...

-- J. Andrews, Goulburn, N.S.W.

[[Transistors are OK if you stay within their voltage ratings. To transistorites your 3W is real QRO. A lot of our small stuff is in the 100-600mW range! Take a look at the small stuff described in a recent Ham Radio, along with details on the QRP Club-Ed]]

Review: THE 1969 ARRL RADIO AMATEURS HANDBOOK -- R. A. Reynolds

The new edition has been presented in essentially the same format as previous editions, and it appears that there is no reason to change at this stage, as the present form is quite readable.

As usual, most of the subject matter is a repeat of the last edition, and where feasible it has been rearranged for ease of reading or page layout. The Editors of the Handbook have redeemed themselves to a certain extent in my sight; they have seen fit to reduce the number of 'high power' unit descriptions in favour of more moderate designs.

On the other hand, design procedures and theory have been reduced further in quantity and quality. As an example, a couple of really unique charts on audio and linear amplifier design constants have disappeared; a section on adjustment of linear amplifiers has also been removed. This year a couple of designs for quite conventional power supplies have crept in; I can see little value in this, because one always wants to design a power supply for one's own situation. Much better would have been more thorough power supply design notes, including LC filter charts. In the same vein, much space is devoted to describing transceivers or receivers which are nearly identical except for frequency of operation. Far better use of space would be to present more practical material on optimum design of circuit elements, and let individuals apply it as appropriate to each situation.

What remains? A book in which the basic electrical theory is the same as it was about 25 years ago, with a lot of good quality equipment designs, but virtually no detailed theory of recent technical developments. This is an insult to the average amateur. 'Names' are mentioned, such as the 7360 beam deflection tube, which means that the Editors have heard of the thing, but there is no detailed or comparative description of its operation as a valve, and more particularly as a converter or product detector. This kind of thing is appalling to anyone who has been exposed to the large amount of developmental innovations which have appeared in British and other publications during the past 10 years. Indeed, much excellent technical material has also appeared in QST, with which the ARRL is presumably associated.

In the 1969 ARRL Handbook there is far too much commercialism. I am sure that it is a waste of type-set to specify the manufacturer and part number of petty components like knobs and similar hardware. It is lamentable to devote space to the technique of cutting up prepackaged commercial inductance coils. It would be much better if the space were devoted to design nomograms, which would be much more use to the progressive amateur, and might even inspire the over-financed hand-fed radio operator to become an amateur experimenter of **traditional** calibre.

In our opinion, the 1968 Handbook* was slightly better than the 1969 edition. Will 1970 follow in the same tradition?

* *

ARE RADIO AMATEURS HUMAN?

[[Excerpts from "How's My What?" by E. Cole, W7DF, 73, Sept. 1962, p. 28; It is in the nature of a commentary on a previous article in 73 by K7NZA, entitled "How is your Ham Image?"]]

... My point is that we take ourselves too seriously as artisans and not seriously enough as members of the human race.

To the superficially curious non-amateur [most of us were, once] the sounds of RACES, MARS and other activities inspired by patriotism of simple sensitivity to community needs are just not distinguishable from the tired inanities, contest numbers, DX riots, AM-SSB needling and rollicking round tables. As individuals we sound

* Reviewed, EEB, Dec. 1968, p. 130.

incomprehensible; as funny licence plate types, we seem to be a phenomenon of the electronic era with a common hunger for more and wider kilocycles. These we want for sending code, chatter [English and sideband], telephoning from cars and running spooky typewriters ... The narrowness of scope, editorial inertia and prolix re-hashing of worn ideas in too many issues [of magazines] suggests to me that we are regarded as communication-oriented readers with spines topped by small knobs.

Hopefully I submit that we can be thoughtful about ends as well as means, although the means have been getting all the attention. Consider the potential good of diverting to more productive channels the constant wrangling over filters, modes, linear efficiency, etc. All the answers are in the books, but we fight it out anyway, expending time, airspace and temper usually to fall through the ropes into ambiguity or error. We get deadly serious, and deadly tiresome, for example, about a subject like SSB. Actually there is nothing new about the concept and nothing to justify our ridiculous quarreling -- but if we didn't argue about someone else's ideas we would have to get some of our own ...

[Concerning DXpeditions,] I wonder if it wouldn't be possible to provide a foreign ham or ham club near the target with expense funds and some equipment to do the job, rather than ship the stuff and people from here to there and back again? Perhaps it wouldn't be practical but there is a measure of madness in our fabric anyway, and practicality is the foe of pleasure, otherwise parties would break up at midnight in favour of early morning gardening ...

Making friends is important, like breathing, but in times of world crises when it would mean the most it comes under a cloud. The barricades that rise, men have seen before, but the cloud is unique and while there is time to improve the American [[and Australian!!]] Image we had better get at it. It is our distinction, as radio amateurs, that we have the means to help, and it shouldn't take much soul-searching to see the obligation implicit in our franchise.

Consider this profundity: One way of improving relations with people is to be friendlier. Yet the conventional DX contact is brief and sterile ... Most of them sound slick and laconic and give the impression that their attention is focussed on a spot above the other fellow's shoulder, or on the next country. In these conversations the preliminary exchange of names, locations and tube size normally is followed by an almost audible mental block, a hearty anticipation of future contacts and a diffident goodbye.

If we can't achieve the status of the tail-coated ambassadors it won't hurt to remember that military cemeteries around the world bear witness to their smashing success as couriers of good will. They could use some help, and all we have to do is flip a switch to enter the homes of men everywhere struggling to work out their destinies in a jumpy world. Moreover, in the skies we travel, our laws make no reference to creed or colour or economic status, and our privileged communications flow heedless as the wind over borderlines and battlefields.

If this sounds rather grand and rhetorical it's probably my sense of personal involvement and frustration bugging me. We are all mortals running out our span of years in mixed moods and circumstances, commonly afflicted with corns and taxes, generally content to search for happiness in the achievement of reasonable ambitions. Individually we want peace and justice; nationally our governments are at each other's throats. And while the diplomats in what may be a generic twilight grope for omens in their chicken entrails, what messages do we send around the world?

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Review: A GUIDE TO AMATEUR RADIO -- RLG

-- A Guide to Amateur Radio, by M. Pat Hawker, G3VA [RSGB 1968] Stg 6/- + Post.

My first impulse was to say, 'Oh just one for the kids', but when I saw the magical name of Pat Hawker, I took a closer look. It is certainly a beginners book, analogous to the ARRL equivalent , but not merely 'for the kids'. Looking over this informative booklet I am reminded that it is a rare person who remembers much about what he has read, unless he actually uses it, or unless he is exceptionally intelligent. Those of you who may feel complacent about this ought to take a look at this book; there is a depressingly large amount of truly basic stuff which one can forget. And then there is the new material which developed since one learned one's basics; yes one has read about it in the periodical literature [maybe], but it is definitely informative to see it put together in one place. Order through WIA or NZART, or directly from RSGB [c.f. Oct. '68 EEB]

Sections are:

1] Introduction: Answers basic questions about amateur radio, with special reference to conditions in the U.K., but most will apply here as well.

2] Getting Started: " There is no better way of starting Amateur Radio than to spend some time with a shortwave receiver ...." Amen. Basic power supplies, notes on SSB, TVI, Aerials, and station layout.

3] Communications Receivers: This becomes quite nice. If anyone feels that our EEB discussions about receivers has been too 'high powered' he ought to read this up, and follow it up with readings from the Radio Communication Handbook, also by RSGB [see EEB April 1969 for review]. It is all here, including 'Practical Designs' for several receivers and accessories, valve or transistor. I get the impression that this book is rather a scaled-down version of the Handbook, containing a wealth of good information for those who are put off by the higher price and thicker format of the more serious work.

4] Amateur Transmitters: Same comment as for receivers, except that the limitations of space become more obvious; this is an enormous subject, and can only be introduced here. Included are sections on 'The Master Oscillator', 'The Power Amplifier', 'The Tank Circuit, Harmonics and Parasitics', 'Keying the Transmitter', 'Phone Operation [including SSB and NBFM]', 'The Aerial', and 'Frequency Measurement'. Typical designs are given; this section is all valves, but in view of the fact that the RSGB [unlike ARRL] is well aware of semiconductors, it is evident that they believe that knowledge of valve operation is prerequisite to that of transistors. And so say I.

5] The Licence Examinations: Similar to, but not identical to ours. Further details about local conditions are found in the PMG publication: " Handbook for Operators of Radio Stations in the Amateur Service" , available from WIA or any PMG Radio Branch for 30c.

6] Operating an Amateur Station: That's what I'll do someday. CW, Q code, abbreviations, prefixes, colour codes.

7] The RSGB and the Radio Amateur: What the Society is and does. Aside from several idealistic reasons, the main practical advantage to us is to receive Radio Communication [formerly 'RSGB Bulletin'], which contains a few technical items, but ones which are well worth the price of membership. Membership costs stg 50/- [25/- if under 21 yrs old]. " Anyone with an active and genuine interest in Amateur Radio is warmly welcome to apply for membership". They prefer that you can be referred by a Corporate Member of the Society, but if you don't know any, " a brief reference in writing should be submitted from a suitable person who can vouch for your interest in Amateur Radio". Such persons can be found at any WIA or NZART meetings, or we'll vouch for you. A lot of foolishness, in my opinion, but worth it. " A specimen copy and full details of membership may be obtained from Radio Society of Great Britain" , [Dept. EEB], 35 Doughty St., London W.C.I., England.

Continued P. 68

I might add that the advertisement pages of Radio Communication are second only to those of Wireless World, and for those of us [e.g. us] who do not subscribe to the latter, the RSGB publication provides a valuable contact with sources of new or inexpensive components or equipment -- keeping in mind the existence of customs duties and sales taxes here, about which one must make specific enquiry before ordering anything.

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LETTER

Are Integrated Circuits Practical?

I have been wondering why you are not enthusiastic about Integrated Circuits, and I have a few ideas which may be relevant. IC's are a transistor package, with numerous components all in a small plastic package about the size of an ordinary transistor. They can be used in most audio or radio equipment to about 20Mc with little trouble, and with a big saving of space compared to transistors.

What, then, is stopping a wider use of IC's? I should like to propose that the reason lies in a fact mentioned in the December 1968 and February 1969 EEB: their relatively high current drain. Ordinarily we make use of all of the transistors in the IC package, and for some reason they draw a lot of current, quite a lot more than ordinary transistors.

For this reason, I think manufacturers have produced IC's to operate at low voltages, usually up to 6V ... Now if you want to make a frequency divider to divide 100kc to 5kc, the ICs required would draw about 175mA, yet a comparable ordinary transistor setup would draw about 10mA.

Since the IC's require a regulated power supply, one can well ask whether the saving in space by the IC's themself is worth the increased space [and cost] of a regulated power supply handling an appreciable current, not to mention the requirement for the larger power transformer, and the difficulty of mobile operation from batteries.

-- L. S. Dixon, VK3TE/VK4LF, Elwood, Vic.

[[In this, as in many other matters of modern electrics, it would appear that a healthy dose of common sense is required. Space requirements must be considered as a whole, efficiency, reliability, cost, ease of construction must all be considered in the context of the real needs of human beings. Along with this goes another real need of people: If you want to build something, are you 'building' it if you hook up someone else's connections??

The general argument against the casual use of Integrated Circuits by experimenters is well summarised by C. C. Zaranski in a very useful article entitled 'Minimum Cost Semiconductor Silicon Survey', 73, April 1969, p. 30. To wit: " For most ham work I prefer discrete components to Linear integrated Circuits, due to the poor noise performance, power supply voltage restrictions, and signal handling capability of the integrated circuits". To this we may also add high current drain for a given performance, poor linearity, and high susceptibility to transients. -- Ed.]]

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SPECIAL OFFER: Subscriptions to Ham Radio magazine. Courtesy of the EEB.

To assist this new publication to become more widely known in Australia, we are willing to act as agents for subs and renewals, but with these restrictions and benefits:

1] Only available for three-year subscriptions or renewals.
2] Only available when two or more subs are sent to same address; ideal for Clubs.
3] Only available for Australia and Territories. Sorry, not N.Z. [See NZART].
4] Only $A9.00 for the three years! Back issues for this excellent magazine are most unfortunately not printed in adequate supply, so you'll be sorry if you delay. Regular price is $6 for one year now, or $12 for three, and I'll bet it will go up even more...

EXTRA BONUS: With each sub, free First Edition of HR, limited number available; ACT NOW.

Jan - April 1969 Well worth asking for the back issues were pretty good.

MIXER PERFORMANCE IN FET'S AND BEAM DEFLECTION TETRODES -- Asst. Ed., VK7ZAR

Rick Matthews discussion of the Simulated Tetrode configuration of two triode FETs was very interesting [EEB, April 1969], but I should like to point out one important limitation of that simplified arrangement. The cascoded triodes will not have the dynamic range capability of the tetrode, and are therefore more prone to overload by adjacent-channel signals, viz., 'cross modulation'. The cascoded triodes are, however, more rugged, and thereby present certain operational advantages. A beam deflection valve mixer is even more rugged, and also possesses high dynamic signal capabilities.

Product Mixer Theory

A perfect mixer is a pure product detector without the spurious responses normally associated with conventional mixers. The process of mixing must be linear, but the overall response must be non-linear; for clarification of this apparent conflict of requirements, see the discussion in EEB of July 1968 ['Improving r.f. and Mixer Performance']. If you are not familiar with this subject, that reference should be consulted. Otherwise I should have to take considerably more room here with graphs and diagrams.

A single-gate FET is not a product mixer [i.e., it is basically additive], and owes its high mixing efficiency to its linear response over a wide range of input conditions.

If two ideal FETs were used in cascode, a true product mixer could be obtained; that is to say the output would consist of the product of the [sum and difference of the] signal and oscillator frequencies. The unwanted carrier and its sidebands could then easily be filtered out, leaving the required i.f. signal. The amplitude of this i.f. signal would vary linearly with input signal. The result is that spurious sidebands would not be generated in the mixing stage.

On the other hand, the practical situation is one in which the output is not a pure product. The source nonlinearities of the two FETs interact, and departures from overall linearity are accentuated. The result is that although the mixing performance of two FETs in cascode is better than that of a single one, it is not as good as that of a true tetrode.

If one looks at a single FET, its drain current must be a linear function of its gate voltage, as would be the anode current relative to the grid voltage of a valve. In a valve, however, it is not ordinarily possible to have two control elements [i.e., grids] with identical control characteristics -- but in an FET it is possible namely in the tetrode FET.

When there are two identical control elements, e.g., gates, then since the output current is proportional to each gate voltage, the output current must be a product of both! This is largely achieved in the tetrode FET, but is only approximated by the cascoded triodes, for reasons related to the above discussion.

Limitations of the MOS FET

One must mention an important qualification to the apparent superiority of the tetrode, namely that the tetrode is a MOS FET, and is therefore considerably more sensitive to overload in the gate circuit than is the more commonly used triode junction FET, which is inherently protected. It seems evident that there could be applitions in which the cascoded triodes would be used to take advantage of their greater ruggedness, even though some mixing performance would be sacrificed.

Advantages of the Beam Deflection Valve

A noteworthy exception to the impossibility of identical control elements in a valve is the 7360 beam-deflection tetrode. In this valve, each of two virtually identical deflection plates has the same control over the electron beam, giving performance analogous to that of the true tetrode FET [as long as the balanced valve mixer circuit is used]. Although there is the restriction that the 7360 load has to be tuned in order to obtain optimum performance, the valve has the considerable advantage of enormous non-destructive overload capabilities. This is not unimportant in amateur installations, where considerable r.f. power may appear at receiver inputs.

References

A note about the use of the 7360 appears on the front cover of this issue of EEB, and specific circuits have been published in the periodical literature from time to time. A good circuit for a beam deflection mixer appears in the 'Receiver Topics' section of Technical Topics, or of Amateur Radio Techniques, published by R.S.G.B. [See Review in EEB, Oct. 1968]. See also RSGB Radio Handbook.

A good general background on practical FET theory and applications is found in 'FET Principles, Experiments, and Projects', by E. M. Noll [Sams][$US 4.95]. A general review of FET literature, with reprints of various VHF converters is found in the EEB 'FET Packet' [for 4x9 SAE + separate 9c stamp].

The relative cross-modulation performance of bipolar, single gate, and dual gate FETs appears in an interesting article, 'Understanding and Using the Dualgate MOSFET', Radiotronics, August 1968, p. 49. [Back issues of Radiotronics are 50c, when available, and the magazine is well worth a subscription at $2/yr, to The Sales Department, Amalgamated Wireless Valve Co P/L, Private Mail Bag, Ermington, N.S.W. 2115.]

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LETTERS

Making Practical 24-hour? Digital Readout Clocks

I found your ideas concerning 'practical' digital clocks interesting, in the February [1969 EEB p. 28] Editorial, but there may arise limitations in 'simplifying' them. For instance, for the purely transistorised version, if you use the apparently less-confusing 12-hour readout, it would logically go:

11.59, 00.00 -------- 00.59, 01.00 etc, but even better of course would be

11.59, 12.00 -------- 12.59, 1.00 etc.

Which means the second last decade from '2' back to '1' on the pulse following 12.59. And we still want the '0' there to cater for 10.00. And it must not reset after 2.59. Very simple; I make it another 435 transistors worth of ICs!

But of course there is a much simpler way to do it with your Antique Clock. Simply bore holes all round the dial in a circle, one minute apart, so that they are traversed by the minute hand which masks each hole in turn. You have a photoelectric cell behind each. Make a similar circle of holes on a smaller diameter for hours, and there you have it. Illuminate the clock face with a 500 watt lamp in a parabolic reflector so that light reflected from the dial illuminates the room brightly, aided by the bright red neons which indicate the time. QED. All rights strictly reserved.

As to saving space in EEB use Albert's fourth dimension to convert this to time, and you'll be able to do all you want.

-- L. J. Yelland, Prahran, Vic.

[[Wrong! I have even less time than space. -- Ed.]] [[See Note, p. 63, in Contents]]

Efficiency in Transistorised Transmitters

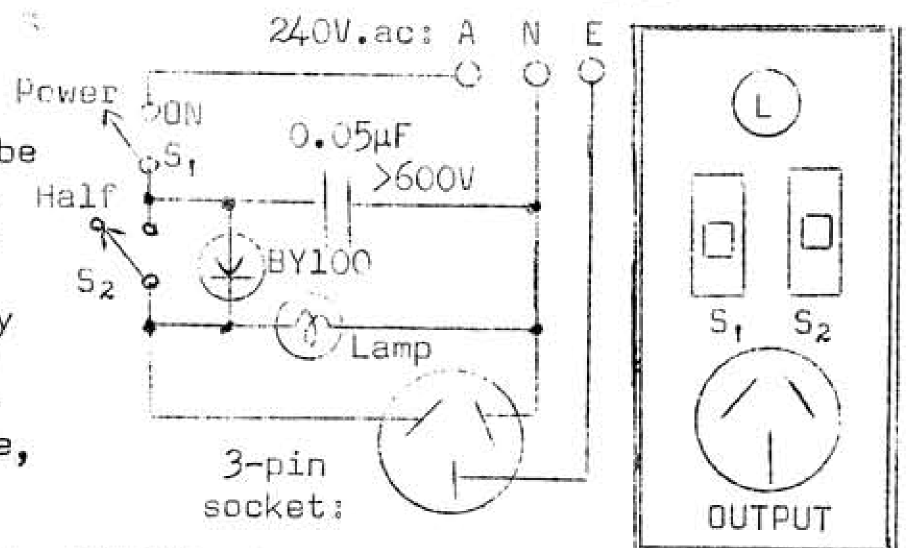
The April article on the 455kc sweep generator is just what I have been looking for, but I am surprised to see that the transistor transmitters in the two previous editions use link coupling throughout, with two exceptions. I would have thought that more people would be experimenting with L and π interstage networks, especially seeing that STC ['Components Review' Dec. 1968] have obtained 13W output at 180Mc at 67% overall efficiency, and 91% efficiency in the output stage, using 3 cascoded transistors and 70mW [FM] of r.f. input; 22.5db power gain, 12.5V battery supply. The bandwidth was 8Mc, just the thing for two metre tuneable operation; L-networks are used throughout, and the lineup used by STC is: 2N5422 --> 2N5423 --> 2N5424.

-- W. M. Holliday, VK2ZUP, Wahroonga, N.S.W.

[[I am strongly inclined to agree with you about coupling, and I made the same point several times in the series on transistorised transmitter design in EEB during the past couple of years. And the notable exception in the February 1969 issue was the rig by Jim Fisk, who is not unknowledgable in such matters. And yet, Doc Kelly has probably built more rigs than the three of us together, and he maintains that simplicity is what matters, and that he would 'just as soon bung on another stage' so as to avoid worries; this is particularly relevant with respect to voltage requirements; see EEB, Aug. 1967, p. 104. And in the June 1969 EEB, Jim Fisk manages to look convincing while using link coupling throughout. Does high efficiency really matter so much with transistors, particularly when it is obtained only at the expense of safety margins and of operating flexibility, as I have asserted in these pages? Consider another excellent design, appearing in Miniwatt Digest, May/June 1969: 'Silicon NPN Emitter Grid Transistors for VHF Power Amplifiers'. These new transistors are improvements over Overlays; the transmitters shown are beautifully designed: 18db gain in three stages with output of 15W at 160Mc, with T and L coupling throughout, as used too in many RCA designs; overall efficiency 65%; be sure to look up the article; The design and constructional details are fascinating, and highly practical. But the point is this: If you follow these efficient designs faithfully, both electrically and mechanically, you may get good results, but deviations can be disappointing, and adjustments elaborate. I.e., you have to know what you are doing. This may require a degree of competence many experimenters are unwilling to exhibit, or perhaps more likely it is the above-mentioned matter about being impatient for results, and who cares about the fine points. While these attitudes can be useful in overcoming unnecessarily academic precautions, experimenters are finding that modern transistor technology often requires more than the 'suck it and see' approach. In EEB we try to steer a middle course -- Ed.]]

Soldering Iron Standby Control

I have found the circuit shown here to be quite effective as a cheap 'standby' control for small soldering irons [Adcola or equivalent] operating from the 230V mains. The 'Half' position keeps the iron warm and ready for use within a few seconds of switching to 'Full'. It reduces ocidation of tips considerably. Mine was mounted on a 9 x 3" base, and a 15W red pilot lamp gave rapid visual indication of operation.



-- W. J. Currie, VK3AWC, Seymour, Victoria

Greetings from U.K.

Congrats on fine issues; glad to hear what the 'upside down' electrons do down there! My 73 to all VK's, especially those in Melbourne that I have QSO'd. I hope to see you all again one day when I'm not so busy.

-- G. V. Haylock, G2DHV, Kent, England

UNSTABLE RESISTORS

-- A picture story by D. J. Bedford & L. R. Rerhnug !

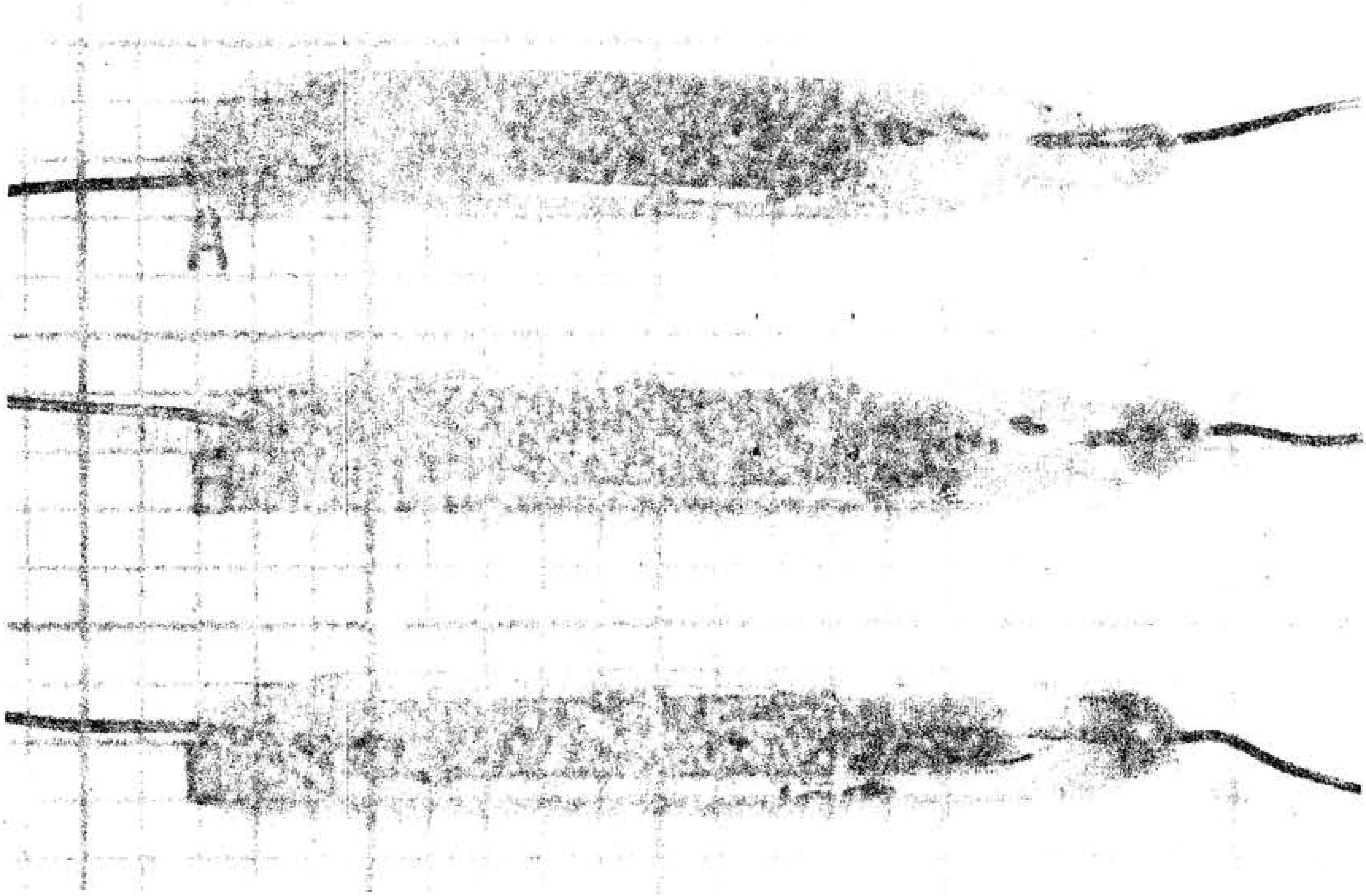


Fig. 1 : The high resistance resistors. A, B, are wax-filled. They come in 125 Meg Ω, 1K Meg, and 10K Megs. Ideal for HT multipliers? Don't you believe it! Examine the curves here.

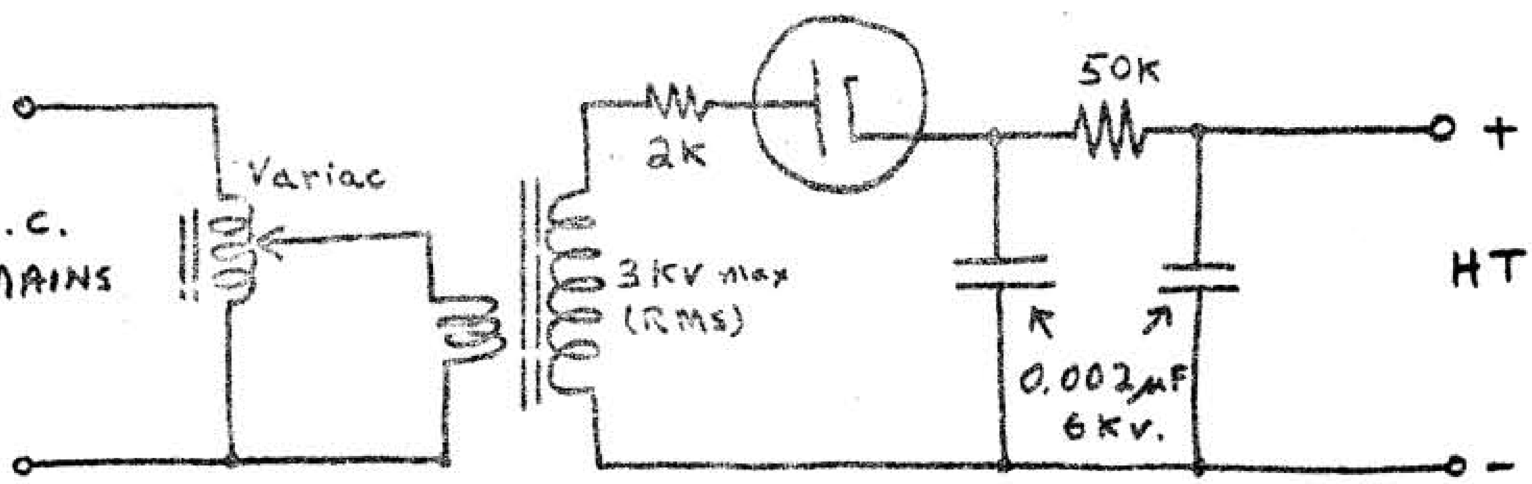
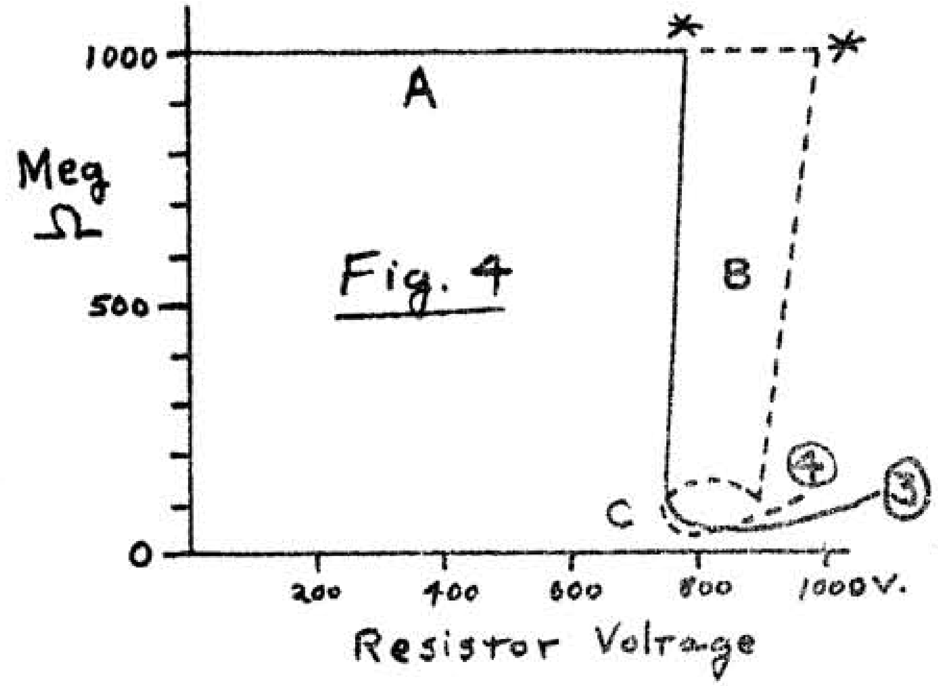
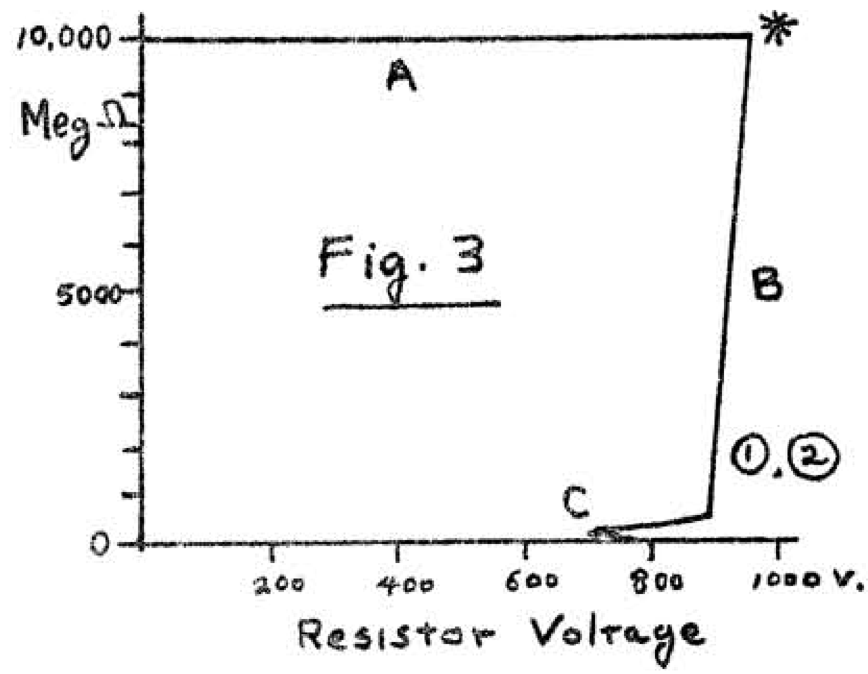


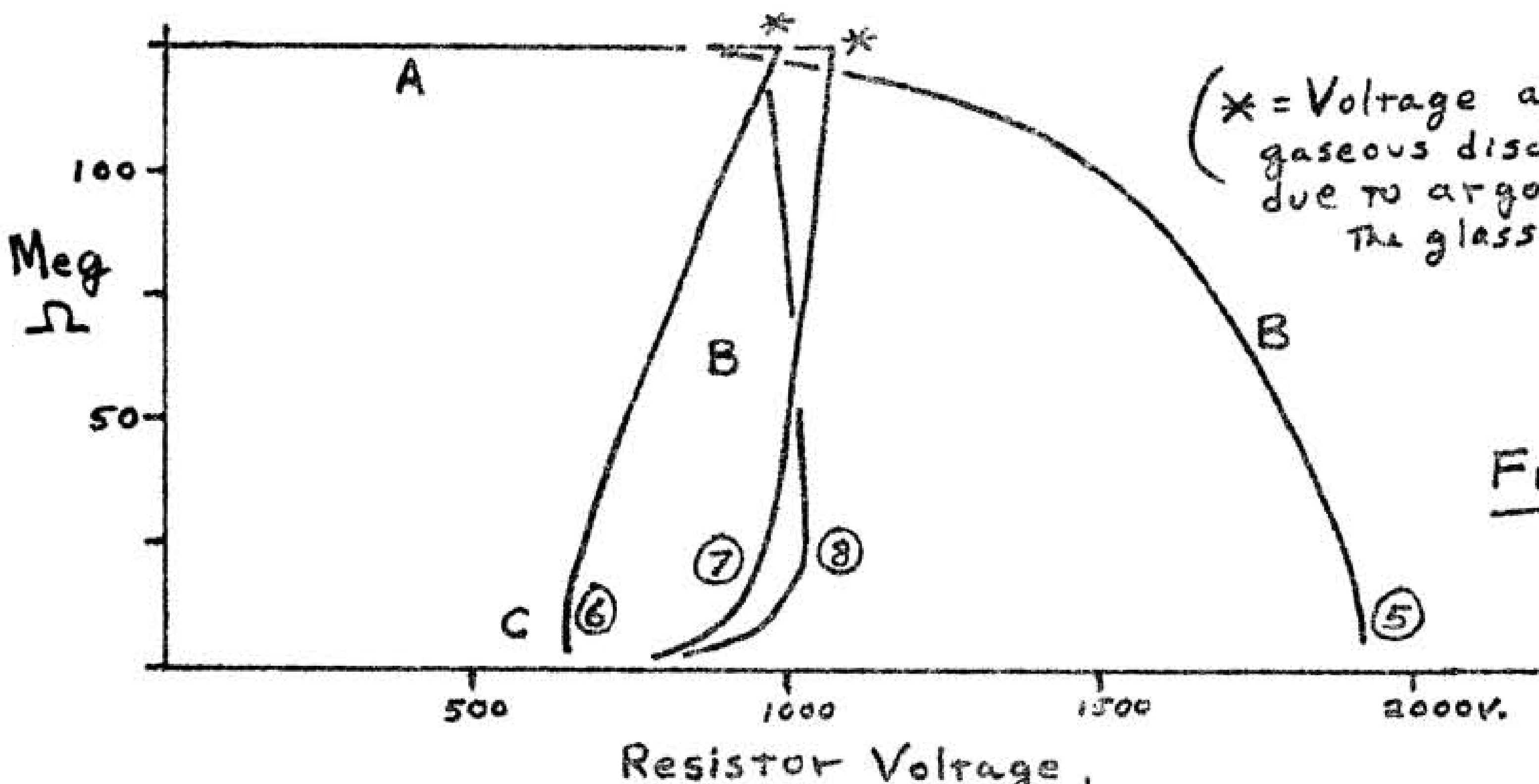
Fig 2: Power supply used for tesring resistors
(Encircled numbers on curves refer to sample No., no other significance)

UNSTABLE RESISTORS

The resistance behaves very strangely with applied voltage!







(* = Voltage at which gaseous discharge starts, due to argon gas in the glass envelope!)

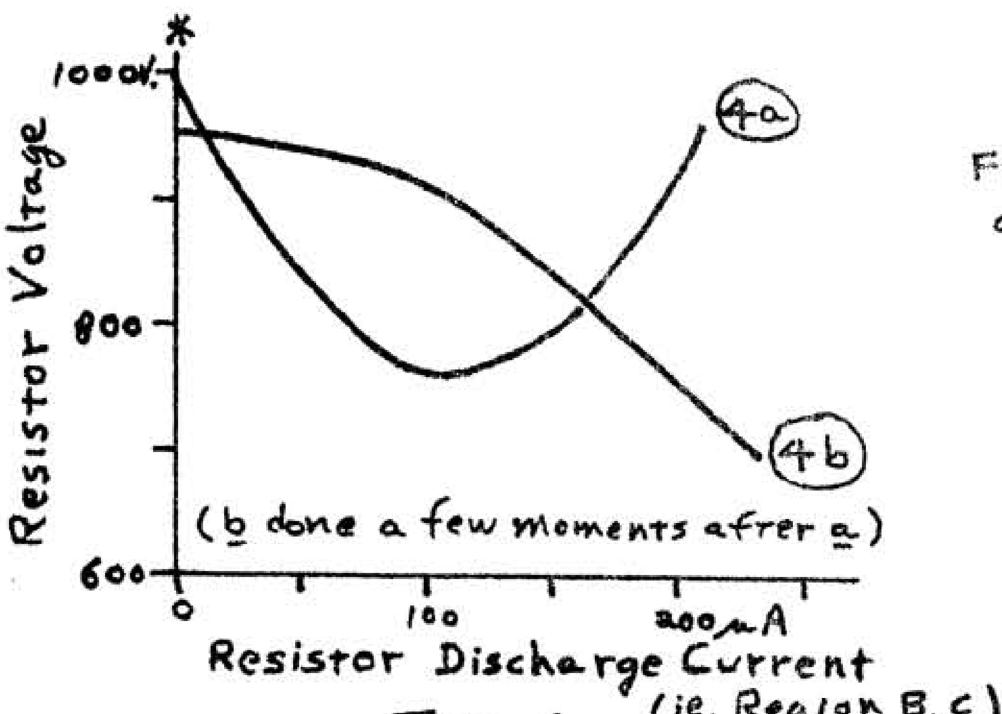


Fig. 6

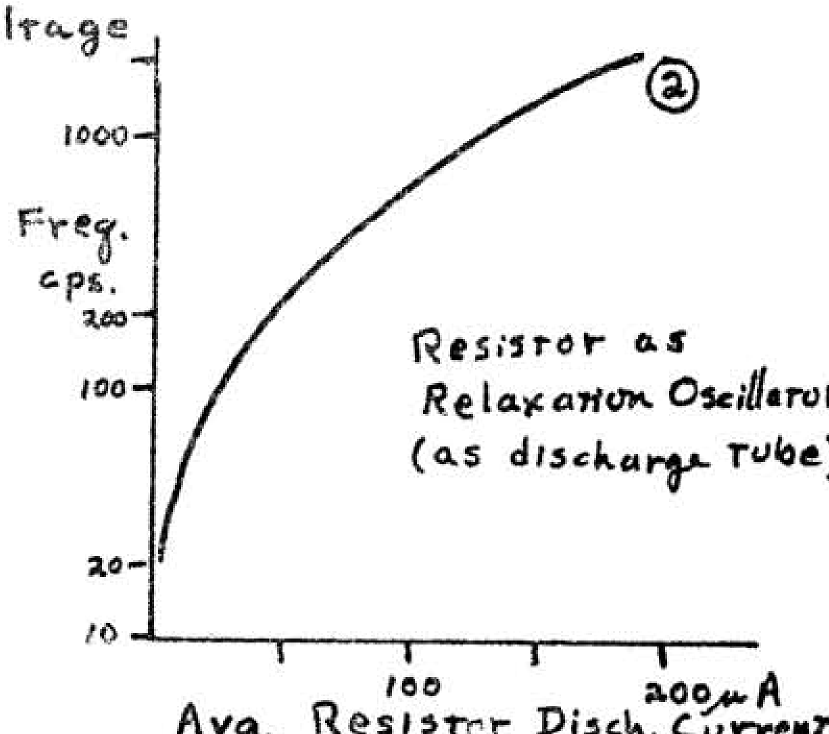


Fig. 7

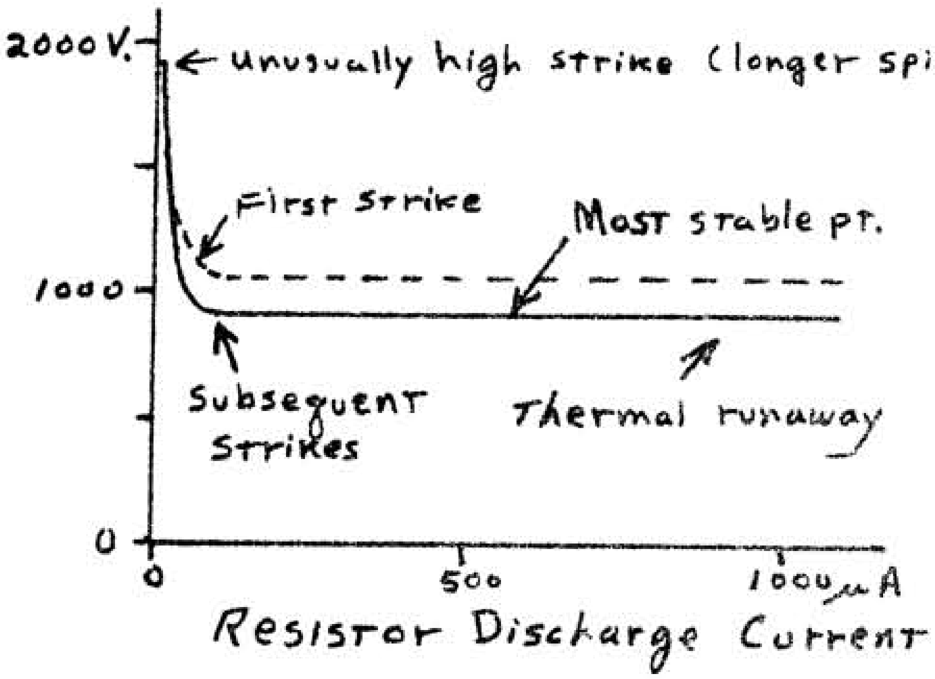


Fig. 8: Resistor as Voltage Regulator. "1000 Megs" nominal, 1 Meg pwr supply resistance. (An unusual case; most showed non-reproducible or short-lived plateaus)

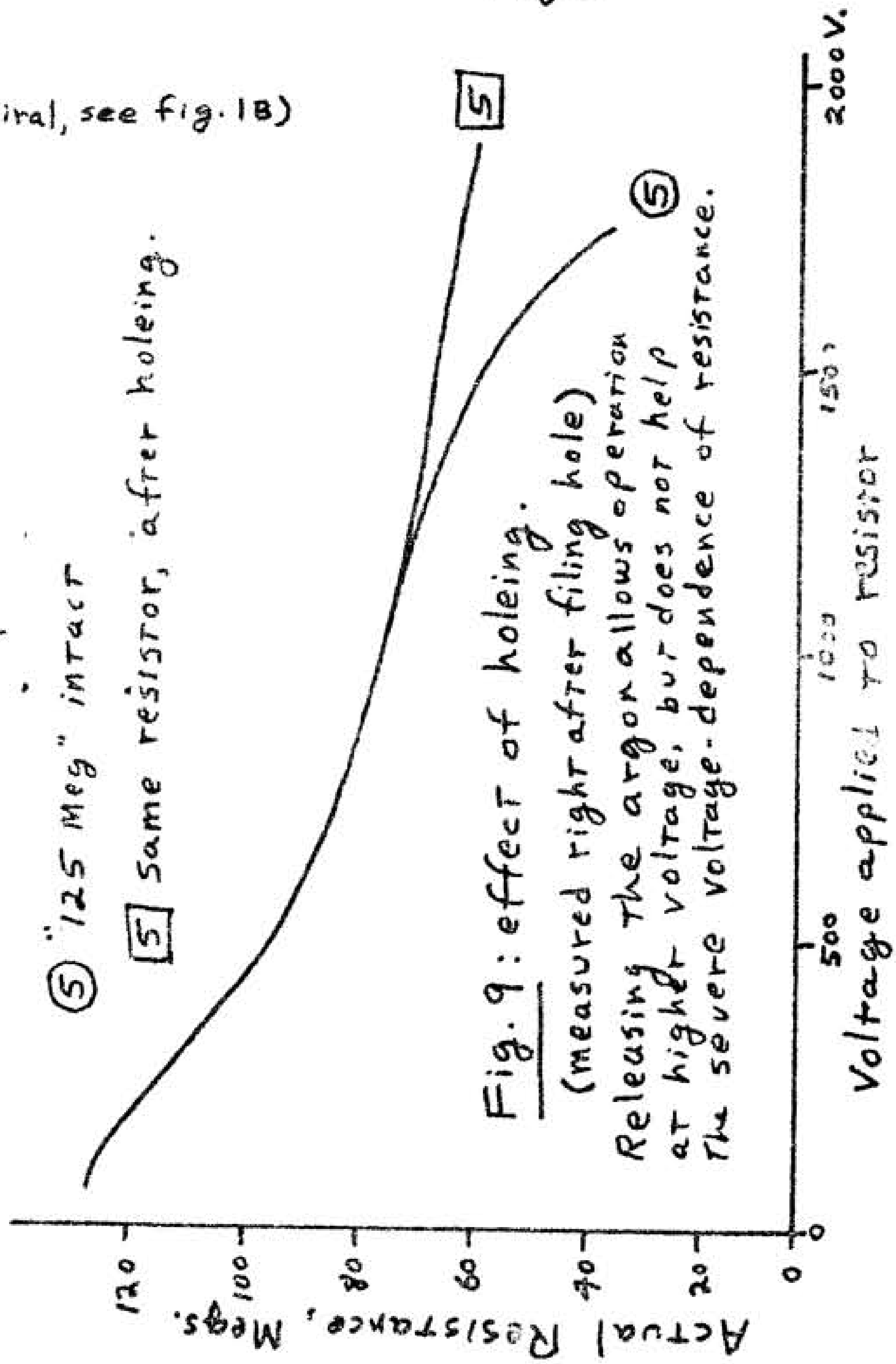


Fig. 9: effect of holeing.
(measured right after filing hole)
Releasing the argon allows operation at higher voltage, but does not help the severe voltage-dependence of resistance.

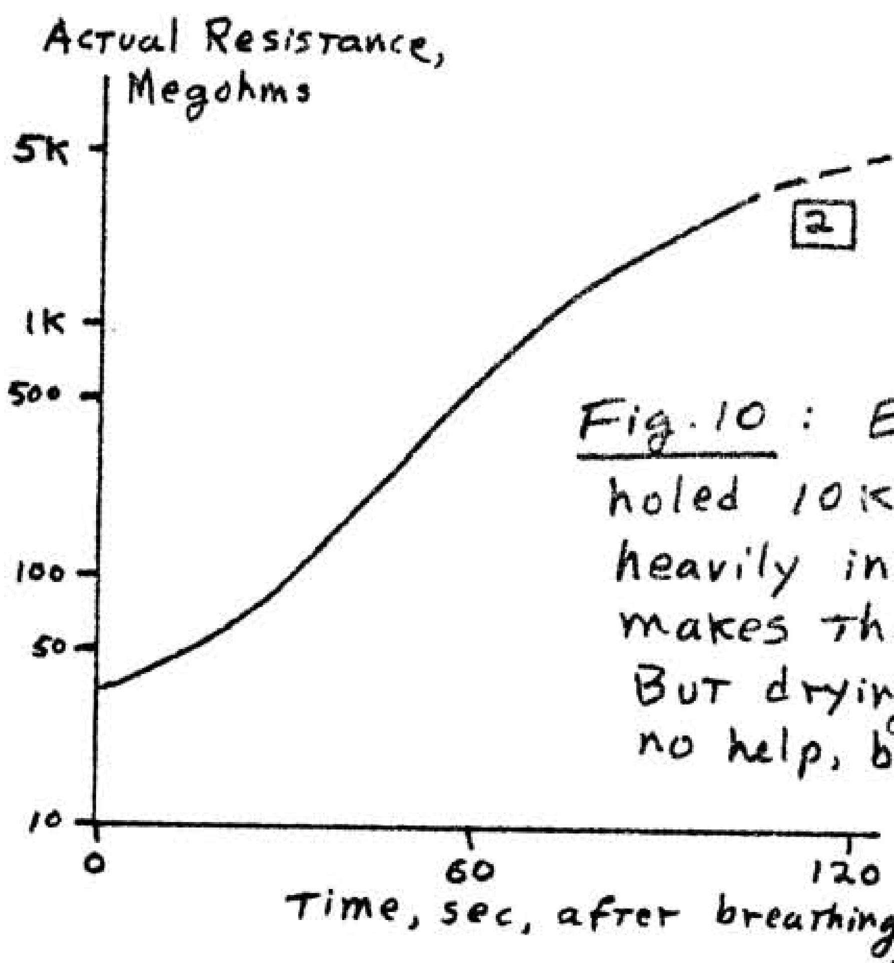


Fig. 10: Effect on resistance of holed 10K Meg after breathing heavily into the hole! So- The hole makes the resistance humidity-sensitive. But drying and sealing (as per fig. 11) was no help, because resistance still voltage-dependent. (As per figs. 9 & 11)

UNSTABLE RESISTORS

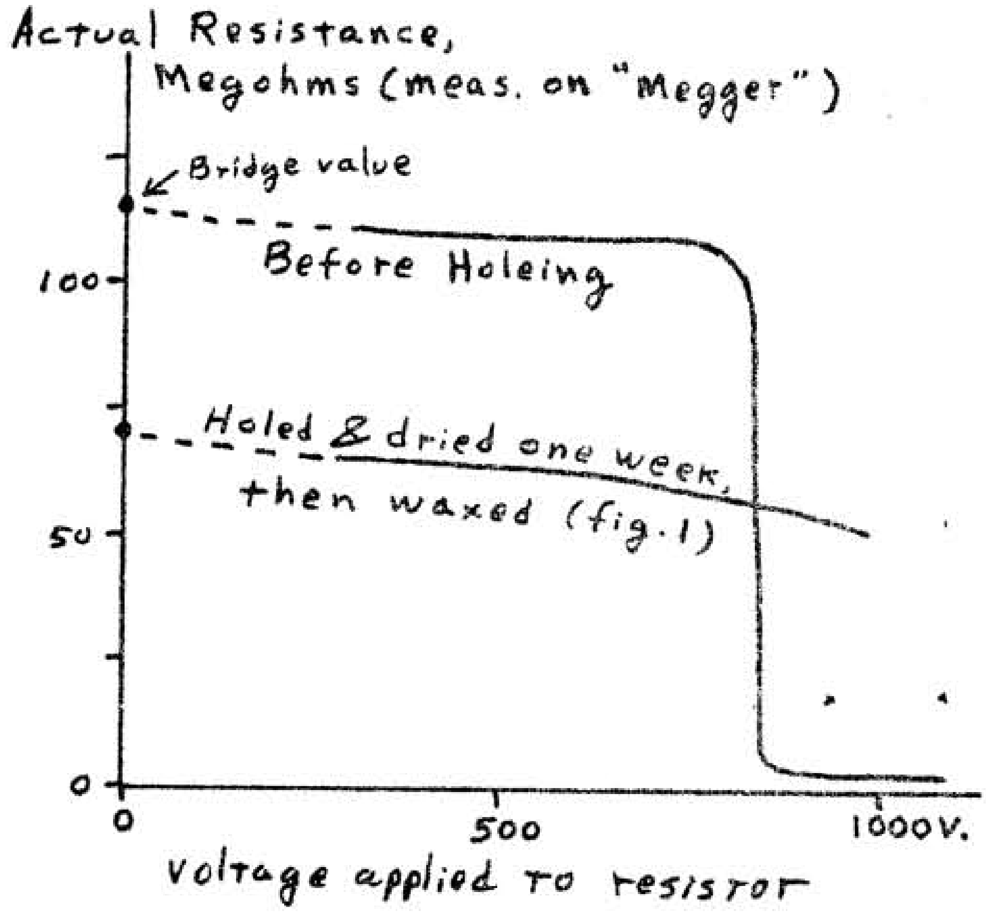


Fig. 11

CONCLUSION: Owing to gas-discharge breakdown, these resistors cannot be used as voltage multipliers above abt. 700V ea. Indeed, because of voltage dependence of the resistance, they are not dependable >100V.

This leaves them suitable only for the purpose for which they were probably designed: LT applications for electrometers, pH meters or the like.

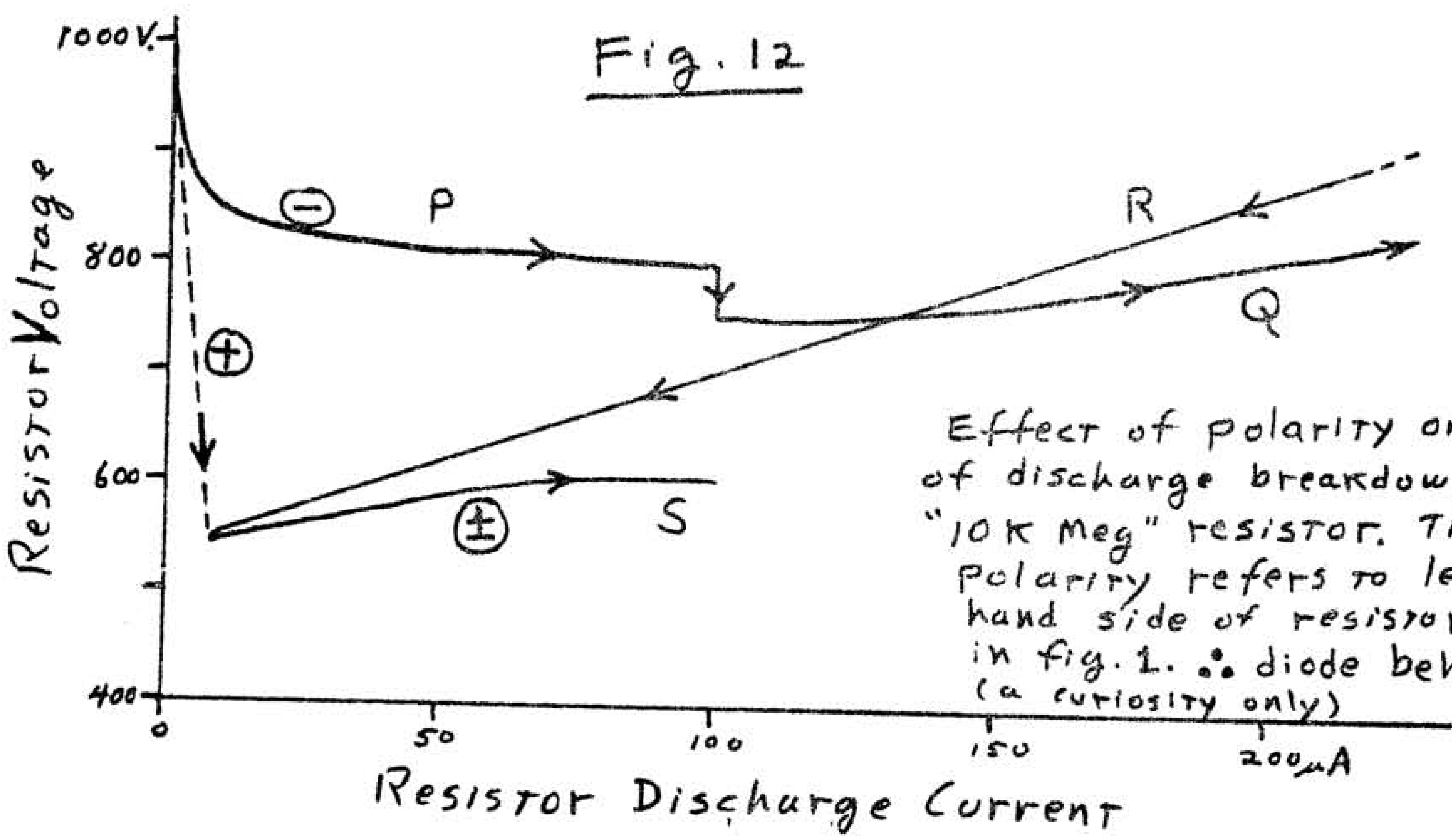
We are using them successfully in VTVM, as load for condenser microphone, and to calibrate a high gain photocell amplifier, but with caution.

The resistors are not suitable for HT glow-discharge regulators, because that behaviour is erratic & unreliable.

The "10%" tolerance seems to be mainly on the low side. Rarely did 125 Meg ones exceed 110 Megs, and some went as low as 70 Megs.

BEWARE!

Fig. 12



Effect of polarity on path of discharge breakdown in a "10K Meg" resistor. The polarity refers to left-hand side of resistor shown in fig. 1. ∴ diode behaviour! (a curiosity only)

"To adore theorems for any length of time,
faith is not enough; one also needs a police."
-- A. Camus

EDITORIAL --RLG

The other evening I was converting a farmer's radio to a.c., using the workshop I have only now got into shape, sort-of. As I worked on the power supply I thought about Stan Dixon's Letter about Integrated Circuits, Camus, the May 1969 issue of Ham Radio, and several things I have said about IC's in these pages. Here I was constructing a regulated power supply of modest though individual design. Now there are integrated circuits which can do it in about 100th of the space, and 1000th of the effort. I asked myself why I was doing this, stringing wires in the three-dimensional type of construction which is currently unfashionable.

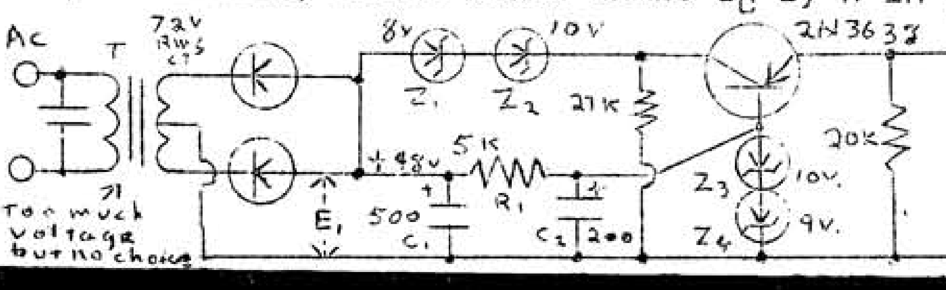
When the construction was finished, everything got checked carefully, as one must do for semiconductors, and found an electrolytic connected backwards. Then power was applied. Output from both supplies was too low, and regulation of one was terrible. And the series regulator transistor got too hot. I'll spare you the details here, but enough to say that when I finished chasing the 'bugs' I understood more than I had previously about design and practice. I also felt pleased with myself.

If newcomers to electronics simply assemble prepackaged modular Things, what will happen to this kind of experience? Furthermore, I am not altogether a newcomer to the field, yet I found occasion to learn by designing and troubleshooting my own circuit.

The question then comes to ends rather than means. If we adore the theorem that electronics is a creative experience, we need to police it with constructional experience. If electronics is a method for producing amplifiers, radios, power supplies quickly and cheaply, one can profit well from the use of IC's, Modules, and the Bargain Sales at the local Departmental Store. If the aim is to produce amplifiers etc quickly so that more profound work can be accomplished, one may needs ask whether the work to be accomplished is more important than the means to accomplish it. Perhaps it may so be, but considering the financial penalty of transients and wrong connections, the learning experience may prove upsetting, as reflected by several letters we have received on the subject. More often ICs will simply be used to save effort.

IC's are valuable, therefore, when their use achieves some engineering goal, whether it be for financial or functional profit. But they should not be used indiscriminately by experimenters merely to save effort. Why?? Because effort is a learning and a creative process. And for what other reasons do we choose electronics as a hobby?.... When you look at all those glittering IC's in the May Ham Radio, and when you think "my, thats nice, look at all the circuits I can build without trouble; why suffer when you do not have to?" -- think the second thought: If I were able to go out and buy the already completely assembled amplifiers etc, for say 10c each, would I be enjoying a hobby any more? My hobby would, perhaps, be collecting amplifiers, and maybe operating them from radios or guitars, but that would not be electronics as we know it.

For those of you who may be interested, the regulated part of one of the supplies is roughly as shown below. For fixed output, regulation is achieved with most simplicity by using zeners to control base voltage of the emitter follower; this subject will be explored in some Power Supply articles to be published here in due course, culminating in a magnificent yet simple supply by RAJR, having PERFECT regulation! Below, the zeners in the collector reduce both collector voltage [for rating], and dissipation at the expense of dynamic range; this allows use of a smaller transistor, because C_1 cleaned up the d.c. sufficiently, and output load variation was modest. Note the interesting property that if output is short circuit, I_c is limited to $\beta[E_1/R_1]$. For high output current, could still limit I_c by R in place of Z_1 and Z_2..... etc. β varies with I_c



E_{out}
18.0V at 0mA
17.6V at 80mA

Maximum output current, I_o:

$$I_o = \left[\frac{E_1 - E_o}{R_1}\right]\left[h_{FE}\right]_{at\ I_o}$$

$$= \left[\frac{48-18V}{5K}\right][13]_{at\ 80mA\ out}$$

THE AUSTRALIAN EEB

AN INFORMAL ELECTRONICS
EXPERIMENTERS BULLETIN

Editorial Office:
P.O. Box 177
Sandy Bay, 7005
Tasmania,
Australia.

20c per copy

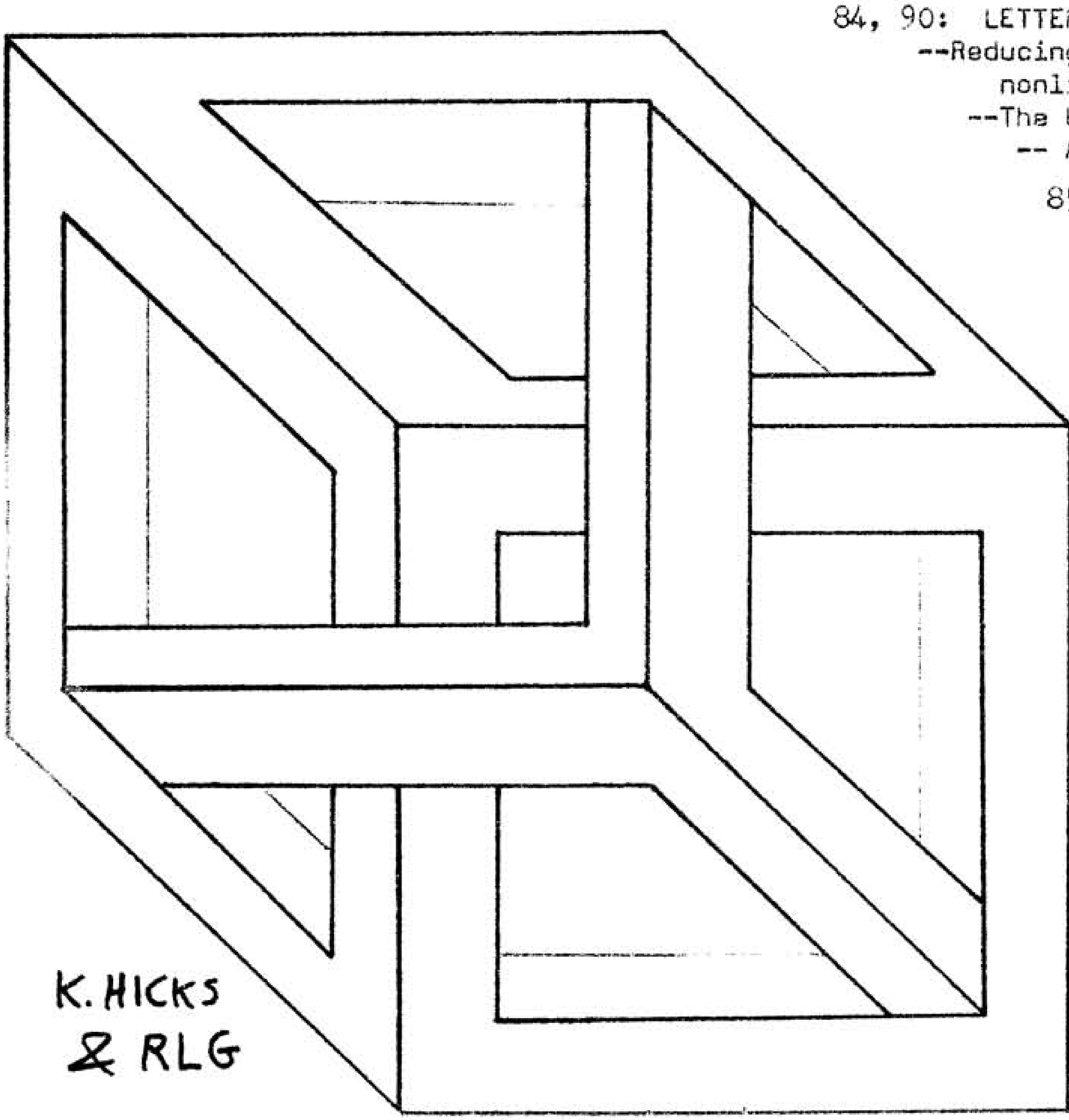
Australia and N.Z. :

1 yr.	2 yrs.	3 yrs.
$1.00	1.75	2.25

Foreign: 80% higher

AUGUST 1969 VOL. 5, No. 6 P. 79

CONTENT:



NEXT ISSUE: Sept.

The Receiver Signal Slicer, a marvelously useful device.
And: Periodicals of Interest, a long-awaited feature.

ELECTRONIC ORGANS, Part II [Ref EEB, June 1969, p. 50]
-- Tone Generators using Computer Board Transistors -- R. E. Dunk [VK2]

The LC Oscillator part of the circuit shown in fig. 1 was described in 'Mullard Outlook,' March/April 1966. The second transistor was added as an overdriven buffer to degrade the sine wave output waveform to increase its harmonic content.

As the computer circuit boards contain both NPN and PNP transistors, two circuits were used with the tone outputs a.c. coupled into the keying circuits to isolate the different polarities.

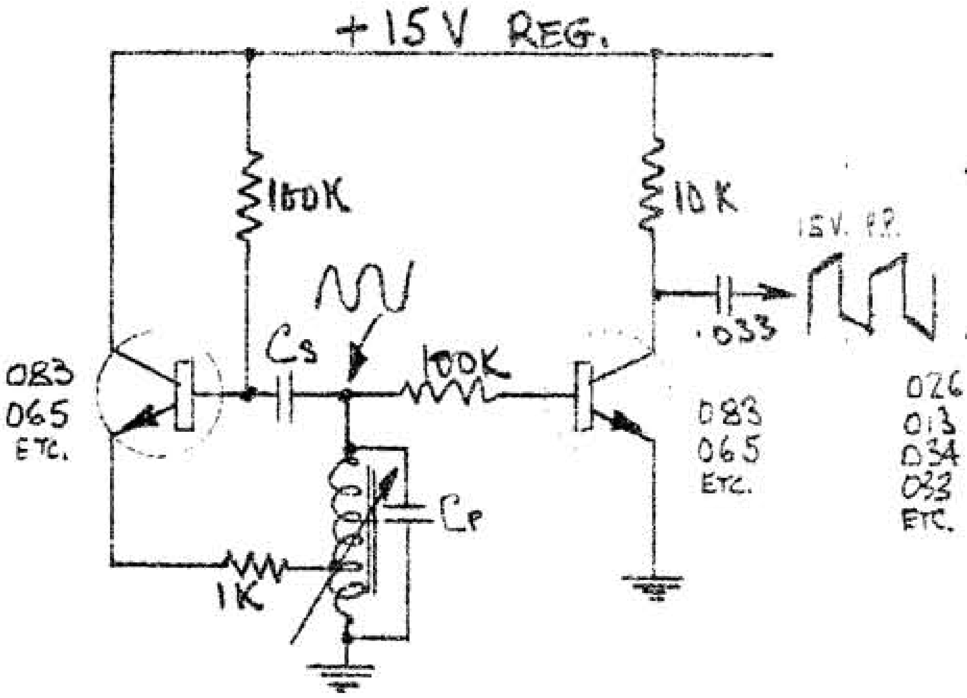


Fig. 1. NPN Circuit.

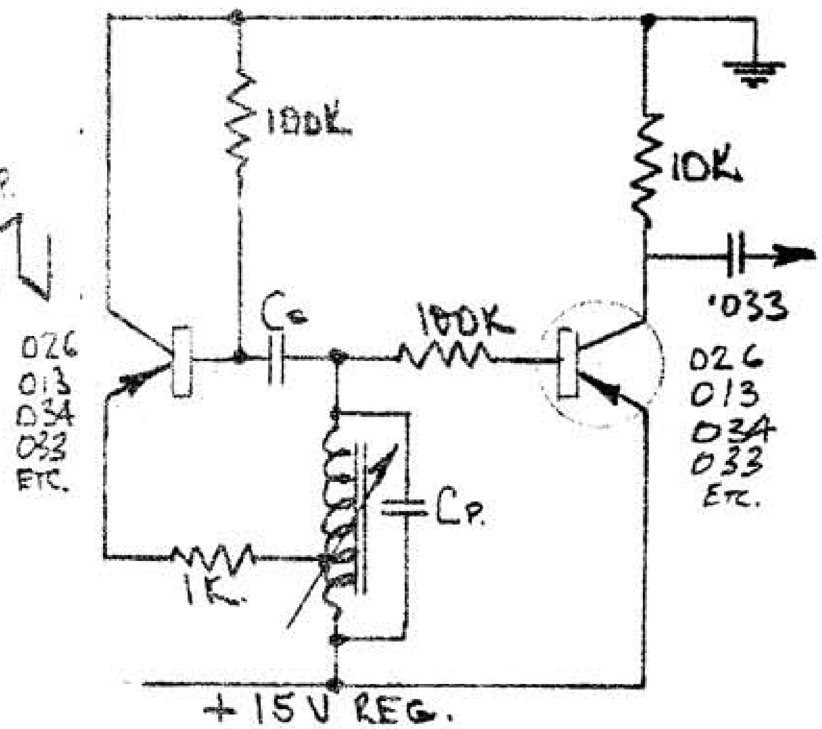
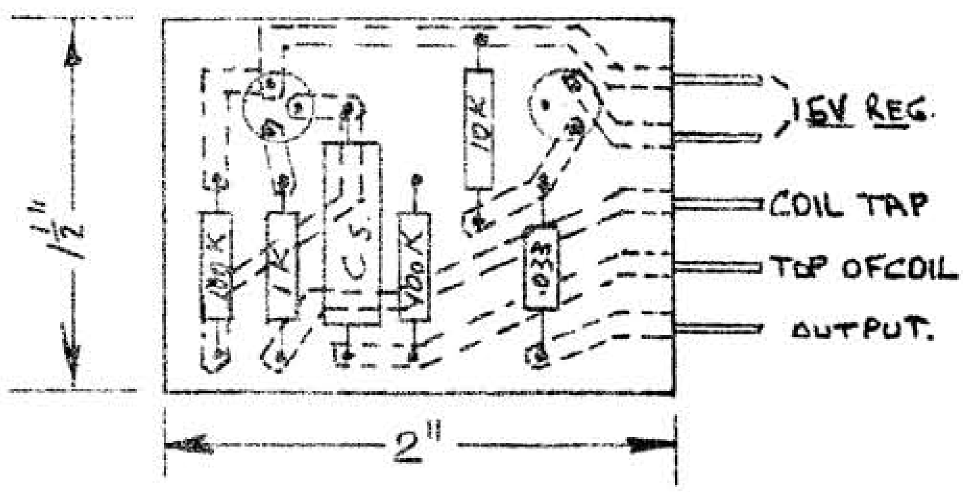


Fig. 2. PNP Circuit.

Fig. 3. Circuit board layout viewed from component side.



A printed circuit board was designed to carry all the components except the coil and the tuning condenser, C_p. The full-sized layout is shown in fig. 3. A drilling jig was made of sheet brass, and after drilling the boards, the bitumen paint and ferric chloride etch process was used quite successfully, according to conventional techniques [e.g. EEB, Vol. III, Apr, June-Aug, Oct, Dec; Vol IV, Mar, Dec].

The coils were scramble wound on square plastic bobbins using 36 B/S enamelled wire, and then mounted on a 1/2" standard EI lamination stack as used for small speaker transformers. The clamping bracket was modified as shown in fig. 4 [p. 81]. The I section of the pack is a tight fit in the clamp, and is moved by the adjusting nut to alter the air gap and hence the inductance of the coil, for tuning.

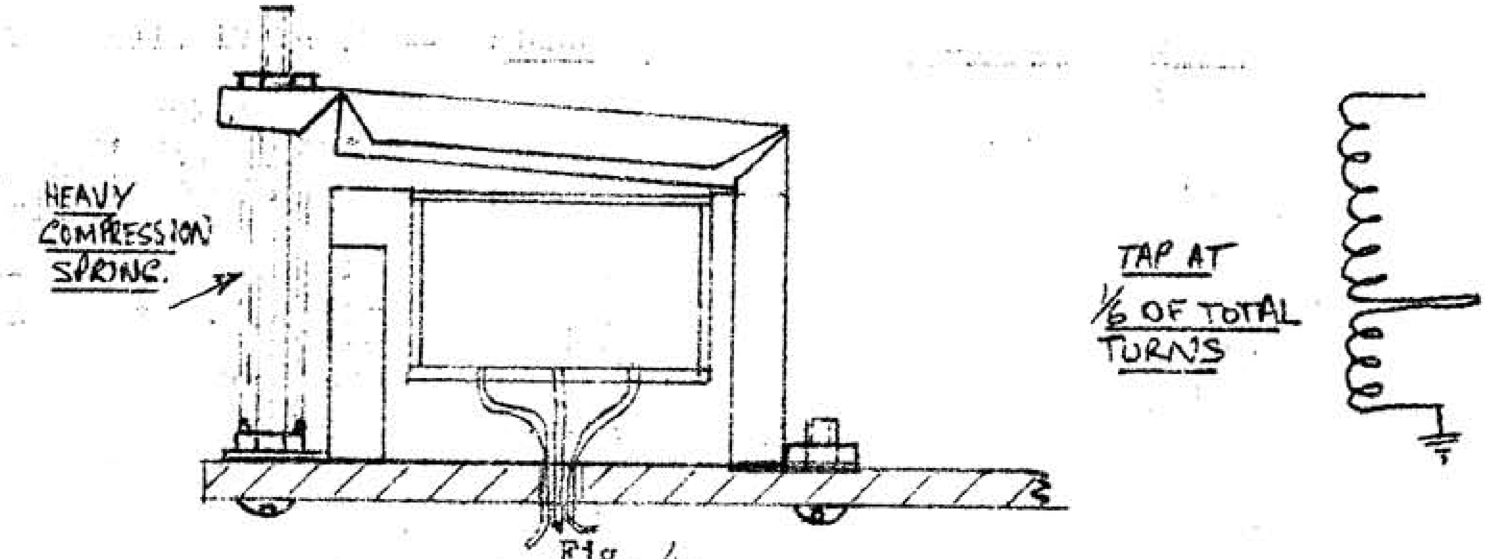


Fig. 4.

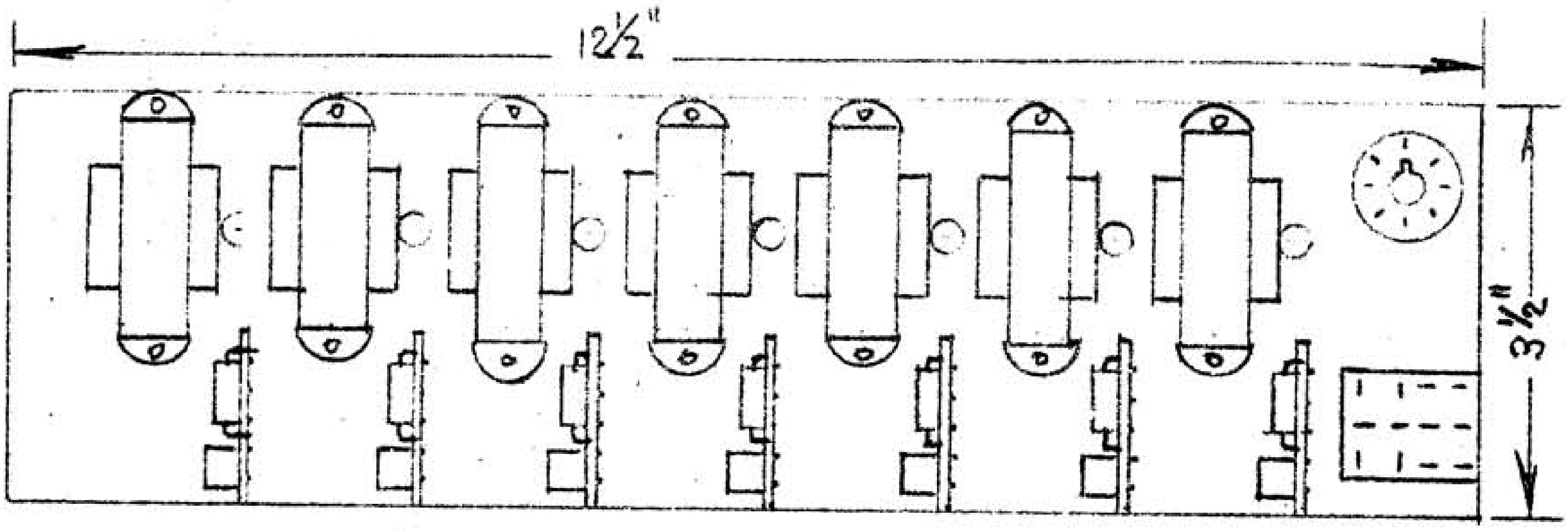


FIG. 5

Five and one-half octaves have built so far, totalling 66 tone generators, and it is intended to extend this to 7 octaves to improve the versatility of the two-manual organ.

As can be seen from fig. 3 [p. 80], the inductors are not mounted on the circuit board, as it was decided to group the 7 octaves of each note on a 1/8" thick bakelite panel 3-1/2" x 12-1/2" with the inductors mounted beside the circuit boards. Fig. 5 shows the layout of one of the 12 panels required. The 8-pin socket supplies the 7 tones to the lower keyboard, and the 12-pin socket takes in the 15V power and applies the 7 tones to the upper keyboard. The polyester tuning condensers [C_p] are under the panel, soldered to the appropriate pins of the circuit boards.

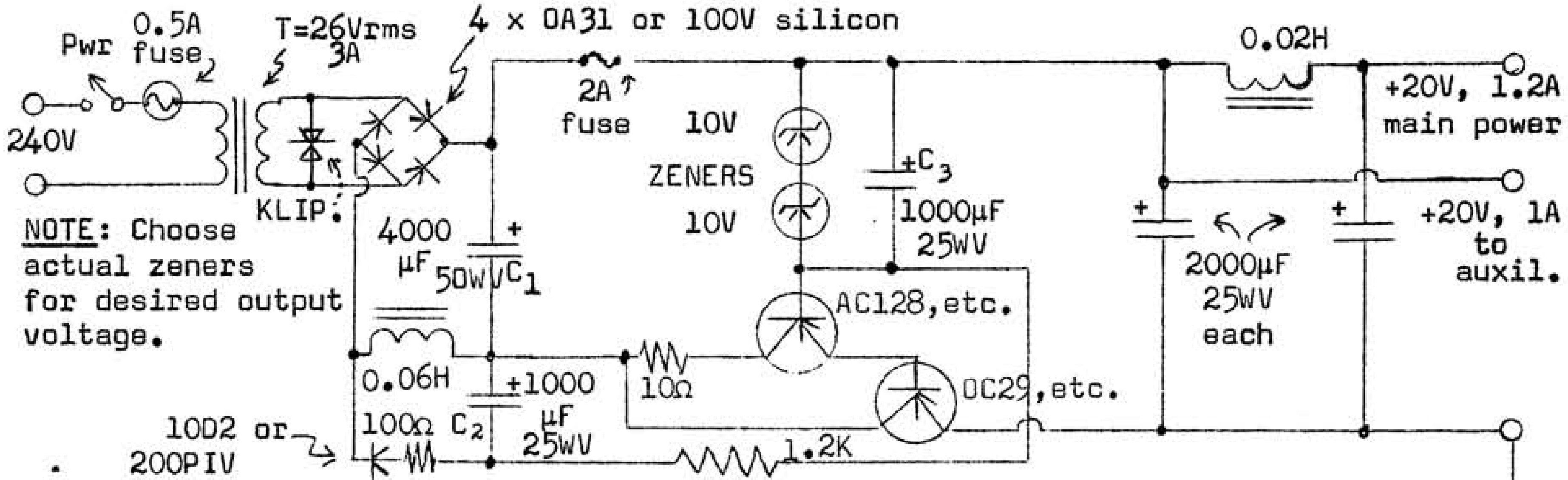
The set of tone generators has been operating in the organ for many months now, and apart from a few weeks settling in, has maintained good frequency and amplitude stability.

NOTE	FREQUENCY	C_p, µF	C_s, µF	TURNS ON COIL
C1	64.406cps	0.47	0.1	5000
C2	130.81	0.22	0.047	4000
C3	261.83	0.1	0.015	3000
C4	523.25	0.027	0.0047	3000

NOTE	FREQUENCY	C_p, µF	C_s, µF	TURNS
C5	1046.5	0.015	0.0033	3000
C6	2093.0	0.0047	0.0022	2000
C7	4186.0	0.0022	0.001	1000

I should be pleased to hear from anyone else who is interested in electronic organs, to exchange ideas. [[Editor's Note: Mr. Dunk furnished such excellent drawings that we were able to use them directly, for which we are most grateful. For mechanical details about organs, try early RTVH, 1957-9 or so; Also July 1969, p. 105]]

A REGULATED POWER SUPPLY SUITABLE FOR AN ELECTRONIC ORGAN: -- K. H. Vieritz [VK4]



NOTE: Choose actual zeners for desired output voltage.

Features: High efficiency, extremely good regulation, extremely low ripple [very necessary for the miles of wiring used in an organ, and the number of pre-amps necessary]. Long turn-on time prevents that annoying THUMP and keying circuits turning on.

As described [independently] last month [EEB p. 76], zener control of voltage is the simplest method for obtaining high degree of control; to do as well with amplifiers requires much circuitry. One other important fact which RLG didn't have room to mention was the 'condenser multiplier' action of the emitter-followers. The effective value of C_3 is multiplied by the cascaded amplification of the two transistors. For a reasonable combined β of say 1500, the effect is the same as through a condenser were used at C_1 having a value of 1000µF x 1500 = 1,500,000µF or 1.5 Farads! You see why ripple is low? In general, however, be warned that this trick works only if C_1 has cleaned up the d.c. considerably already, because the transistors are not a condenser [i.e., they do not store any energy], they only act like one [to reduce ripple]. The zeners also reduce ripple.

The zeners are 300mW types [Australian or European rating; Americans use 1W]. The 2A fuse is placed on the output side of C_1 to reduce tendency to blow it via the charging current of C_1. If C_1 goes, the 0.5A fuse will go, so don't worry.

For transient protection I used a two-plate 'Klipsel', but a 0.1µF condenser would work as well if diodes are used with a PIV of at least 100V. Alternatively 0.01µF could be used across primary [but do NOT use both!], but then it ought to have a voltage rating at least 800VW. The subject of transient suppression will be considered as part of the series on Power Supply Design, eventually to appear in EEB.

The input choke is also necessary, for reasons I shall discuss in my part of this series, though its value is not particularly critical. It may be constructed easily from 100T of No. 17 on a one square inch core with no air gap. Output choke = 17Turns.

> > > > > > > > > > > > > > >

SNAFU -- RLG

At the end of 1967 we ordered a 'Hobbies Manual' from a group called 'Electroniques' in England. I was curious, and thought you might like to know what was in it. Through the past year and a half, various correspondences have been exchanged with them, but still with no Hobbies Manual forthcoming. Finally I got disgusted and asked them to refund the 26/6. They did this, including a gracious form letter thanking me for my interest, and saying that the 1968 issues of the Hobbies Manual were now sold out! I thought you might be interested to know.

QUOTE WITHOUT COMMENT:

"Nothing annoys those who govern, more than the suggestion that they might after all not be so wise as they themselves imagined..." -- Bertrand Russell.

A LIGHT-OPERATED HEADLIGHT DIP SWITCH -- R. M. Gebhard [VK5RI]

Some time ago I felt the need for a light operated headlight dip switch, for the current car. After some experimentation I came up with the one detailed here. It is quite sensitive and inexpensive.

Components

All transistors are the type 083, or equivalent NPN taken from the current rash of computer circuit boards. This is also the source of the two diodes. These are suitable for a negative-earth system. For positive-earth, one could use 033 or 034 transistors from the boards, or equivalent PNP's [but not 015, 016 etc; See Computer-Board Transistors article in Amateur Radio, Aug. 1969]. In that case the diodes and 100µF polarities would be reversed.

The light-dependent resistor is a type made in a small glass capsule, known as B8 731 03, made by Philips, but the unit would most likely work OK with any similar resistor. The dark resistance of this one is 2-4Megs. In strong light [e.g. direct sunlight] it falls to about 10Ω. In this circuit, it would probably be operating in the range of 0.5Meg dark [with some ambient light] to perhaps 1000Ω in the light of an approaching car.

The relay is a small sealed item available locally for 75c. It has two separate 500Ω coils, and is said to be a 24V relay. Any fairly sensitive relay could be used if it had the same coil and contact configuration; without T4 and T5 system, only one coil would be necessary. The coils of this one are connected so that when energised they aid each other.

The diode, D_1, is intended to make the switching action more positive, but a 25Ω resistor could be used instead.

Operation

T4, T5, and their associated relay connections and circuitry have the effect that when the unit dips the lights, it will not allow a return to high beam for about 10 seconds. It can be omitted if this property is not desired.

The LDR should be fitted in front of the driver at the lower edge of the windscreen where it cannot 'see' the reflected light from the road. The sensitivity control, the 5K pot in the base of T3, should be fitted in an easily reached position to allow the unit to be adjusted by the driver. Some adjustments may be necessary in the initial stages. In my case, the lights would dip in the light of a full moon if the sensitivity were turned up.

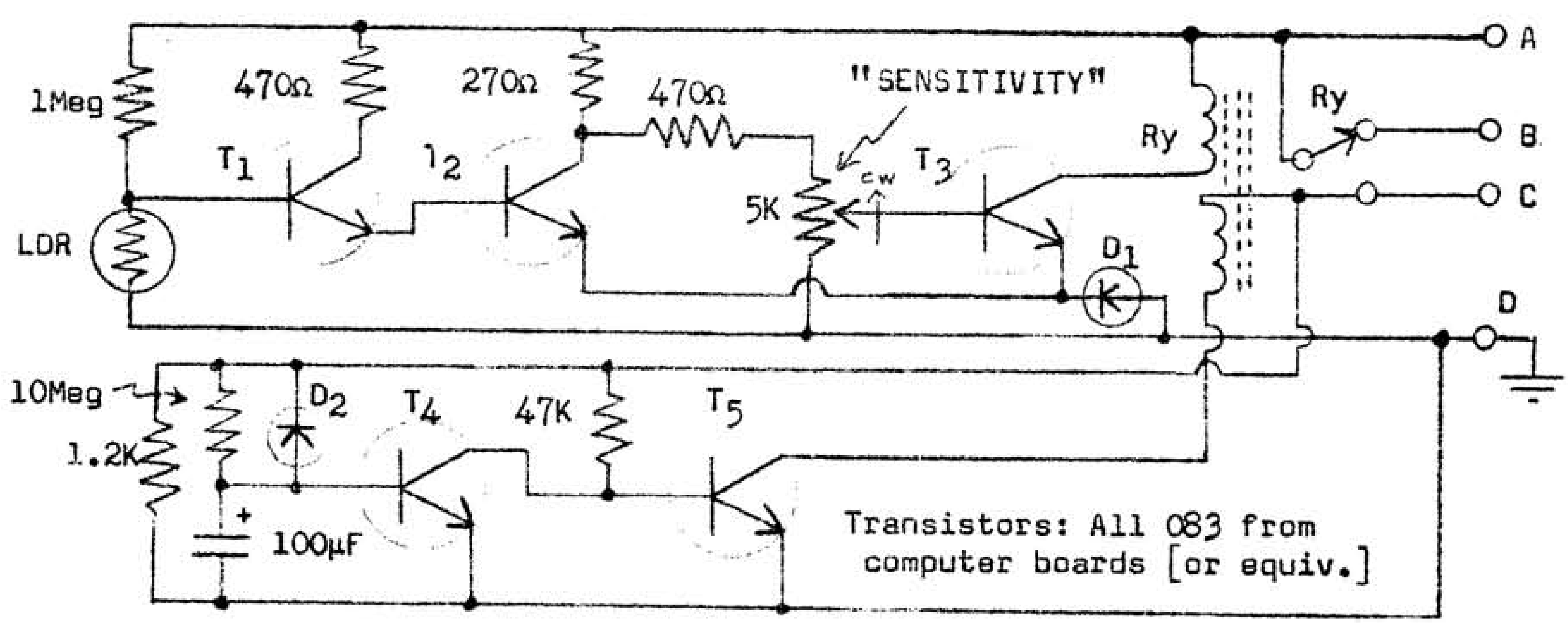


Fig. 1: Circuit for the Lamp Dimmer: 12V Negative-ground only, but see text.

screen where it cannot 'see' the reflected light from the road. The sensitivity control, the 5K pot in the base of T3, should be fitted in an easily reached position to allow the unit to be adjusted by the driver. Some adjustments may be necessary in the initial stages. In my case, the lights would dip in the light of a full moon if the sensitivity were turned up.

There are various ways in which the unit can be hooked up to control the headlamps, but specific application will be left to individual experimenters; anyone able to construct the unit will have no difficulty with the relay connections. In general however, A will go to the foot switch, B to the Highlights Relay, and C to the Lowlights Relay. On the other hand, in my installation, the unit is used to switch additional high power lights mounted low on the chasses; they are merely switched off when the lamp-dimmer is energised.

One thing is mandatory: it is essential that the small relay in Fig. 1 not be used to control appreciable current; that must be handled by conventional headlamp relays, suitably connected.

As shown, this unit is suitable only for 12V negative-ground systems. Positive ground modifications have been described above. The circuit could undoubtedly be altered to work on a 6V supply by suitable choice of base bias resistors and relay.

Editor's note: This is a nice idea, but the operator ought not always to rely on it, unless sensitivity could be adjusted for the situation in which the opposing car comes around a sharp bend in the road. In that case, some operation of the manual dip switch may be necessary, because the eye might catch the glare from the other lights before the LDR did; this can be tested only in practice [let us know the results]. Some constructors may also wish to install a spring-release type toggle switch to 'blink the lights' to stimulate virtue in the kind of driver who does not automatically dip his lights when your own car approaches. If you use extra Quartz-iodine lamps, you will obtain excellent light, and the stimulus to said virtue will be considerable.

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LETTER: Reducing Nonlinearity in Bipolar Transistors

I read anything I can get hold of on radio generally and transistors in particular. Unfortunately I don't have anything approaching your book and periodical list! And it seems that I have missed something along the line in the last 3-4 years -- I refer to cross-modulation in r.f. stages using [ordinary] transistors.

I have a book, 'Design of Low Noise Transistor Input Circuits', by William A. Rheinfelder which goes into the subject in some detail. He maintains that there is a particular current at which third order curvature and cross-modulation are nulled to zero. Apparently it varies with each transistor and with the input impedance of a particular circuit, so would need to be checked in every case. If, however, you have gear to measure noise figures of very few db's, this shouldn't be a problem as I see it. So there it is; where could he be wrong? There must be a flaw somewhere?

I was thinking pretty much along the lines of using his data, together with the diode mixer [ring modulator?] in a recent Electronics Australia, and using passive AVC. But I shall do some thinking about FETs first.

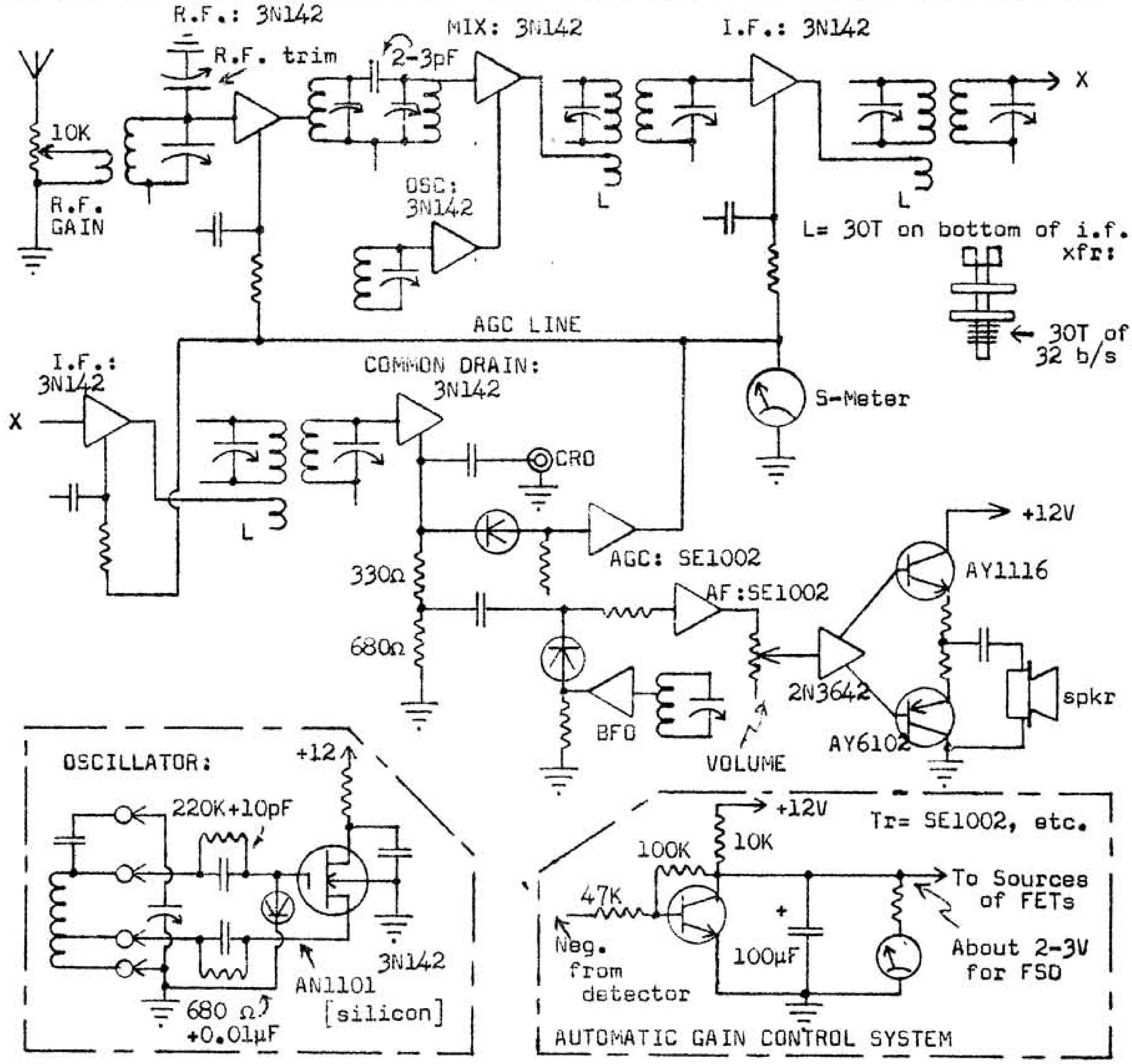
-- A. Hill, East Victoria Park, W. A.

[[This third order correction idea is quite OK, and would solve matters if that was all there was to it. We do already operate at the most linear part of the characteristic curve available. We face the problem, perhaps not considered by Rheinfelder, that the input signal can go right off the end of the curve when it is too strong, causing havoc. Under such circumstances it is unrealistic to talk about the most favourable operating point. When such gross overload occurs, we find 2nd, 4th, 5th, and higher order products. It is to the elimination of these that we have been devoting much space here since June 1968. [Continued on Page 87]

FET CONVERSION OF AN HRO RECEIVER -- I. N. Kallam [VK3]

It appears to be the fashion to convert receivers with FETs [e.g. EEB, April 1969, p. 39], but this article was written before all that and has been languishing in EEB files -- bad them [See also: AR, 6/68: 'Solid State Modules.']

I have been using 3N140 tetrode and 3N142 triode MOS FETs at high frequencies, and they are by far the best I have struck yet; they leave the MPF and 2N3819 far



behind. I applied the 3N142 to the conversion of an HRO, ex U.S. Navy rack mounted receiver, originally very bulky. I took a hacksaw, and now I have a MINI-HRO, 12in. wide, 9in. high, and 8in. deep.

The above diagram is abbreviated, rather. If you know what I'm talking about, you'll have no difficulty, and if you don't, you shouldn't attempt the job anyhow.

I might say a few words about a few circuit details, and particularly about the choice of transistors.

Performance

I found the single r.f. stage with bandpass tuning to be much better for avoiding cross-modulation, than two stages, and S/N was quite satisfactory. The original i.f. transformers work very well with the added primaries ['L']. Total current drain is about 30mA, no sig at 12V. Sensitivity is about 1µV for 10db S/N. That's not bad, but it could be much better if coils were altered somewhat to match the antenna and the FETs. Selectivity is +12kc for -80db, which is also not too bad for single conversion.

The AGC System

The AGC system is not unlike the rather more involved one described by G. G. Miler, Jnr in QST for April 1969 ['Amplified AGC for the Heath Mohawk Receiver', p. 35]. It derives from a system I have used on valves since 1960, controlling the cathodes rather than grids; this eliminated any high resistance in the grid circuit, preventing grid blocking with strong signals or noise pulses. I have carried on the idea with FETs, as it allows the tuned r.f. circuits to be earthed, simplifying band changing. With FETs I usually bias the gates positive about 2V on a 10V or 12V supply, and vary this and the source resistor to give the desired AGC characteristic for that stage. The system works just as well with ordinary bipolar transistors.

Instabilities

With most FETs I now put a 100Ω to 1000Ω stopper in series with the gate, even at HF, and with a common drain stage it is mandatory if the tuned circuit is low C [below 100pF]. The stopper is particularly mandatory to stop instability >12Mc when using 3N140's or 3N142's.

Transistors

The choice of transistors in the i.f. stages and following, is not particularly critical and may well depend on availability as much as anything. After the above circuit was constructed, 3N- series transistors became scarce in Melbourne, so I built up an i.f./detector system using 2N4360 junction types; although the 2N4360 is a much inferior transistor, it worked fine. Provided AGC in the r.f. stage prevents i.f. stage overload, no problems were encountered.

I might note that when using the junction FETs as i.f., the source-fed AGC system is mandatory. Not only does application of AGC to the base or gate of a junction type produce high cross modulation, it is highly undesirable because variation of gate or base bias detunes the input circuit -- presumably owing to varicap action. Only with insulated gate FETs is it possible to apply AGC to the gate.

The tetrode FET has a reputation for improved performance, but I found that the 3N140 was unstable as an r.f. stage above 10Mc in my unit, therefore the 3N142 triode. Certainly it is attractive to be able to vary gain by applying AGC to the second base of a tetrode, and to mix by applying oscillator signal to the second base of a tetrode, but there can be other factors to consider. As R. A. Reynolds has pointed out so cogently in last months EEB, the MOS FET is considerably more sensitive to overload in the gate circuit, compared to the junction FET.

I know that a number of radio amateurs are finding the MOS series very delicate and several have said that they are going back to two MPF106 types in cascode, as protective diodes do not conduct fast enough to protect 3N-series transistors. I have been caught many times with new and marvellous semiconductor devices which did what they were supposed to, but which also were beasts for troubles. Consequently all of my designs allow for the use of alternative devices. Thus, although dual-gate control has its advantages, my source-controlled AGC system has allowed me to make various substitutions as convenient; for example the HRO now uses an MPF102 oscillator and the i.f. strip using 2N4360's shows that these would probably work satisfactorily in the HRO i.f. circuit.

The high gain is nice, but as Mr. Ferris points out, only useful over narrow bandwidth. As soon as it is broadbanded, gain falls, but that is not the worst. You also end up with a multiplicity of lobes out at the sides, and the broader the response, the bigger these become [that is why forward gain decreases]. This degrades the Front/Side ratio, not to mention the Front/Back ratio. Furthermore this behaviour is not constant with frequency; the pattern changes drastically at different frequencies of operation!

By infinite fiddling about with antenna geometry you can make a fair amount of compromise between these complexities, for 'optimum' performance, but at the end you will find that you have produced something like a log periodic array. Then why not do it properly in the first instance, and start with a log periodic? We can calculate the theoretical values for constructing one of these log arrays. For example, see Telecommunications Journal of Australia, Feb 1967, "Cairns to Weipa Radio Link," by R. P. Tolmie. Although Mr. Tolmie's article goes into considerable detail, he also presents a simplified procedure which will allow design of a practical antenna for really good performance, depending on the size and expense you are willing to tolerate*.

Can Amateurs do better? [-- RLG]

It would appear that Dick Ferris has nearly been 'scooped' by the news in the recent Ham Radio, but he has a trick or two up his sleeve; but alas it will have to wait until examinations are over.

Of considerable relevance to the present subject is the also-interesting article in the July Ham Radio by B. Clark, K6JYO, "Direct Methods for Measuring Antenna Gain." It should be read in conjunction with "Finding True Receiver Sensitivity," by J. J. Schultz, W2EEY/1, CQ, Nov. 1968, and reprinted recently in Amateur Radio. K6JYO shows how considerably more reliable measurement of antenna gain and pattern may be obtained by using a calibrated attenuator with receiver, and switching between a reference antenna and a test antenna. And, among other things, he describes how a commercial array claiming 'over 17db forward gain' actually measured negative 2db off the front, and +6db off the back! "Cutting the antenna in half got about +8db forward gain."!

In the same vein, I wonder what is the meaning of a prominent advertisement for a three element Yagi, claiming 'optimum spacing' for 'full power.' This "maximum gain performance excells most four to six element arrays." Excells them how? Assuming that magic has not been invoked, if gain is high, bandwidth will suffer; if broadbanded, whence the gain and directivity? The arrangement of elements is unlikely for logarithmic performance. Unless something obvious is evading me, the conclusion seems inescapable: the narrow bandwidth problems described in the above exchange arise from the wide use of commercially-made beams designed for 'maximum gain performance.' Just as many of the problems of communication on the amateur bands would seem to arise from the facile use of commercial transceiving equipment.

High Performance is Desirable! [-- RAJR]

I have received some letters which suggested that some matching faults might well prove beneficial by altering the radiation pattern of an antenna in one way or another. In an era when maximum performance in almost any field appears to be desirable, this sort of thinking seems to me unjustified. The job of putting up an aerial must be an exacting one. Whenever incorrect design is used to change the performance of an aerial outside its design range, the performance at the original design centre must be degraded. We usually strive for peak performance in a receiver, so why degrade an otherwise peaked aerial in order to obtain performance, say, in another band where, at best it can't be much better than a piece of wire strung up the side of the mast?

---

* Imagine an antenna [of considerable dimensions] having appreciable gain, allowing true SWR < 1.05 over the range 2Mc to 9Mc!

ANTENNA GAIN, FACT OR FICTION?? -- A Squaretable* : Thoughts from VK7

When is an antenna?? [by R. Ferris, VK7ZDF]

In these days of super-performance low-noise crossmodulation-proof high-gain VHF FET converters, it is appalling to see the preponderance of basically inefficient antennae connected to them!

A good example of this is the performance of the ubiquitous Yagi array. When constructed and adjusted to give reasonably high gain, its truly good performance is achieved only over a very narrow bandwidth, typically several hundred kc at VHF. This is directly analogous to the performance of an ordinary resonant circuit of very high Q.

Everyone who has built one of these directional arrays will know how sharp they are, from the critical adjustment needed just to get the things to take power, viz., to make the magic SWR meter read 1:1 [remember this when you read the Orr letter on P. 90 here]. More often than not, a typical 2M Yagi is peaked on 144.1Mc for the AM nets. At 146Mc for the FM nets this typical aerial no longer has gain; it is an attenuator, with a lousy radiation pattern too. On 148Mc it need no longer exist**. Some people complain of 'no activity' in that part of the spectrum. Small wonder.

If you had tweeked every coil for absolutely maximum gain in your receiver, studiously adjusted neutralisation and aerial tap for that last db of noise figure, you'd have to be out of your mind to detune the i.f. to give a 15db signal loss. Yet this is what happens, effectively. Aerial or i.f., the detector doesn't know the difference.

When easily-built high-gain broadband antennae such as the low-Q skeleton slot, or continuously resonant log periodic arrays are available, the present practice borders on the unbelievable.

Satisfactory designs of some sensible antennae have been described in the RSGB Handbook, and in the periodical literature. For example, in Ham Radio for July 1969, Crowell and Orr present a "Log-Periodic Yagi Beam Antenna." It is a hybrid design featuring a flat high gain characteristic over a 2Mc range at 50Mc, with extremely high attenuation for signals outside of its pass band.

This is an excellent practical design, and represents a welcome departure from the narrow band tradition described above. By using a different design it is, however, possible to obtain significantly better performance for a broadband antenna. A typical design with this characteristic will be evaluated in a forthcoming EEB.

Antenna Gain: Fiction! [by R. Reynolds, VK7ZAR]

Mr. Ferris' suggestion that an off-tune Yagi behaves like an attenuator is being kind. The existence of a peak in aerial performance close to the working frequency causes the additional problem of intermodulation from stations working on this peak, and also worsens the problem of Noise.

At this point we may hear outraged comments from readers who will maintain that they have managed to adjust their Yagis for 'fine' broadband operation. But they reckon without the fact that operation of a directional array is not as simple as tuning an L/C circuit; there are numerous subtle factors which interact.

For instance, broadbanding of an ordinary Yagi lowers gain. For a modest VHF array of, say, 6-7 elements with unloaded Q of 200, and covering 144-148Mc, overall 'gain' will only be about 6db over a dipole. For 2Mc bandwidth, this goes up to 9db. This obviously shows why such narrow bandwidths are obtained when people tune up for 15-20db gain. For 10 elements, perfectly adjusted, gains would be some 10db better than for 6 elements, with a corresponding decrease in bandwidth.

[PTO]

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* A Squaretable is a Roundtable with two sides.

**Unbelievers refer to graph of gain vs frequency of arrays in 'VHF Handbook' by Orr and Williams < Radio Data Publications>.

EFFORTLESS CROSS MODULATION -- R. A. J. Reynolds, VK7ZAR

In all the articles on receivers and cross modulation which have appeared in EEB during the past year, not once has anyone mentioned a particular problem which occurs often in urban areas, close to powerful transmitters. This problem consists of a particularly obnoxious type of interference, which in fact has come to our attention because it occurs from time to time in Hobart.

It consists of an apparent cross-modulation which cannot be eliminated at all in the receiver. It has its origin in the fact that a semiconductor diode possesses a threshold of conduction, so that it will not start to conduct until a voltage exceeds a certain critical level. Now if one's receiver is located in the neighbourhood of a powerful transmitter, it can pick up a signal from cross products of the powerful station plus a weaker one. The remarkable thing about this is that the mixing of the signals may not necessarily occur in the radio receiver at all! It can occur anywhere in the nearby vicinity where there exists the possibility of a semiconductor junction, as for example a tin roof against a spouting, or possibly aluminium window frames.

In these situations, the stronger signal develops a potential of the order of one volt or more at the semiconductor [viz oxide] junction. Then cross modulation takes place in the junction in much the same way as in any real diode mixer. When this happens, your down spouting reradiates the mixed products to the nearby receiver, and all the selectivity in the world will not unscramble them!

This phenomenon occurs not only when the desired signal is the weaker one, but in the unexpected situation when the desired signal is the stronger, as long as one of the two signals produces enough local voltage to exceed the diode threshold. I have measured the pickup voltage from a commercial signal to be as high as 10V from the roof of a well-known Academic Institution in this fair city. Under these conditions, the signal from a desired signal from the Hobart area was about 2.5mV. The two beat together nicely in the metalwork, and radiated a signal independent of either. That means that it interfered with both!

What does one do about strong signals in places like America, where 1000W [and more?] amateur radio stations proliferate sometimes in relatively limited area? K6KA has published material describing the use of front-end crystal filters, but even those would not stop pre-receiver rectification.

To this situation may sometimes be added harmonics that result from unfavourable modulation characteristics when clipping at high percentages of modulation, and the resulting 'crash' noise which interferes with nearby signals. These are due to spurious sidebands, and sound like cross-modulation, but they aren't. They can be cleaned up to a certain extent by improved front-end selectivity. They could be cleaned up even more by technologically enlightened government action.

Even the problem of pre-receiver cross modulation itself is not entirely hopeless, though it is difficult. It is possible to remedy it, but it requires a most exacting and systematic elimination of all possible extraneous semiconductor junctions in your immediate area; if they involve your neighbour's roof, some politics may be necessary. It means bonding all loose surfaces, or at least tightening them up considerably, one by one until the interference [continuously monitored] disappears. This may be tedious, but there seems no reasonable alternative.

* *

LETTER: Reducing Nonlinearity in Bipolar Transistors [continued from p. 84]

[[The very fine detail of cleaning up the last vestage of cross modulation, as Rheinfelder considers, would be applied to, say, telephone system demodulators where harmonic distortion must be kept to a minimum: of the order of $< 1\%$. -- Asst. Ed.]]

ADDENDUM: In the middle of p. 88, please add the following important reference: "Measuring Antenna Gain," by J. J. Schultz, W2EEY/1, 73, May 1969, p. 42.

LETTER: The Uses of Baluns and SWR Meters [Ref: EEB 'Antenna Dilemma' Jan-June issues]

The discussion on coaxial lines and line currents is very interesting. One point not touched upon [or at least I don't remember it] is the fact that when the balanced antenna is fed by the coaxial line, the line becomes a portion of the radiating system by virtue of the unbalanced field about the line. This may be a virtue at the lower frequencies as it could possibly "Fill in" the low angle radiation usually missing from a dipole near the earth.

In the case of beams, however, line radiation can easily degrade the F/B ratio of a beam. A case in point: W6CHE had a multielement Quad fed by a coaxial line and an ineffective balun. The F/B ratio was very poor, of the order of 6 db or so. Substitution of a good balun raised the F/B ratio immediately to better than 25 decibels. Very noticeable on both reception and transmission. As a check, the poor balun was reinstalled, and the F/B ratio disappeared.

In addition, radiation from the line can really confuse SWR readings, as the SWR meter may or may not be sensitive to these currents. Also, the SWR of the system [antenna + radiating line] is measured, NOT the SWR of the antenna alone. Thus, with line radiation, substitution of one SWR meter for another will often give entirely different readings. When the line is properly terminated and no line radiation exists the SWR meters will read closer [say 10% or so].

I have finally just about given up making SWR readings except for curiousity, and have gone back to a r-f generator and General Radio R-F bridge, plotting the data on a Smith Chart. This removes some of the uncertainty from the problem.

Am hard at work on the 18th Edition of the Radio Handbook . . . . .

-- W. I. Orr, W6SAI, San Carlos, California

[[OK, Bill, but if you must use IC's, pls supply diagrams of the insides -- RLG]]

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LETTER: Antenna Theory

I did really appreciate the articles on the unbalanced dipole dilemma [EEB, Jan-April 1969 plus several letters, to date]. I think it is the best thing I have read on basic antenna theory.

Dabbling recently with that loop antenna described in the RSGB 'Amateur Radio Techniques' has also helped me to get down to basic principles in antenna theory. But one thing still has me puzzled: if smaller diameter wire decreases the Q of an inductance [and this is clear enough], why does it increase the Q of an antenna [at the expense of its broadband capabilities]? I have read the ARRL Antenna Book, but nothing there.

I have reread your Transistorised Transmitter Design notes in the January 1969 EEB. They are excellent. You might convert me yet!

-- Fr. A. Turner, C.P., Vanimo, New Guinea

[[Recent article in Break-In made me sit up and take notice: all about how to couple a coax to a dipole antenna -- without hint of using a balun. I don't understand the technical details too well, which the Giants have been discussing, but for a net conclusion, I suspect the balun is desirable. -- Ed.]]

Reply by Asst. Ed:

The effective length of an aerial is not the measured physical length because of end-effects, as we all know. What is not generally appreciated is the fact that this effective length actually depends on the frequency of the signal driving the antenna! A higher frequency effectively shortens it more, so that as far as the transmitter is concerned the antenna still looks as though it is in tune; this is 'forced resonance'. But the net effect is that the output from the antenna depends less on frequency; as usual, bandwidth is traded for gain. This automatically defines a lower Q.

The greater the length/diameter ratio for open dipoles and parasitic elements, the more exactly the effective length of the dipole corresponds to its mechanical length. There is, of course, a limit to this. If the conductor size gets too small, the resistance of the conductor will start to become appreciable and so govern the performance of the aerial. On the other hand, the wire can get pretty small; in one of the American magazines a few years back, there was an article on invisible aerials for flat-dwellers, and it seems that quite good results were obtained from wire of vanishingly thin dimensions.

-- R.A.J.R., Asst. Ed.

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FET MIXERS REVISITED: True Tetrodes vs. Dual Gate Types. -- RAJR

In the mixer article in last month's EEB I considered the performance of a 'True Tetrode FET.' I think that it is necessary to emphasize that this did NOT refer to the conventional dual gate FET [e.g. 3N140] operating in the normal configuration, but to a rather special FET having identical gates.

I regret it if this caused some confusion, but the basic principle still remains valid. The truly dual gate FET is as yet an experimental type, an example of which is the Texas Instruments TIXS81 and TIXS82. These can be used either as conventional square law mixer, or as a product mixer because of the identical gate characteristics. It is the latter mode to which I referred last month. At this point I might remark dryly that at least EEB keeps up with the latest State of the Art.

On the other hand, this does suggest the interesting experiment of trying to use the 3N140 as a product mixer. This would, however, require that the signal levels be kept low, because linear operation in a conventional FET can be approximated only if a small portion of the curve is used.

This raises the also interesting point whether all conventional FET mixers must operate in the square-law [i.e. non-linear] mode, because of the non-linearity which can easily be seen when looking at a plot of drain current vs. gate voltage [as for a valve]. Although this is technically reasonable, linear operation can be approximated closely when the gate is biased well up on the curve, with small input signals applied.

In practice, normal mixer action is indeed square-law operation, because input signals are large, and the drain is swung well into the non-linear portion of the curve. If one is willing to sacrifice conversion gain, the linear condition would be feasible, particularly if care were taken in matching input and output circuits to the FET. At the cost of adding another i.f. stage for gain, the very considerable advantage of linear mixing could be achieved, to reduce cross-modulation. Thus, even a conventional dual-gate FET could be used to obtain good results. Lets try it!

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ANNOUNCEMENTS

Ham Radio Magazine Subscriptions are still available through the EEB at the very low special price of $9 for 3 years; only for Australia and territories; renewals can also be handled. The July issue was a real beaut, with an excellent article on antennas, a comprehensive one on transistorised crystal oscillators, and a good transceiver.

HR back issues become scarce lamentably soon after publication. Take note.

Subscriptions to 73 Magazine are now being handled also by EEB at the low price of $A4.25 per year, if five or more subscriptions are sent in at the same time. As I have mentioned, 73 is a real experimenters publication, approved of by EEB. Recent exceptional issues involved whole issues devoted to Antennas and to VHF equipment.

Transistors on Computer Boards! The long-awaited article by Ron Brown and RLG has finally appeared in the August 1969 Amateur Radio. As from Sept. 1, 1969, AR will be available ONLY to members of the WIA: Enquire of P.O. Box 36, East Melbourne, 3002.

EDITORIAL -- RLG

The Bombs go bang!
The People go help!
And the world is growing smaller.
-- Stephen Gunther

Critical letters to EEB are sufficiently rare that I sit up and take notice when one arrives. The one published last month [p. 64] was from a good friend, who also sends much other comment on the Human Condition, alas mostly unpublishable.

When such letters are received, I consider them seriously, and take remedial action if necessary. In this case, I think that there is not too much to be done about our basic approach. The world is full of Responsible Professionalism, and look at the state it is in, well summarised by Stephen's aphorism. Look at the incredible professionalism of governmental and business dignitaries, and the lack of contact with reality by those who would leglislate our morals if they had the chance.

I'm not against the good sober reporting found in the magazine 'A' mentions [and we have defended it several times in print], and Elsewhere, but I do believe EEB can fill the need for an irreverent look at the world of electronics [at least]. 'We guarantee nothing' is designed to be a statement of humility, not of incompetence. We are amateurs, and are honest about it; we do our best, but it can hardly compete with the good sober stuff found elsewhere.

If I believe something, I am willing to be enthusiastic about it. If greengrocers do the same, they are Alive too. Ultimately you can judge EEB by the same standard as greengroceries: by its fruits!

Useless Circuits

Last month our Assistant Editor made an interesting point: why present a lot of elaborations on a basic circuit. Why not present only the basic circuit, with a bit of design philosophy which allows the experimenter to adapt it to suit his own needs -- which is exactly what he does anyhow.

This philosophy can be put to good use in making sense out of the various magazines. They splay a great mess of circuits across my desk each month, and how to make sense of it all? But most of it is not necessarily useful. For instance, I build Power Supplies around parts I have, and for specific requirements -- not around stuff I must buy, unless quite unavoidable. So I generally ignore articles on power supplies. Or on various methods of control switching; I have my own requirements.

Choose a random example from the nearest magazine on my desk right now. QST for March 1969 presents a Band Marker Generator, a very ordinary switched crystal oscillator using an FET. I suppose that this justified, since the ARRL Handbook doesn't sport an FET crystal oscillator*, but there are certainly plenty of them in other common references.

Or consider from that same issue in 'Hints and Kinks' a transistor and a valve amplifier for increasing VFO output. Again, completely standard circuits. Why bother? I'm not picking on QST in particular; the same thing happens often elsewhere. You can save yourself frustration by looking at circuits, and if they are quite ordinary circuits go on to more important articles. For example, in that same QST are several other useful items: Receiver Offset Tuning, a Triband One Loop Quad, and an ingenious slide rule to compute reflection and dissipation in antenna feedlines [except that it assumes that SWR is known accurately! See this EEB, p. 90.

Does this even apply to EEB?? Perhaps, but if we present ordinary circuits, we like to think that we make particular commonsense out of them. That is important.

*That's all right, they haven't yet heard of the Vacker Oscillator either [Ref. EEB Dec 1968, p. 134, Feb 1969, p. 19-20] in the latest Handbook, although strange to say they did present a valved version of the Vacker as an afterthought in the 'Transmitters' section of the 1957 Handbook [p. 213], and then dropped it in favour of less startling designs.

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FOR SALE: One 522 Transceiver, complete with crystal for 144Mc: $20. Class C Wavemeter, $20. 3-6Mc Command Receiver, $5. W. L. Shaw, 19 Fairmeadows Road, Nambour, Qld 4560.
= =
FROM AUSTRALIAN ELECTRONICS, 32 Waterworks Road, Dynnyrne, Tasmania 7005. -- Maybe the EEB Editor designs his own power supplies and switching circuits, but you notice he carefully refrained from mentioning anything else. For the simple reason that his electronics talents are limited [though he is very good with Words]. When he needs a circuit he generally looks in the various Handbooks and Manuals [at least as a starter], two of the most useful of which are:

1] Transistor Circuit Manual, by A. Lytel $5.25, postpaid.
2] Handbook of [more] Transistor Circuits, "   5.25, postpaid.

Both books are published by Sams and are good, even though they include only a paragraph or so to discuss each circuit. Between them they sport about 500 circuits of the most use ful types. If you are short of cash you can have both for $9.55, but below this we refuse to go. On our regular price we make about 75c per book, after post, and need it to help run EEB. Elsewhere they cost over $7 [plus post!], in Australia.

For the Undecided, we can furnish Tables of Contents and fuller details, for a SAE.

THE AUSTRALIAN EEB

AN INFORMAL ELECTRONICS
EXPERIMENTERS BULLETIN

Editorial Office:
P.O. Box 177
Sandy Bay, 7005
Tasmania,
Australia.

20c per copy

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1 yr.	2 yrs.	3 yrs.
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SEPTEMBER 1969 Vol. 5, No. 7 P. 95

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ADVANCING STATE OF THE ART -- VK7ZDF

(Inspired by recent Amateur Literature)

1950: Here is a Single Sideband Suppressed Carrier Transmitter; Mount V2 socket and connect R2 to Pin 7. . . . .

1960: Here is a Single Sideband Transmitter; Mount Tr2 socket on Printed Circuit Board, and connect R2 to Pin 3. . . . .

1966: Here is an SSB Transmitter; Solder IC2 and IC3 into PCB2. . . . .

1970: Here is an SSB Transceiver; Join Pins 2 and 3 on Exciter Module to Pins 3 and 4 on R.F. Amplifier Module. . . . .

1973: Here is an SSB Transceiver; Screw SSB Transmitter Module 122 and SSB Receiver Module 522 into Cabinet No. 13C42. . . . .

1975: Here is an SSB Transceiver; Place One Thousand Dollars Deposit in Envelope A. . . . .

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CONTENT:

NEXT MONTH: October

A Nice Transistorised Transmitter.

An Improved Transistorised Automotive Ignition.

Improved Modulated Light Communication.

Etc.

PERIODICALS OF INTEREST

Amateur Radio, P. O. Box 36, East Melbourne, Victoria 3002, Australia. Australia's principal strictly-electronic serious magazine, official publication of the Wireless Institute of Australia. AR is sometimes technically excellent, often interesting. Practical material is as good or better with that anywhere in the world. A series of articles by VK7ZRO and VK7RG (me) is appearing in AR beginning August 1969, and will be of special interest to EEB readers..... AR is received only as part of Membership in the WIA. Cost depends, to a certain extent, onlocation. It is well worth it for fellowship and personal information. Write to above address for specific details.

Auto-call, C/- G. Wetmore, Circulation Manager, 4104 Byrd Court, Kensington, Maryland 20795, U.S.A., $US1.50 per year. Like EEB, this mag is 'indefinable.' There is not really much technical stuff, often much gossip, but often interesting. We have some copies....

Break-In , Box 1733, Christchurch, New Zealand. $NZ2.50 for Assoc. Membership; also available through the WIA (See 'Amateur Radio') for same price in $A, or $2.35 for Institute Members. BIis the N.Z. equivalent of AR, with similar comment to be made. A small but very active experimenter community does first class work, and often reflects an interest and competence lacking in the more affluent societies. See RLG in 4/69!

Collector and Emitter, C/- Aernautical Centre Amateur Radio Club, Postal Station 18, Oklahoma City, Oklahoma 73169, U.S.A. Probably about $US1.00/yr. Of primarily local interest, but has a good monthly review of world electronic literature. Its main use to EEB readers is its connection with THE BOOKSTORE, which has been mentioned several times in EEB: allows you to order any American book at an unusually good (e.g. discount) price. It takes several months, but savings can be substantial compared to Australian prices. We shall publish some adverts for them someday in EEB.

Coryra, Box 649 P.O., Canberra, A.C.T. 2601. $A1.60/yr, $2.40/2-yrs. A 'Youth Radio' publication, but often contains practical articles of wide interest. Electronics parts of good variety and quality are advertised, as well as several bound volumes of considerable interest. Recommended.

CQ, 14 Vanderventer Ave., Port Washington, Long Island, N.Y., U.S.A. 11050. $US6.00 per year. The oldest present amateur magazine other than QST. Strong on antenna theory and practice, good beginners projects, story features. Very attractively presented.

Electronics Australia, Box 2728, GPO, Sydney 2001, Australia. $A4/yr locally. Australia's main feature magazine foi electronics and associated subjecte. Slick, thick, full of interest for everyone, with occasional technical items of value, particularly for the beginner. Its advertisements are an important means by which much electronic merchandise is publicised in Australia, including many disposals bargains.

Electronics Illustrated, Fawcett Bldg, Greenwich, Connecticut, U.S.A. 06380. $US4.00 here. From a report sent by a reader, it appears to be something like Popular Elect. though perhaps more elementary. Amateur and general experimenters projects, etc.

Electronics-world, 307 North Michigan Ave., Chicago, Illinois 60601, U.S.A. $6.00/yr in U.S., probably 7.50 Elsehwere. Similar to Radio-Electronics; see latter for comment.

Ham Radio, Greenville, New Hampshire, U.S.A. 03048. $US6.00/yr, $US12/3-yrs ($A9/3yrs through EEB). America's newest amateur radio magazine. In spite of the Lurid Title, it is technically excellent in a variety of fields, primarily of interest to radio amateurs, as the Name implies. Layout and print are unusually readable. Its policy of inadequate printing of back issues is lamentable. Some back issues are very good.

Miniwatt Digest, Electronics Division of Philips Electrical P/L, 20 Herbert St., Artarmon, N.S.W. 2064, Australia. $3.00/yr, bimonthly. Sometimes highly practical amplifier and power sup ply designs, but rather dear for a dozen pages of information which essentially constitute advertising for Philips.

Mullard Outlook, Mullard-Australia P/L, Technical Serivce Dept, 35-43 Clarence St., Sydney, N.S.W. 2000, Australia. Comment similar to Miniwatt Digest, but M-O free.

Practical Electronics, Practical Television, Practical Wireless, Newnes Ltd, Tower Hse, Southampton St., London, W.C.2, England, U.K. £2.2.0 each, per year. These magazines often contain novelties of interesting sort. Elementary, practical; ideal for beginners, explaining why and how projects work. Rich in many interesting advertisements.

Popular Electronics, Ziff-Davis Publ. Co., 307 No. Michigan Ave., Chicago, Illinois, U.S.A. 60601., $US6.00/yr here. Advertised as 'world's largest-selling electronics magazine,' and it may well be. It is similar to Radio Constructor, with good construction projects, numerous pictures and pictorial diagrams at various levels; for experimenters in general, not only radio amateurs. Various special interest columns.

QST, Main St., Newington, Connecticut, U.S.A. 06111. $US7.00/yr here. A large slick magazine, published by the American Radio Relay League. Although the last few hundred pages of each issue can be discarded safe ly, the tehcnical standard of the magazine during the past few years has been high. The money ostensibly pays for a fictional 'Associate Membership,' but since this exempts several important privileges of actual membership (permitted only in U.S.A.), it is essentially what it appears: a magazine subscription.

Radio Communication, Radio Society of Great Britain, 35 Doughty St., London, W.C.1, England, U.K. £2.10.0 per year. It shares with QST many surplus pages, but also contains a small but very good technical section. The 'Technical Topics' included in the magazine every month is worth the price of membership -- a membership which is real, not 'Associate.' To qualify, you theoretically need to be recommended by another; ask and I'll recommend you. If you read EEB, you qualify.

Radio Constructor, Data Publications Ltd, 57 Maida Vale, London W.9, England, U.K., £2.2.0, foreign $US5.00 or presumably equivalent. Highly practical constructional articles on beginning and intermediate level, similar to the American Popular Electroncs Some valves, but now mostly transistors, and well presented, as P.E. is.

Radio-Electronics, Gernsback Publications, Inc., 154 West 14th St., N.Y.10011, U.S.A. $US7.50/yr here. Similar to Electronics-World, catering primarily to the TV Serviceman, occasional pieces of interest to the gadgeteer, experimenter, or audiophile.

Radiotronics, AWV, Private Mail Bag, Ermington, N.S.W. 2115, Australia. $A2/yr. A very nice little magazine, along the lines of 'Outlook' and 'Digest' but better. Includes numerous practical projects and theory on audio, r.f., and power control.

Radio TV Experimenter, Science and Mechanics Publishing Co., 229 Park Ave., South N.Y. 10003, U.S.A. $US4/yr. Novelties and Gadgets of simple kinds.

RSGB Bulletin: Now called Radio Communication. See above.

73 Magazine , Peterborough, New Hampshire, U.S.A. 03458. $US6/yr ($A4.25 through EEB in groups of five). Published by the controversial Wayne Green, originally Editor of CQ. A strange man, full of hates and loves. Some of his Editorial views are masterfully expedient, some are astutely bombastic. He is Alive and Aware, even when he is wrong. He publishes a good experimenters magazine too: 73.

Spectrum , Auckland VHF Group Inc., P.O. Box 5268, Auckland, New Zealand. $NZ1.50/yr ($A1.60 through EEB). A first class Experimenters Magazine, along the lines of EEB, though with much emphasis on local news (of interest to radio amateurs). The technical material is primarily amateur, and often reflects considerable experimenters talent. Similar comment about that, as for Break-In. Recommended.

The Australian Experimenter. This beginners magazine ceased publication in mid-1969 owing to lack of reader support, and its capable Editor, C. Witchell has pledged his support to Coryra. It is presumed that Coryra will accept the offer.

The Australian EEB, P.O. Box 177, Sandy Bay, Tasmania 7005, Australia. $A1/yr, higher Elsewhere. Informal, emphasis on semiconductors, theory simple to intermediate. Practical articles on a wide variety of subjects. 'Editor fights Progress, but can often be ignored in favour of the articles, some of which are quite good.

VHF Communications, 2 Beaconview St., Balgowlah, N.S.W. $A5.50 by air per year. Published in English by Verlag UKW-Berichte, West Germany. Transmitters, receivers, test equipment etc for VHF and Beyond. Lots of solid state, plumbing, and German competence. Well recommended for VHF/UHF enthusiasts.

Wireless World, Iliffe Technical Publications Ltd., Dorset House, Stamford St., London S.E.1, England, U.K. £ 2.15.0 yearly. All aspects of electronics on intermediate to advanced level, often practical, sometimes esoteric. Magnificent advertisements, hundreds of pages of them per issue! Probably the best source of bargain disposals (and new) gear in Britain, but remember that Import Duty.

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LETTER:

How to be 'without it' (Ref. EEB, July 1969, p. 63)

Bill Matthews is very right of course, with his remarks about TVI, SSB vs FM; after all, what sort of cross modulation can a signal of constant amplitude cause? Unfortunately for popular acceptance, the number of chrome-plate appliances for FM is as yet negligible. Nevertheless, one of Bill's points is worth further amplification: 'that if every SSB station suddenly began using NBFM, the overall communications efficiency would suffer far less than many SSB enthusiasts would be prepared to admit.' Let us examine this a bit:

A) Use of Spectrum: An NBFM signal (Modulation Index about one) occupies a bandwidth equal to twice the highest audio frequency present, the same as an SSB signal effectively occupies, for reasons mentioned in the referred article.

B) Signal/Noise Ratio: Assume that the receivers used are suitable for the mode, i.e. proper discrimination (not slope detection) for FM, and only a 3kc bandwidth for SSB. Then SSB will have a 3db advantage because its receiver receives half as much noise power as the FM receiver (ASSUMING that the receiver also has sharp 3kc skirts).

C) Power efficiency: At the transmitter for FM, a Class C final may be used having, say 75% (or more) efficiency. For SSB the Class B final is 50% efficient if you are lucky. Thus, for the same final power input, the FM signal power output is at least 1.8db up on SSB. This brings the overall S/N ratio advantage of SSB down to only 1.2db. I challenge anyone to pick that difference with their ears.

D) Simplicity: A varicap across the VFO with a few volts of audio, or even a transistor reactance modulator (EEB, April 1969) is utter simplicity compared with balanced modulation, crystal filters, phase shift networks, and MONEY for SSB. Anyone who doubts the importance of this point need only regard the success of the commercial SSB transceivers in providing the majority of 'amateur' communications. Cf.p 95.

-- R. Ferris, VK7ZDF, Dynnyrne, Tasmania

((Since the above was written, a most interesting Editorial has appeared in the current QST, describing how commercial equipment is now becoming available for FM, and that -- hardly surprisingly -- there is now a rebirth of interest in FM among 'amateurs.' And QST supports it. For a change, ARRL is on the right side, and I am going to have to dust off some articles on FM in the Files, which I was saving for a rainy day when SSB became less fashionable. The Earth does move, albeit slowly -- Ed.)) See also good recent issues of Spectrum, N.Z.

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EDITORIAL -- RLG

'Owing to a Technical Breakthrough, there will be a slight delay in the Human Race.'
-- The Australian, July 18, 1969

For Beginners?

Recent enquiries of lapsed subscribers showed that the majority discontinue because of lack of time or interest in radio. A few go because EEB is 'too technical,' a few because of lack of finances (though we have a special Poor Student rate of 75c per year). It would appear that if anyone has serious reservations about EEB, they don't subscribe in the first instance. No doubt my stands on faddism and commercialism have offended some parties, but most people appear to have enough sense to concentrate on the strictly technical content.

Do we have insufficient amount of beginners material? I am not an engineer, but I get tired of talking about Ohm's Law. Rod and Dick are engineers, but theyget tired of Laplace Transforms. We meet here on a common ground of commonsense interest.

If readers want good beginners material, they have only to read Corvra. If they want good articles about radio amateur equipment, there is AR. There is the excellent 'Basic Radio Course' published by Electronics Australia. And then there is the monthly Electronics Australia which does an admirable job with numerous features and constructional projects. It also carries a wide range of useful advertisements. From time to time we hear criticism of EA, but it inevitably comes down to complaint that the very wide field of activity promoted by that magazine is insufficiently wide. But the same people complain that the magazine is too big; it would be even bigger with all that extra copy in it.

Of course EA doesn't do everything; that's why our various minor publications exist. But EA serves the Australasian community admirably in covering all the high points, and in a professional and competent manner. We have said all this before, and see no reason to change this opinion now. Ea appeals to most of us who have only passing acquaintance with electronics, and in a democracy this is as it should be.

That Unwanted Sideband (E.g., the one which is transmitted?)

In this issue we are reprinting the valved version of the 'Signal Slicer,' because it is such a fine idea, and because it is now no longer available since the original publication is out of print. It is a simplified version of a unit which appeared in QST of July 1948. It has also been discussed in the excellent article, 'That UNwanted Sideband' which appeared in 73 of Oct 1965, and which was mentioned in EEB of October 1968, p. 115. Our article was 'Receivers and Unwanted Sidebands' and ought to be read as background. The 73 article is well worth obtaining, as we suggested, because it describes a number of sideband-eliminating units, as well as a considerably simplified audio phasing network to replace the one described here by G.E. It should be noted that although these various devices may be used to generate a spurious Sideband on the air, they are particularly useful to improve performance of receivers.

Now, Dick, how about designing us a Single Sideband FM, ummm?

By the way, it looks as though Dick Ferris, VK7ZDF, is well on his way to becoming another Assistant Editor. I can see more work coming up -- for me. EEB staggers on.

xxxxxxxxxxxxxxxxxxxxxxxxx

A SPECIAL EEB FEATURE: (Sept. 1969, p. 100)

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G. E. HAM NEWS

Although this is an old design, it is still a very useful device for receivers. See EEB: Oct 1968, p. 111, 115.

JULY—AUGUST 1951

VOL. 6—NO. 4

SIGNAL SLICER

Four Tube Receiver Adapter for Improved Reception of AM, NBFM, CW or SSB Signals

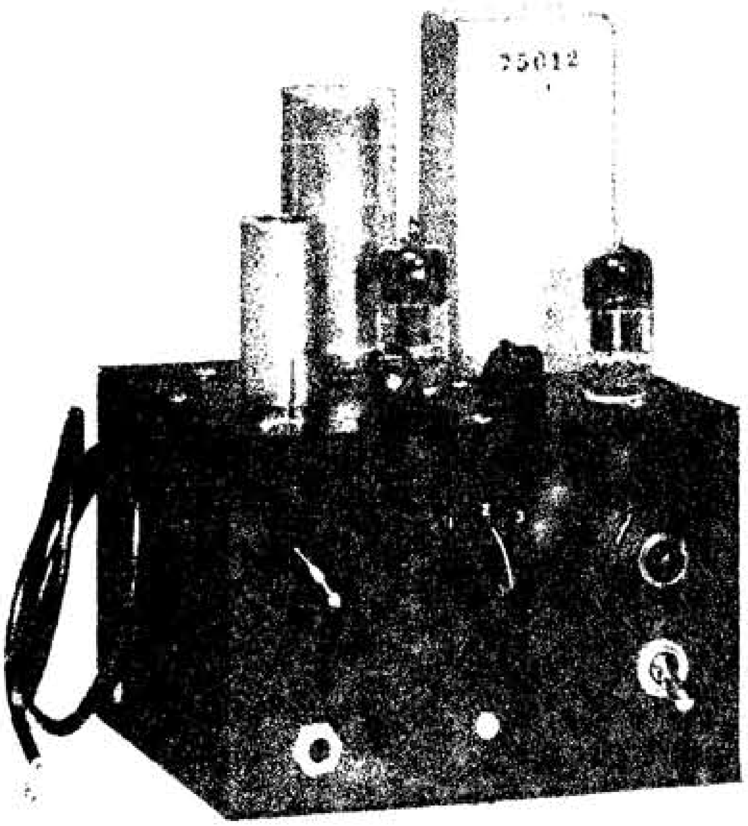


Fig. 1. Front view of the Signal Slicer. The input cable is at the left of the unit.

Ever since the SSB, Jr. transmitter appeared in the G-E Ham News *my readers have been asking whether it would be possible to design a simplified receiver adapter incorporating the same simple phase-shift network. The Signal Slicer described in this issue is W2KUJ's answer to those questions.*

—Lighthouse Larry

ANOTHER G-E HAM NEWS SSB SPECIAL

SIGNAL SLICER

The Signal Slicer is a complete receiver adapter for converting the conventional communications receiver having 450–500 kilocycle I-F to a single-sideband receiver. The system utilized to obtain single-sideband response is of the phase-shift type, utilizing either a commercially made or a home-built phase-shift network of the type described for the SSB, Jr., transmitter (G-E *Ham News*, Vol. 5, No. 6). The name Signal Slicer has been applied to this adapter because of its ability to slice the selectivity curve of the conventional receiver in two, permitting one to listen at will to signals in either the upper or lower frequency portion of the receiver's normal I-F selectivity curve.

In contrast to the original SSB receiver adapter (G-E *Ham News*, Vol. 3, No. 6) the Signal Slicer requires no vacuum-tube probe, utilizes only four double-purpose tubes, and has no carrier synchronizing circuit. Notwithstanding a rather drastic reduction in its complexity, this adapter is a practical answer to the question, "Why not describe a simplified single-sideband receiver adapter?"

The Signal Slicer, when attached to a communications receiver, gives you a combination which permits you to do away with at least fifty percent of the QRM when receiving conventional AM or phase-modulated phone signals. The same holds true for the reception of CW signals, with the Signal Slicer supplying the heterodyning signal so that the BFO in the communications receiver is not required. True single-signal reception of CW signals is possible with this combination.

For reception of single-sideband signals, this adapter furnishes a carrier against which the sidebands may be demodulated. By selecting the proper sideband with a switch, the modulation may be read. Although it is now pretty well understood that a special adapter is not required for reception of single-sideband signals, many amateurs who have heard or used the original *Ham News* SSB receiver adapter appreciate the benefits of such a device.

CIRCUIT DESCRIPTION

The complete circuit diagram for the Signal Slicer is shown in Fig. 2. As is the case for most equipment described in the *Ham News*, an effort has been made to utilize completely standard components wherever possible. The built-in power supply is a conventional voltage doubler with a selenium rectifier and a conventional resistance-capacitance filter. No further comment on this portion of the circuit is necessary except to point out that a transformer is used to isolate the circuits from the a-c line in order to prevent interconnection problems between the adapter and the communications receiver.

The phase-shift type of adapter consists basically of two detectors (demodulators) supplied by a signal to be received and signals from an oscillator which acts as a local carrier source. The outputs of the

Electrical Circuit

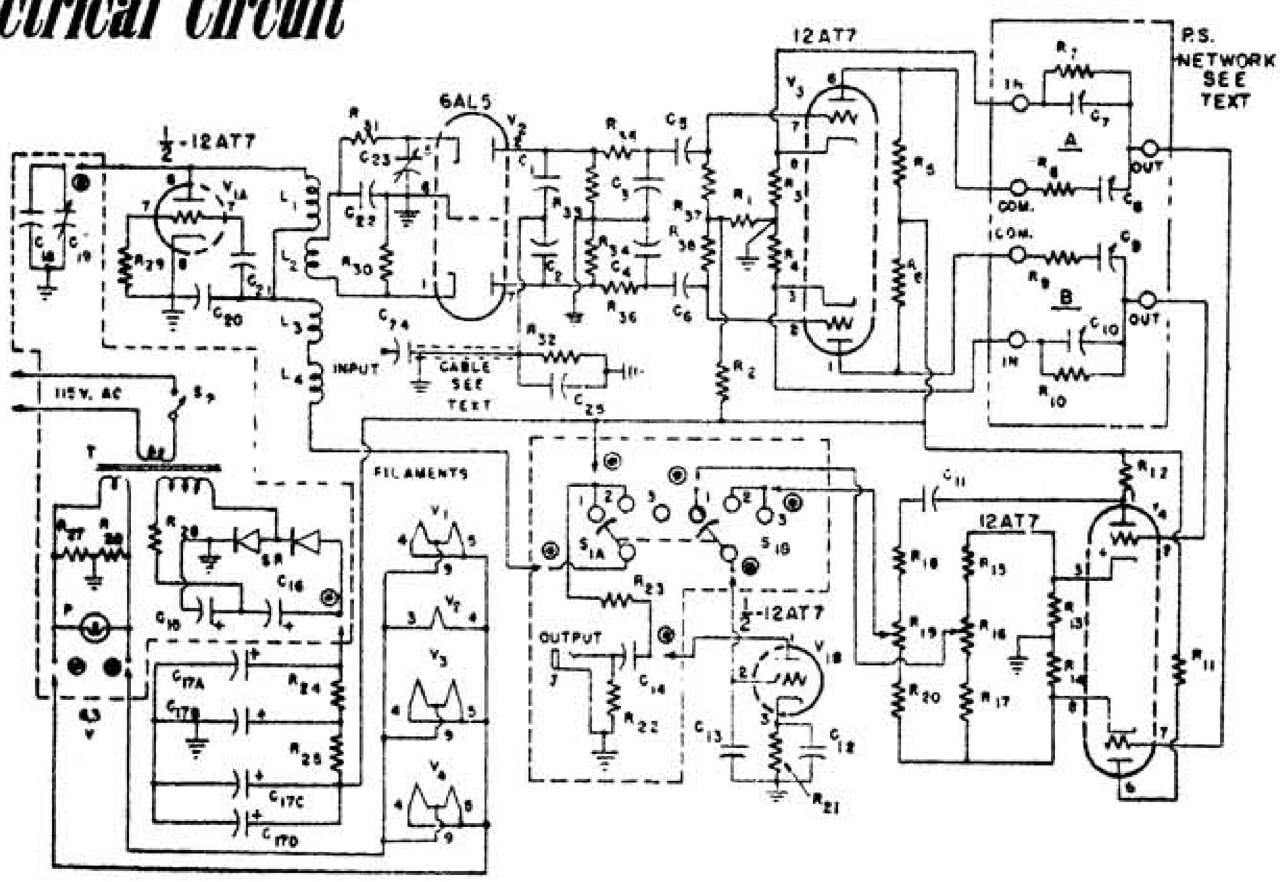


Fig. 2. Circuit diagram of the Signal Slicer.

·parate demodulators are fed through a pair of phase shifters of such characteristics that the algebraic sum of their outputs consists of audio signals created by I-F signals which lie on one side of the local oscillator frequency, and the algebraic difference consists of audio signals created by I-F signals which are on the other side of the local oscillator frequency.

In the Signal Slicer half of the double triode V_1 is used as a Colpitts oscillator whose output is coupled into the two halves of the double-diode V_2 acting as the two demodulators. These demodulators are also supplied with signals from the I-F amplifier of the receiver with which the adapter is used. The demodulator outputs are supplied to the double triode V_3 which in turn feeds two phase-shift networks (Millen No. 75012 or a home-made equivalent).

The outputs of the phase-shift networks are then applied to the two triode sections of V_4 whose outputs are fed to the combining circuits (R_{15}, R_{16}, R_{17} and R_{18}, R_{19}, R_{20}). These, in turn, feed through a selector switch into an audio amplifier, the remaining section of V_1. The purpose of the selector switch is to permit choice of sideband and to permit conventional receiver operation. With reference to the circuit diagram, positions 1 and 2 of switch S_1 are the two sideband positions, and position 3 is the proper position for normal operation of the receiver.

CONSTRUCTIONAL DETAILS

The Signal Slicer is simple to build, especially if a commercial unit is used for the phase-shift networks. The entire unit is built into a standard four by five by six inch utility box. Most of the components are mounted on one of the five by six inch removable cover plates. This plate will be referred to as the "top."

Refer to the circuit diagram, Fig. 2. Note that two groups of components are shown inside dotted-line boxes. The components that are in these two boxes are those that are mounted on the utility box proper. All the other components are mounted on the top plate, including the phase-shift network assembly which has been indicated in the circuit diagram inside a dashed-line box. This box is marked "P.S. Network." Don't confuse this with the two dotted-line boxes in the diagram.

It may be seen that each of the two dotted-line boxes has connection points indicated by a circle with a large dot inside. There are ten of these points. These represent the connections that must be made when the wiring of the box is complete and the wiring of the top plate is complete, and you are assembling the two sections. The leads shown with the arrow at each of these points indicate a length of wire which is left long so that the connection may be made after assembly. The photograph of the top plate in Fig. 3 shows these ten wires clearly. The wires are longer

CIRCUIT CONSTANTS

(All resistors and capacitors ± 20% tolerance unless specified otherwise)

C_1, C_2	*100 mmf mica or ceramic (matched within 5%)*
C_3, C_4	*100 mmf mica or ceramic (matched within 5%)*
C_5, C_6	0.01 mf mica, paper or ceramic
C_7	*2430 mmf (0.002 mf mica ± 5% with 170-780 mmf trimmer in parallel)*
C_8	*4860 mmf (0.0043 mf mica ± 5% with 170-780 mmf trimmer in parallel)*
C_9	*1215 mmf (0.001 mf mica ± 5% with 50-380 mmf trimmer in parallel)*
C_{10}	*607.5 mmf (500 mmf mica ± 10% with 9-180 mmf trimmer in parallel)*
C_{11}, C_{14}	0.1 mf 400 volt paper
C_{12}	0.5 mf 200 volt paper
C_{13}, C_{25}	470 mmf mica or ceramic
C_{15}, C_{16}	40 mf 150 volt electrolytic
$C_{17A, B, C, D}$	20—20—20—20 mf 450 volt electrolytic
C_{18}	*300 mmf mica ± 5%, for 456 to 465 KC. (Use 240 mmf for 500 KC, I-F receivers)*
C_{19}	50 mmf variable (Hammarlund HF-50)
C_{20}	*0.003 mf mica ± 10%*
C_{21}	1000 mmf mica or ceramic
C_{22}	*330 mmf mica ± 5%*
C_{23}	5-50 mmf mica trimmer (El Menco T-52210)
C_{24}	10 mmf mica or ceramic
[illegible]	Open circuit jack
L_1, L_2, L_3, L_4	All made from one R-F choke (see text)
R_1	*10,000 ohm, ½ watt (± 10%)*
R_2	*680,000 ohm, ½ watt (± 10%)*
R_3, R_4	*2,000 ohm, ½ watt precision (± 1%)*
R_5, R_6	*7,000 ohm, ½ watt precision (± 1%)*
R_7, R_{10}	*133,300 ohm, ½ watt precision (± 1)%*
R_8, R_9	*94,000 ohm (100,000 ohm ½ watt ± 1% precision resistor in parallel with a 1.5 megohm ½ watt ± 5% resistor)*
R_{11}, R_{12}, R_{13}, R_{14}	*3,000 ohm, ½ watt (± 5%)*
R_{15}, R_{17}, R_{18}, R_{20}	*220,000 ohm, ½ watt (± 10%)*
R_{16}, R_{19}	100,000 ohm potentiometer
R_{21}	*5,600 ohm, ½ watt (± 10%)*
R_{22}	2.2 megohm, ½ watt
R_{23}	47,000 ohm, 1 watt
R_{24}, R_{25}	470 ohm, 1 watt
R_{26}	*400 ohm, 4 watt (± 10%) (Two 200 ohm, 2 watt resistors in series)*
R_{27}, R_{28}	47 ohm, ½ watt
R_{29}, R_{32}	10,000 ohm, ½ watt
R_{30}	*1,000 ohm, 1 watt (± 5%)*
R_{31}	*1,000 ohm, ½ watt (± 10%)*
R_{33}, R_{34}	*1.0 megohm, ½ watt (± 10%)*
R_{35}, R_{36}	*51,000 ohm, ½ watt (matched within 5%)*
R_{37}, R_{38}	*3.3 megohm, ½ watt (± 10%)*
S_1	Double pole, three position shorting type rotary switch
S_2	SPST Toggle Switch
SR	Voltage doubler type selenium rectifier, rated 160 RMS volts at 100 ma (Federal 1008A)
P	6.3-volt pilot lamp
T	Power Transformer, 135-volt A-C RMS secondary at 75 ma, 6.3 volts at 1.5 amps (Thordarson R-22R12)
P.S. Network	Millen No. 75012 or home-made equivalent (see text)

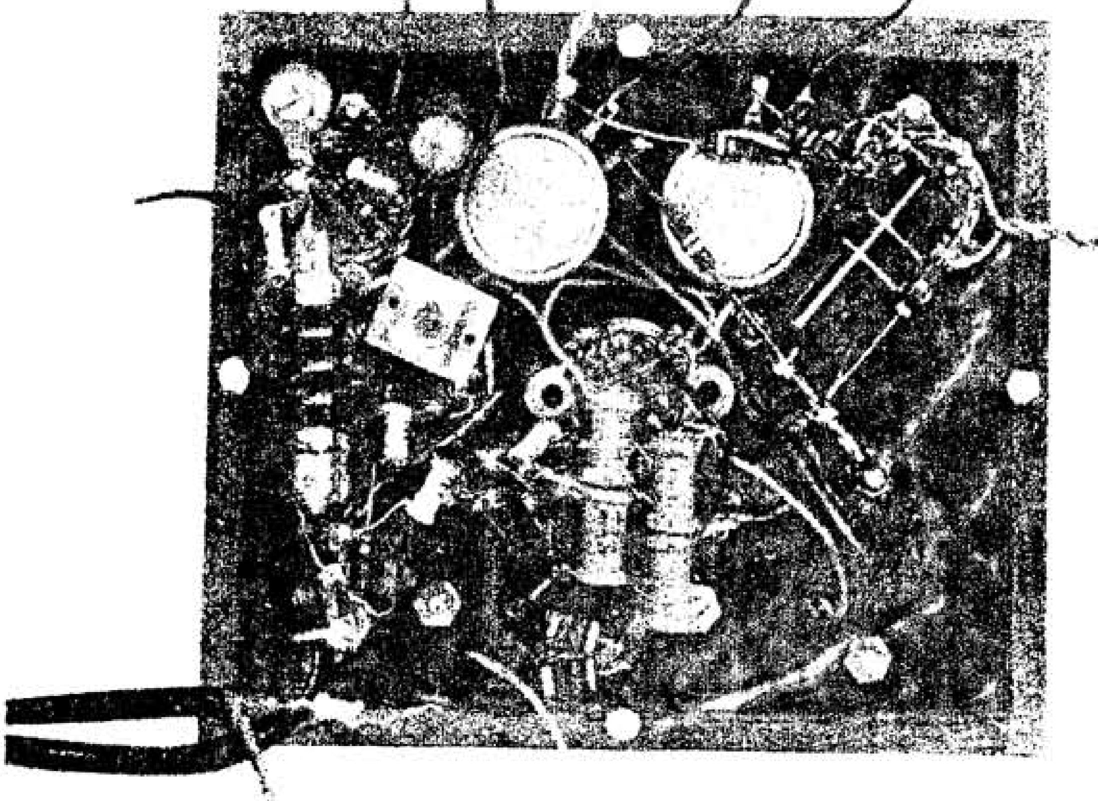


Fig. 3. Detail view of the wiring on the top panel of the Signal Slicer.

than the photograph shows. Make each one about 5 inches long, then cut them to length when assembling the adapter.

A drilling layout is shown in Figs. 6, 7 and 8 for those who wish to duplicate the original unit exactly. If another type of construction appeals to you, a reasonable duplication of the layout shown is suggested.

With reference to Fig. 4, the power transformer, the selenium rectifier, condensers C_{15}, C_{16} and resistor R_{24} are mounted on the rear apron of the utility box. This rear apron also has two grommets mounted on it to handle the a-c line and the input probe cable. On the front apron you mount the pilot light, power switch S_2, resistors R_{27}, R_{25}, oscillator tuning control C_{18}, C_{19}, output jack, selector switch S_1, condenser C_{14} and resistors R_{22} and R_{23}. All the wiring involved with these components can easily be completed if the two removable plates are not in place. Because of tolerances on certain components and the particular I-F of your receiver, it is well to mount C_{18} directly across C_{19} so that possible pruning operations may be done conveniently without removing the top plate.

The one inch diameter hole specified for the phase-shift network is used regardless of whether a Millen unit or a home-made unit is employed. Details of the home-made unit will be given later.

It is desirable to remove the paint from the top lip of the utility box, and from the four edges of the top plate, to ensure good electrical contact when the two parts are joined.

Coils L_1, L_2, L_3 and L_4 require explanation. All four coils are made by making some minor changes on a single National R-100 R-F choke. This choke has four pies, and each pie becomes a coil. To make the necessary changes, refer to Fig. 5, and proceed as follows. Examine the coil and the individual pies. You will note that one lead on each pie comes off the outside of the pie, and the other lead comes from the part of the pie nearest the ceramic support. Orient the choke in your hand until it is as shown in Fig. 5, that is, so that the lead from the right-hand end goes to the outside of the farthest-right pie, L_1.

Carefully loosen two turns on the outside of L_2 a then cut the wire to provide an inch or so of lead from the inside of coil L_1. Remove the insulation and the enamel from the end of this lead. The two connections to coil L_1 are now the original pigtail and the inch or so of wire removed from the outside of coil L_2.

Repeat this operation on coil L_3 to provide leads for coil L_2, as well as a connecting lead from L_3 to L_1. Continue as shown in Fig. 5 until you have L_1 in series with L_3 and L_4, with L_2 having separate, unconnected leads. Tin the ends of all wires and solder the connection between L_1 and L_3. Double-check to make certain that your leads are as shown in Fig. 5, that is, that the leads come from the top of the pie where so indicated and from the center of the pie, where so indicated. This is important, because this determines the direction of the winding on the form. The entire procedure probably will take less time to do than the time you have spent reading this. The inductance of each pie of the National R-100 choke is approximately 420 microhenries.

For wiring details of the top of the Signal Slicer, refer to Fig. 3. The coil assembly (L_1 through L_4) is mounted with the L_1 end fastened to a ceramic stand-off post and the other end connected to one lug of a terminal strip. The common connection of L_1 and L_3 should be made to the end lug of the terminal strip nearest V_1, and the two connections from L_2 to the next two lugs. Make certain that the coil will clear the lip on the box as the chassis is mounted. The remainder of the wiring is quite straightforward and should present no difficulty. Note that R_4 and R_6 actually each made up of a 3000 and a 4000 ohm resistor in series, since 7000 ohm resistors were not immediately available.

Remember to leave several inches of hookup wire at each of the ten connection points, so that the final assembly consists in cutting these wires to length and

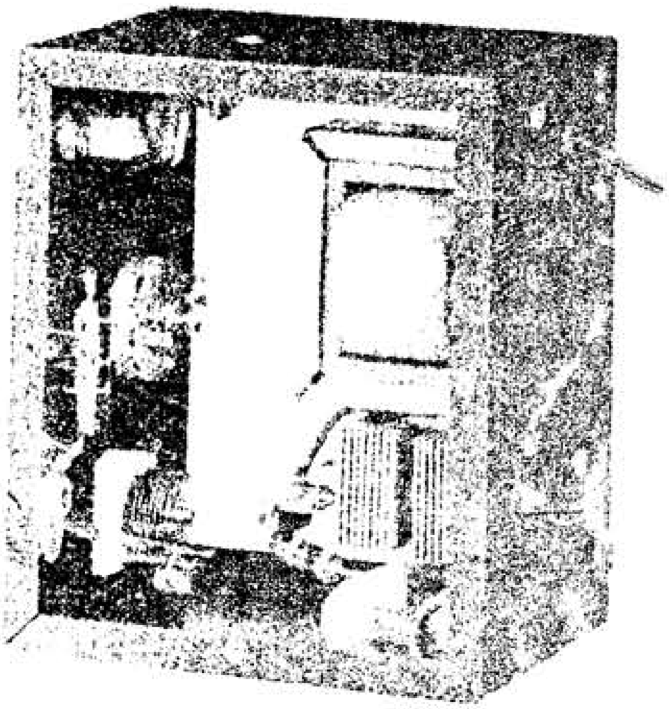


Fig. 4. Detail view of the completely wired interior of the Signal Slicer

soldering them to the proper points on the box proper. Obviously, all wiring should be completed on the top plate before the final connections to the box are made. The probe cable should be made of approximately two feet of RG-58/U cable, and C_{11} soldered to the far end. The cable may be shorter or longer, but try to keep its length under six feet.

PHASE SHIFT NETWORKS

The Millen No. 75012 network is a complete and aligned pair of phase shift networks. To use this unit in the Signal Slicer a slight modification is required to achieve optimum results. Each of the 100,000 ohm precision resistors (R_4 and R_5 in the circuit) should be paralleled with a 1.5 megohm five percent tolerance ½ watt carbon resistor. To do this the can must be taken apart to permit access to the resistors. The photograph (Fig. 9) shows where these resistors have been added to the Millen unit. Make no other changes or adjustments, since these units are pre-aligned at the factory.

The change mentioned is beneficial in taking account of the effective source impedance presented by V_3 and associated circuits.

If desired, you may make your own phase-shift network unit. The home-made unit pictured in Figs. 10 and 11 is made in a Millen No. 74400 plug-in shield can. The octal base pictured is a part of this unit. The components are supported on a vertically mounted piece of insulating material, such as bakelite, poly, etc. The size of this piece is $3\frac{3}{4}$ by $1\frac{3}{4}$ inches by $\frac{1}{16}$ inch thick. This is secured to the mounting posts by two small right-angle brackets. The suggested terminal arrangement is pictured quite clearly in Figs. 10 and 11. The fixed mica condensers are mounted on one side of the insulating material, and the adjustable trimmers and resistors on the other side. Mount, but do not solder these components in place until the phase-shift networks have been aligned.

The suggested pin connections for a home-made unit are as follows: Pin 1, ground; pins 2, 3 and 4, network "A"; and pins 6, 7 and 8, network "B." Electrically the two networks in this can are identical to the ones used in the SSB, Jr., except for the modification noted above for the Millen unit. (For convenience, the symbol numbers indicated in Fig. 2 in this issue are the same as were used in Figs. 2 and 3A of the Vol. 5, No. 6, *Ham News* describing the SSB, Jr.)

After completing the phase-shift unit leave the can cover off until the adjustments are made and the two 1.5 megohm resistors added across R_4 and R_5. Run a wire from pin 1 on the phase-shift unit to one of the mounting posts inside the No. 74400 can to allow grounding. To prevent inadvertent short circuits, a stiff piece of insulating material (such as waxed Kraft paper) should be placed inside the can as is usually done in commercial I-F transformers.

If a home-made phase-shift network is used, an octal socket will be required on the top plate to accommodate the Millen No. 74400 unit. The alignment of the home-made phase-shift network will be discussed later.

COMPONENT PARTS

As is true with many equipment designs, there are some component parts in the Signal Slicer that must be chosen carefully. The precision resistors specified are important if optimum results are to be obtained. Continental "Nobleloy" 1% resistors were used in the original models of the Signal Slicer (where 1% resistors are specified) although any other make of equal quality should work equally well.

Some of the other resistors are specified with tolerances of 5% or 10%. This has been done to ensure a piece of equipment which will be capable of being tuned up properly after you complete it. If you desire, use 20% tolerance resistors which you have measured to make certain that they are within the required tolerance. Certainly one or two of these values may vary as much as 20%, but if all the resistors varied this much, in the wrong direction, you might have a much harder job getting the unit to work properly.

The adjustable mica trimmers used in the phase-shift networks may be any good grade of trimmer. Those actually used are El Menco: T52910 for C_7 and $C_{..}$, T52510 for $C_{..}$; and T52310 for C_{10}.

It is important that you use a National R-100 2.5 mh. choke for L_1, L_2, L_3 and L_4. Other chokes will undoubtedly work, but the National R-100 is universally available, and no attempt was made to check the suitability of other four-pie 2.5 mh. chokes.

Mica condensers should be used where mica only is specified. In the other cases the specifications call for "mica or ceramic" or "mica, ceramic or paper" condensers. In general, the ceramic condensers are smaller than either the mica or paper condensers, and should therefore be used if feasible. Be certain to obtain condensers within the tolerances specified.

The selector switch, S_1, should be of the shorting type. Loud switching transients will be produced unless this precaution is observed.

The selenium rectifier specified is capable of handling 160 volts RMS. Most small selenium rectifiers are rated for only 130 volts RMS, and these were not specified because the transformer, unloaded, supplies more than 130 volts RMS, which would damage the lower-rated rectifier.

CIRCUIT ADJUSTMENTS

With the exception of alignment of the phase-shift networks (if you build your own) very few adjustments are required in the Signal Slicer. The two

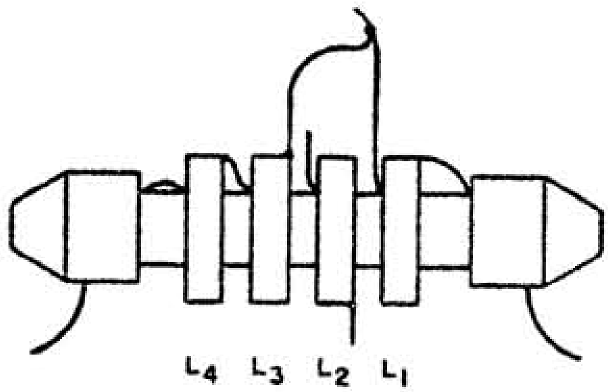


Fig. 5. Sketch of the altered R-100 choke

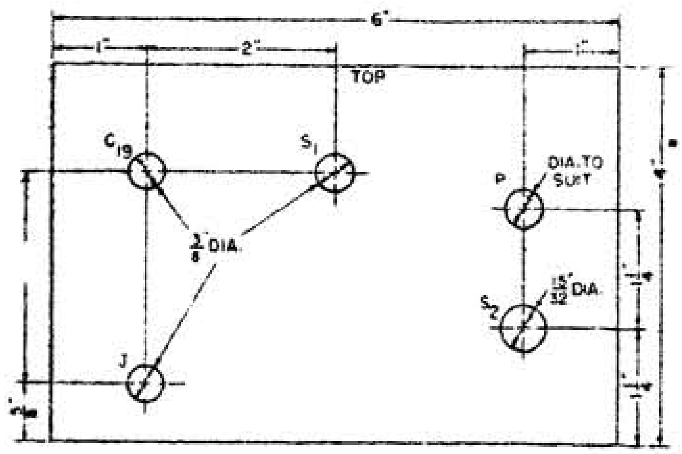


Fig. 6. Layout dimensions for the front of the Signal Slicer. The dimension on the left which is blank should be 1 3/4 inches. Note also that the holes for C_{19} and S_1 are not shown in true perspective, because they are actually closer to the bottom of the panel than the hole for the panel light. The dimensions shown are correct.

methods for alignment of the home-made phase-shift networks are identical to those described for the **SSB, Jr.** The simpler method is to use accurately measured parts (R_7 through R_{10} and C_7 through C_{10}). The more exact method involves four test frequencies which enable one to adjust each of the four capacitors, C through C_{10} for perfect alignment.

The adjustment procedure using the test frequencies is as follows. First, determine that the resistors R_7 and R_8 (as well as R_{10} and R_9) bear the ratio of 133,333 to 100,000, that is, 4 to 3, as closely as can be determined. If there is any doubt about the value of the resistors, double-check their values on an accurate bridge. Next procure the two necessary instruments, which are an audio oscillator capable of providing output frequencies in the range between 300 and 2000 cycles per second, with good waveform, and an oscilloscope. The oscillator may be calibrated by the method described later. Connect the oscillator output through a step-down transformer (a conventional audio transformer run "backward" will do nicely) into a 1000 or 2000 ohm potentiometer with the arm of the potentiometer grounded. See Fig. 12.

Adjust the arm position so that equal (but opposite) voltages appear on each half of the potentiometer. A steady audio frequency signal of any convenient frequency may be used with an oscilloscope acting as a convenient voltmeter for this job. Swing the vertical deflection lead from one end of the potentiometer to the other and adjust the arm to obtain equal voltages (a true center-tap). Set up a temporary double cathode-follower circuit using a 12AT7 with 500 ohms from each cathode to ground and connect as shown in Fig. 12. (It will be convenient to provide leads M, N, and 1 and 2 with clips at the ends to facilitate checking.) The horizontal and vertical plates of the oscilloscope should be connected to the 12AT7 cathodes as shown in Fig. 12 and the 'scope common connection should go to the arm of the potentiometer.

Now, refer to the circuit diagram, Fig. 2, and disconnect the elements in your home-made phase-shift network as follows. Disconnect the left-hand end of

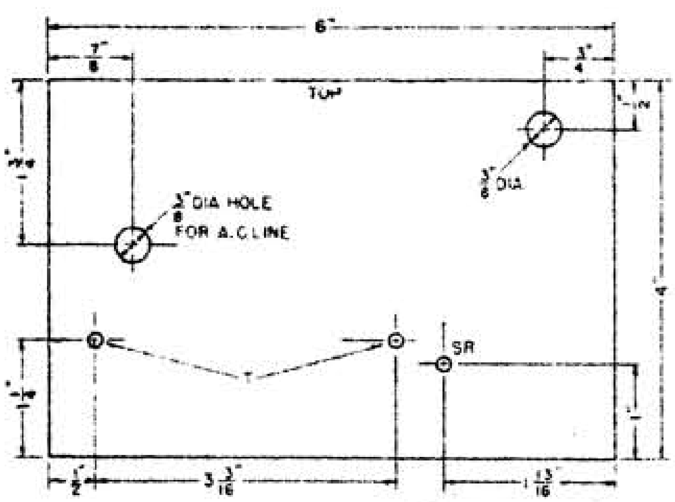


Fig. 7. Layout dimensions for the rear of the Signal Slicer.

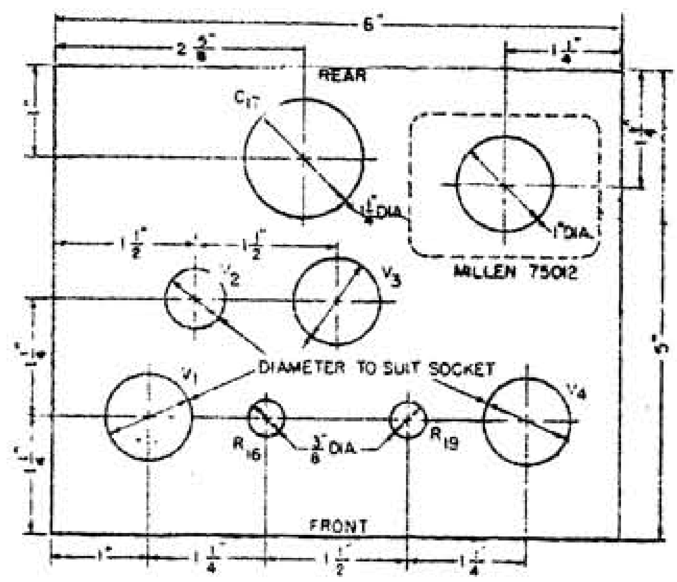


Fig. 8. Layout dimensions for the top panel of the Signal Slicer.

R_7 from C_7. Disconnect the left-hand end of R_{10} from C_{10}. You are now ready to proceed with the alignment.

Connect lead M (Fig. 12) to the left-hand end of R_7 and connect lead N to the left-hand connection C_7. Connect leads 1 and 2 (Fig. 12) to terminal M. Adjust the horizontal and vertical gains on the oscilloscope to produce a line about $1\frac{1}{2}$ inches long slanted at 45 degrees when the oscillator is set to a frequency of 490 CPS. If the oscilloscope has negligible internal phase shift the display will be a straight line instead of a narrow slanting ellipse. If the latter display appears it is necessary to correct the oscilloscope phase shift externally by using an adjustable series resistance (a 50,000 ohm potentiometer) mounted at either the vertical or horizontal input terminal, depending on what correction is necessary.

At any rate, the objective here is to get a straight line at 490 CPS. In some cases a series capacitor may be needed to provide the necessary correction. Try values from 0.05 to 0.0005 mf. Now shift lead 1 from the left-hand end of R_7 to the junction of R_7 and C_7. Adjust the trimmer of C_7 to obtain a circle on the oscilloscope. It will be noted that as this adjustment is made the display will shift from an ellipse "leaning" to one side through a circle or ellipse (with axes parallel to the deflection axes) to an ellipse which leans the other way. If desired or necessary, the appropriate gain control on the oscilloscope may be changed so that a circle instead of a "right" ellipse is obtained at the point of correct adjustment. After changing the gain control on the oscilloscope, check (and correct, if necessary) the phase shift in the oscilloscope by moving lead 1 back to the left-hand end of R_7, and then repeat the setting of C_7 with lead 1 back again on the junction of R_7 and C_7.

In general, always make certain that the oscilloscope is used in a phase-corrected manner. As a double-check (if the deflection plates in the 'scope are skewed, for instance) connect lead 2 to the left-hand end of C_7. If the circle changes to a slanting ellipse, readjust C_7 to produce an ellipse half-way between the ellipse (obtained by switching lead 2) and a circle. Changing lead 2 from the left-hand end of C_7 to the left-hand end of R_7 and back again should give identical skew to the display when C_7 is set correctly. Failure to get symmetrical ellipses (egg-shaped, or other display) is due to distortion, either in the oscilloscope, the oscillator, the transformer, or the cathode follower. Conduct the test at as low a signal level as possible to avoid distortion.

Next, connect lead M to the left-hand end of R_{10} and lead N to the left-hand end of C_{10}. Connect leads 1 and 2 to lead M, set the oscillator frequency to 1960 CPS, correct 'scope phase-shift as before, and move lead 1 to the junction of C_{10} and R_{10}. Adjust C_{10} for a circle as was done for C_7, using the precautions outlined for that case.

Now connect lead M to the left-hand end of R_9 and lead N to the right-hand end of C_9. Connect leads 1 and 2 to lead M, set the oscillator frequency to 1307 CPS, correct 'scope phase-shift as before, and move lead 1 to the junction of R_9 and C_9. Adjust C_9 to obtain a circle on the oscilloscope, as before.

Repeat the above procedure for the remaining R-C pair, R_8 and C_8. Use an oscillator frequency of 326.7 CPS. This completes the alignment of the phase-shift network. None of the preceding alignment instructions need be carried out if a Millen No. 75012 network is used.

Re-connect the phase-shift units, connecting the left-hand end of R_7 to C_7, and the left-hand end of R_{10} to C_{10}. Connect the phase-shift units to the base pins of the plug-in can assembly and solder all connections. Shunt R_7 and R_8 with the 1.5 megohm resistors previously mentioned, then place the cover on the plug-in assembly. Remember to use some insulating material inside the can as mentioned previously.

AUDIO OSCILLATOR CALIBRATION

It will be noted that the frequency ratios are such that the 12th harmonic of 326.7 CPS, the 8th harmonic of 490 CPS and the 3rd harmonic of 1306.7

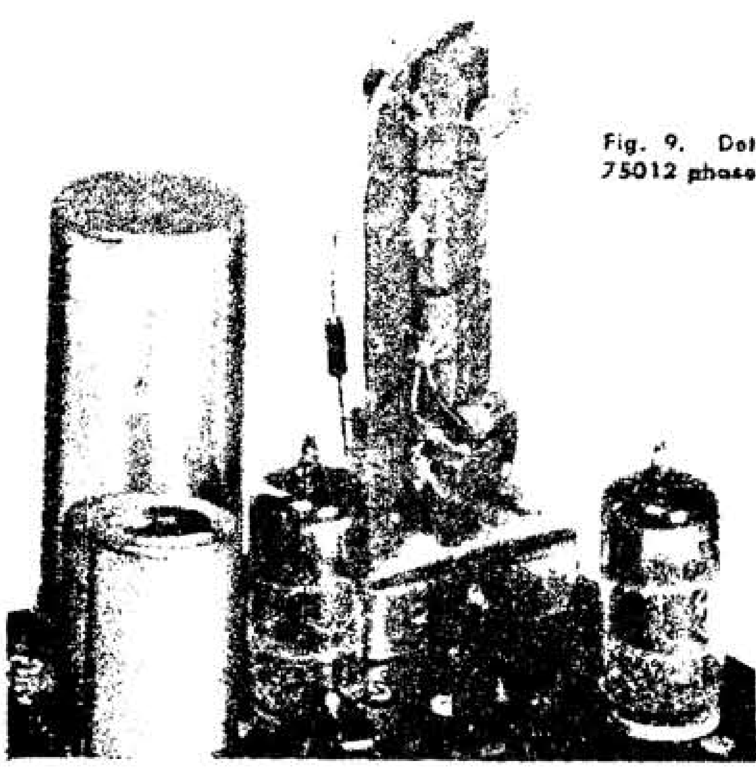


Fig. 9. Detail view of the Millen No. 75012 phase-shift network.

CPS are all the same as the 2nd harmonic of 1960 CPS, namely, 3920 CPS. Thus, if a stable source of 3920 CPS frequency (such as a thoroughly warm audio oscillator) be used as a reference, the frequency of the test oscillator can be set very closely to one-half, one-third, etc., of this reference frequency if both oscillators feed an oscilloscope and the resulting Lissajous figures observed.

Use of a calibrating frequency in this manner assures that the frequency ratios used are correct, even though the exact frequencies used are unknown. The frequency ratios (just as the resistance ratio previously mentioned) are far more important than the actual values of frequency (or resistance) used.

CONNECTION TO RECEIVER

After completion of the wiring and a thorough wire-check you are ready to connect the adapter to the receiver. The connection from the "hot" side of the I-F transformer to the diode plates of the detector in the receiver should be removed, and the audio connection from the detector output to the A-F gain control should be opened. The shield of the adapter cable connects to ground on the receiver, and the 10 mmf capacitor connects to the hot side of the I-F transformer, in place of the diode plates.

The output of the adapter may be used directly on headphones, or an audio lead may be plugged into the output jack of the adapter (J) and wired into the audio input of the receiver. It can be seen that the Signal Slicer essentially replaces the detector normally used in the receiver. The AVC action in most receivers so altered will now be completely out of service, as will the S-meter. (Even if the AVC is not disabled, it should not be used when using the Signal Slicer.) The RF gain control will be the main gain control of the receiver. It is difficult to give specific information for connection of the Signal Slicer to all receivers, but the above information covers most cases that will be encountered.

Some receivers have an accessory plug in the rear. Find out whether the amount of power available from this plug is ample to supply the requirements of the Signal Slicer if you contemplate borrowing the power from the receiver instead of using a built-in power supply. The heater power required is 6.3 volts at 1.2 amperes and the high voltage required is 250 to 300 volts at approximately 25 ma. It is recommended that the filter section consisting of R_{24}, R_{25} and C_{17} be retained regardless of the power supply used.

FINAL ADJUSTMENTS

Turn on both the receiver and the Signal Slicer and allow a few minutes warm-up time. The R-F gain control of the receiver should be all the way to zero and the AVC switch set for "manual" or "RF." Plug headphones into the output jack (J) on the adapter, set the selector switch to normal (position 3), advance the R-F gain until the receiver sounds "live" and tune in an AM station, governing the output with the R-F gain control. Keep this output reasonably low. Be certain to *tune* the receiver to maximum output (remember, there is no AVC and no S-meter) with minimum I-F bandwidth, if the receiver is so equipped, but do not use the crystal filter at this time. Trim the secondary of the last I-F transformer to compensate for any shift of its tuning caused by connection of the Signal Slicer input circuit. Set the two balance potentiometers (R_{18} and R_{19}) about midway and turn the selector switch on the adapter to one of the sideband positions (position 1 or 2). This actuates the oscillator in the Signal Slicer.

Tune the oscillator (with C_{19}) to zero beat with the received carrier, at which point good, clean audio reproduction should result. If the oscillator will not tune to zero beat within the range of C_{19}, replace C_{18} with different values of capacitance until zero be[at] can be obtained with C_{19} near mid-range.

Now, detune the *receiver* until a beat note of about 1000 CPS is heard. Try detuning first on one side, and then on the other, leaving the receiver set for the *weaker* heterodyne. Adjust the appropriate resistor (R_{18} or R_{19}, depending on the selector switch position) for a *minimum* heterodyne. Then detune the receiver to the other side of the signal, switch to the other sideband with the selector switch, and adjust the other potentiometer for a minimum heterodyne. Quite possibly neither minimum will be a complete null at this time.

Adjust C_{23} for a further reduction in heterodyne strength (readjusting the oscillator frequency with C_{19} if necessary to maintain the same beat note). Adjust the potentiometer (R_{18} or R_{19}) for still further reduction of heterodyne strength, switch to the other sideband position, retune the *receiver* for a beat note of 1000 CPS on the other side of zero beat, and adjust the other potentiometer for a minimum heterodyne signal strength. You will find that the sharpness of the minimum becomes more pronounced each time the above process is repeated until C_{23} is set at the optimum point, just as in balancing a bridge.

Throughout the above adjustment procedure it is assumed that the Signal Slicer is in working order other than for the correct settings of the few adjustments just covered. If no signal is heard at any time, or if excessive hum or other evidence of trouble appears, a thorough trouble-shooting routine is in[di]cated.

OPERATING INFORMATION

After a short time of familiarization the user of the Signal Slicer will find that he listens almost exclusively to one or the other of the sideband positions, rarely ever going back to normal reception. In most cases reception of AM, NBFM, CW and Single-Sideband signals will be greatly improved over conventional reception methods. If interference appears when listening to one sideband of an AM or NBFM signal, simply switch to the other sideband to dodge the problem. Do not try to "tune out" interference—switch it out instead. Sometimes, even then, the going is rough, as we all know. That's the time to switch to normal reception to find out how rough it really is. At least, with the Signal Slicer, you can always get rid of the interference that appears on any one side of the received signal.

Since extremely close tuning (within 100 CPS) is generally necessary, the receiver should have a good bandspread arrangement, and should, therefore, have excellent stability. Some signals will be found where the Signal Slicer is of no advantage whatever because the signals themselves are characterized by excessive drift, syllabic instability, or other obvious faults. Then too, some receivers exhibit faults quite similar to those mentioned for transmitters. Do not expect the Signal Slicer to cure either a "rotten" signal or a receiver that, for instance, makes *all* CW sign[als] sound rough, or one that has excessive drift.

In general, operate the receiver with the lowest R-F gain control setting that gives comfortable audio output. An overloaded receiver is just as bad as an overloaded transmitter (perhaps worse) as far as the listener is concerned. The crystal filter in the receiver may be used in the conventional manner.

SIGNAL SLICER 9/69 EEB-ix-

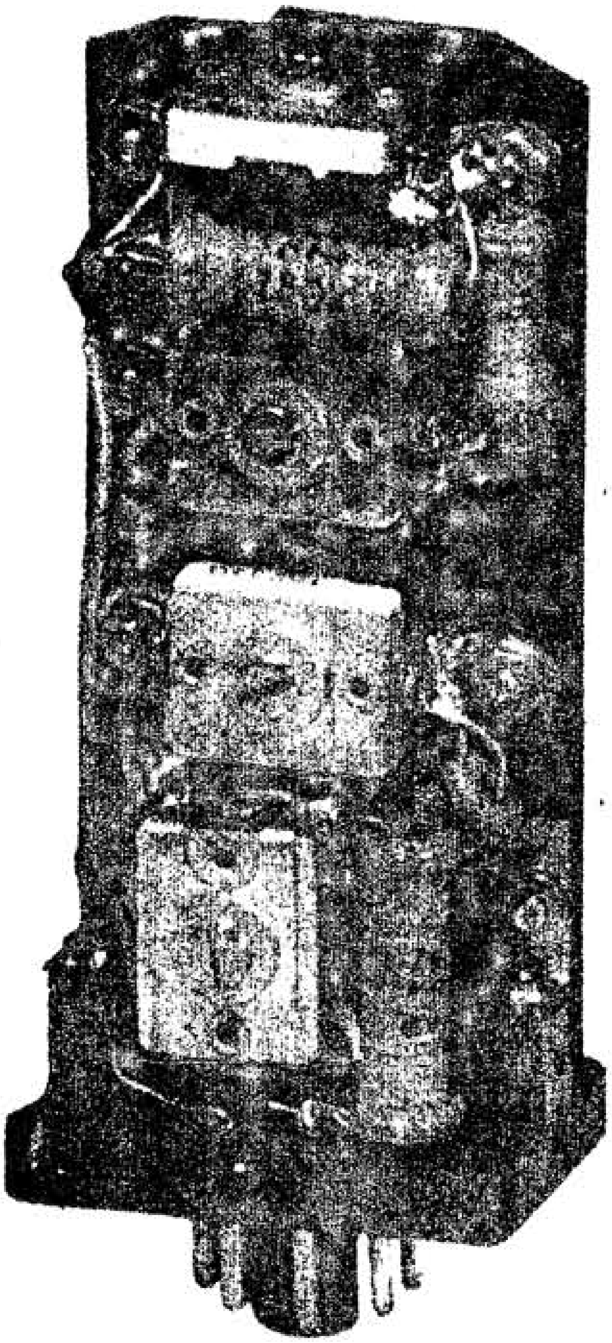


Fig. 10. Internal view of the front of the home-made phase-shift network.

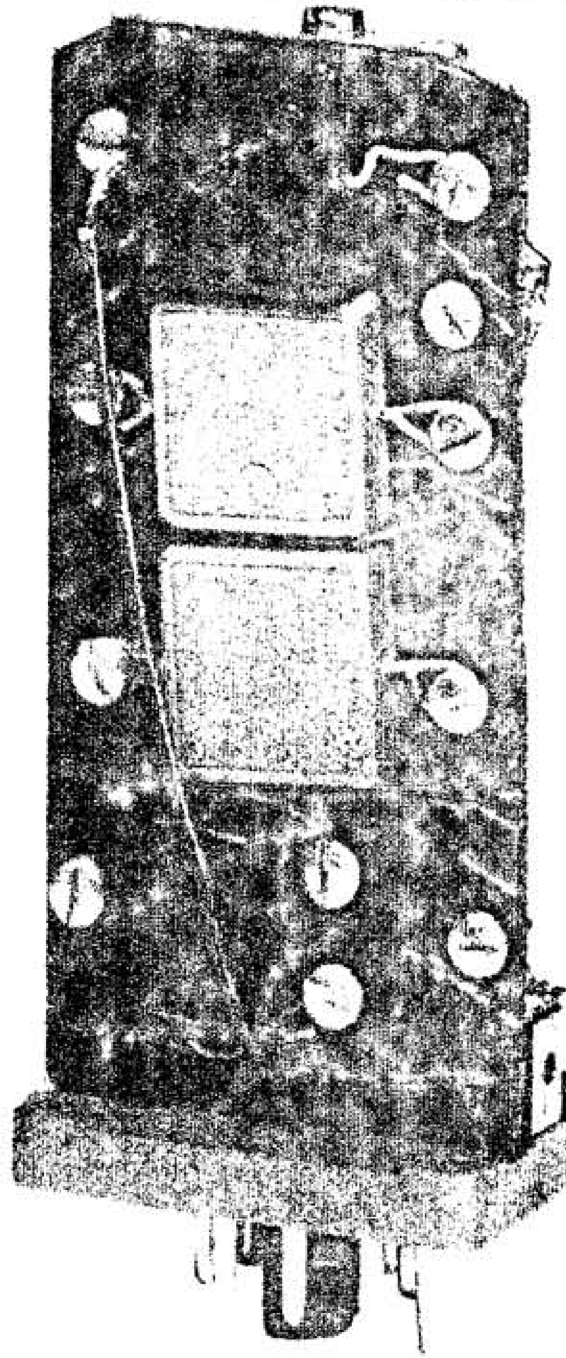


Fig. 11. Internal view of the rear of the home-made phase-shift network.

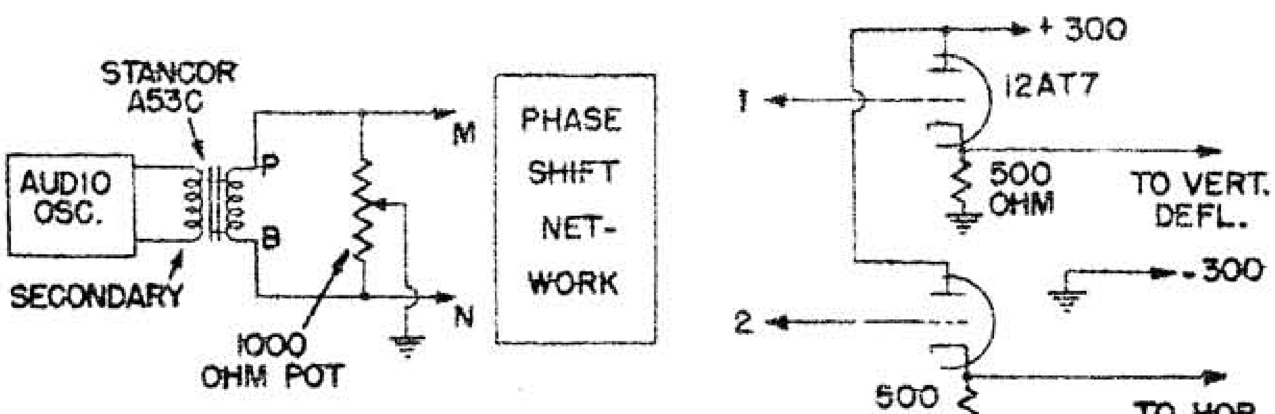


Fig. 12. Temporary layout required to test phase-shift networks.

Designer's CORNER

9/69 EEB -X-

Notes on the Application of the Signal Slicer

I asked the designer of the Signal Slicer, W2KUJ, to make some general comments on the characteristics and use of this new SSB unit. The following remarks are his.

—*Lighthouse Larry*

Many hams who do not operate single-sideband 'phone stations feel that a single-sideband receiving system would be of no use to them. The fact is, it is probably more useful to them for receiving CW and AM 'phone signals than it would be to a SSB enthusiast for receiving SSB signals (although the SSB ham has long since learned the usefulness of such a receiving system).

In other words, if the Signal Slicer is good for SSB 'phone reception (I can assure you it is—Ed.) it should be dandy for CW, especially traffic nets, where one or more of the stations may slip away from the crystal filter and turn up missing on a few receivers.

Going a bit further in our thinking, an AM 'phone station is just like two single-sideband stations (at the same carrier frequency) that just happen to be transmitting identical signals on opposite sidebands. Therefore, one isn't missing anything if he doesn't listen to one of the signals. The Signal Slicer allows the receiving operator to select which one of the signals he doesn't want to hear. This sounds ridiculous on the face of it, until you consider that one of these "stations" is liable to be severely heterodyned, which is a polite way of saying that the QRM on that station is terrible.

If this QRM situation exists, the operator can flip a switch and hear the same transmission on the other side, where no heterodyne exists. Obviously, the operator isn't choosy about which side he listens to, as long as he can hear the same thing on either side. This is what is known as broad-nosed selectivity with extremely steep side-slope—a rather valuable asset in many situations.

The Signal Slicer, however, goes one step beyond providing just usable selectivity as such. The demodulator is made as nearly distortionless as one could pray for, because *all* incoming signals are smaller by a factor of some 200 or better than the carrier signal that is supplied by the built-in oscillator to the detector system. This is exalted carrier operation with a vengeance, but it certainly pays handsome dividends.

One dividend is the elimination of "mushing up" when receiving a fading signal; another is in reduction of the apparent volume range of a fading signal—so much so that loss of the AVC function in a receiver using the Signal Slicer is actually a distinct gain. But, don't take my word for it—try it yourself.

A word about the demodulator circuit is in order at this point. You might be tempted (even as I was) to use germanium diodes in place of the 6AL5 diode tube, and thus end up with a three-tube Signal Slicer. If you like to listen to noise this simplification is recommended. However, if you want a good SSB receiver adapter, use the 6AL5 or some other thermionic diode tube. My physicist friends tell me that the effective noise resistance of germanium diodes is extremely high, compared to a tube like the 6AL5, when you operate at low frequencies with only a few microamperes of d-c flowing in the circuit. My friends were correct. The tube is as quiet as a tomb lined with rock wool compared to the germanium diodes. For this particular application, a tube works out better than germanium diodes.

Somebody (perhaps it was Aesop or Confucius, I don't recall) said that the merit of a radio receiver was not in what it would receive, but in what it *wouldn't* receive. Of course, receivers have on switches, but what I mean is, doesn't your present receiver receive too much?

I am certain that you will agree that many, many times, on a single frequency, you have received more signals than you knew what to do with.

So, if these ancient philosophers were right, the Signal Slicer is a merit improver, although it's not perfect. The frequency range over which you can expect to get at least 40 db. signal rejection is controlled by the phase-shift network, and its range is 225 to 2750 cycles per second. This, of course, more than covers the region of most acute hearing, but what about the audio frequency range outside these limits?

At 4000 cycles the signal rejection due to the phase-shift network is between 36 and 37 db., and at 8000 cycles it is about 30 db. The audio amplifier in the Signal Slicer is deliberately designed to have a response which is down 3 db. at 4000 cycles, 9 db. down at 8000 cycles, etc. (This is at a rate of about 6 db. for each octave.) Thus, at the slight sacrifice of high fidelity it is fair to say that the signal rejection is about 40 db. all the way along, because the audio response has been tailored in an identical way on the low-frequency end of the spectrum.

Add to all of this the I-F selectivity curve of your receiver and you may begin to see why we think the Signal Slicer is really about as good as anyone might want when you consider the practical aspects of reception.—W2KUJ

THE AUSTRALIAN EEB

AN INFORMAL ELECTRONICS
EXPERIMENTERS BULLETIN

Editorial Office:
P.O. Box 177
Sandy Bay, 7005
Tasmania,
Australia.

20c per copy

Australia and N.Z.:

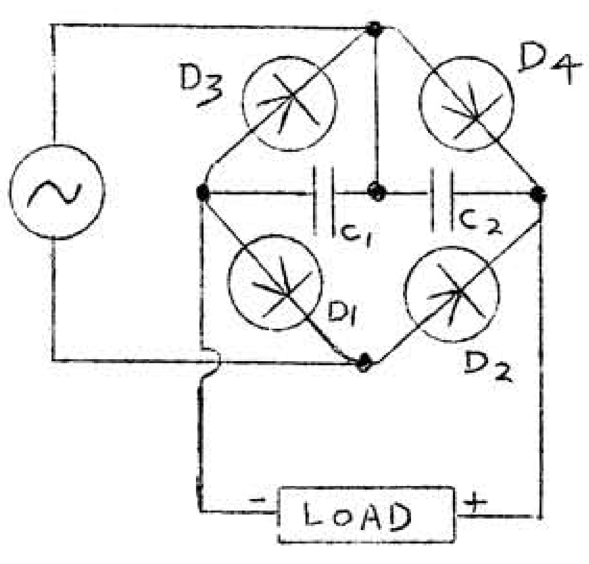
1 yr.	2 yrs.	3 yrs.
$1.00	1.75	2.25

Foreign: 80% higher

OCTOBER 1969 Vol. 5, No. 8 P. 111

CONTENT:

PUZZLE: THE FOLLOWING CIRCUIT IS A "FULL WAVE VOLTAGE TRIPLER" WHICH APPEARED IN THE BOOK "RECEIVERS" BY JIM KYLE (73 PUBL. 1964), P. 54. A ONE YEAR SUB OR RENEWAL WILL BE AWARDED TO THE FIRST PERSON WHO TELLS US HOW THIS MOST UNUSUAL CIRCUIT OPERATES AS A FULL-WAVE VOLTAGE TRIPLER. ((Extra time for W.A., etc))



NEXT ISSUE: December (not November). Unfortunately that makes nine issues this year. Bah.

Electronic Organ Design.
A Novel 100W a.f. Amplifier.
The Full Wave Tripler.
Transformer Design Controversy.
A valved Transmitter!
An elaborate Transistorised Transceiver.
An Effective T-R Switch. ((If we can get all in))

POSTSCRIPT: After this issue was done, I adjusted this old electric typewriter some more, with somewhat better results, as on this page. Letters x and z and a few others do need more work; it will be done slowly but surely. At the end, it ought to be a pretty good piece of machinery. Sometime next year we then intend to sell it, and get a really nice one, probably IBM or Adler. If you will possibly be in the market for a well- reconditioned old electric model, let us know now. Typing on an electric is such a pleasure!

EDITORIAL -- RLG

"A burnt child gathers no moss."
-- Vietnamese proverb

Current Issues of EEB:
This month's issue contains different articles than promised, and last months and this and next month's are going to look rather odd with lots of electronic stencils and articles which ought to go in various series, but we can't help it. We have some startling plans for the format of EEB in 1970, and the present stuff will not fit in conveniently then. We beg your indulgence, and promise that we shall return to (relative) sanity next year. And we must also apologise to authors for the delay in appearance of their articles, but you won't be sorry when you see how lovely the articles look.

Puzzle: Twenty-six one ohm resistors are bonded immovably to a buss bar which is shorted at one end; the other end is free, and reads 0.1 ohm. If three of the resistors are connected in parallel, how many are connected in series? A year's free sub or renewal to the best answer, I mean the correct answer. Illustrated, of course.
But the Puzzle on this month's cover is for real, and a real headache too.

The virtues of Diversity: From the comments we receive with renewals etc, it would seem that we appear to be pleasing everyone. Some say we have too many radio amateur articles, some say we have too many experimenters articles. No one has yet had the courage to admit that he didn't understand our elegant discussions on receiver and antenna theory. Now look, articles should be read for their value. How are you ever going to find out anything about the world if you only read about things you already know?

If you never plan to build an organ or a transistor ignition, they will still enrich your background -- and you might find yourself building some of them after all. If you think that talking about banalities on the air is pointless, cheer up, so do I. But that is no reason to ignore designs and comments on receivers, or even transmitters. Receivers are generally useful to everyone, and if you know abit about Class C operation (transmitters), you might discern why that recent Fairchild 3W amplifier board sounds terrible unless biased to Class B; More about that, later....

If you see an article which shows a condenser to suppress r.f. oscillations in a transistorised d.c. pwr supply, it may occur to you that the seemingly impossible stuff you have been hearing in your hi-fi amplifier may be caused by the fact that the fi is too high; 50Mc transistors used for a signal never more than 0.02Mc. EEB-type approach suggests that intelligent bypassing or feedback is the answer.

FM: And suddenly now FM has become popular (last month, p. 98), and the American magazines are bursting with advertisements for expensive gear and nice big issues of articles featuring FM, and we can help to support the Economy (and the magazine) by buying it. And what about the many non-USA voices which have been promoting FM for many years? Oh they were not Realistic, because other stuff was more practical; i.e., more practical to buy off the shelf... Now that it has happened, I think I won't dust off that FM file after all. Who wants to be on the side of Commercial, I mean Ham Radio (Cheer up, Jim, I always underline the names of magazines). My, isn't it nice that we don't have to depend on equipment manufacturers for the support of EEB?

This and That: Got a new "Silberfaber" pen the other day, one of those clever new gadgets with only a plastic tip, no conventional point. Doesn't work very well with ordinary ink, but it is simply magnificent when cleaned out and refilled (by use of a syringe) with Indian Ink. It is the only pen I have seen which can be used successfully with Indian Ink, and we shall make good use of it for draughting.
That review of VHF Communications in last month's "Periodicals" list was stolen from copy I have seen in AR and Spectrum, because the Sydney Representative did not bother to supply us with a copy as requested. I hear it is a good mag; does anyone have an extra copy to loan? By the way, thanks to reader for copy of Electroniques Cat -- such as it is...

CURRENT LITERATURE -- RLG

In recent times I have been omitting literature reviews of this type, but sometimes I can't resist it when interesting months happen. It was brought on by:

73: This mag has been turning out consistently interesting issues since early 1969, eg May. They have had numerous short articles, some quite good; the Sept issue has 35! Along with teletype, IC and such, there is some good oil for Transistor Transmitterites: "The Magic T" (an excellent idea for paralleled transistors), "Transistor Transmitter Aspirin" (a wealth of good suggestions for precautions), and "2½W Transmitter." And: "Improvement of Phone Intelligibility by Base Clipping." (a remarkable idea, but it makes sense), and "More Taylor Modulation." The latter is a fine and efficient system of modulation, though it is difficult to adjust properly. Obviously 73 is far from "folding up" as many were forecasting a year ago. Speaking of the Devil,

HAM RADIO continues with fewer but longer articles of high calibre. The September issue has a beautiful piece by W6SAI on FM circuits, in spite of my words in this month's Edit. And a significant article by W5JJ on transmitter loading and efficiency; he has an article coming up soon in EEB on a related subject.

CQ: R.f. interference to transistors, p. 78. What won't the Yanks think of next?

RADIO COMMUNICATION continues to have the most fascination for me in G3VA's "Technical Topics." In August he tells about a conducting adhesive tape (by 3M) for easy r.f. shielding, a circuit of an FET Transmitter (see also: FET Principles and Practice, by Ed. Noll), a novel idea for base-modulating a Tr Tx (like grid modulation, but it won't work unless you use negative feedback), helpful hints for reducing cross-modulation in receivers, and a clever sine wave multivibrator using no inductance at all!

AMATEUR RADIO has been particularly good recently, particularly with those contributions by Ron Brown and RLG; more of the latter coming up soon. Don't miss it!

BREAK-IN in August has a good FET Phase Modulator (FM), and in true ZL style, a fine one transistor electronic keyer, with self-completing dots,etc. All unfashionably simple.

CORYRA: The current (June) issue of this interesting magazine for beginners leaves their previous Ceramic Filter research project, and gets down to beginners stuff again with 2 good simple receivers, a siren, amplifier design, and signal monitoring techniques. And the use of crystal set to power amplifiers; can be used for easy c.w. monitoring.

SPECTRUM, included in last month's "Periodicals" list, is only for experimenters and avid enthusiasts ((like EEB)). A number of issues have been good this year, but the Aug. one has topped the lot in many respects, with both QSP and technical stuff on all levels. Among much else, ZL1TAQ has a brief but competent look at all essential transistor parameters, and it should be clipped out and attached to the article on much the same topic by me, appearing soon in AR, though my treatment is not as succinct.

On the other hand, I might disagree with OM Morris on one point: When one compares characteristics of a given (e.g. disposals) transistor with a transistor required for a given circuit, it is commonly unnecessary to compare ALL of the main parameters. While the majority of circuits using transistors are relatively uncritical, the nature of any special requirements will generally be evident from inspectionof power, frequency, etc. I don't have room to expand further on this here, but I have discussed it before in EEB and shall do more later; this is only a plea for common sense.

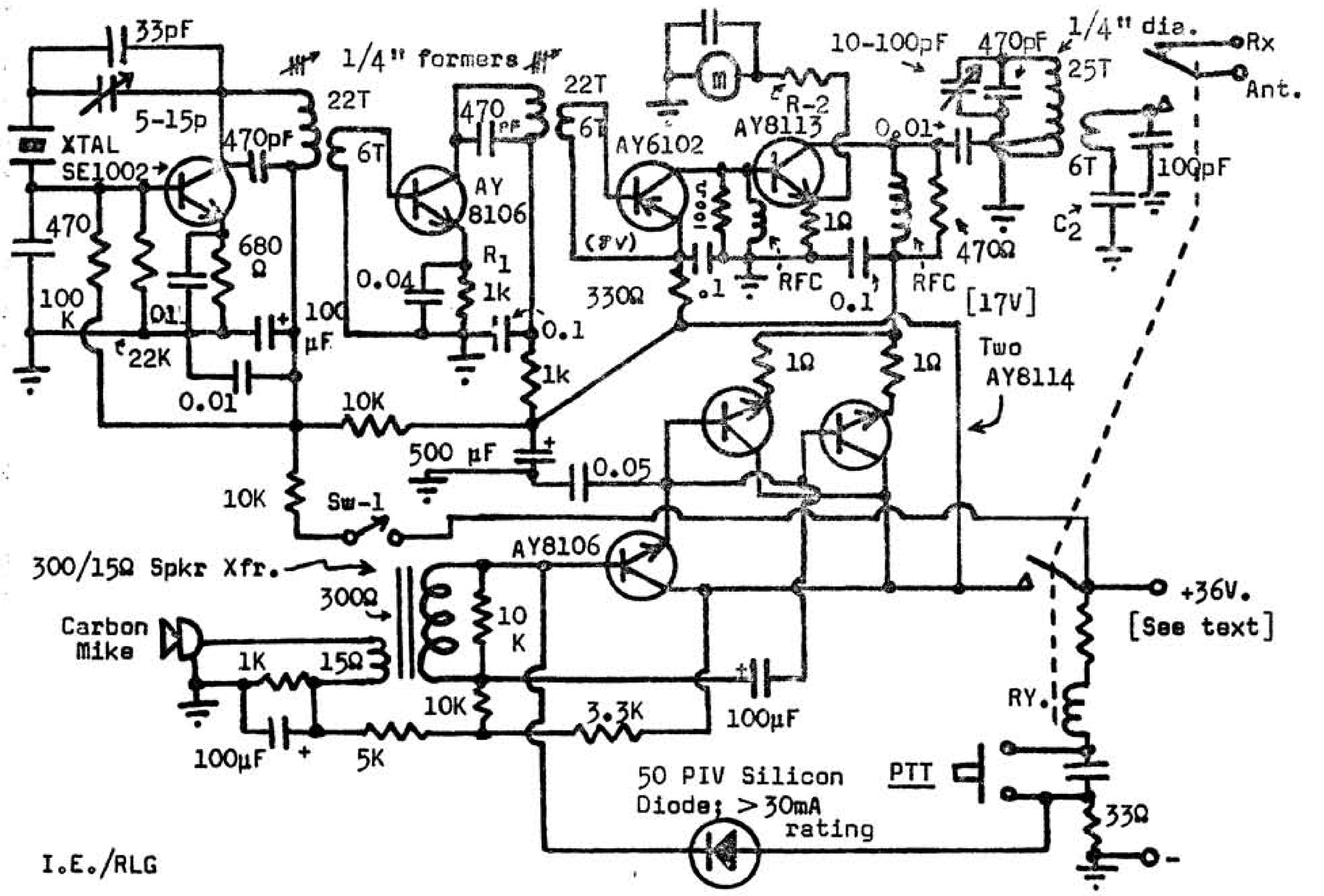
Before Spectrum I was not particularly interested in VHF, but when I see all the fun those chaps are having with it, I am becoming converted. E.g., ZL1BFA uses a Klystron at 5800Mc!, and the way he puts it, it looks easy. And there are continuing articles on techniques of soldering aluminium; a long article on Y-Parameters (though I have become used to h-parameters), a complete condenser-discharge ignition system, and the second in a series of articles ona well-designed AM/FM solid state transmitter. A fine magazine.

A 13W SERIES MODULATED TRANSMITTER -- I. N. Kallam [VK3]

There has been a lot of gab about the advantages of this kind of circuit, so I shall say here only that elimination of the Modulation Transformer obviously reduces the voltage requirement of the p.a. transistor, and that it went fine at 100% modulation with no aerial. From the various warnings in EEB, you know that this is good performance. The 470 ohms across the RFC in the p.a. collector undoubtedly helps. In fact I used a 40V p.a. transistor in testing, and it stood up, but since the supply can increase to 45V when the batteries are being charged, I used the 120V transistor in the final unit. Originally I used SE3030's, but these have now been discontinued, necessitating specification here of the AY8113 as p.a. [also made by Fairchild]. It has f_T of 80Mc, but the AY8114 [50Mc] can also be used at this frequency. These are available, and relatively inexpensive.

A lower voltage equivalent is being built, featuring dual-voltage capability. With 6V on internal battery, output should be about 1W r.f., and with 12V from car etc, output will be at least 5W r.f. But the full output will, of course, be obtained only from the 36V supply. Easy in the car: just put three old 12V batteries in series, charge in parallel while receiving; maybe use diodes to do it automatically. For permanently lower voltage, more modest transistors could be used, e.g. AY8112. The AY8116 are also very good, but with much lower power rating; several can be used in parallel for good results.

The crystal in my unit works around 3Mc, but you can adjust everything slightly if you want operation in the 80M band. P.a. output is on the fundamental. The crystal can be pulled slightly by C-1. R-1 is varied to adjust drive. Adjust R-2 so that the meter M, reads full scale when emitter voltage is 1V. Load and drive should be adjusted so that the final loads up to about 750mA [0.75V on the meter], giving 27W total input. If you apply too much drive, you'll pop the base-emitter of the p.a. stage, so ensure that load is optimum before cranking up drive. C-2 is selected for the maximum output with a given aerial. Mine was 680pF. Sw-1 is used for tuning. "PTT" means Push-to-talk, assuming you have something worth saying.



I.E./RLG

A TWO PLUS SIX METRE DI-PLEXER -- R. W. Brown, VK7ZRO

A Diplexer is a matching device which allows you to feed two transmitters into one antenna without switching, andwithout appreciable loss. It is particularly convenient in automobile mobile.

The most practical method of coupling is to use coaxial cables. See Fig. 1 (P.116). The coupling works with only sections A, C, D, and F, but SWR is high. Correcting stubs B and E solve this problem. Construction and tuning are as follows:

Set up the system of Fig. 2. At about 73 inches along the coax, push in a strong pin to short the inner and outer conductors of the cable. Note the meter reading. Move the pin up $\frac{1}{4}$ inch, and again note the reading; continue until a minimum is obtained. This gives a length, L. Cut one piece from the coax, exactly $(L/2) + \frac{3}{8}$" long (i.e., about $36\frac{5}{8}$" long. Strip one end back $\frac{3}{8}$" from the end. This becomes Section C. The remaining piece will become Section A.

Repeat this whole procedure (Fig. 2), but with a 28" length of coax, and a frequency of 146.000Mc. Be sure to remove all pins!

Using suitable input and output connectors, connect the four lengths of coax so obtained, as per Fig. 1 sections A, C, D, and F; B and E will come later. Actual mechanical arrangement is shown in Fig. 3, but the topmost connection is not yet connected (viz., Coax B and E are missing).

Construct as per Fig. 4. Section A is now progressively shortened $\frac{1}{8}$" at a time (making sure each time that it is not shorted by the cutting process), until a minimum is obtained on the meter. Using 5W of r.f., I obtained a minimum reading of about two microamperes on the meter. Repeat Fig. 4, but interchange Tx and Meter, and use Tx at 146.000Mc instead. Adjust Section F in the same manner. Seal the two ends.

Set up as per Fig. 5, which now includes the correcting stubs, B and E. Start with B = 4 inches, and E = 25 inches. Adjust Stub E with a pin (as before), until the lowest SWR is obtained; it should be less than 1.1:1. Cut, short properly, and seal. Repeat for Stub B, interchanging lower Dummy Load and Tx, and using 2M transmitter. The adjustments are now complete.

It ought to be possible to use various coaxial cable impedances for the Diplexer; 50 ohm or 75 ohm coax, or even 300 ohm ribbon. In my case I made it out of 50 ohm cable, and added the extra facility of making the system into a matching transformer: 70 ohm to 37 ohm; the system is shown in Fig. 6. My antenna is better matched by 37 than by 50 ohms. This is achieved by paralleling two 75 ohm lines. The 70 ohm input is provided by the pi-network of the transmitter, which is simply tuned for maximum output.

Installed in the car with a roof-mounted helical compromise-length whip, the overall SWR on both bands was less than 1.8:1. Rather than using the more conventional "$\frac{5}{8}$-$\frac{1}{4}$" compromise whip with loading coil, mine was about $\frac{1}{2}$ wavelength long on 2M, but electrically $\frac{3}{4}$-wave because of the helix, with no need for loading coil. This is shorter, and gives good results. Moderate values of SWR are quite harmless if the line is not too long. No break-through or similar adverse effects have been noticed.

If, on the other hand, coax of the same impedance is used for the antenna feeder as for the various stubs, no transformer system is needed. The specific system used will depend on the particular requirements of your antenna, and of material available.

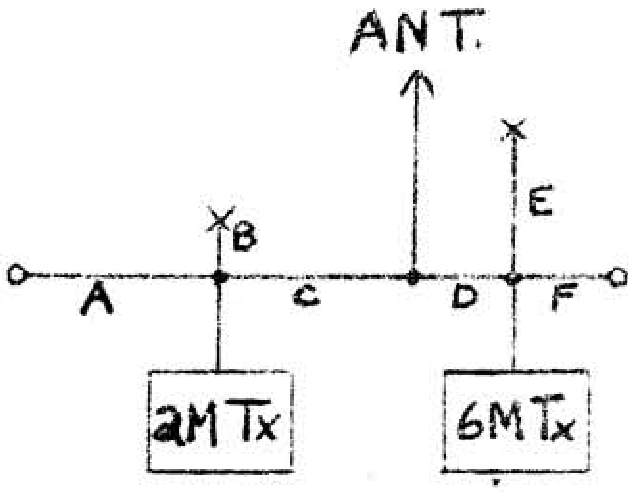


Fig. 1: Diplexer Coax Sections.

Section	Electrical Length	At λ.
A	1/4 λ	6M
C	1/4	6M
D	1/4	2M
F	1/4	2M
A + B	3/4	2
B + C	3/4	2
D + E	1/4	6
E + F	1/4	6

x = shorted end, o = open.

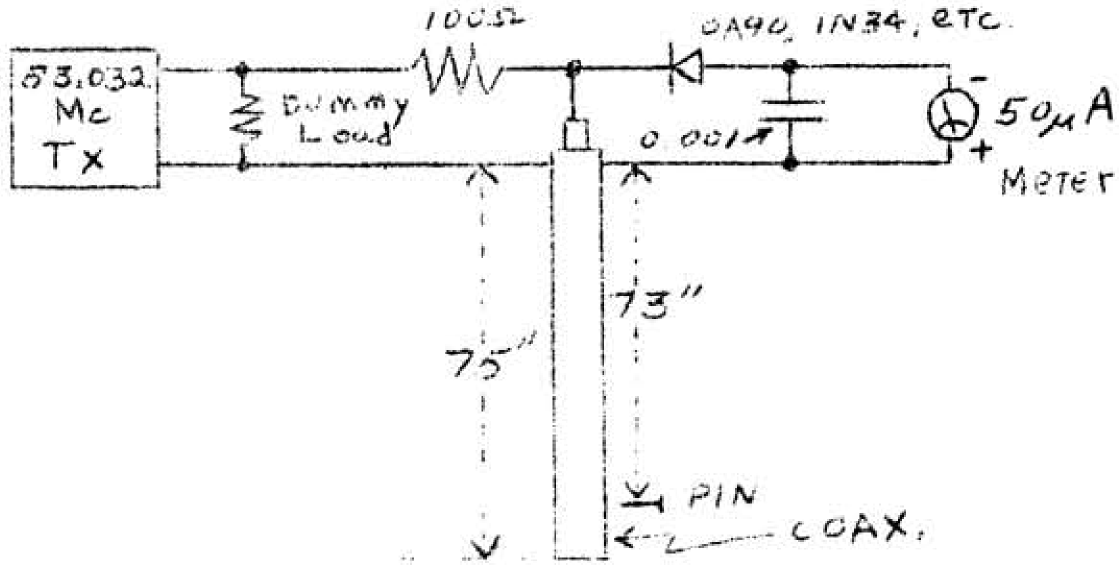


Fig. 2: Test System to determine λ/2 at 6M.

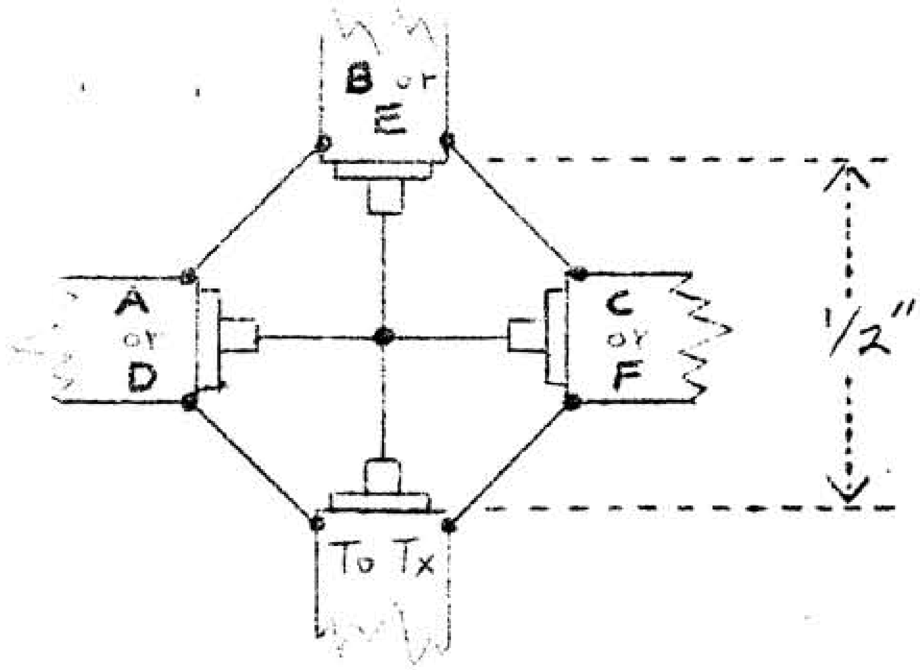


Fig. 3: Mechanical layout of Coax junctions.

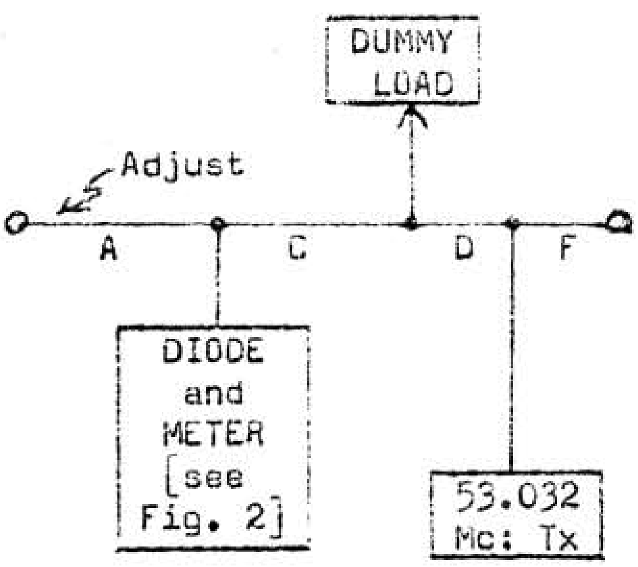


Fig. 4: Fine-tuning setup

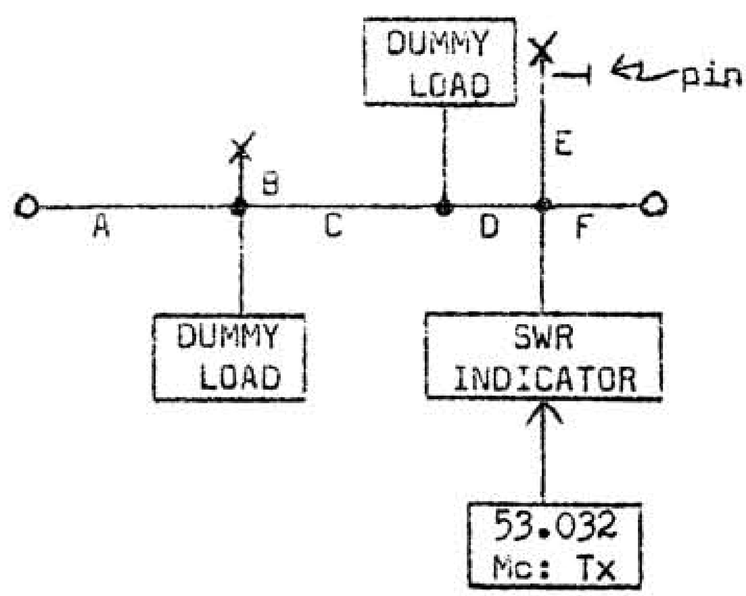


Fig. 5: Tuning the correcting stubs

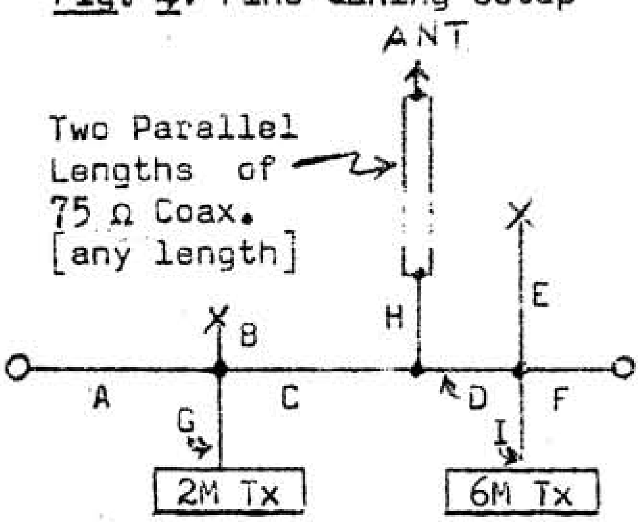


Fig. 6: Matching Transformer System.
[G + C + H = 3/4 wave on 2M; H + D + I = 1/4 wave on 6M. See Text]

-VK7RG

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- - - - -

THE TUNA FISH CAN RF BRIDGE VOLTMETER

Or

OHMS - REACTIVE AND OTHERWISE

By - John L. Reinartz, K6BJ

- - - - -

Would you like to add a simple instrument to your collection with which you can ascertain resonance, the impedance of a circuit containing resistance and reactance: the reactance of a condenser or coil as well as resistance values within its range? Then build yourself a tuna fish can rf bridge voltmeter.

For instance, in tank circuit calculations we can use a sufficiently accurate yet simple formula to obtain the values of the capacitative or inductive reactance for resonance and need to know only the plate voltage to be used, the power output desired and the desired Q of the circuit. The form of this expression is:

For triodes: $$\frac{(.63\ E_b)^2}{Q\ P_o} = X_L \text{ or } X_c$$

For tetrodes: $$\frac{(.57\ E_b)^2}{Q\ P_o} = X_L \text{ or } X_c$$

Where $(.63\ E_b)$ equals the RMS plate voltage swing, E_b equals the dc plate voltage, Q equals the desired circuit Q and P_o equals the desired watt output.

From the attached reactance table we can very readily determine both the capacitance value and the inductance value at the desired operating frequency, needing merely the reactance value obtained from the values used in the formula.

To measure the reactance of a condenser or coil, we can use the simple voltmeter bridge circuit shown in Fig. 1

Because this bridge measures ohms or impedance and since the resistance is negligible in a good condenser or a small inductance of good design, the value read off the dial at a specific driving frequency is the reactance ohm value. When a series resonant circuit is measured at its resonant frequency, the value read off the dial is the resistive component. Only when a resistor is being measured that is non-reactive, will the reading of the dial be the same for any driver frequency up to 30 mc., the bridge accuracy limit.

Tuna Fish Can RF Bridge [continued]

The characteristic impedance of a line less than one-half wave length long at the highest measuring frequency may readily be determined if previously unknown. It is but necessary to connect one end to the bridge and a variable carbon potentiometer to the other end. When the voltmeter no longer changes its zero reading with a 2 to 1 change in driver frequency, the bridge will be in balance and the dial reading will be the Z of the line, as will be the setting of the carbon potentiometer at the end of the line.

A quarter wave mobile antenna may be measured for resonance, also its resistive component at resonance. We simply connect our bridge between the base of the antenna and ground, or the point at which the coax, when used, is connected into the antenna system. We can check the driver frequency at the car receiver if the rf driver frequency is not accurately calibrated.

Calibration of the bridge can be by the use of an ohmmeter - rotation of the dial will indicate the resistance on the ohmmeter. If a zero to 100 ohm potentiometer is used in the bridge, calibration can be for every 5 ohms. When a 500 or 1000 ohm potentiometer is used, calibration may be at 25 ohm points. If values under 100 ohms are expected to be measured, a 100 ohm potentiometer is suggested otherwise, a 500 ohm potentiometer will serve most purposes.

Initial balance with a resistor of known value connected to the bridge after calibration can be accomplished through the addition of a 1000 to 5000 ohm resistor placed across any one of the points marked with an X, since it cannot be determined beforehand how the diodes and resistors will balance.

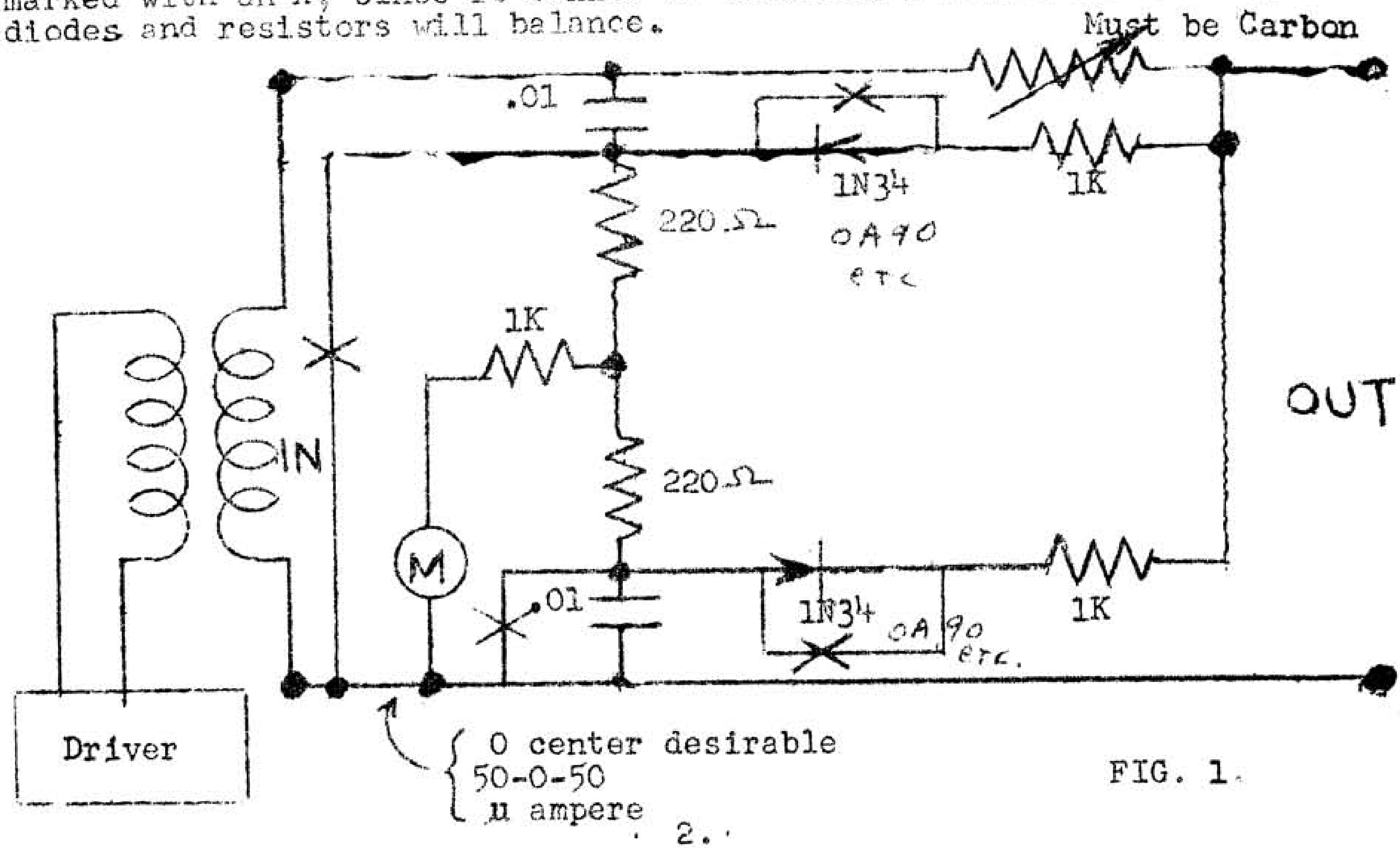


FIG. 1.

Tuna Fish Can RF Bridge
[continued]

TETRODES

$$X \doteq \frac{(.57\ E_b)^2}{Q\ P_o}$$

E_b	P. In	P. Out.	Efficiency	Q	Ohms Reactance
1000	133	100	75	12	270
1500	267	200	75	12	305
2000	536	400	75	12	270
2500	800	600	75	12	282
3000	1000	800	80	12	305

An average value of 300 would serve.

E_b	P. In	P. Out.	Efficiency	Q	Ohms Reactance
1000	133	100	75	15	217
1500	267	200	75	15	243
2000	536	400	75	15	217
2500	800	600	75	15	225
3000	1000	800	80	15	243

An average value of 225 would serve.

TRIODES

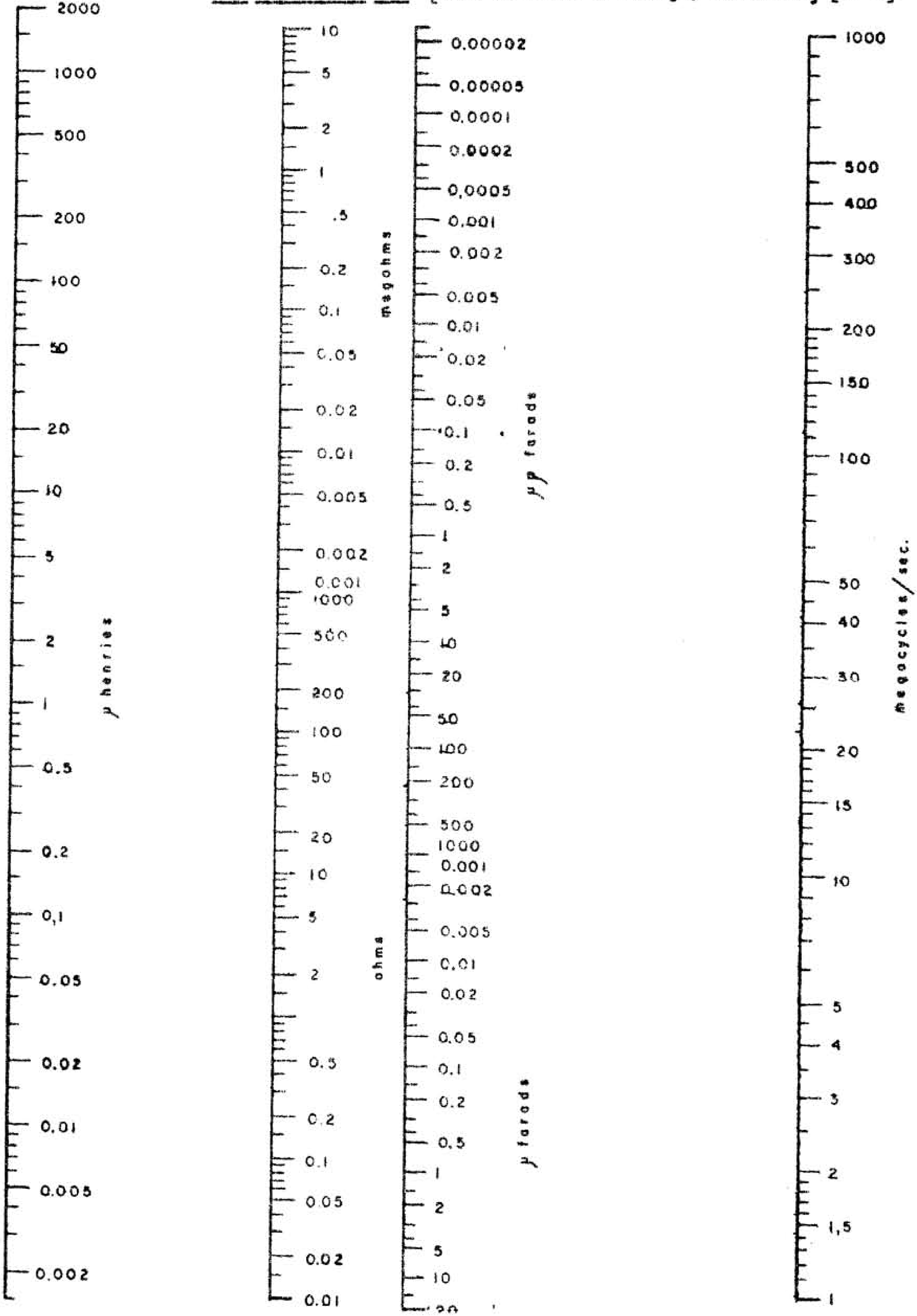
$$X \doteq \frac{(.63\ E_b)^2}{Q\ P_o}$$

E_b	P. In	P. Out	Efficiency	Q	Ohms Reactane
1000	133	100	75	12	330
1500	267	200	75	12	372
2000	536	400	75	12	330
2500	800	600	75	12	345
3000	1000	800	80	12	372

An average value of 350 would serve.

E_b	P. In	P. Out	Efficiency	Q	Ohms Reactane
1000	133	100	75	15	263
1500	267	200	75	15	297
2000	536	400	75	15	263
2500	800	600	75	15	276
3000	1000	800	80	15	297

An average value of 275 would serve.


μ henries
2000
1000
500
200
100
50
20
10
5
2
1
0.5
0.2
0,1
0.05
0.02
0.01
0.005
0.002
megohms
10
5
2
1
.5
0.2
0.1
0.05
0.02
0.01
0.005
0.002
0.001
1000
500
200
100
50
20
10
5
2
0.5
0.2
0.1
0.05
0.02
0.01
ohms
μμ farads
0.00002
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0.0001
0.0002
0,0005
0.001
0.002
0.005
0.01
0.02
0.05
0.1
0.2
0.5
1
2
5
10
20
50
100
200
500
1000
μ farads
0.001
0.002
0.005
0.01
0.02
0.05
0.1
0.2
0.5
1
2
5
10
megacycles/sec.
1000
500
400
300
200
150
100
50
40
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15
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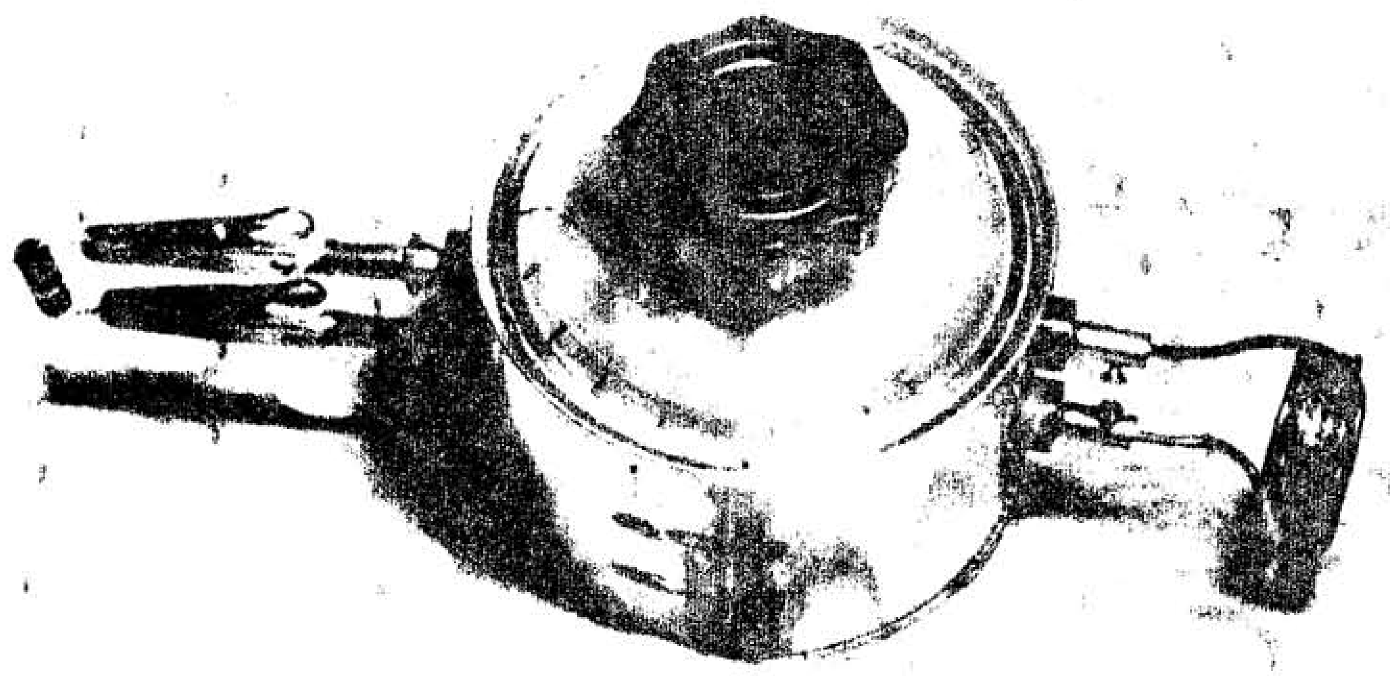
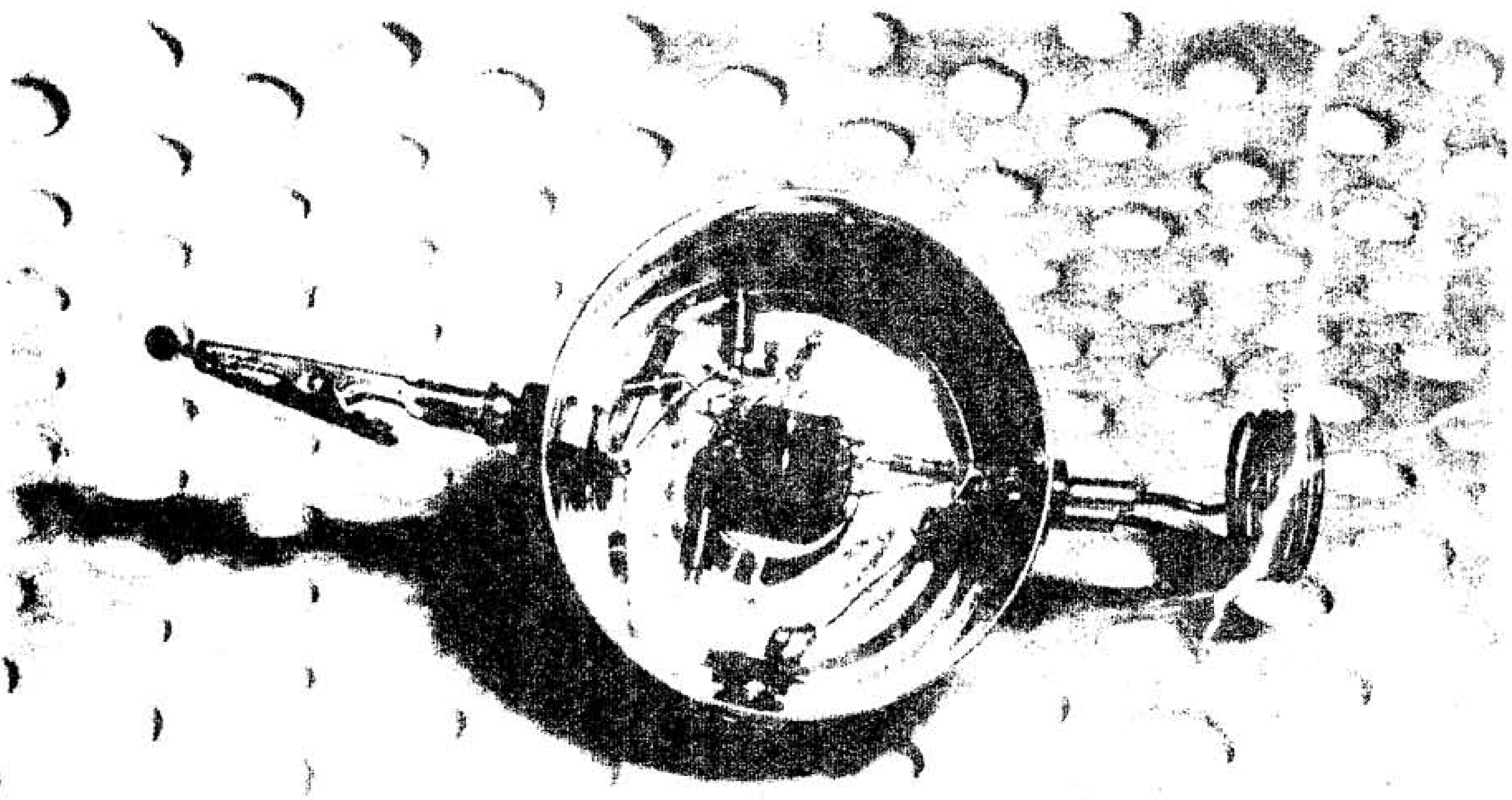
5
4
3
2
1,5
1

And here in its Glory is the Tuna Fish Can RF Bridge!:





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5	25	16	13	200	10	25	21
10	10	13	11.5	200	25	29	23
10	25	18	14	220	50	45	41
10	50	23	18	400	40	58	55
22	50	26	23	470	50	70	65
25	25	20	16	500	10	33	27
30	10	15	13	500	25	40	35
47	50	30	26	1000	10	49	42
50	10	17	14	1000	25	60	53
50	25	21	18	1000	50	1.20	1.00
100	10	19	15	2000	25	95	85
100	25	25	21	4000	60	2.85	2.45

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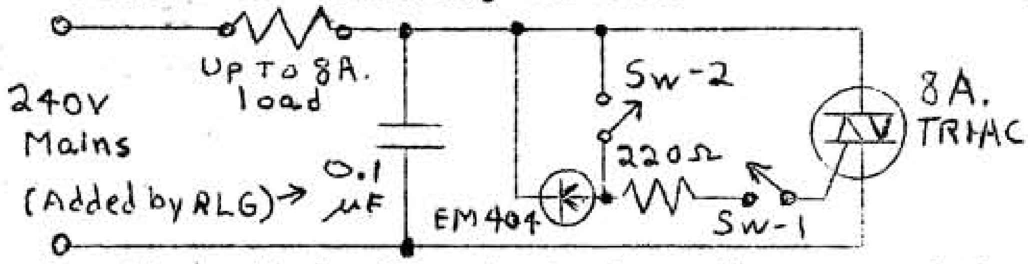
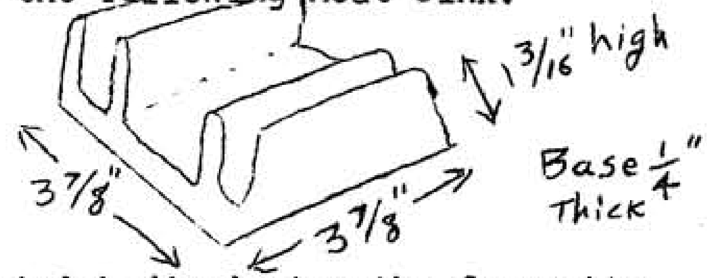


And the following Heat Sink:



The circuit is that of a simple lamp-dimmer, and the heatsink dissipates the few watts given off by the Triac. A Triac is like an SCR which works in both directions, and like an SCR it remains off until triggered. With Sw-1 off, no current flows in the load. With Sw-1 and Sw-2 on, the gate of the triac is triggered every half cycle, so that full mains voltage appears across the load (less an insignificant voltage drop across the Triac). In this respect, the unit is simply one which allows control of a large current through a small switch; Sw-1 can be a thermostat, or any other convenient control element.

When Sw-1 is closed but Sw-2 open, the Triac gate is triggered only every other cycle, and so is the current through the Triac. This effectively cuts output power in half. If the load is incandescent lamp(s), the lower efficiency of the lamp at reduced power automatically gives about half the light output. Thus, a simple lamp-dimmer. The disadvantage is that unless the lamps are large, there will be a certain amount of 25cps flicker observed. This can be avoided by the use of a conventional full-wave control for the triac gate, details of which may be found in conventional literature references; space is limited here!

We sell the HEAT SINK, plain black, as is, for 70c. It has a total area of 56 sq.in., and is very useful for power semiconductors in general. The Heat Sink drilled, with porcelain mounting insulators = 90c. Heatsink, insulators, 8Amp Triac, tagstrip, 2Amp Toggleswitch, Diode EM404, 220 ohm resistor, all for $4.90. Please allow additional 20c for P/P.

We might mention that we have run this circuit with an 11Amp load for 24 hrs, with switching from conducting to non-conducting state for 150,000 times, with no apparent ill-effects. The rating of 8Amps to a resistive load seems reasonable.

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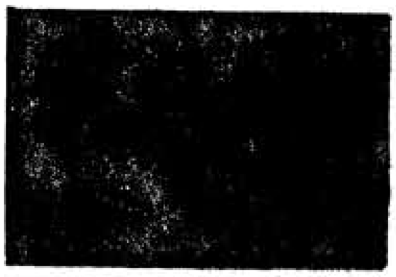
DECEMBER 1969 Vol. 5, No. 9



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Be it decreed that man
shall be free from the yoke of lies.
Never more will the
shield of silence be used,
neither the armour of words.
Man will sit at the table
with a clear look
because the truth will be served
before dessert.

(Article V)

-- Thiago de Mello
(transl. by G. Pax)

From: MOTIVE,
Oct. 1969, p. 9

NEXT ISSUE: February 1970, and very very special too -- if we survive the ordeal.
Regulated Power Supply Design, Part I
More Modulated Light Communication
Light-emitting-diode Characteristics
The Plessy Receiver
Complementary OTL Amplifiers, Part I

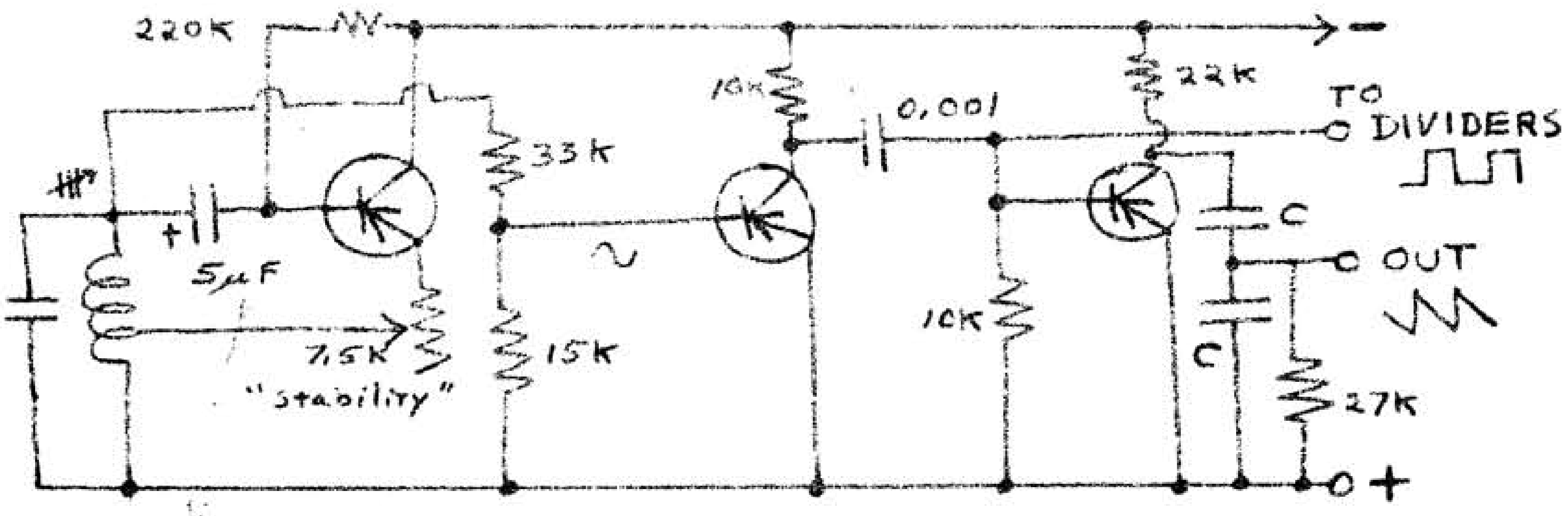
CONTENT:

ELECTRONIC ORGAN DESIGN -- A Squaretable

Improved Oscillator System -- Fr. P. Salmon, C. P., Melbourne, Victoria

I have some misgivings about the organ circuit described in the Aug 1969 EEB (p. 80). The circuit itself is OK, but the rub comes with the handwound coils for the oscillators. Hand wound ones have the disconcerting habit of having uneven tension on the turns, and hence temperature changes alter each coil differently to the next. In organs built along this principle I have noted some tendency for them to drift out of tune rather quickly.

The Schober system uses coils wound on a bobbin, with ferrite slug tuning. The coils are quite small, and are set in a plastic solution to stop any mechanical move - ment of the windings. The slug tuning is much easier to handle and quite sensitive. Our organ hasn't been retuned in 3 years, although it is about due for a touch up now. The oscillator circuit shown below, incorporates a tiny pot, the resistance of which improves stability. The output transistor drives into a condenser to give a sharp front sawtooth wave, very rich in harmonics. The waveform output shown in the abovementioned



issue of EEB is close to a woodwind output.

Suitable values for the two identical output condensers, C depend on frequency. Because of the limitation of typewriter, "sharp" here is abbreviated by apostrophe.:
C'DD' = 0.022uF, EFF' = 0.018, GG'A = 0.015, A'BC = 0.012.

Is it Necessary? -- R. E. Dunk, 21 Morella Ave., Sefton, N.S.W. 2162 (QTH previously inadvertently omitted)

As outlined in my article in the June 1969 EEB, there are advantages and disadvantages to both the divider chain and the independent oscillator systems of organ tone generation. Opinions differ, but the object of an organ is to be musically perfect, not necessarily mathematically perfect. Most good music was composed before the advent of perfectly synchronised electronic systems, and sounds all the better with some slight random frequency or phase variations between different footages of the one tone.

To relate Mr. Salmon's theory to practice, I have not tuned my organ for 9 months now, and the maximum mistune between two octaves of the one tone, e.g. A2 (220) and A3 (440) is 2 beats per second. This represents less than ½% error, with the beat between most octaves less than one beat in 2 seconds (0.125%). This can hardly be noticed even in complex chords, and is more in tune than the average pipe organ.

To sum up, the enthusiast does not take the easey out by having the tuning adjustments restricted to the top octave of 12 notes, as it is rather like using integrated circuits instead of the more complex but more flexible and interesting discrete transistor approach. The more flexible system produces better music for the musician, and better electronics for the experimenter.

In the Schober design, one point which I do favour, however, is the provision of the waveform-shaping transistor to produce a sawtooth wave from the square wave. I have had a similar prototype built up for some time now with a view to adding this extra stage to all of my tone generators from octave 5, down.

ELECTRONIC AERIAL SWITCH
FOR MOBILE TRANSCEIVERS

This article describes an electronic t-r switch which is intended to replace the mechanical aerial relay in mobile transceivers. The investigation has been done at 165MHz with a transmitter power of approximately 12W. The device used for this purpose is the variable capacitance diode type BB105. In the transmit position the insertion loss is 3.3% (power) of which only 6mW is delivered to the receiver. The current consumption in this position is 20mA at 13.8V. In the receive position the insertion loss is 3.5% (power).*

A description is given in this article of a solid state circuit that switches the aerial from transmitter to receiver and vice versa. It is intended for mobile transceivers in the 160MHz band with a transmitting power of about 12W.

The solid state t-r switch is the first step to the elimination of all mechanical relays in mobile transceivers. Its advantages are higher reliability at the same or lower cost, less power consumption and automatic protection of the receiver against a too high input voltage.

Description of Circuit

Fig. 1 gives a simplified circuit diagram of the switch, in which the bias provisions are not shown. When the transmitter is operating, the diodes D_1 and D_2 are forward biased and present only a small resistance. During reception, D_1 and D_2 are reverse biased and present a high-Q capacitance. The diode D_3 (BAY38) has zero bias in both cases. During transmission D_1 short circuits the circuit L_2C_1, so that the transmitter signal reaches the aerial.

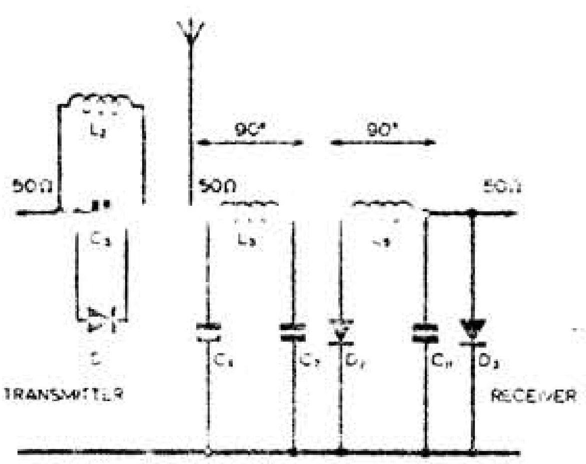


Fig. 1—Simplified circuit diagram of aerial switch.

The diode D_2 also forms a short circuit, but the 90° low-pass network transforms this short circuit to an open circuit at the aerial. Because D_2 is not an ideal short circuit, some transmitting power will leak through and reach the receiver. This power is limited by diode D_3, which becomes conducting as soon as the RF voltage exceeds approximately 0.5V RMS. During reception L_2, C_3 and D_1 form a parallel-tuned circuit, blocking the transmitter from the aerial. The received signal can reach the receiver via the two low-pass sections. When the signal exceeds approximately 0.5V RMS the diode D_3 becomes conducting and clips the signal.

Fig. 2 shows the complete circuit diagram. To keep the power consumption low, the diodes are put in series for DC flow. The DC path is R_1, L_1, D_1, L_3, D_2 and L_4, while the capacitors C_1, C_2, C_5, C_9 and C_{10} are DC blocking capacitors. The bias voltage is 13.8V for transmitting as well as receiving. Switching from transmit to receive and vice versa is achieved by reversing the polarity of the bias voltage. In the transmit position, a forward current flows through the diodes and is chosen to be 20mA by means of R_1. Although an RF current of about 0.5A RMS flows through the diodes, this low DC current of 20mA is sufficient because the periodic time of the RF current is very small with respect to the reverse recovery time of the diode, and so the RF current is flowing mainly through the diffusion capacitance.

In the receive position the diodes are reverse biased, the bias voltage being equally divided between R_2 and R_3. The RF choke L_6 completes the DC path for diode D_3.

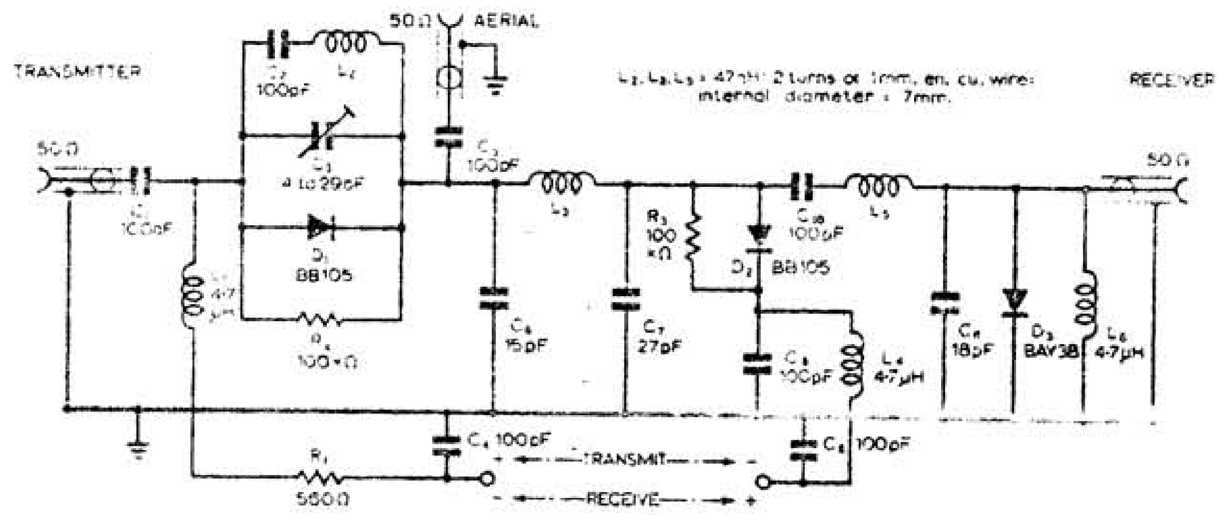


Fig. 2—Full circuit of aerial switch.

Performance

Measurements have been made at 165 MHz. All diodes have been measured with a 100pF capacitor in series, and Table 1 shows the results obtained for three samples of the diode BB105.

The BAY38 which is used here as protection diode showed the following parameters: $V_D = 0$, $c_D = 0.5pF$, $R_p = 15k\Omega$ at f = 165MHz.

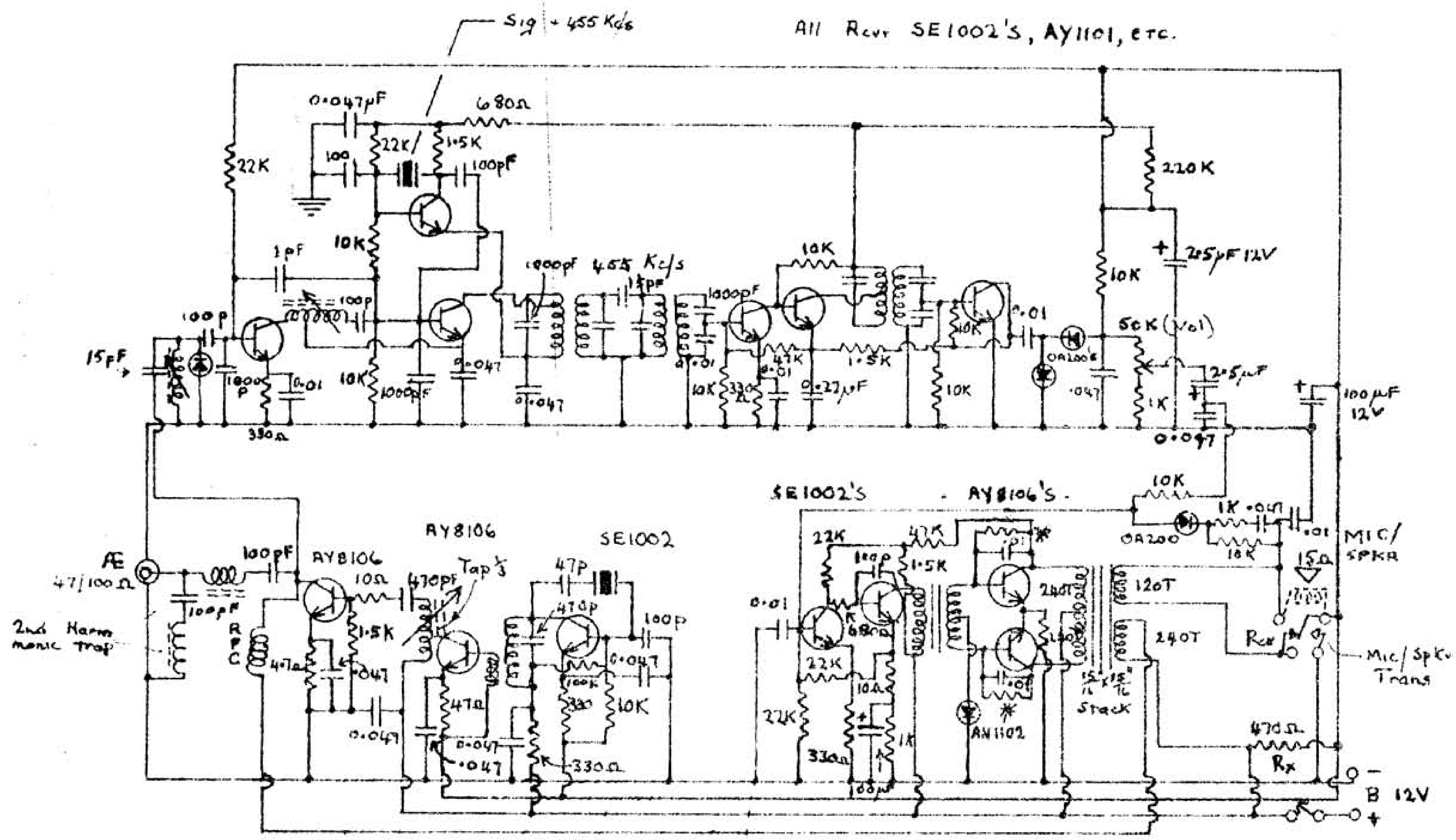
It was decided that a maximum insertion loss of 5% is acceptable both for transmitting and for receiving and it has been found that the BB105 meets this requirement. The BB105 in this circuit gives a power insertion loss of 3.3% in the transmit position, and 3.5% in the receive position. In the transmit position a power of 6mW reaches the receiver. At 50Ω input impedance this corresponds to 0.55V RMS, which agrees passably well with the threshold voltage of the protection diode D_3.

The following measurements have been made with development samples of the BB105. When the bias voltage was varied ±20% the reception loss increased to a maximum of 4.5%. The second harmonic distortion in the transmit position was found to be −63dB measured with an input signal having 95dB suppression of the second harmonic. With a receiver having an intermodulation suppression of 60dB, no additional intermodulation due to the aerial switch was found in the receive position.

TABLE 1
Parameters of BB105 at 165MHz

Sample of BB105	R_s (Ω) at I_F = 20mA	c_D (pF) at V_R = 7.0V	R_p (kΩ) at V_R = 7.0V
1st	0.41	6.5	40
2nd	0.49	6.23	36
3rd	0.47	5.5	28

* Reprinted from Mullard Technical Communications.



Schematic: TRANSISTORISED TRANSCEIVER [I. N. Kallam]

*: Adj for Class B

A NICE 1W TRANSISTOR TRANSCIVER -- I. N. Kallam (VK3) (Circuit, p. 130)

This unit was designed to operate on a single frequency in the 2.5 to 4.0Mc range operating from two 509 (6V) lantern batteries in series. Since then I have found these batteries to be very unreliable due to a new internal connection system, so this unit is being redesigned to operate on 6V. For the present, anygood 12V source will suffice.

The main features of the unit are: no relay (to get dirty etc), non-critical loading (of Tx). This was a prototype, so driver and i.f. trannies were specially wnd.

The receiver's r.f./mix/i.f. power is taken through 470 ohms across which are the transmitter oscillator and driver stages. When this line is earthed via the mike sw., the receiver is disabled and the transmitter is energised. A germanium diode across the receiver aerial coil is reverse biased during receiving. During transmitting, the silicon OA200 connects the speaker to the audio input for use as a mike. The Class B mod cum receiver output stage uses a slightly (?) unusual input system to prevent excess negative drive to the base.

Receiver alignment is normal: connect a 0-3V 20k/V meter across the volume cont, and tune all stages for max. For transmitting, connect a 0-1V meter across the 47 ohm AY8106 driver emitter resistor, and tune the oscillator for maximum, consistent with reliable starting. Shift meter to mod amp emitter and tune driver collector for max. Connect a dummy load and tune output for max. Couple an absorption wavementer to the dummy load and tune harmonic trap for minimum output at second harmonic.

Performance -- Receiver:
Sensitivity: 10db S/N, 50mW output for 2 microvolts from 50 ohm input, 30% modulated.
Image & I.F.: At least 70db down.
Selectivity: -6db @ 3kc off tune, -10db @ 4kc, -30db @ 7kc, -60db @10kc, -80db @12kc.
Output: Limited to 500mW to conserve batteries, reached at 5 microvolts input.
Consumption: Less than 9mA at 12V, 160mA @ 500mW output. Min bettery voltage = 9V.
A.G.C.: 6db rise in output for inputs from 10uV to 100mV.
Freq. Resp.: -6db at 200cps, and at 3500cps with respect to 1000cps.
Distortion: Less than 8% at 500mW.
Freq. Stab.: Better than 0.005% for supply voltage ±10% and temperature ± 20°C.
Temperature: The above test figures hold from 0°C to over 60°C.

Performance -- Transmitter:
Output: At least 1W of carrier into a 47 ohm load; at least 0.6W into 150 ohms.
Harmonics: Not more than -42db under any conditions.
Spurious output: Nil.
Stability: Better than 0.005%
Modulation: 95% maximum. Noise: At least -50db.
Distorition: 10% maximum. Temperature: At least 0°C to 65°C.
Frequency response: -6db @ 200 & 3500cps. Consumption: 450mA at 12V maximum.

Some thoughts on Transistor Transmitters, mainly using silicon NPN transistors:
1) Be careful of negative peaks applied to base; over 4V peak = poof.
2) Peaks developed across collector tuned circuit especially with no or light loading will break down a transistor rated at 10 times the d.c. collector supply. For safety it may help to add a resistor 10x the collector load across the collector load.
3) Be careful of overdriving amplifiers -- excessive harmonics or spuriouses result.
4) ALWAYS CHECK for harmonic or spurious outputs especially at $1\frac{1}{2}$x output frequency.
5) Transistor gain usually varies with collector current, often drops drastically over a certain value. Result: poor modulation capability. See RLG article, AR early 1970.
6) For reasonable efficiency do not operate above $\frac{1}{4}f_T$. Keep capacity in tuned circuit high when associated with crystal oscillators, for maximum stability.
7) 50% efficiency seems abt avg for output stage by the time harmonics have been reduced to 40db below carrier. Compare with "60%" or more one frequently hears.
8) D.C. meters indicate average current, NOT peak, but for transistor ratings always allow for the peak current and voltage in the circuit.
9) NOTE all points on p. 3-4 of EEB for January ("Frapnuary") 1969!

100WATT A.F. AMPLIFIER WITH LOW STANDING CURRENT -- I. N. Kallam (VK3)

(Circuit on p. 133) Specifications are as follows:

WATTS (RMS):	1	5	25	50	75	100	(Tested at 12.8V supply. Oscillator distortion
% DISTORT.:	6.5	6	5	5.5	8	12	is 2.0%, taken into acct. Dist. figures approx)

Full output is obtained from a dynamic mike and 2N3638A preamp. Freq. response is limited sufficiently to prevent r.f. feedback. The driver transistors should be matched. The driver transformers were wound on Anodeon bobbins, type 7097-031-02 with 24 B&S. Cores 1" x 1¼". Turns ratios; L1:½L2 = 8:1, L3:L4 = L3:L5 = 1:1.1 . For T3, Anodeon former 7097-026-01, core 2" x 1¼", fill with 14 B&S wire. The core of T3 is only rated at 150VA, but it works fine. L2 is only one winding, because the resistance of the base windings tends to equalise drive to the finals. The heat sink for the 2N441s was Delco 7281366, or equivalent. Adjust the 2.35 ohm resistor to give 0.05V across the 0.5 ohm emitter resistor, not particularly critical; note that these resistors provide important negative feedback. Note that it may be necessary to adjust some components for optimum performance, depending on specific transistors etc used.

xXXXXXXXXXXXXXXXXXXXXx

LETTER: The Use of Ceramic Filters for FM.

Would it be possible to design an i.f. Strip for NBFM use, using Murata Ceramic Filters, as described in Electronics Australia, Sept/Oct 1969? Namely, with a pulse-counting arrangement as a detector. Perhaps you or your readers would have an idea?

I have made up an AM version, but it suffers from wide selectivity and a fair amt of insertion loss. The loss can be overcome by using another stage (e.g. MPF102), but the wide spread of characteristics with these filterssuggests possible use in an FM system, leading to smaller less complex FM receivers.

One final query: are Gallium Arsenide LASER Diodes available in Australia?

-- D. Thomas, VK3ZVT, Mt. Waverley, Vic.

((Murata do make ceramic filters up to 17.5kc wide having good skirt characteristics, so suitable for use in FM i.f. stages, but they are quite expensive. It is true that if 2 or 3 Simplified Murata Filters with adjacent pass-bands could be found, they could be (suitably) paralleled for wideband i.f.s. On the other hand, a well-designed triple tuned ordinary i.f. stage can give excellent results for wideband FM -- probably exceeding the performance of two paralleled ceramics, particularly as the latter would require selection for response at the extreme ends of manufacturers tolerance. Even so this would limit maximum passbard to some 8kc, making reasonable assumptions for V.F. and Modulation Index. This is too broad for NBFM, and less wide than is often used for BBFM,e.g. 15kc.

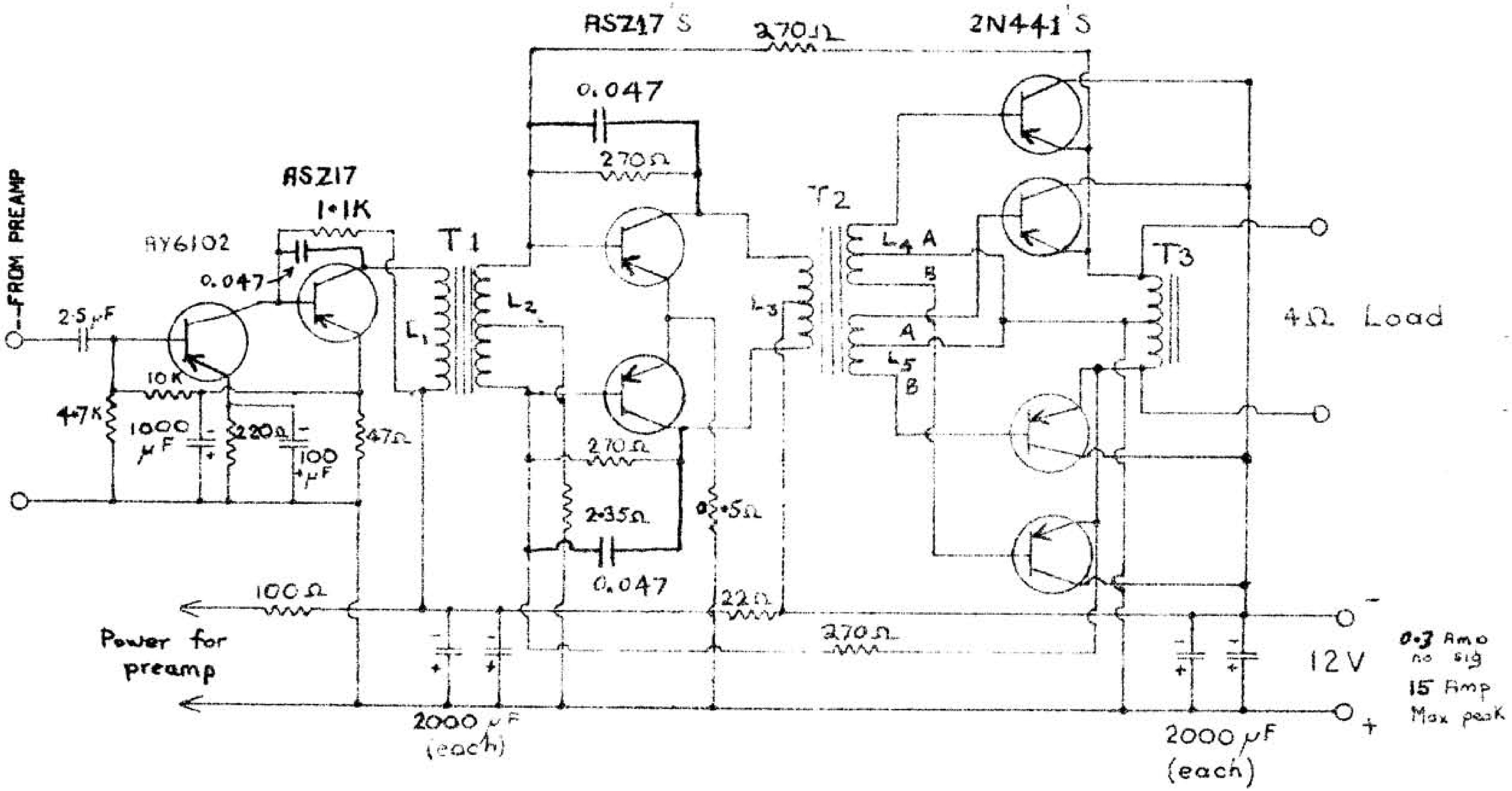
On the other hand, the filters would be eminently suitable for Narrowband FM, requiring a bandwidth similar to that of AM, if maximum V.F. is perhaps 2kc for Modulation Index not more than about 0.7 (-20db second sideband). The question of what this means in comparison with SSB has been discussed by VK7ZDF in our Semptember issue (p. 98). In any event, S/N for virtually any practical FM will be better than the best nominal AM or SSB, assuming ordinary receivers fitted with proper discriminators.

The question of a pulse-counting FM detector is covered in this issue, p. 136. The pulse-counting FM detector does have some advantages over the conventional discriminator: less susceptibility to centre frequency shifting, and better S/N at high-ish signal levels -- but weak signals are more important when considering S/N.

Gallium Arsenide diodes are available, on order, from Radio Parts P/L in Melbourne. But it should be kept in mind that the ordinary Light Emitting Diode emits non-coherent radiation. Some specifications will be given in the next EEB.

For those interested in information on FM it is widely available in the Literature, e.g. AR 12/69, 73 3/68, RSGB Bull 9/60, and of course HR 10/69 etc, RSGB Handbook, etc. These articles compare with AM/SSB, give S/N figures etc etc. -- Asst. Ed.))

THE AUSTRALIAN EEB



Schematic: 100W AUDIO AMPLIFIER WITH LOW STANDING CURRENT (Kallam)

Full Wave Tripler Myth

Murray Baird W6LWE
1231 Tenth St.,
Manhattan Beach, Calif.

Recently the need arose for a good husky voltage tripler power supply—one that would deliver power to a pair of television sweep tubes operating as a linear amplifier. In reviewing the learned writings of the various authorities the article in June 1961 issue of "73" came under scrutiny. Cad, how I would like that day to live over! Included in the article was a "Full Wave Tripler" circuit claiming all sorts of advantages over the conventional half-wave lashup. For those miserable souls who had their Sept. 1961 issue thrown out with that stock of newspapers lying around the house, the circuit is reproduced in Fig. 1. If you're smart you will immediately clip it out and throw it away. It's as phony as the proverbial four-foot yardstick.

To get back to the sad story, I pondered the glib explanation of how the thing worked both as a bridge rectifier and a full-wave doubler, the voltages thus produced adding to supply triple output. It seemed the perfect answer, so ignoring the small voice of common sense, it was breadboarded and fired up. Instead of the expected 450 volts, a disappointing 300 volts appeared. Check the circuit, the diodes, the capacitors, still only 300 volts. One whole evening wasted monkeying with the thing, plus half the night pondering the unhappy situation. I re-read the blasted article a half dozen times on the assumption that old "never-say-die" Green must have slipped it in as a joke. But no, he sounds serious and you get the idea that it's really supposed to work.

The next step was a fast letter to the editor. The not-so-fast reply was to the effect that there was no mistake—it was supposed to triple—and out of umpteen thousand readers I was the only one with the temerity to question the authenticity of it all.

More pondering. It looked as though I was worse off than at the beginning. I still needed a good husky voltage tripler and now I had to prove that 73 Magazine had slipped its trolley for once. After dissecting their ill-begotten circuit to see what actually happens during each half-cycle of input voltage it came out looking like Fig. 2.

In Fig. 2A input terminal 1 is positive, terminal 2 is negative. The current path is through diode D1, through capacitor C1, and finally through the 5 ohm resistor to the positive terminal. The current charges C1 to about 150 volts. Notice that no current flows through diode D4 since no potential difference exists across it. In other words, capacitor C2 is not charged during this half-cycle, only C1.

On the alternate half-cycle things are reversed. Current flows through C2 and D2, while D3 sits idly by. C2 charges to about 150 volts and the D-C output is the addition of the charges on C1 and C2, around 300 volts. Removing D3 and D4 from the circuit neither helps or hurts matters; they were just sitting there doing nothing in the first place. So much for the full-wave tripler myth.

Actually the article was a good thing: it stimulated some thought on the subject. A couple of hours doodling produced the circuit in Fig. 3. If we are thinking in terms of full and half-wave triplers, I guess this one would be called a ¾ wave tripler. During one half cycle C1 and C3 charge; C2 charges during the alternate half cycle. It represents a substantial improvement over the conventional half-wave device. Since none of the capacitors are charged to the full output voltage, a higher capacity, lower voltage capacitor can be used, thus improving the regulation while still maintaining the same overall size. There is both 60 and 120 cycle ripple present in the output but they tend to cancel so that overall ripple voltage is substantially lower. In all fairness, it has the same drawback as all the full-wave types—both sides of the 117 volt a-c line are floating with respect to the rectified output.

With the values shown in figure 3, output voltage under load comes out as:

No load	520 volts
100 MA	490 volts
135 MA	480 volts
220 MA	460 volts

. . . W6LWE

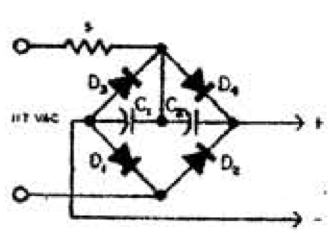


Fig. 1. "Full Wave Tripler." It doesn't work.

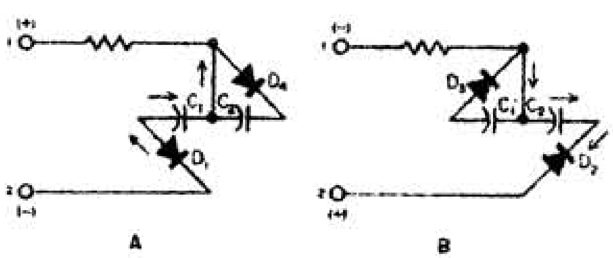


Fig. 2. What happens in the circuit of Fig. 1.

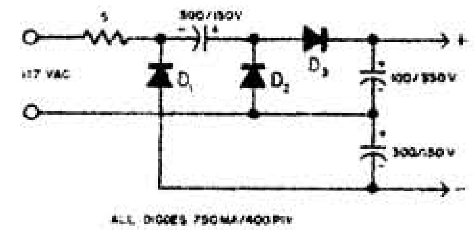


Fig. 3. Good tripler circuit.

THAT SHORTED BUS BAR! -- Conducted by The Editor

I was disappointed in you good people. In response to last month's Resistor Puzzle (P. 112) we received several reasonable answers, of the type shown in Fig. 1, but this merely shows that, like most of my Students, you don't read the Question with much attention. The Question said: "The resistors are bonded immovably to a bus bar which is shorted at one end; the other end is free and reads 0.1 ohm." In Fig. 1 do you see any shorted or free bus bars, huh? No.

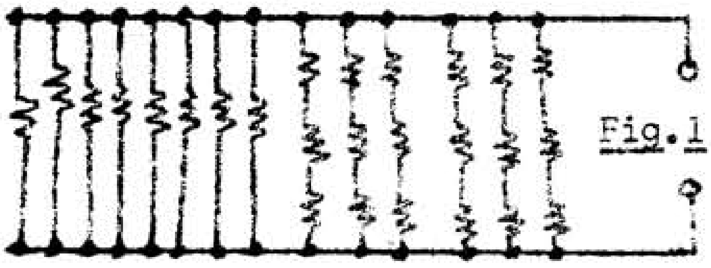


Fig. 1

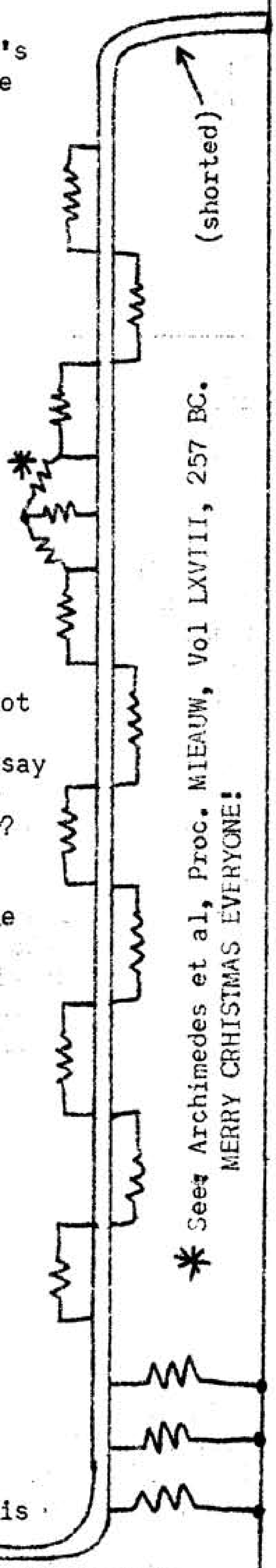
You might have interpreted it in the form of a bus bar bent into a U-shape, with the resistors all in parallel across it, bonded immovably to it; after all the Question said that the resistors were bonded to the bus bar, not to each other! So how can you have any in series? Or you might have portrayed a single bus bar shorted to itself at one end, with the resistors bonded immovably to either side of it, and with the other end free. Above all, the Free End had to read 0.1 ohm. An alternative arrangement is depicted on the borders of this page; I'm not sure where the 0.1 ohm comes from, but there you are.

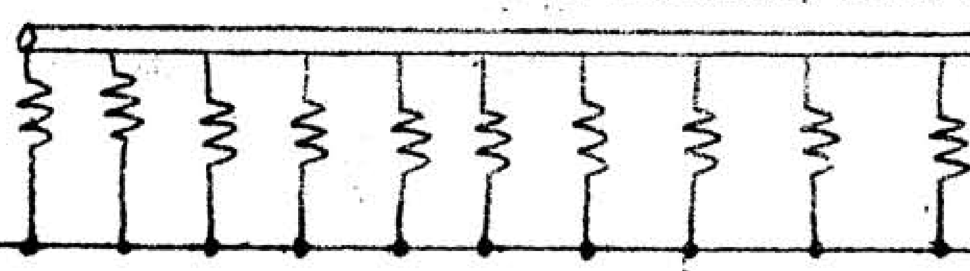
The answers submitted ranged from the ingenious to the banal. A. J. Scott, VK3AQY summed it up reasonably well: "Your problem... does not make sense to me. You say that the bus bar is shorted at one end -- shorted to what?" Yes, precisely, something to make you THINK. "You say the other end is free -- this doesn't help much. You do not say where to measure the 0.1 ohm." Why -- you measure it at the end, where else? "I think in fact you are just stirring here." Yup.

OM Scott does come up with something interesting, after giving a Fig. 1 type answer. It turns out that there is a relatively (?) simple method for calculating the values of parallel resistances, though it would seem to apply best for simple cases. To make it easier here I shall abbreviate "//" to mean "in parallel with."

Thus, where everything is in ohms of course, if you put in parallel resistors of 8, 4, and 2 ohms, this is equivalent to 8// 8//8 8//8//8//8 = 7 resistors of 8 ohms each. The total resistance is thus 8 divided by 7 = 1.14 ohms. Similarly, 6//4//2 = 12//12// 12//12//12// 12//12//12//12//12//12 = 12/11 = 1.09 ohms. In perhaps simpler form, where "/" means "divided by," as usual, 6//4//2 = 12/2 // 12/3 // 12/6, a method which allows calculation in either direction. If LCF stands for Lowest Common Factor, working from the front, the numerator is the LCF of the resistances. The denominators are in each instance the numbers which give each original resistance. Working from the end, on the other hand, you can sum up all denominators, to make the proper division; simply divide out 12 by 2+3+6 = 11, 12/11 = 1.09 ohms. Simple, no? I started to work out a general algebraic solution for this, but got bogged down. What say, Barrie?

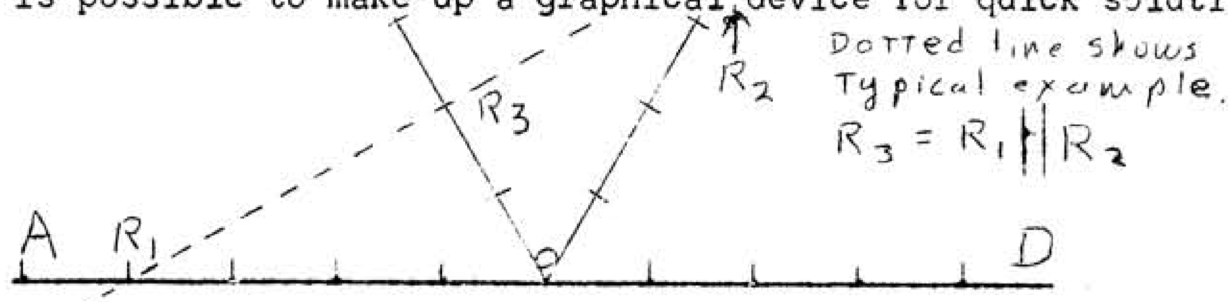
Mr. Scott continues with, "Admittedly this method is only useful where the resistors have a reasonably small common multiple, but this is





TWENTY-SIX ONE OHM RESISTORS ARRANGED BY DICK FERRIS, VK7ZDF. ALL RIGHTS STRICTLY RESERVED; PATENT PENDING.

often the case, and the awkward 'one over the one over' calculations can then be avoided." In my case I find it simple enough to work out $R_1R_2/(R_1+R_2)$ on the slide rule, but this does become awkward with R_3. He continues: "Finally for the more odd values it is possible to make up a graphical device for quick solution to the same problems, thus:



Draw three lines as shown, each with linear scales, AD, BO, & CO.

Then, if two resistors, R1 and R2 are in parallel, mark R1 on scale AO. Mark R2 on Scale CO. Lay a rule between R2 and R1 as shown, and the equivalent parallel resistance R3 is read on BO. If a further parallel resistor is added, mark this on scale DO. Then place the rule from the previously found value R3 across to R4 on Scale DO, and read the new parallel resistance value, R5 on scale CO again." Now that is a cute idea. Allan Scott wins the Grand Prize (a year renewal), though I had hoped for even more inspired Solutions.

T. M. Palmer of N.S.W. finds it more useful to compute parallel resistor problems by adding Mhos. This still comes down to calculationg 'one over the one over,' but it can make it easier to solve Puzzle Problems. In complex circuits, one would be utterly lost without Mhos and such (complex, e.g. reactive). Mr. Palmer has an interesting tale. Seems that Dr. (now Prof) R. Bracewell posed the following question a dozen years ago: "What is the simplest network of one ohm resistors which has a resistance of one ohm between any pair of points on nodes, with the condition that if a current is made to flow in and out of these points, no two resistors shall carry the SAME current." Seems that this requires that the Network can have <u>no</u> symmetry, no simple or parallel or series connection of resistors is involved. The solution involves a "hideous three-dimensional array of some 30 resistors. It appeared in 'Nature' or some other erudite journal. As far as I know no one else has yet suggested any other solution at all." I wonder what <u>EEB</u> people will make of that.

Many thanks to Mr. Palmer, who will get his reward via two excellent articles he submitted recently. In respect to the voltage tripler thing, of course no one explained how it could work as a tripler, simply because it can't; the Article on the subject in this issue of <u>EEB</u> shows that the problem is not trivial, though the answer is. Thus, content in the knowledge that you have felt grateful for having learned something from this (about power supplies, of coursæ), I'll take the prize for myself: an extra year of Slavery to the <u>EEB</u>. But thanks anyhow.

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<u>LETTER</u>: Improved FM Discriminator (See also: Letter on p. 132)

I have almost completed a pulse-counting FM Discriminator. It will accept any input voltage from 0.1V to 10V RMS input. The output is ±30mV per 10kc deviation at 7000kc i.f., which I am using because of the crystals available. It is a simple matter to modify the circuit to 455kc. The maximum voltage change due to level change is ±1mV.

The circuit is a diode limiter, followed by transistor amp, differentiating circuit, then a monostable, followed by integrating output. The monostable flip-flop gives 80ns rise time, and 150ns delay time. This is with a pulse width of 0.6 microseconds. I should be able to send this circuit soon, after I have finally finished building the final version.

-- G. Cohen, O'Connor, A.C.T.

((Se look forward to receiving that circuit. We have already received a very interesting SCR Condenser-discharge Ignition system article from Mr. Cohen, which will be published following a couple of other ignition system articles in our files. Readers should also examine the letter and reply on p. 132 this issue, with relevance to FM --Ed.))

LETTER: Correct Design with FET Tetrodes; or: Poor Olde ARRL.

I should like to add a note to the excellent Review of the 1969 ARRL Handbook, by your Assistant Editor in July. The details of their circuits for r.f. amps and mixers using tetrode FETs (3N140, 141, etc) are not correct. In support of this I point to a number of circuits which have appeared in the international literature, e.g. Amateur Radio (Aust.), Spectrum (N.Z.), and several times in Ham Radio (U.S.A.) and elsewhere. Furthermore, ARRL disagrees with RCA ("Ham Tips," November and December 1968, QST or Break-In, back cover June 1969) who make the things. To wit:

1) ARRL presents the 3N140 as a NEUTRALISED r.f. amplifier (p. 120 of 1969 Handbook). What nonsense. Feedback capacitance is about 0.02pF, less than that of a grounded-trid triode! Unless ARRL use an unsatisfactory layout, the only source of fedback is the neutralising circuit itself. Since these devices (above references) do not need neutralising on 2 metres, it seems hardly likely they would need it at lower freqs.

2) Bias Circuitry:

a) R.f. Amp: For full gain and maximum a.g.c. range (thus lowest cross-modulation) gate NO. 2 should be forward biased; see Rick Matthew's graph on p. 38 of the April EEB.

b) Mixer: Again, gate 2 (injection) should be forward biased for maximum conversion gain and best dynamic range.

The last-mentioned point is particularly important, because the mixing process in the tetrode is mostly "multiplicative"; see Radio Communication, Jan 1969, p. 25; and EEB, July 1969, p. 69. Where ARRL uses only emitter bias (p. 89, 104, 118, 120 of 1969 Edition) one would expect appreciable reverse bias to be developed. Besides limiting dynamic range, it would limit the amount of injection which could be tolerated without distortion, thus either limiting conversion gain, or worsening cross-modulation spurious products. It would also worsen signal/noise.

If 1970 follows in the same tradition, and if this is "The Standard Reference Work and Text for everyone..." amateur radio will have fallen upon dark days.

-- R. H. Ferris, VK7ZDF, Dynnyrne, Tasmania.

((Editor's Note: The situation with respect to bias may not necessarily be as grim as Dick implies. Although RCA does show Gate 2 forward-biased, they also use a source resistor (analogous to cathode resistor) to apply negative bias to both gates; the net bias to Gate 1 is slightly negative, to Gate 2 is slightly positive. It is, however, important to note the comment on p. 50 of the Aug. 1969 issue of Radiotronics ("A Dual-Gate MOS-FET Preamplifier for the 10 Meter Band") that the d.c. bias level of Gate 2 "is a compromise between optimum gain and optimum cross-modulation resistance." Maximum gain is not in itself, the only desirable factor, as we and others have pointed out. A tendency to bias the gate too much in either direction will exacerbate nonlinearity and cross-modulation. On the other hand, when negative a.g.c. is to be applied, one would obviously start with a positively biased Gate 2. On the other hand, maximum signal/noise is obtained when a transistor or valve is not bias-controlled for gain. In the case of the optimally-biased FET preamplifier described by Radiotronics (RCA), no agc was applied to the preamplifier itself, and no cross-modulation was observed from a neighbouring 1-kilowatt transmitter only 200 feet away.

This is not to say that a strong adjacent channel signal could not overload subsequent stages, because of lack of adequate selectivity at r.f., but this can be minimised by choice of suitable transistor (e.g. tetrode) or valve (e.g. beam deflection in balanced configuration) as mixer, and by the minimum interstage coupling necessary to achieve a given level of sensitivity. These subjects have been covered in EEB in 1968, and will probably appear here again one day.))

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QUOTES WITHOUT COMMENT (from "Auto-Call")

A Fool and his money are soon popular... The real problem with your leisure is how tokeep others from using it.... One of the best face saving devices is keeping the lower half shut... Many who talk like big wheels often turn out tobe mere spokesmen.....

LETTERS: Transformer Design Controversy

I note the letter on p. 64 of the July 1969 EEB, particularly the comments on what I take to be Clive Witchell's transformer book. After study of the book I comment:

My basic criticism is that Clive uses a Turns Per Volt figure which is too low for all but the smallest core size. This means that the working flux density is very high, perhaps dangerously so with local steels, as your correspondent implies.

A small transformer can be run at a higher flux density than a large one, say 13 kilogauss for a $\frac{1}{2} \times \frac{1}{2}$ core, down to 10kG for anything over a 1x1" core. Clive appears to have gone astray on p. 18 of his book where he says, "for design purposes the value of B_{max} can be taken as 10 kilolines/sq.in..." Incidentally, just as Mr. Hertz is now being credited with inventing the cycle per second, so Mr. Maxwell should be honoured with the "line." Clive must mean 10kilogauss (or 10 kilolines/sq.cm). Now, 1 gauss = 1 maxwell/sq.cm (1 maxwell = 1 line), and 1 gauss = 6.45 maxwells/sq.in. Therefore the value of B_{max} should be "10 kilogauss". (or 64,500 lines/sq.in = 64.5 kilomaxwells per sq.in.). It is this figure which should be used in the extended formula he quotes. Unfortunately it appears he has used the "10 kilolines/sq.in" in all his subsequent calculations. Thus, the formula on p. 18 of his book should be replaced by;

(a) $TPV = 10^4/4.44 B_{max} a.k.f$ OR: (b) $TPV = 10^4/28.64 B_{max}' a.k.f.$

where B_{max} = kilomaxwells/sq.in (range 64.5 to 84.9), B_{max}' = kilogauss (range 10-13), 4.44 = V.2.pi, k = stacking factor = 0.9, f = cps (Hertz). In this metric age, (b) is to be preferred. With f = 50cps, (b) reduces to the following for various values of B_{max}' in kilogauss:

Kilogauss	TPV
10	6.98/a
11	6.34/a
12	5.81/a
13	5.37/a

Now, returning to your correspondent's comment about the designs being "pinched" from American 110V practice. Firstly, from the relatively few American transformers I have seen, it appears that a somewhat higher flux density may be commonly used, than in transformers of British (i.e., also N.Z. and possibly Aust) origin, and your correspondent may be basing his judgment on this fact alone, not taking into account Clive's error, as explained above.

As for the designs themselves, consider for example, No.1, the 6V/150mA dial light transformer. I presume this is on a $\frac{1}{2}$x$\frac{1}{2}$ core. If so, with 6000 turns on the primary it is actually "better" with respect to the flux density, than the design I use -- of which thousands have been made and used successfully.

Or, consider Example 3, the "Scope" iron trani; since this is rated for "intermittent" service, a higher than normal flux density can be tolerated. So no problem?

Example 2 is a little more suspect. Although the core size is not stated, I would put a 65VA trani on a core area of 1.5 sq.in, using B_{max}= 10kG, i.e., TPV = 5. Clive uses TPV = 2.9, giving B_{max} on my core about 17.5kG, which is somewhat high. However his core is possibly somewhat larger, which may bring the flux density down to about 15kG. Although this is excessive, it would not be "catastrophic," though you could probably cook your breakfast on the thing!

Finally, I might make a note on the current ratings in his wire chart. The rating can be increased by 50% on sizes up to about 20 B&S.

-- "Old Peth," Auckland, New Zealand

P.S. I like EEB just as it is. I know where it is going: Nowhere! It stops in one place, but it is free to dart out in any direction, and then back again -- P.

Reply from "A.":

My judgment of the Witchell opus does not necessarily derive from any considerations concerning designs pinched from American 110-117V practice. American practice (for 60cps, which allows slightly less copper) as I have observed it, is generally sound, and introduces the same physics as used by electrical engineers anywhere. A man who has designed transformers -- surely a necessary prerequisite for authoring a booklet containing "designing" in the title -- would not decorate his text with equations he would find meaningless....

On the T.P.V. proposition, what Witchell seemed to me to have done was to have collected some U.S. formulae for T.P.V. relative to given core areas, forgetful or ignorant that total turns anticipated a mains grid at 110-117V at 60cps. For example, in his Table 1 (page 17) he gives T.P.V. at 3.6 for a 1.25 sq.in. core area. Consider now, the ABAC originally prepared by Dr. R.T. Beatty for publication by "Wireless World" under the title "Radio Data Charts" which accompanies Chart 28. Here T.P.V. for a 1.25 sq.in. core area is shown as 7.2 -- twice the figure charted by Witchell! Furthermore, this assumes B = 50 kilolines per sq.in, a reasonable value for Stalloy at 50cps.

Witchell explicitly states: "For design purposes the value of B_{max} can be taken as 10 kilolines/sq.inch. It should not however exceed 12 K-lines/sq.in. for stalloy and other silicon steels." This is obvious nonesense. It is equally apparent that Peth knows what he is talking about in the above letter.

Note by the Editor:

This matter makes me uncomfortable. I dislike giving unfavourable publicity to a fellow author, but if the material is true we have no alternative than to publish it, as a responsibility to readers -- since it is true that we did give the book some favourable publicity some time ago. I have written to the author several times in the past few months, but have not yet received a reply.... By the way, Peth and A. are not reserving the use of names for coyness, but because both are transformer manufacturers, and they do not feel it would be appropriate...

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QUOTES WITHOUT COMMENT

Recent Wage Increase	$360M
% Wage Earners in Government	25%
Government Payout	$90M
Govt share of Extra Tax	100M
Apparent Govt Profit	10M
State Share of Wage Payments	72M
Approximate Govt Reimbursement	36M
Net Increased State Burden	36M
Actual Government Profit	46M

Increased Worker Wage	3%
Higher Cost of Living	6%
Worker Loss	3%
Government Gain	12%
Government Expenditure	15%
Worker Loss to Govt	3%
Net Decrease Money Value	3%
Net Decrease in Purch. Pwr	3%
Cost of Breathing	(Unchanged)

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"It's not true that a good Editor should have tasted his mother's wedding cake.... You can be an Editor for money; what you earn helps pay the surgeon's bill when you pop your ulcer. Or you can do it for love, love of humanity, or love of the gospel you preach, or just love of seeing your name in print, unassailable, imprgnable, right up there, month after month. Its a great feeling and you get to enjoy it like a hole in the head.

-- Sylvia, CQ, Jan. 1967, p. 53.

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Home-made Cleanser which Cleanses!

Are you annoyed by the gutless modern cleansers that are kind to baby's skin? Try one cup whiting, one packet soap (not detergent) powder, one cup ground pumice stone, mix well, and keep in a handy container near the washbasin. Not recommended for babies.

A Simple Fly Remover (to remove Simple Flies)

Obtain concentrated DDT solution (8%, 25% or whatever available) from the hardware or garden-supplies shop. With an ordinary small paint brush, brush it on all interior window frames, carefully avoiding the glass. The flies walk on it sooner or later if they are in the room, because they are attracted to the light. And then they simply disappear. More effective and cheaper than 'Pest Strips', no fumes (after the first couple hours), and nicer than fly sprays. If you get impatient for Nature to take its course you can always resort to the Fly Swat, a remarkably effective instrument......

"The surest way to avoid nuclear war is to get ready for it." -- Edward Teller, Ph.D.

EDITORIAL -- RLG

All by Myself??

Recently a supplier expressed surprise that I paid someone to operate the Duplicating Machine. I explained, but he did not look convinced. What could be more simple, after all, than operating an Automatic Machine?

As anyone knows who has operated one, there is no such thing, particularly when one is as antique as our machine. It takes constant attention, particularly when printing on bond. It takes a solid working day length to print one issue of EEB; double that for bond. I just don't have that many weekends in a month.

One of the reasons why I can manage EEB and keep sane, is that I pay staff to do most of the monkeywork, though I must admit that I don't pay them enough.

Concerning Regenerative Switches and SCRs

In February 1968 EEB, p. 9 I commented that there seemed enormous value in the simple two-transistor regenerative switch. It might substitute for UJT, SCR, or even tunnel diode. Simplicity suggested the name of Pseudo UJT, or PUJT. For the past month I have been doing some research into SCR behaviour (enough to fill many issues of EEB, so you people stop sending so many articles so I can have a go!), and the results have been surprising in several respects. Very very briefly, the two-transistor PUJT is NOT as good a switch as the Unijunction Transistor, although the PUJT can indeed function effectively as a low power SCR, SCS, or tunnel diode (having adjustable slope!). The reason for the trouble is that unless an SCR is triggered with a steep wavefront pulse, it shows considerable temperature sensitivity. This doesn't much matter with a motor speed control, ordinarily, but when you set a lamp dimmer to a given output, you want it to stay there, particularly for critical applications.

The kind of output wave from a PUJT is just too sloppy to ensure low SCR temperature sensitivity unless the SCR has a very high gate sensitivity indeed, e.g. a few microamps. For normal SCRs this just doesn't work very well; readers of RCA's SCR Experimenters Manual please note. Similarly, relatively poor results are obtained from the conventional widely-used R/C phase shift method of gate control if large gate currents are involved. Adequate triggering is obtained by using either a neon-trigger of conventional sort, or triggering by another SCR (e.g. as a cathode follower) having higher sensitivity than the main SCR. There are a number of the former types available with microampere sensitivities, from G.E., Motorola, or the disposals merchant "Solid State Sales" in the U.S.A. (Don't ask for high sensitivity units; ask for their "1.5A" SCRs, a number of which do have high sensitivity; they are actually 0.75A by Australian rating, and gate sensitivities range from 1 uA to several mA). Alternatively, good triggers are the Diac or SCS, as shown in Mullard Outlook, Sept/Oct 1969, p. 59.

I have learned a lot from this exercise, some of it not always the same as implied by information in some publications. I'll write it up here sometime.....

Articles in this issue

There are quite a few of them, because of reasons mentioned in the last issue, and perhaps too, to woo the unusually large number of readers whose renewals fall due about this time. It is amazing how often the proportion of people renewing depends on the quality of the last issue they receive. And it is depressing too, because different issues cover different things -- some of which are better (for you) than others.

In regard to the Full Wave Tripler, it all started when Dick Ferris came to me with a strange look in his eye, saying "can you say how this works as a tripler?" We actually managed to dig up an article which tells about it, saving us a lot of bother. Nothing new under the sun.... I admit that there was NO correct answer to the Full Wave Tripler Puzzle, simply because it can't possibly triple; fie on those of you who asserted that it tripler (almost) because it puts out 2.8 times the RMS input. A proper tripler puts out triple everything. I admit that this is a vile trick, but at EEB anything is.....

The article on Mullard's solid-state TR switch should be read in conjunction with two articles from Ham Radio: "Solid-state Antenna Switching" by W2EEY, Nov. 1968, and

"Solid-state Antenna Switch for Two Meters" by K2ZSQ, May 1969. In the former is described more elaborate versions of the system essentially used by Kallam in this EEB and in the latter article what amounts to a system similar to Mullard's. But the Mullard circuit contains more explicit constructional information.

Seasons Greetings

The item on the cover of this issue replaces a rather banal and perhaps cynical poem which was originally designed for these pages. Who, by the way, is Thiage de Mello? I like his sentiments, nicely calculated to infuriate those who consider themselves Realists. The rest of the Statutes are just as good, and appear in the referenced magazine. They appeal to my respect for Man, even though I may have difficulty admiring some individuals of that species.

I hope that my many friends will excuse me for the heinous crime of not sending out Christmas Cards this year. It was prevented by a tremendous amount of end-of-year work, plus this oversize extra issue of EEB! Perhaps just as well. The virtually obligatory ritual of card-exchange I find distasteful. It lies within the same narrow exercise of commercialism which has turned Christmas into a status-exalting formalism. Anyhow, I take this opportunity to extend to you the sincere greetings of our staff and families, and to wish you all a creative and interesting New Year!

Those of you who have families and who also feel trapped by Fr. Christmas may be interested in one small solution we have found useful. Each Sunday of Advent we exchange a few presents, with considerable emphasis on things which have been made by ourselves for use or beauty. The kids are enthusiastic about the new arrangement; they have been making "surprises" for months, most of which put our relatively practical/ growup gifts to shame.... Then, on Christmas we ponder the meaning of Christmas in our own way. We also carefully avoid the wireless and its tedious exhortations to virtue 'midst sleighbells in the snow.

This & That

The more discerning amongst you may have discerned that our front page Heading this month bears a slightly altered record of subscription fees. One of our excellent correspondents stated it succinctly: "I'll throw in an extra 50c for inflation and stamps. This is a three-year subscription, and in three years you'll be losing money." Paper continues steadily to increase in price, as well as other materials, and with the inflation,we have felt obliged to increase wages a bit. Your cost of living is NOT going up; it costs about the same to breathe, but the value of your money IS going down, for reasons which are suggested elsewhere in this issue. We are not increasing the basic cost of domestic subscriptions, but we cannot continue to offer much discount for long-range ones. You do save the cost of a (small) beer on a three-year sub, or half a beer if you add the 5c to enrich Mr. Bethune's Treasury, but there you are.

Incidentally, talking about money, I have been involved in ordering equipment costing vast sums of money, and I have been struck by the disparity between the cost of equipment sold to laboratories compared to sales on the open market. The labs are charged considerably more for the same stuff. For example, instead of paying at least £30 for a good stirring motor, we looked around and got a lovely one for $15-- but it was called a sewing machine motor!

The first article about Computer Boards appeared in the August Amateur Radio, as I mentioned previously; the second one has now appeared in the December issue, and it too will be of considerable value to people who have bought the Boards; there are more articles coming up in AR on this and related topics. If you are not yet a member of the Wireless Institue of Australia, you are missing out on a lot. Foreign subscriptions are also possible. All enquiries to P.O. Box 36, East Melbourne, Victoria 3002. Tell them that you were inspired to it by EEB. Ken will like that.

In the August Coryra is an interesting announcement that their combined January 1970 issue will be an 85 page monster full of much useful information. As I understand it, you can get in on this if you send them your subscription immediately: $1.60 per year -- but in this instance it would be kind to add another 20c for post of the Monster.

SPECIAL HONOUR

It appears that The Australian EEB has been awarded the following certificates of proficiency by the "Amateur Radio News Service," an excellent organisation of Editors of various club bulletins:

SPECIAL AWARD: Perfect (sic) Score in Technical Articles
FIRST: Technical Articles
SECOND: Masthead Category
SECOND: General Format
SECOND: Usage of Items from Other Publications
THIRD: Editorials ((heh heh))

Each award was represented by an attractive Certificate, signed by the President of the A.R.N.S. The Judging Panel consisted of Dick Ross, K2MGA, Mel Snyder, WB2DLW, and O. Perry Ferrell. Frankly, I am a bit staggered to receive commendation from such a distinguished panel.

I have always regarded certificate-hunting as nonesense, and the Russian mania for medals in the same light, but now that we are wearing the medals, it seems different somehow. There is much work in publishing EEB, and not much to show for it save a certain notoriety at WIA meetings, and an occasional comment with renewals. So it is rather nice to receive international recognition by A.R.N.S., although our interest is somewhat broader than Amateur Radio, and even though we are a strange kind of "Club." Yet, I suppose we are kind-of one, consisting of you good people out there who participate, and who put up with our eccentricities. And RLG burning midnight oil trying to make sense of everything, and Rod Reynolds with penetrating and expert comments, and his good articles in spite of the verbal maths or theory. And Dick Ferris who churns out good ideas faster than they can be put to paper. And numerous contributors who have supplied more articles and ideas than could ever be repaid: Rich. Maddever, Les Yelland, I. N. Kallam, an Engineer in N.S.W., and many more. And the services of our paid staff, all of whom contribute quite a lot more than is justified by the pay -- with RLG picking up and delivering to each on pushbike; how quaint.

Even Gestetner P/L, Hobart, is a part of the group. Their cooperation has far exceeded business obligation. They like to make money like anyone else, but I believe that their cooperation stems from their generally helpful attitude toward people. Their help has made it possible to publish EEB in a more attractive form, to include more interesting contents, and to do this on a budget which can only be generously described as modest.

Why so many people to produce a thin Bulletin? We do it in spare time, as possible.

What next? EEB is entering on a new phase -- maybe. I look forward to a greatly improved appearance, with the same old stuff inside. But I refuse to be the slave of any system. If the experience with bond paper proves too much of a headache, or if you don't like it, we'll go back to the blotter paper. And I refuse adamently to increase total words-per-issue very much, for oft-stated reasons: EEB is to be read, not just admired. I still don't know what makes EEB unique (as many inform me), but I know that it would be unmade if it got big and slick. It will be a little slicker, but there it must stop. Success involves use. To be big and impressive without use is unsuccessful.

One further word: If you have a nice simple project of value to beginners and such, please send it to Coryra (Box 649, P.O., Canberra, 2601), rather than to EEB. We don't mind publishing it, but we have so much other stuff, that it would take an age before an article of simple type saw print. We have recently received a very nice article on a Reflex Receiver, and have relayed that information to the Author.

And: we do not solicit articles on techniques of fixing television sets, for reasons which will be explained carefully by our Assistant Editor in the Feb or March EEB. We DO solicit articles on anything imaginative, experimental, useful, or useless, as long as it features a commonsense treatment and tries to ask WHY, on a simple level. It need not be wordy or elaborate or literary, but it should make technical common sense.

ADVERTISING

PLEASE SAY THAT YOU SAW IT IN THE EEB!

PERSONAL ADVERTS 5c per line. COMMERCIAL ADVERTS 10c/line.

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FOR SALE: One 109 Transceiver, 2.5 to 5 Mc, with a.c. power pack. $30 or best offer.
-- C. Richardson, 45 Dimboola Road, Horsham, Victoria 3400.

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COMPUTER CIRCUIT BOARDS ARE AVAILABLE AGAIN! See technical articles in Amateur Radio, Aug and Dec 1969. We sell the boards for 13c/transistor; other components (diodes, resistors, condensers, etc) free. Or 12c/tr in lots of 50, 11c/tr in lots of 100. With each order we can also supply technical information if requested.... Also available: 12BL6, 12AU7, and 6SN7 valves, 30c each. Please add 10c P/P for each order.
-- P. GARDE, VK3ZDF, 184 Warrigal Road, Burwood, Victoria 3125.

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FOR SALE: C24D, a limited number of deluxe 12W-per channel Stereo Amplifiers in teak or maple cases. Controls: Bass, Treble, Vol, Bal, Mic Vol, Monitor, and Selector. Separate Mic. Pre-Amp for P.A., and separate compensated tape playback pre-amp. Headphone and Mic jacks. Response 45cps-19kc. B.S.R. Macdonald auto-changer with matching wood base included: $147.50 for the lot. Amplifier plus Goldring DM10 Microphone ($16.80 value) for $119, post free -- J. Winters, 14 Punchard St., Innisfail, Queensland, 4860.

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FOR SALE: Marchant Electric Calculator, desk-top model, in excellent condition. $105, freight paid anywhere in Australia or territories. An electric calculator is very handy for any kind of operations involving numerous figures; this one will add, subtract, multiply, and divide; two registers. In any business it can pay for itself the first time you compute accounts and income tax for the year.

Blank plates for Addressograph Machine, 2c each, plus post; limit = 1000. These are actually the frames in which the metal tabs are placed, and they cost more than double this price new. These are in good condition. If you pay an addressing service to do your work, you can save money in the long run by doing it yourself; a suitable Print-out machine can also be made available for $30 plus freight.

Books: Power Supplies and Regulators, by Techpress. Simple theory and practice, very good for beginners, and for others who want to know more about power supplies. S.A.E. for further detailed information about this book. $2.95, Post Free.

FET Principles and Practice, by E. Noll, published by Sams. Highly recommended by EEB for readable coverage of basic principles of Field Effect Transistors, and a number of useful circuits, including transmitters using ordinary FETs; Australian equivalent types are readily available. FETs are the coming thing. They have all the versatility of valves, without filaments. $5.25, Post Free (Higher Elsewhere).
--AUSTRALIAN ELECTRONICS, 32 Waterworks Road, Dynnyrne, Tas. 7005. Phone 237-670.

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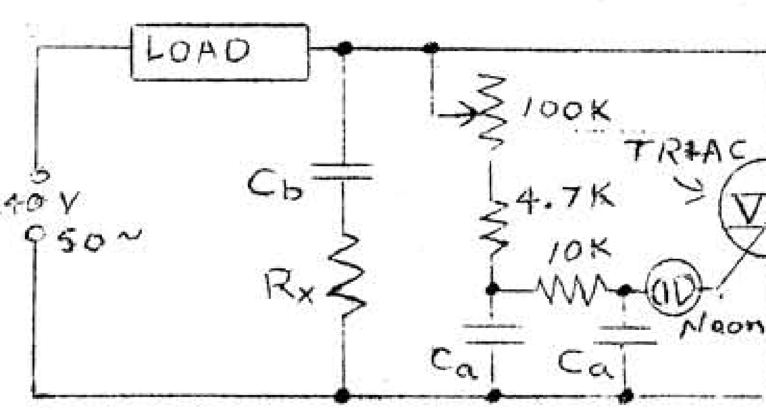
HEAT SINKS AND TRIACS are still available, as illustrated in our advertisement in the October EEB. Heavy black aluminium heat sink, 56 sq.in. area, suitable for one or two heavy semiconductors, 70c. Drilled heat sink, with porcelain standoff insulators, 90c. Heatsink with Triac, Diac, and miscellaneous parts for the simple lamp-dimmer/remote-switch unit described in the October EEB, $4.90. With only a few extra parts you can also make a simple adjustable full wave lamp dimmer using the quite conventional circuit shown here at the right: C_a is 0.01uF to 0.1uF, depending on results desired. For lamp load, C_b=0.01uF, R_x = 0. For a motor load, C_b=0.05uF, R_x=100 ohms. It is not recommended to use a transformer load with this, or with ANY SCR-type circuit, because of the pulse-type nature of the output waveform. A DIAC may also be used in place of the Neon; see Mullard Outlook, Sept/Oct 1969, p. 59. Further information about TRIACS widely available in publications by GE, RCA, STC, Motorola, Philips, most Circuits Books, Periodical literature (e.g. Oct '69 QQ).



-- H. FIETZ, c/- SCIENTIFIC EQPT MFRS P/L, 2 Uren St., Magill, S.A. 5072. ADD 20c P/P.