THE AUSTRALIAN EEB
P.O. Box 177
Sandy Bay, Tasmania
Australia 7005

JANUARY 1972

-- THIS IS THE EEB: an Electronics Experimenters Bulletin.

The EEB is a voice for people with ideas. The bias is toward experimentation, but a variety of ideas is covered, some serious, some not. The enclosed issue will give you an idea of our coverage, but only an idea: it varies from time to time.

The EEB delivers constructional material, theory, frank reviews, dry humour, and philosophy informally and with a strong attempt at commonsense...

> If a part gets too hot, it is dissipating too much power, no matter what the book says; from early EEB articles this has come to be known as the "Grandma's Test" method, as good for bad transistors as for bad eggs!

The EEB appeals to radio amateurs, experimenters, brewers, politicians, housewives, and plumbers [plumbers are good at VHF]. It may appeal to you too.

> Why not try it?
>
> And: If you want to contribute to EEB, please contribute: techniques, ideas, methods, opinions, recipes, anything of interest to creative individuals.

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VARIOUS NOTES

methods, opinions, recipes, anything of interest to creative individuals.

The EEB Editor contributes too, and one of his ramblings [from Oct 1970] is reproduced on the obverse, with other filler.

The EEB Editor has a number of biases, as who doesn't, but there is no "EEB Policy" as such. Whether you delight in operating, tinkering, or creating ideas, there is room for you in EEB.

The EEB is published as a hobby. It is late almost always; it hasn't been on time in seven years. But whatever happens, a year's subscription pays for at least six issues, usually in even-numbered months.

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VARIOUS NOTES:

Money: We need it to run EEB, bags of it, but with inflation and Government fiscal policy and extortionate postal rate increases, we never come out ahead. We regret the relatively high level of the abovementioned prices, but if you have the answer to the problem of spiraling costs, do let us know...

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New Subscribers: PLEASE print your name, address, and postcode clearly. Thank you.

We conduct no Consulting Service; we don't know the answers either! But we do encourage readers to join the W.I.A. [P.O. Box 67, Melbourne 3002] or the N. Z. A. R. T. [see above] -- preferably both, since both publish good technical magazines for the amateur.

EDITORIAL — RLG "Never strike a happy Medium!" — 'Scope', A.B.C.

Deus ex Machina Computare ("Two Machines are more cunning than one")

The following is part of a piece from the text of the programme "New Sights to Excite" on A.B.C. wireless, 4/1/70. It was devised jointly by Stan and Clare Ostoja, Gordon Robertson, and a Computer:

Buildings was drooping out, impression over the mountains
Tidal element, certain light suggested fifteen but so huge
Tidal of the mind too
Beyond again for parted to them all
Extended he could on spires
The further it looked ground, thickest ground on
the mountains
Other mind and unwork, drooping a half light
Could looked parted or white in palid others steep
narrower half light about allow.....

I quote Stan Ostoja Kotkowski: "It was left to the computer to select the words that the computer came across and put them into their decided programmed form. What it means is that the computer looked for a word, selected another word and a third word until it came to the desired length of line and finished the line there and started on a new line. Naturally the poem doesn't make sense like a normal poem does, because a computer cannot make sense of actual words; but because of its nonsensical nature, the human mind tries to make sense out of it. No rational human mind would put for example certain two words together, yet the computer did and the human mind tries to make up for it, tries to understand. The computer came up with several yards of this poem, I selected a small section from it and asked Judy Dick to recite this and then we put a bit of electronic sound on the background and as a result, I feel we have a sort of atmospheric poem which, although it doesn't make sense, it does create an atmosphere."

Lest you reject the poem out of hand, I wish to attest that when read in an impassioned tone of voice with suitably passionate electronic music in background, it can be most impressive. It made at least as much sense (to me) as some other modern poetry, and more than most. Well, now what?

There's nothing obviously wrong with Computers, only Man is vile, remember?? In my files I have several items showing the considerable usefulness of these beasts.

ceased to exist, and everyone else assumed that as well, since the Machine was incapable of error, by definition (Its own?). He was unable to continue to obtain food, employment, or shelter. He was driven out to the bush to face Survival because the body machine of society had spit him out. Luckily for him in this instance, a female human had also been cast out.... etc.

It is curious how often such tales end with some kind of return to Nature, as though somehow exposure to the wilds will cure our sicknesses. But it is just such wilderness which we have all worked long and hard to escape — the brutish struggle for food and shelter, the sickness, the slavery and poverty that comes from inadequate production. People who glorify Nature rarely do it as Thoreau did by immersing themselves in it, but go to the bush from the safe vantage of a secure home and Unemployment Insurance, with an occasional forray off the road armed with tinned beans and a propane stove.

It was to escape inseecurity and to maximise profits that we created our present civilisation. Our goals have not changed, but our methods have deteriorated. This has increased Error or introduced Noise, thereby widening the gap between desired and achieved goals.

Computers may function well to increase the accuracy of our evaluations, hopefully allowing us to act on the basis of real (rather than imagined) facts. If we choose to interpret them insanely, so we choose, but is that the fault of the Computer?

And if this hastens us to our doom, so we choose, but in our increasingly complicated society we shall at least choose our doom based on accurate data. Heh!

== Merry Christmas. - Leo & Rod.

SOME MISCELLANY, chosen from EEBs at random:

To Waterproof a Tent

This one is particularly suitable for those lovely modern tents which look so nice, but through which the rain pours. Mix together 2 oz of terebene and one quart boiled oil, and apply to the cloth. Allow it to dry in the sun for two days; the tent will be perfectly waterproof. Also works for previously untreated canvas.

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From: "So Human an Animal" by R. Dubos:

"... In 1905 the American historian Henry Adams glo-

beasts.

For example in the Aug 1970 Ham Radio magazine, K1ORV discourses at length on how computers can be used to eliminate trial and error in circuit design. My first reaction to this was "how awful!, everything I have learned of practical value was learned by making design mistakes", but I realised quickly that is no answer for serious work.

The Computer is a tool, which can be used to produce good or bad designs, good or bad poetry, good or bad art. Thus, in the "Calcomp Newsletter" from California Computer Products (May/Jun 1970) is shown the use of the Computer to make radiation dose calculations more efficiently by plotting isodose curves; if you have ever had to do this kind of thing, you may appreciate that some expert help could be welcome in doing the monkeywork; the Computer is just a trained monkey. Using similar techniques they also map ocean floors, the earth's magnetic field, geophysical maps, heat radiation studies, and meterological charts.

In that same issue are shown three drawings ("plots") by the Computer. They are really very interesting, and I'd like to reprint one on the front cover of EEB (after I ask them for permission)....

See also: "Computers and Ham Radio" by W5TOM, Ham Radio Magazine, 3/69. Also Electronics Australia, April 1967....

But then there is Peter Ryan's article, "There's every reason to fear Computers" from The Australian, June 9, 1970. He shows how a Mad Computer is able to make an awful hash of normal human affairs when It is trusted, and runs amuck.

I have experienced it too, as no doubt have you. On one notable occasion I paid cash for something, and the Computer wasn't programmed for that — with amusing consequences, but never mind.

Ryan suggests that it is no good to say that only man is vile, since his vileness will inevitably pervert any good tool. Perhaps, but is that an argument for throwing away tools?

More essentially Ryan argues for certain legal safeguards to protect us from nasty-minded machines. Without this, "the potential for evil of computers, as instruments of enslavement, is greater than all the gunpowder in the world."

I am reminded of a curious story I once read, describing a Computer-dominated society. The Machine made an Error. The result was that a certain chap became an Unperson. As far as the Computer was concerned, he

"... In 1905 the American historian Henry Adams glomily predicted that the cult of the Dynamo was to be the modern substitute for the cult of the Virgin. The present scene appears to confirm his prediction, but the future may still prove him wrong. One begins to perceive disenchantment among the worshippers of the Dynamo..."

"When life is considered only in its specialised functions, the outcome is a world emptied of meaning. To be fully relevant to life, science must deal with the responses of the total organism to the total environment..."

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Better Butter:

When churning butter, just as it begins to break, add slowly one cup of hot water, but don't make it too soft. If the weather is hot, use rather more cold water instead. Finish churning, wash and salt the butter, and let it stand in a warm room for about an hour, then work it well; this is most important. This butter will never get hard. Those of you who scoff at this may never have tasted farm-made butter?

Lacking the above knowledge our family has been using polyunsaturated margarine for easy spreadability — but I suppose we'll continue to use it, because its healthier. Imagine — healthier than butter! What a strange world we live in.

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To Strengthen Weak Chests:

Take one tablespoon lime water and one yolk of fresh egg beaten together half an hour before breakfast every morning. If unpalatable add a little ground cinnamon. This is supposed to be effective, but works for men only.

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Plagiarized from AUTO-CALL (KØNL):

A woman complained to the telephone company that men in her back yard were using profanity, so the President asked for an investigation. Came the answer: "There was no profanity. The situation was this: A man up on a pole was soldering wires and a man stood at the foot of the pole under him. The man at thefoot of the pole then said, 'Horace, you really ought to be a little more careful with that pot of hot solder up there. I do believe you have just tipped over the whole pot and it fell on my shirt front and trousers.'".... Highway sign: If you must kill yourself, get off the road.... Teenage girl(to boy friend) "Of course Dad doesn't mind our being alone together. He thinks you're a girl." ..... The school of experience would be more pleasant if there were a vacation once in a while!

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→ Commonse Electronics

AN INFORMAL ELECTRONICS EXPERIMENTERS BULLETIN

FEBRUARY 1972 vol. 8, no. 1 P. 1

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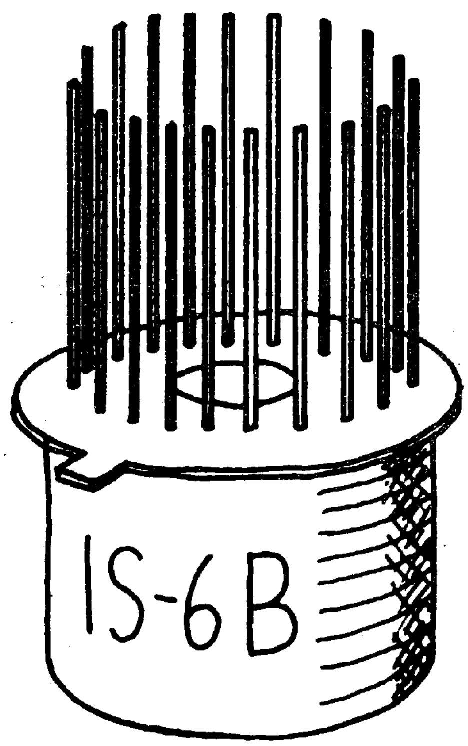

INTERPLATED SNICKETT 6 BAND RECEIVER MODULE WITH FULL LATTICE FILTER, AUTOMATIC TEMPERATURE CONTROL, AND INTEGRAL LOUDSPEAKER (NOT IN VIEW) -- MADE FOR THE AVID EXPERIMENTER AND ENTHUSIAST

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Trap! (P.C. Trimmer Intermitt.)
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L: Another Transistor Manual.
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6: L: Novice Licensing, concluded.
7: Linear a.c. probe for TVM's.
8: L: Proximity Detectors, etc.
L: Non-renewal Notice...
L: A wee drop of balm.
9: Some good books, and where to buy
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11: Editorial
12: Advertising, if any.
15: What NOT to do?
Blossom Feild.
16: Noise and the Establishment..
L: Noise Figure and Commonse.
17: Home Made Output Transformer.
Tape Recorder Trickery.
18: L: Light-Beam Keying, RTTY, and SSTV Notes.
19: L: ARRL Strikes Back. Hmpf.
20: Object of an Amateur Radio Handbook.
23: L: Essence of Reality.
L: The Postal Service.
Little Red Volkswagen....
24: SWOOP.

A GEIGER COUNTER PREAMPLIFIER, transistorised -- by I. Newman (VK7)

The very high current sensitivity available from modern transistors suggests that they may be used as current amplifiers in high impedance circuits. This would allow much higher input impedance than obtainable from the usual common- emitter configuration, and indeed, from nominal common-collector ones.

I present here one application of this idea to a Geiger Counter system. Although EEB readers might not be involved with radiation-detection devices, the principles illustrated are readily applicable to other systems.

Transistorisation of Geiger Counter systems is desirable when they need to be made portable, or more compact. The latter situation obtained here, where I needed a preamplifier which would fit conveniently inside of the "Lead Castle" housing of the GM (Geiger Muller) Tube, and powered from the same (500V) HT supply.

The input had to have a resistance of about 10 Megohms (the recommended load for the GMT), with a signal current of 10-20μA. Fig. 1 shows the preamplifier ckt.

The GM Tube may be considered as a switch which closes briefly at frequent intervals, in proportion to the amount of radiation present. Voltage to operate the transistor is taken from the voltage divider R4/R5, the bleed current of which tends to stabilise collector voltage. R2 biases the transistor into its linear-conduction region, so that about 1.5 V appears across the transistor and about 2 V across R3. The value of R2 may vary from one transistor to the next, depending on gain, but is most non-critical. R_1 presents the required high impedance load to the GM Tube. C_1 and C2 provide a low impedance path for the power supply. C2 is necessary only if not already incorporated in the HT supply, or if long loads go to the HT supply.

When the Tube conducts, current flows through the base-emitter junction of the transistor, turning the transistor on, and developing a voltage pulse across R3, which is coupled to the output circuit through C3. If the transistor is driven to saturation, the output pulse will have essentially the full amplitude of V_{ce}, about 1.5 V in this instance. If the transistor is not driven to saturation it will simply act as a linear amplifier.

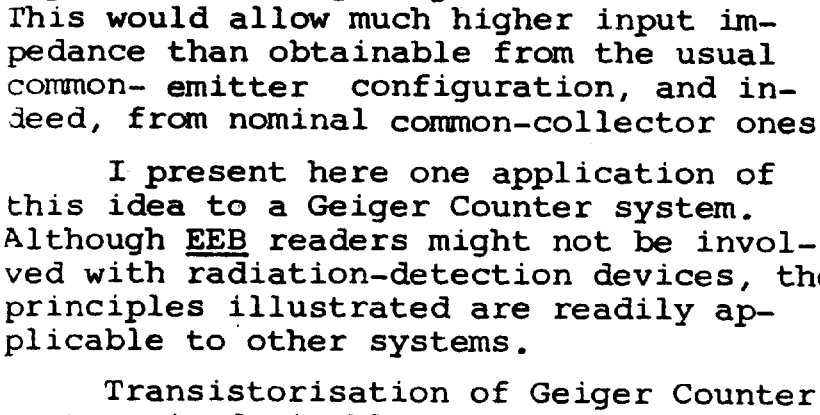

FIG. 1: The preamplifier
*Depends on Geiger Tube plateau voltage.

FIG. 2: Battery supply

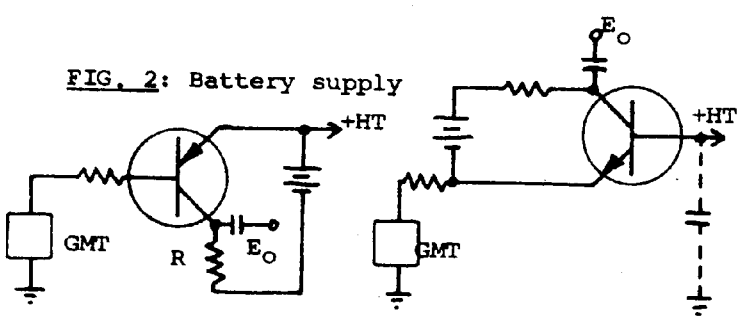

Fig. 2 represents a simplification of the circuit (for NPN or PNP configuration) For my installation I preferred not to use it, because of the necessity of changing the battery a few times a year; very high and constant reliability was essential. In addition, I needed maximum sensitivity to detect signals from weak radiation.

Fig. 2 could, however, be used where the conditions permitted. The base is not biased, so there will be some loss of signal, but this would be no problem in ordinary installations detecting hard radiation. "E" is a 1.2 or 2.4 V mercury battery, and can be left "on" permanently because of the very low current drain.

R is adjusted to the largest value which gives negligible voltage drop across it at the highest likely operating temperature of the transistor; this might be simulated in ordinary conditions, simply by warming the transistor thoroughly with the fingers. This would apply to a high impedance load.

But for a low impedance load, R would have to be small enough to provide sufficient power drive; the smaller the value of R, the more current drain (though not very much if signal is pulsed). The best procedure is to use a pot and adjust for optimum. The voltage output will depend on the voltage at E. An electrolytic might be necessary across E if pulses very short and if the battery is not immediately adjacent to the transist.

Note that in figs 1 and 2, the actual HT voltage used will depend on the plateau voltage of the specific GM Tube used.

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Editor's Note: (continued from p. 2)

This article was received before FETs became commercially practical, and doubtless the same job could be achieved by a common-source MOSFET acting as voltage rather than current amplifier.

On the other hand, the voltage signal for same would have to be obtained across the Tube (or equivalent in ckt), thus necessitating a high value for R_1. In another laboratory it was found that tube life could be increased substantially if tube current were kept high; adjustment of this is feasible when the bipolar transistor is used in series with the tube, but not with the FET.

Incidentally the transistor could alternatively go in the anode lead of fig 1 rather than the HT side (with suitable polarity consideration), and this might be rather more convenient when using a battery, as in fig. 2.

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"SOME PLAIN FACTS ABOUT ANTENNAS, FEEDERS, AND TRANSMATCHES"

-- C. C. Drumeller, W5JJ
((Abbreviated somewhat from Col./Emit. 6/71))

Did you read this article in the May 1971 issue of QST, by Lewis Mc Coy? If not, read it! Encourage others to read it. There is more commonsense in this one short article than you'll find in any fifteen articles on the subject in other magazines.

Reading what Lewis Mc Coy has to say on the subject should go far toward laying to rest the... myths that have sprung up about a simple, straightforward subject...

Lew could have placed a little more emphasis on one aspect of the subject: He could have mentioned more firmly the fact that power can be fed to a partially-reactive, partially resistive load. He says it, but he needed to say it louder and repeatedly.

Some (people) have held that reactance blocks the feeding of power to the resistive portion of the load... and have stupidly ignored the fact that as Lew points out, the reactive element is easily negated by an equal amount of the opposite type of reactance between the feeder and that cheaply-built transmitter that'll load only into a 50Ω nonreactive power sink.

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"Pulling her leg, maybe?"

The lady tourist couldn't contain her curiosity about the service station attendant's missing leg.

"Were you in an auto accident?"
"Nope", he replied laconically.
"Wounded in the war?" she persisted.
"Did you -- "
"Listen, lady", he interrupted. "If I tell you how I lost the leg, will you promise not to ask another question?"
"I promise".
"It was bit off".

((From QRM, Bulletin of the Ozone Amateur Radio Club Inc, Rt.1, Box 185, Bay St. Louis, Miss., 39520, U.S.A. QRM is edited by Jim Pfeiffer, who has published much material in the ARNS Bulletin, and he does a first class job of organising his little magazine. Any Club Editor who wants to a better job on his own magazine should belong to ARNS, and should take a look at Jim's QRM. -- RLG))

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REMOVING INTEGRATED CKTS FROM P.C. BOARDS

Doesn't it make you feel like quitting when you think of all those transistor circuits you have spent hours and hours construting and then the Industry comes out with a dinky little old IC that does the whole works at a price that is more than reasonable? A decimal counter for around two dollars that used to take a man-day of effort, to say nothing of the cost of the parts. And if you want to buy surplus circuit boards, the IC's cost even less.

How to get them off? After trying many methods (and ruining a few in the process) I found that the only sulccessful way for me was to cut the circuit board with a pair of tinsnips reasonably close to the contacts. Be sure each pin is straight up, generally pins 1 and 8 are bent over to hold it in the board before its originally soldered. Then immerse the whole printed circuit board piece in a pool of molten solder. In one second the thing comes right off -- and I haven't lost one yet out of about 50. Easier than using a "solder sucker". (KØNL, Autocall 1/71)

TRAP!

Should you be using a printed-circuit type ceramic variable trimmer in a project, and the circuit stops suddenly, suspect that the trimmer has gone open-circuit. Very nasty?
-- VK6ZCY, W.A. VHF News Bull, May 1971.

ODE ON CODE

C.W. is a tricky mode (but we like it),
It proves we should give up on code
(but we like it),
It makes us mad,
It makes us sad,
It takes the fun from this old dad,
Its the worst darn time we've ever had
(but we like it).

-- WØCCT, ARNS Bulletin, April 1971.

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CONSTRUCTION OF LOW INDUCTANCE CONDENSERS

-- by W. H. Sayer (WA6BAN)

This project was undertaken to find a way to reduce the inductance of commercial ceramic condensers found in the pi-L network of an amateur transmitter (KWM-1). The circuit is shown in fig. 1.*

The fixed condensers as supplied are Ceramic CRL 850's. The 75pF and 100 pF condensers are connected together with a wire 1-1/4" long, and they are parallel-resonant at 124 MHz. Changing the wire to a 1/2" strap increased the resonance to 146MHz. Even better results were obtained by replacing those two condensers with a double-deck fibre glass printed circuit board, the construction of which is shown in figs 2 and 3. This new condenser has extremely low inductance, and I could not find any resonances with the dipper available here ((presumably up to 250 MHz)).

The use of copper-clad board was first described by Collins engineers in November 1968 QST, and it is a good idea. For example, two of the commonly used coupling condensers are 500pF, spaced 1-1/4" with 1/2" copper strap, and they resonate at 50MHz. Did you ever wonder why your amplifier was unstable at 28MHz?

The copper-clad board illustrated in figs 2 and 3 had a capacitance of 18.5 pF per square inch, and it can handle considerable power. With this information, one can design condensers of any desired capacitance, simply by cutting to size, or paralleling as necessary.

((Editor's suggestion: It might be a good idea to measure the capacitance of a given sample of copper-clad board available to you, to ascertain the capacitance per square inch, allowing convenient calculation of capacitance desired in terms of dimensions to cut.))

* I refuse to draw this kind of thing! See any Handbook for the circuit--RAJR.

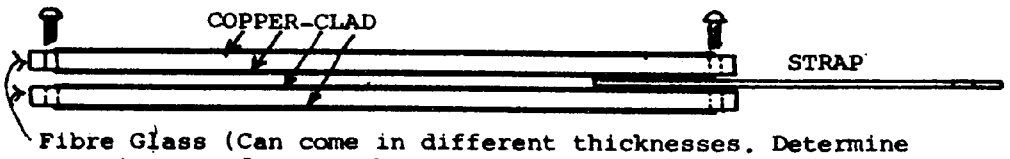

Fig. 3

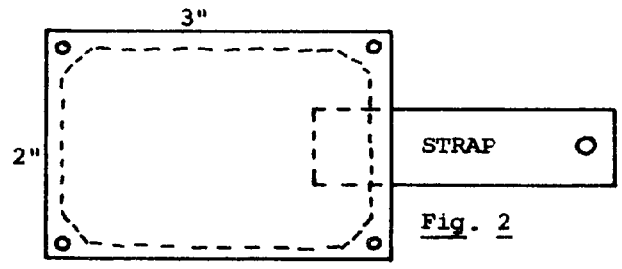

Fig. 2

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LETTER: Another Transistor Manual
((Ref. EEB, Oct. 1971, p. 78))

Last year I started getting an English publication called The Radio Constructor (advertised from time to time in Ham Radio). In the March 1971 edition tucked away on page 495 was mention of a transistor data manual published by the AVO (Thorn) people. The price in the U.K. was £ 4.40 including packing and postage. I wrote to them and was told that the price would be £5.00 stg, including packing and postage. I sent for it and in due course received the publication called "THE SEMICON INDEX, VOLUME 1".

This book gives one line of information on each transistor listed and is very good on European transistors and the Japanese 2SA, 2SB, 2SC, 2SD series (not covered by the Motorola book), as well as the 2N American series. It also gives a substitution list from the CV series, e.g., the BC109 is a possible substitute for the CV 10769.

I just saw this publication in a bookship priced at $20.70, so I saved quite a few dollars by buying it in the U.K. But note that the book lists transistors only. In the back of the book is a coupon for updating. It reads, "New data is continually becoming available. In order that your information may be kept fully up to date, pls complete and return this card. You will then be advised as soon as the next edition of this manual is published (September each year)". I do not know of the availability of any other Volumes, but possibly they will be involved with future increas es in size....

The book is available, as above, from: AVO Limited, AVOCET House, Dover, Kent, England, U.K.

-- L. L Sharp, VK4NS, Chermside, Qld.

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To Smoke Fish: Fish prepared like this will make commercially prepared stuff look sick. Get a fairly large box, e.g. 2-ft high, and screw some hooks in the bottom. Then dig a hole in the ground, about 2-ft deep. Place some sawdust (pine, NOT gum!) in the bottom of the hole, and set alight. When it is burning steadily, hang the fish on the hooks, and place the box over the hole. If there should be insufficient ventillation, bore a couple of holes in the sides of the box. Sprinkle a little sawdust on the fire from time to time. Two or three hours are usually necessary. The same procedure can be used for large pieces of meat, if the time of smoking is prolonged suitably. The taste and keeping-quality can be improved if the fish or meat is soaked first in about 10% brine for several days; longer smoking also improves keeping quality, but even brief smoking can afford a real taste treat for a variety of meats.

A SENSITIVE NULL-POINT DETECTOR

AND: The Maddever TVM Resurrected

-- R.S. Maddever (VK3)*

There are many occasions where it is necessary to measure the null-output from a bridge. When it is a d.c. bridge, the detector may be a simple high sensitivity zero-centre microammeter. When the bridge is powered by a.c. (as in the Owen Bridge described by Pitcher in the Sept 71 EEB), the signal may be detected by using that microammeter in a conventional diode rectifier arrangement. But this arrangement lacks sufficient sensitivity for many applications, particularly when it is necessary to detect nulls in the region < 1 µA. Furthermore the rectifying diodes introduce considerable loss of sensitivity owing to the minimum threshold voltage needed to make them conduct.

Why?

Why bother to measure such low currents? Strictly speaking it is not possible to measure a null, because it does not exist! One merely "zeros in" the null point indicating bridge balance. The more sensitive the detector, the closer you can approach to zero, therefore the more accurately to define the true balance point. If you use a 25-0-25 µA meter as readout, you'll do well to discern a 0.5 µA wobble near zero, yet for reasonable accuracy one can need a factor of tenfold better sensitivity than that.

The solution

The answer is to use a d.c. amplifier, and a simple yet good one is shown in fig. 1. Cascaded emitter followers are used in a differential arrangement, to minimise temperature effects.

* As transcribed by RLG from Inspired Scribble. Errors may safely be assumed to be those of the transcriber.

Nearly any transistors will suffice as long as $Q_1 = Q_2$ and $Q_3 = Q_4$. Computer board transistors work fine, as do SE1002s, with the silicon transistors giving obviously less temperature dependence.

TRANSISTORS	R_{fb}	M	SENSITIVITY
a) 083	-	1mA	0.2 µA for FSD
b)	100K	"	0.4
c) SE1002	100K	"	0.5
d) 2N4250	100K	"	0.3?
		200µA	0.06?

NOTES

a) Noise and drift appreciable here.
b) Reasonable results.
c) Use meter scale 250-0-250 nA. (1 nA = 0.001 µA)
d) Estimated, higher gain transistor.
e) A more sensitive meter will give even better results, if available.

In condition c, there was a warmup drift of about 20 nA on warmup, and thereafter 10 nA or so per hour. Noise was just discernible. With other transistors, other values of R_b might be appropriate, as needed to produce about 1V across the 2.4K emitter resistors. Base stabilising resistors (base to emitter return) across Q_1 and Q_2 reduce sensitivity and are not necessary if things are reasonably well balanced.

R_{bv} is too coarse for the zero adjust, and if I had bothered to match the two values of R_b more carefully (and the transistors), 10K would have been better.

To use the detector for a.c. one could simply use a germanium diode in series with the meter, and another diode in the opposite direction across the meter + first diode. Or a bridge of diodes could be used for probably more sensitivity.

Note that there would be nothing to be gained here by using Hot Carrier Diodes for rectification; although the HCD have a very large front-to-back

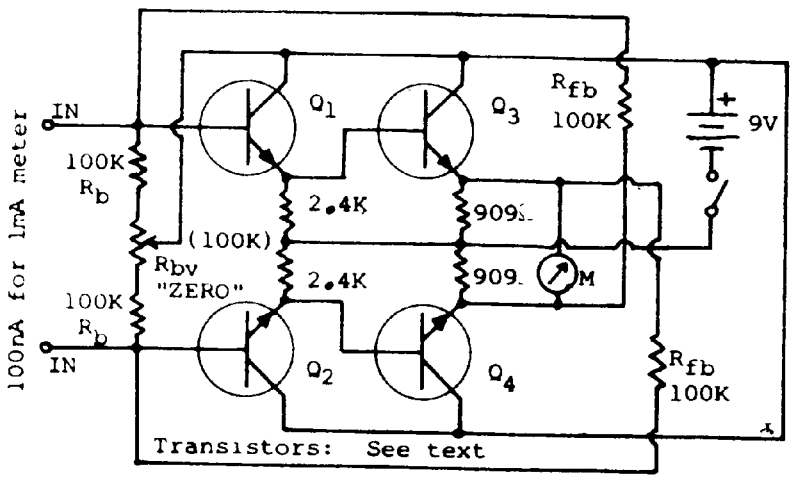


FIG. 1: SENSITIVE METER AMPLIFIER FOR NULL DETECTION

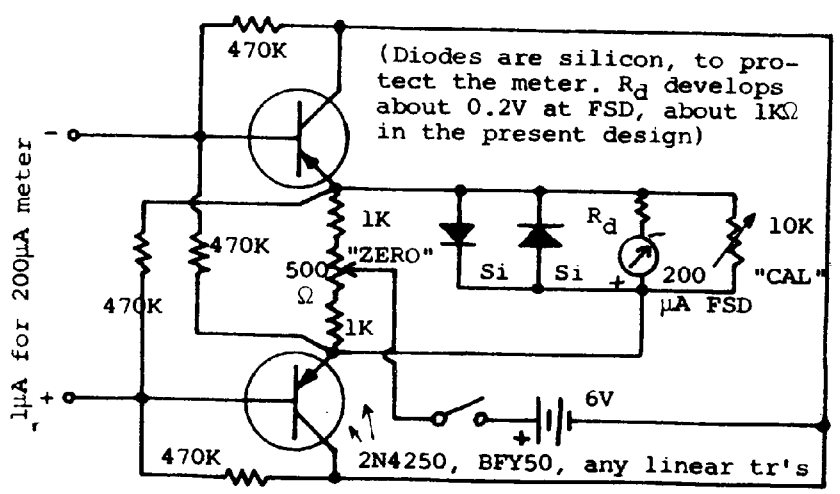


FIG. 2: PREVIOUS DESIGN (10/67) FOR LINEAR AMPLIFIER

ratio , their forward voltage drop is only in the typical germanium region. Copper oxide diodes would be better, but only if they will respond sufficiently to the high audio frequency of the oscillator which drives the bridge.

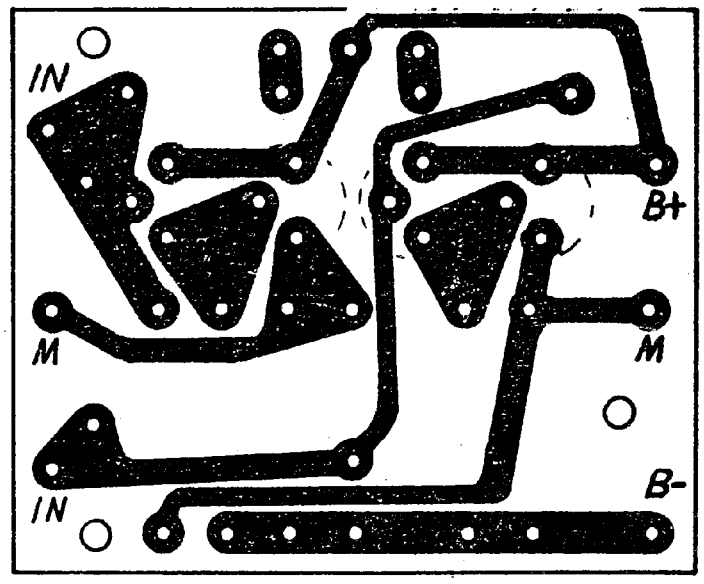


FIG. 3: P.C. DESIGN FOR THE NULL-DETECTOR OF FIGURE 1: FULL SCALE.

The Linear Amplifier, Revisited

Readers with long memories may remember something similar to this in the October 1967 EEB, as the basis for a versatile transistorised voltmeter, or the common-emitter equivalent in December 1967 (said to have less hum pickup).

In that instance it was desirable to use the Fairchild 2N4250 because of its exceptional linearity. We hear that the BFY50 is also very linear.

For interest, the basic circuit of the 1967 article is reproduced here in fig. 2, and the printed board layout for fig. 1 is shown in fig. 3 (full scale).

In fig. 2, only a simple single differential amplifier was necessary for the sensitivity needed. Multiplication of voltage or current scales was accomplished in the usual manner, as well as a conventional ohmmeter circuit.

XXXXXXXXXXXXXXXXXXXXXXX

LETTER: Novice Licensing (concluded)

With reference to comments on page 102 of your November 1971 issue on the subject of Novice Licensing, I note statements in opposition quoted from the Bulletin of the Tasmanian Division, WIA. The following points are relevant:

(1) Re amendments to the Posts and Telegraph Act: I cannot see this as a major argument against the Novice concept. The introduction of AOLCP and Limited Licence appears to have left the structure of the PMG Department reasonably intact and, one might presume, capable of absorbing the shock of introducing a lower-level licence on the lines of widespread overseas practice.

(2) Re what Novice Licensing would achieve. This is partly answered by the abovementioned reference Pare (2) "IN SUPPORT OF THE PROPOSAL". Note that the greatest supporters of Novice Licensing are persons and groups and Clubs associated with the training of would-be amateurs; the greatest oop-position appears to come from individuals who are engaged in electronics professionally and who are therefore, not bona fide "amateurs".... It is an amateur service, and therefore genuine amateurs should not be (influenced by) the professionals, who have skills and backgrounds well outside the hobby field.

(3) Re Novices lacking skills and knowledge to combat TVI and BCI. This is a red-herring which has no basis in the proposals submitted to the WIA Federal Executive. Any form of training and examining to cover the N$_o$vice candidates would necessarily include study and testing by the PMG of topics related to these matters. (Full information on this) in the sample examination paper which the Committee compiled and sent to the Eastern Zone of VK3 Division for comment.

(4) Re lowering of existing high standard of VK operating. This has been thoroughly answered in the Report of the Committee to F.E. The aim of Novice Licensing is to IMPROVE the standards of VK operating and... (it should be noted that the) American experience is that persons who entered General Class Licence (equal AOCP) ((sic)) via a Novice apprenticeship are, in the main, better operators than those who came in directly at General Class level.

In any case the existing method of preparation and examination does not guarantee good operating standards. How many Full AOCP holders could still pass the Code Test at 10wpm after 6 months? The "professionals" with telegraphic experience would have no trouble, of course, but of those people prepared by WIA and Radio Club courses, I suggest that a large proporation have never used and will never use CW again ((what a pity!! -- RLG)), and would fail miserably if the Radio Branch ever decided to re-examine.

Also, in many years of listening on the amateur bands I have heard some pretty shocking examples of poor operating, and have welcomed SSB as providing a means of ensuring that non-amateurs with dual wave receivers do not listen to some of the absolute rubbish spoken on amateur bands by Full AOCP holders of mature years. The poor operating certainly would not be confined to Novices!

(5) Re reducing all Amateur Radio Licensees to HAM status -- this is sheer nonsense and is not borne out in the USA after 20 years of Novice Licensing. The American correspondents state that the Novice Licensees do NOT cause any undue proportion of TVI, BCI or other problems to the FCC; that the Novice Licensees as a group present fewer problems to the Administration than do any other group of licensees. Why do the pessimists in the Institute expect any worse results in Australia?

-- R. C. Black, VK2YA, Springwood, N.S.W.

((Further comments on this subject should be directed at the ample columns of Amateur Radio. EEB correspondence on this subject is now closed.--ED.))

XXXXXXXXXXXXXXXXXXX

A LINEAR A.C. PROBE TO USE WITH THE RSM SENSITIVE TRANSISTOR VOLTMETER

-- By. P. Lumb (G3IRM)

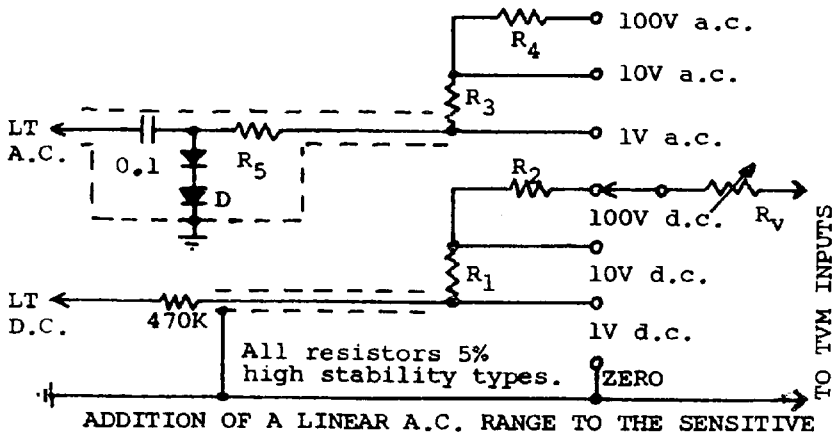
((Editor's Note: This article has been delayed slightly (4 years), with profound apologies, but we haven't had the occasion to ressurect it until the fortuitous reprinting of the Maddever Transistorised Voltmeter in last month's EEB -- which also appeared a couple of years ago in Ham Radio...))

The sensitive transistor voltmeter described in EEB last month was constructed using a pair of 2N2924 transistors. But the power supply polarity was reversed to accomodate the NPN transistors, and a centre-zero 100-0-100μA meter was used. A zener was also used as a calibrating voltage reference, when desired.

The d.c. ranges were compared with an accurate Marconi valve voltmeter and were found to agree within 2% on all ranges and at all points on the scale. Due allowance was, of course, made for the slight inaccuracy of the Japanese meter used in the transistor voltmeter. Zero stability was found to be within ±2% at all normal temperatures, and the stability at reasonably constant temperature was found to be excellent. The meter multipliers covered the ranges in which I was interested, with a sensitivity of nearly 1 MΩ/V.

The circuit thus seems to be good enough to produce superior results even when used witha transistor other than the highly linear 2N4250 (of Fairchild). The function of the d.c. TVM was then extended to cover a.c. low voltages, by adding diodes as shown in the diagram below.

The secret for linear a.c. ranges lies in the use of point-contact diodes. The ones actually used were removed from computer boards, and the same types are ((still)) available in Australia. Almost any diodes may be used, but they must be point contact germanium types. The diodes were seriesed to give higher PIV. If a higher degree of linearity is needed it will pay to experiment with the diodes used, but all types tried have produced an accuracy of 2-3%. Accuracies of 1% in linearity can be obtained by careful selection, even on the 1 V range!



ADDITION OF A LINEAR A.C. RANGE TO THE SENSITIVE LINEAR VOLTMETER, FIG. 2 OF MADDEVER'S ARTICLE.

The meter is first zeroed by setting the switch to "zero" and adjusting the zero-adjust pot. Next set the range switch to 1 V d.c. and adjust R_V for full scale with 1 V d.c. applied to the probe. R_1 is then adjusted on the 10 V d.c. range, and R2 on the 100 V d.c. range.

On a.c. ranges, R5 is adjusted so that 1 V r.m.s. sine wave applied to the a.c. probe produces full scale deflection, after which R3 may be similarly adjusted on the 10 V a.c. range. So far it has not been found necessary to readjust R_V after the initial setting up, and it could well be replaced by a fixed resistor.

The diodes may be reversed (e.g. by a DPDT switch) to read positive (rather) than negative) half cycles input if desired. This can be useful to check a.c. wave symmetry.

Editor's Note:

I have added R4 to the diagram, because it occurs to me that the point-contact diodes, D, might well be replaced by the new Hwlett Packard Hot-Carrier Diodes, HP5082-2800, which have a PIV of 70V each -- double that reported for the HP2800 in the Nov 71 EEB. It is also double the PIV likely possessed by Peter Lumb's point-contact diodes.

This would allow a likely 100 V a.c. position on the switch corresponding to the 100 V d.c. one. Higher input voltages than this don't usually need the high sensitivity of a unit of this sort. One could merely switch the input directly to the meter movement, with suitable multiplying resistors.* Presumably the linearity of the circuit should be as good or better than with the computer board transistors. Would someone like to check on this?

---

*To read a.c. the meter movement must, of course be surrounded suitably by diodes, but for HT these could be HT silicon diodes, all things being = ...

Moulding public opinion is like driving a mule. First you decide which way the mule wants to go, and then you drive like the devil.
-- J. Pfeiffer, WA5CKJ, ARNS Bull. 2/71

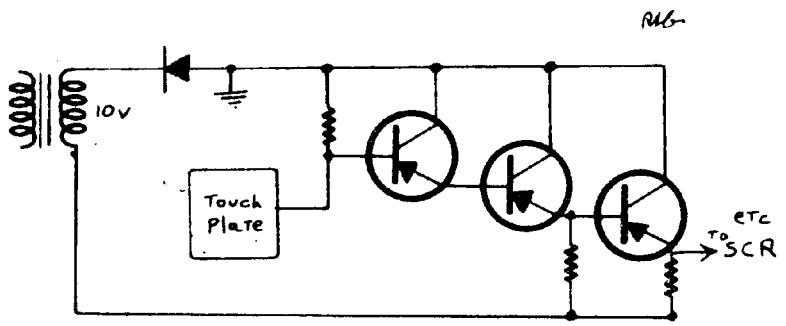
LETTER: Proximity Detectors, Turbochargers, and Fuel-consumption Meters....

It is some time since last I did anything for EEB. A Lightshow thing has run away with all my time for some months now. It is a frustrating business; early last year we developed a triac light-modulator from scratch. It took hundreds of hours and ended up quite a unit. Then a few months later a "Colour Organ" appeared in Practical Electronics, and shortly after another in Electronics Australia. Then a great rash of them in the American magazines. So now all lightshows have triac modulators -- none quite as complex as ours, but still quite workable.

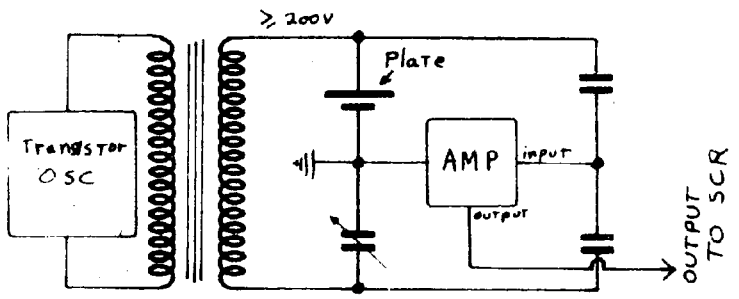
Then VK2AMJ, one of the team, concocted the idea of triggering strobes by flip-flop to get a sort-of phi-phenomenon (apparent movement); previously we had only done this with white floodlights. Over the holidays we went to see Hair, and what awaited us? Alternating strobes! Bah.

I have been working on a number of proximity detectors, but by the time each one was finished, some new development made it less desirable than the old, and so it went on. The results I got were:

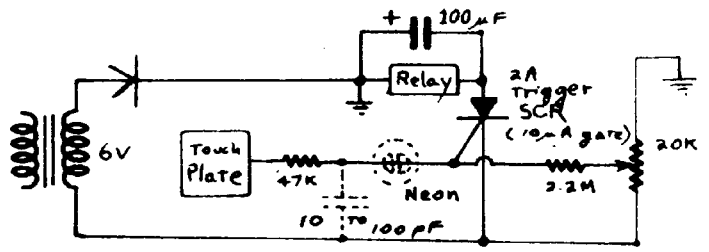
A) Using 3-stage transistor amplifier at $50H_z$ -- sensitivity uselessly low:



B) One-stage transistor amplifier at $10kH_z$ -- touch sensitivity, i.e., about 1/2" for 1/2 V output. Computer board transistors:



C) Supersensitive SCR at 50Hz -- touch sensitivity.

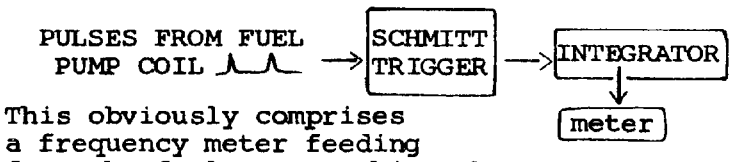


((Dotted-in components are Editor's suggestions. Why not insert FET preamp in this circuit, as per D, below? The larger the touch plate, the higher will be the sensitivity to proximate objects--RLG))

D) FET Amplifier at $10kH_z$ -- never worked at all; ran out of time and patience. Nevertheless it is a promising line, since the big problem is input impedance; actually an FET could be used at $50H_z$. ((Most designs use r.f. osc--RLG))

I do have an idea for converting computer blower motors into superchargers or turbochargers for small-engined cars; depends on how the blades are made. Or if that doesn't work I can use a vacuum cleaner or two in reverse. How would that suit EEB? ((Fine! Just plug in the vacuum cleaner to the nearest mains outlet, tune it up, and drive off!)) Of course if it works I'll build them and sell at a ghastly profit, but EEB readers can have it on the quiet. ((Gee, thanks awfully!))

And then there's a fuel-consumption meter that I've been going to make for a few years; should be easy nowadays with better transistors AND ICs available. The fuel consumption meter would give a constant reading in gallons per hour, or with a bit more complication, miles per gallon. Consider the situation using an electric fuel pump :(only)



This obviously comprises a frequency meter feeding from the fuel pump. This takes care of the fuel end; for miles, some contact must be installed in the odometer.

--D. Brown, Gosford, NSW.

((Good sensitivity for a proximity detector can be achieved by a loop or capacitative pickup to alter the frequency of an r.f. oscillator, and detect the change by a frequency discriminator of simple sort. -- RAJR))

XXXXXXXXXXXXXXXXXXXXXX

LETTER: Non-renewal Notice

I do not wish to renew my subscription to EEB. I find that apart from occasional technical discussions which are occasionally instructive but usually assume a wealth of knowledge that I don't have, I find very little of use to me. Maybe my interest in electronics is too limited, but I have no time at the moment to extend its scope.

-- Doug, VK3---

((We always wish to know why people don't renew, and letters like the above are much appreciated. -- Ed.))

XXXXXXXXXXXXXXXXXXXXXX

LETTER: This does gladden our hearts!

EEB is never late for me, as I'm about as far behind as you are!

-- P. G. Nielsen, Collinsvale, Tas.

XXXXXXXXXXXXXXXXXXXXXX

Did you hear about the man in Texas who inherited five million dollars and proceeded to run it into a small fortune? (A/C 5/70)

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I've seen this, and like it -RLG

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REVIEW: (by RLG)

SOLID STATE QRP PROJECTS, by Edward M. Noll (W3FQJ) ("Editors/Engineers"; Sams, 1970), 125 pgs, $US4.25, paper.

In the original version of this item, I had some four pages of discussion on this Review, bringing in opinions from Ham Radio of Oct. 1971, The Milliwatt of June 1971, and Bulletin of the Amateur Radio News Service, March 1971. But I gain the impression that our readers are becoming weary of such large doses of reviews. So, although both the subjects of Reviewing and of QRP transmitters interest me, quite a lot, we'll truncate this presentation substantially.

In the MW, W9SCH notes the general coverage of transmitters presented, with CW units predominating. He thinks it unfortunate that most are at the one watt or less power level, since these would tend to discourage beginners with poor results. There is some difference of opinion on this subject between amateurs, but surely commonse must prevail. If a beginner gets discouraged with 1W, he can get ten times as much output if he uses a 6AQ5 (etc) valve, with the most elementary possible Class C circuitry. Solid-state is mostly for fun, or at higher powers for special requirements such as mobility.

Note is also made of the departure by W3FQJ from printed circuitry, and in this I also concur with W9SCH's approval. "For the usual, one-of-a-kind amateur project, wire-and-solder construction remains more practical.."

Criticism is made of W3FQJ's use of coaxial cable rather than tuned, open-line feeders. Although I tend to agree, there is a lot of different opinion on this subject too amonst qualified people.

The ARNS Bulletin Review takes a dim view of the enthusiasm of amateurs who try to break records on a mile-per milliwatt basis, but there are indeed numerous Americans (and Australians) who enjoy the sportsmanship of such a venture. A motto for the QRP Club is "Power is no substitute for skill". The criticism is also made that the selection of components tends to be obsolete as soon as the book is printed, because of the rapid appearance of new transistor types.

This view is one which does (or ought) not worry us much in Australia, because we realise that any suitable transistor will suffice which has the relevant frequency and power requirements satisfied. Slavery to transistor type numbers is... silly. The specifications for transistors can be found by consultation with the various Data Manuals, such as Motorola's impressive "Semiconductor Data Book" -- reviewed in the October 1971 EEB. Or by requesting Short-form Catalogues or specific sheets from the manufacturers: Philips, AWV (RCA), STC/ITT, T.I., Varian (in Crows Nest NSW), etc. For instance, Jacoby Mitchell handles the "U" series of Siliconix FETs which are mentioned in Ed Noll's book and in his Ham Radio articles: U183 (200mW), U197-9 (300mW), U221-2 (800mW), in the $2.50, $5, and $34 price ranges, respectively. One might think that valves might be practical in the > 1W ratings compared to FETs, but....

ARNS says: "Wisely, the author keeps away from receivers; solid-state in this application cannot be kept simple and work well, and the description of an adequate receiver would take another book", and the rest!

The HR Review as usual sticks to constructive comments, noting that the emphasis in this book is on solid-state. Hi.

What is the take-home lesson? From a look at the book itself I conclude only that it is a good one for experimenters interested in low-power r.f. transmitters or oscillators in transistorised form.

In addition to the modern module material described (which is also available here, from Philips, STC/ITT, Plessy, etc), Ed Noll has warmed my heart with a lovely antique valve Tx, using the 01-A (formerly 201-A), complete with photo right out of the dark ages. Reminds me of an ambition I have to build a Tx using only antique valves and antique components (even if I have to wind my own condensers!), powered by wet-cell batteries. CW, of course ((and doubtless varying 10kc every time it is keyed? -- RAJR)).

& See Orr's lovely in SQ Nov 71

Ed Noll has continued his QRPP coverage in his monthly articles in HR mag, beginning with 4/71. Additionally

→ p.15

"The more parking places you provide, the more cars will come to fill them. It is like feeding pigeons." - Sir Hugh Casson

IMPROVED CW RECEPTION (Continued from last month's Editorial)

High Sensitivity through Pulse Detection (continued)

What makes this system so effective is the fact that when the CW signal is present there is very little fluctuation in the d.c. output of the heavily limited output. But when the CW is absent there is considerable output fluctuation, and this produces an increased a.c. which is then rectified and used for control. Thus it is the noise which keys the oscillator rather than the signal — and presumably this gives more reliable results because you can always depend on the presence of Noise, but not always sig!

In Hing's system, the heavy limiting of the input signal produces a "threshold", above which variations in signal are unimportant, and which extracts the most possible information from the signal.

I notice that in Hoff's system described by Kelly last month here, severe amplitude limitation of the signal is also applied, and perhaps a similar principle is being employed as used in "pulse detection", but who can tell? The IC circuit is quite inscrutable, and I have no idea how it really works....

In two recent articles, just the opposite principle is used to good advantage, but I can't help feeling that the pulse detection method is better. The first is "Threshold Detectors in a CW Audio Filter" by A. B. Andes, WB2VXR, in QST 12/71, the main part of which is a two-stage IC active audio filter. In the first stage the signal cannot be passed until it exceeds the threshold imposed by series diodes; the second stage is to smooth the rubbish caused by threshold switching; obviously suitable for CW only.

Selective, Quiet Gating

The other threshold article is "Threshold-gate/limiter for CW Reception" by J. J. Duda, W2ELV, Ham Radio 1/72 (great ideas occur in clusters?), which shows that not only does threshold gating reduce noise, but it also reduces the annoying "ringing" that occurs with the use of very selective audio filters (as useful to obtain higher effective selectivity). The final circuit uses diodes in parallel as well as in series, to limit both the maximum and minimum signal level the gate can pass. The produced audio output thus bypasses both noise and excessive audio. The problem of distortion (the above-mentioned "rubbish") is avoided by preceeding the gate by both a Q-Mult. and a high-Q audio filter.

W5JJ, Carl Drumeller, comments in the Feb 72 Collector and Emitter, "(Blast) it, I was intending to write (an article) on this, but W2ELV beat me to the draw."

-- Further clustering of great ideas ?

A Comparison

I must admit that although the pulse-detector will extract the maximum possible information from the signal, it has a severe drawback: when considerable i.f. selectivity is used ahead of it, the noise pulses are lengthened to the point where they key the audio oscillator.

It is evident here that we are on the horns of the usual Heisenbergian quandry: you can't achieve maximum selectivity and sensitivity without a sacrifice of one or the other -- a "tradeoff". One would be tempted to avoid the problem, to get something for nothing by applying the pulse detector to the front end of a Direct Conversion receiver, but that would accomplish little: selectivity will still lengthen noise pulses, whether that selectivity is at i.f. or at a.f. That is one of the take-home lessons of my present state-of-the-art articles.

Thus, the threshold gate systems have the advantage that they can be used with high selectivity systems, and otherwise to get best noise and signal-limiting possible when interference is a significant problem.

Improved Audio Filters?

Several articles have been directed to this hardy perennial subject, but with some curious twists. "The simplest CW Audio Filter" in HR 11/71 (W7DI) simply tunes the inbuilt inductance of a headphone by placing a cpacitor in series with it. While this could not compare to the results from a really high-Q filter, it would be better than nothing, and simple, simple. It also has the advantage for Modern Amateurs that it does not require the alteration of receiver circuits which would reduce the Resale Value of their sets...

In the same vein is the curious suggestion by W1IK in the Jan 72 QST that one's own ears can be used as selective audio filters! His own left ear had a bandpass

(continued, p. 13)

((P.S.; WANTED: ARRL & RSGB Handbooks for beginner. Write EEB.))

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Autotransformer, weight 55 lb., 16 taps between 60V and 230V (suitable for 240V mains), military rating 21A (should be capable of 30A), $35.00 .

Transmitting valve, Philips QB5/1750, 1750W maximum output, new in box, $12.00 .

We always have odd types of auto-transformers and large 240V power transformers at good prices. If you require a large power transformer rated at 50V secondary or lower at 1A - 100A, write to us, giving fullest details of load and duty cycle. Typical price: 50V 20A transformer, "HILCO", wt. 60 lb (240V pri), price $35.00. All transformers tested before despatch, and guaranteed.

Cossor 1049 Mk. 3 double beam oscilloscope, D.C. coupled, $75.00 . Solartron oscilloscope: $110.00 .

Please see advert in the July 1970 EEB for other items, and ordering information. In any event, free list, giving detailed information on other goods is available on request. Please allow for freight, postage, etc. Detailed invoice provided with all orders, and excess refunded promptly. Best method of payment is by cheque with amount left open, and cheque marked "not over $..." top & bottom. 50c handling charge on orders under $5.00. Store open most weekends.

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FASCINATING BIOCHEMISTRY: Story of the body in simple terms with do-it-yourself problems for the layman, student and professional: "The Definitions of Biochemistry", by David Morgan, Ph.D., FAIC, K6DDO. Only $3.20. "Enzyme Circuitry" is a discussion of enzyme function with numerous analogies to electrical structure and feedback concepts — quite fascinating to anyone with a knowledge of electronics and an interest in enzymes! Only $3.20. "Business Communication", a book written in the same commonsense manner, essential for anyone in business who wants to improve efficiency and effectiveness. Only $2.30. All prices, postpaid. Send cheque in $ for the amount indicated, to EEB at Sandy Bay.

EDITORIAL (continued from p. 11)

response from 2 to 4kHz, good for phone, and his right ear peaked at 2kHz, just right for CW! So he just puts in a "phone-CW" switch to select the correct earphone lobe. Heh.

In QST for 2/72, VU2JN approaches the old problem of selectivity in a new way. Mechanical and crystal filters are an impossibly expensive dream in India, so he simply built a good L/C low-pass filter and trained his ear to copy CW at 100Hz. The result, saith he, is superb selectivity at miniscule cost. Something to give us pause in our affluent pursuit of Efficiency, eh?

Improvements through r.f. filtering

In a more affluent society, E. R. Cook, ZS6BT describes in the 11/71 Ham Radio, how receiver bandwidth can be limited to improve sensitivity (viz., reduce noise), and furthermore that this improvement improves, the more places you limit the bandwidth. Thus, he was able to obtain a remarkable 30db improvement in S/N ratio by applying r.f. regeneration and i.f. regeneration (Q-mult.) and two selective audio filters. For a really sensitive low-noise receiver he estimates a noise level at -100db for a signal output of 1-milliwatt. "There is nothing more pleasing to the CW DX man than a really weak signal producing a 1-milliwatt audio signal with an absolutely quiet background"!

High-performance CW Processor/P.S. See: Rad Comm 3/72 p.155

This very interesting circuit presented by D.E. Hildreth (W6NRW) in the Oct 71 HR essentially combines both the triggered-oscillator concept with the threshold-gate one, giving an output which has high noise-rejection ability, even output level, and some flexibility.

I.f. is fed into a system which turns a signal into a Frequency Modulated carrier which is then detected in a conventional discriminator (or PLL). This takes advantage of the high limiting possible with FM, and its high inherent noise-rejecting properties as well.

The author admits that this system shares with the triggered-oscillator ones the fact that the output sounds "sterile", and he solves this by inserting a switch which introduces the BFO for "feel" when noise-rejection is not important. Although I should think that the technique of bypassing the "sterile" Box with some original signal (as described above by D. Wherry) would be the most satisfactory way of achieving the human touch, most conditions are not marginal, and it probably doesn't matter.

Means vs. ends (again; c.f. EEB, Dec 71, p. 125):

In much of this discussion — as indeed as in several of the recent completely automatic CW sending and receiving systems -- there arises constantly the question of ideal ends vs practical means. By exercise of much ingenuity the designer has produced a Black Box which will "process" a signal to get the maximum possible information from it, occupying the least bandwidth, lowest noise, and maximum communication effectiveness. But then he finds (to his surprise?) that the sounds are "sterile", lack "feel", speech sounds as though the bloke "is talking at the end of a tunnel", or is conversing with Donald Duck. So he provides variously palatible alternatives to reinject "feel", shape the response to get somewhat more realism at the expense of effectiveness, or whatever. The phenomenon is not limited to communications; HIFI enthusiasts found that they could obtain more "realistic" sounds from their expensive machines if the middle range of audio frequencies were emphasized. Whence then the super tweeters & woofers?

Inevitably the pendulum swings back, and men begin again to ask not only how to achieve results, but whether the results were worth achieving. Give that some thought the next time you hear someone saying that we'll lose the bands if we don't put twice as many amateurs on the bands (Novice schemes, etc?). Would life on the bands be worth living if QRM was twice as bad (not to mention the intruders)?

If we try to avoid this gabble by sharpening our signals to razor keeness, by squashing our sidebands, by limiting our responses, by amputating "feel", will the resulting cacophony be worth the candle? ((Again, the argument is not restricted to communications: Would an Australia with 75 millions of people be worth living in or defending?)

I say keep amateur numbers down to those who happen by chance to become interested, promote sensible steps to communicate effectively (as well as efficiently) while maintaining human sounds and human values — AM, DSB, FM, reasonable bandwidth, etc. -- and discourage the clods who would turn the airwaves into an immature merrygoround. If this loses us the bands we'll have lived keenly while we have lived (and I might even join you), but as I have said elsewhere, I don'tthink that this would lose us the bands. Other far more cogent forces are at work.

INDEED, in recent editorials in CQ and QST there are the suggestions that improvement in satellite communications etc may actually provide the amateurs with MORE spectrum space. I'm not saying that that may be true, but imagine, if it is, would the truncation of human speech and creativity have been worth the results obtained??

WHERE THE DX IS AT! — by Greg Johnston, VK7KJ

((ED Note: Owing to typing the Contents Page late at night this item was not included therein; with apologies to author. Please mark it in your Contents page, now. Thanks.))

G.M.T.	CALL	NAME	FREQ	QTH/QSL INFORMATION
a) From the Home Station Log:				Skillnadsgatan 37, SF-22100,
0940	OHØNI	Sigge	21284	Mariehamm, Finland.
1250	HKØBKX	Fransisco	14145	San Andres Is.
1345	MP4MBM	Stan	21279	Box 14, Muscat.
1333	VQ9R	Carl:14211+14250		Box 193, Mahe, Seychelles.
1301	SVØWMM	Ray	21339	Crete.
1457	MP4MBC	?	14171	Muscat.
1500	XW8BS	Ben	14225	Laos.
1325	YB3AAY	Jess	14211	Surabaya.
0645	VR5FX	Bill	14110	via ZL2AFZ. (Tonga)
1019	4S7AB	Sunil	21305	Ceylon. As per Call Book.
1406	JX6RL	John	14221	Jan Mayen; via LA8AG.
1448	YK1AA	Rasheed	14244	P.O. Box 35, Damascus.
1440*	5X5NA	Roger	14167	via G3LQP. *also 1520. Uganda
1122	VQ9MC	Bob	14210	Bx 193, Mahe, Seychelles.
0728	3D2FM	Fred	14313	New VR2 prefix. Via W7YBX.
0648	6D4EB	Emilio:14268,195		=XF4:Revilla Gigedo.XE3EB
b) Per Courtesy of "DX-press" (VERON)				
1150	9X5PB		28620	Rwanda.
1157	SVØWS		28595	Dodecanese.
1113	FL8MM		28558	French Somaliland.
1114	CR5XX		28609	Sao Thome.
1227	7Q7AA		28549	Malawi.
1555	TJ1AR		21212	Cameroun.
0541	XT2AF		14162	Voltaic Republic.
0611	CR5XX		14191	Sao Thome.
1600	KG6SW		14250	Saipan. Via W7YBA.
0700	KC6RS		14295	East Carolines.
1200	KC6LG		14242	West Carolines.

NAVASSA IS. KC4DX; May 12th till May 15th:
CW: 3530, 7030, 21030, 28505.
SSB: 3905, 7255, 14280, 28605. QST to W4GKF.

DX-PEDITIONS FOR THOSE INTERESTED:
The VE8RA stint on Wallis Is. (FW8) was to have commenced about March 13th. My latest information gathered in person on March 21st was that the operation was due to start on March 23rd, and run for about a week. As at the time of writing ((24/3/72)) they have not been heard at this QTH ((Editor's apologies for delay in printing this!)).

Minerva Reef: Ed, KH6GLU plans to activate this lump of rock sometime in June. Further information is not available but there will undoubtedly be a 1M prefix or /1M suffix attached. It seems possible that Ed will also include Fanning Is. (VR3) in the itinerary for this trip also. Yrs truly (VK7KJ) will be on Minerva Reef very late in May or early June for about 2 days en route to Tonga (VR5) during the course of a cruise (yacht type) and provided present licensing difficulties can be resolved I will be active around 14195 - 14198 listening on a nominated frequency. A 3-day operation from the Kermadec Islands is also projected for about the third week in May subject once again to licensing. Frequencies as above.

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EDITORIAL (continued from p. 13)

Moralising notwithstanding, it is interesting that in the abovementioned CW Processor, FM is generated by a curious technique: the i.f. signal is split in two; half is fed through unchangedand half produces a DSBSC output (via bal. mod. & a.f. osc) which is 90° phase shifted and mixed with original. The combination of original r.f. with the phase-shifted DSBSC produces FM. How come?? It is a question I hope Dick will discuss for us someday in a "Real truth about FM" article. The factors involved are subtle, and not well treated by the Handbooks nor periodically.

THANKS LES!

Before I go any further, I must say a word of appreciation for Les Yelland of Prahran, Victoria. For some years now he has been sending us a volume of creative and often interesting technical correspondence — and sometimes I despair of being able to publish it all. Les really doesn't always show interest in publishing, but approaches electronics largely as a labour of love. It is a rare and fortunate man who can enjoy work and hobby together.

Les has an unusual profession; he is an Engineer to whom people bring difficult problems. He gets very interested in some of those problems and (often) comes up with some ingenious solution. If you need any such help on a professional basis I'd sayhe's your man.

Les will probably have my scalp for such proselytising, but there you are; its in print and there's nothing you can do about it! Heh.

THE CURRENT AND NON-CURRENT LITERATURE

I have written a bit about certain aspects of this which interest me, and hope to discuss it here next month — with numerous RLG- type comments, of course.

one may note that these articles also tend to amplify the coverage he gave to antennas in the books "73 Dipole and Long-Wire Antennas" (SEE EEB 2/70), and "73 Vertical, Beam, and Triangle Antennas" (c.f. EEB 2/71).

Finally, if you want further basic coverage of FET theory and applications the same author has also published, "FET -- Principles, Experiments, and Projects" (Sams, 1968, $US4.95. See also the interesting Motorola Applic. Note AN-211A, "FETs in Theory and Practice".

These books by Noll can be obtained from Mainland book shops at a bit of a markup, or from Comtec Books (Box 592, Amherst, N.H. 03031, USA) for $US plus 15% for post, or from EEB for $A in the amount shown in $US, which will probably pay for the post.

Whether such material is bought, borrowed, or obtained through libraries (and make sure yours obtains same) -- EEB readers have no cause to complain about lack of good semiconductor literature.

"BLESSED IS HE WHO EXPECTETH NOTHING, FOR HE WILL NOT BE DISAPPOINTED!"

I have any amount of material on the philosophy of low-power communications, euphemistically dubbed "QRPP", but it just doesn't seem appropriate to go into it at length here. The following articles are relevant:

"An Optimum Performance Array...." by Adrian Weiss, K8EEG/Ø, CQ, 9/71 (See also forthcoming in HR, 1972)

"What do you buy with Power", by Carl Drumeller, W5JJ, Collector and Emitter, 4/69. ("Ego satisfaction")

"Some observations regarding transmitter power levels. The difference between 100 watts and 1000 is not as great as you might think -- on the air communications suffer little from lower power levels" (whew, what a title!), by Courteney Hall, HR, 4/71.

Numerous QRP Tr Tx in QST, and often notes in "Letters", e.g., "Transmitting with (power) FETs", 4/70, or "CQ DX QRP", 5/70; the latter reports that a QSO over 1650 miles on 28760 using a power of one microwatt is possible, and work is progressing toward that goal! 100µW on AM phone has been standard, and 50mW is QRO.

I have had some startling confirmations of this in experience; the amount of power needed for a contact is astoundingly small, if all else is equal (which of course it isn't). If you want to keep up on such things read The Milliwatt (see EEB, 9/71).

Seen recently:

"Why not try QRP?", by Mike Czuhajewski, WA8MCQ, 73, Feb 1972. Summary of techniques for skillful QRPP operating. Amazing.

"CQ DX on 1/2 watt", by Dannis Lazar, KL7FSX, 73, Feb 72. An xtal 6AG7.

"Transistor Projects for the Amateur", edited by Paul Franson, WA7KRE, former editor of 73. Published by 73 Mag ($US3.00). An anthology of circuits, including several QRP and QRPP items. Here is one way to keep up on good literature even if you don't obtain the periodicals. See also CQ's Anthologies which are good although somewhat dated. And doubtless Ham Radio will have a suitable Anthology one day, yea, even EEB no doubt.

XXXXXXXXXXXXXXXXXXXX

BLOSSOM FEILD

In the summer
Ther's the glorios flowers
Merrily blowing
In the sunshine
I can smell the scent
And the cool wind
Blowing in my face
The grass
Is green and fresh
The water lillyies
Are floating
On the fresh cool stream

-- Katherine Gunther, Tasmania, 1971.

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"Diapers should be washed as soon as possible and should not be left for weeks before being washed." "Do not wash any other goods with the diapers" (Nappies) -- From a U.S. Advert!

WHAT NOT TO DO ?

There was this chap who was servicing a series-wired TV set which was direct-connected to the mains. He had no isolating transformer, so for safety he EARTHED THE CHASSIS. At switch-on a great flash, outpouring of fumes and expletives. And he was lucky at that.

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Radio Branch
PMG's Department, 7005

EEB, 7005
15/4/71

Dear Sirs,

On p. 9 of the November 1970 issue of Auto-Call is an article describing some of the problems faced by radio amateurs in the USA in reference to noise originating from a.c. mains systems.

This has stimulated us to ask your Department for information concerning comparable situations in Australia.

Specifically we are interested in the use made of facilities to eliminate r.f. interference from flashover of outdoors mains systems.

This could be resolved into the problem of answering immediate complaints about r.f. noise (which may occur late at night), and the more pertinent problem of preventing such noise in the first instance.

Yours faithfully,
(s) -- RLG

((The referred article was entitled:
LINE NOISE: POLLUTION OF THE RADIO SPECTRUM
and among much else, said:

"Somehow, there has got to be a way to force power companies to eliminate power line noise. It is very easy for them to blame radio noise on the proliferation of electric blankets, butter warmers in refrigerators, motors in furnaces -- every one of which devices is urged upon the buying public in order to generate consumption of electric power!"))

Radio Branch
PMG's Dept, 7005

EEB:

19/5/71

Dear Sir,

I refer to your letter of 15th April, 1971, concerning pollution of the radio frequency spectrum and the measures adopted to overcome the problem.

The Australian Post Office does not possess statutory powers to enforce the suppression of interference caused to radiocommunication services (including amateur radio stations) by faulty power lines, electrical devices or scientific, industrial or medical apparatus which employs radio frequency energy.

All complaints of interference from the abovementioned sources, however, are investigated by the Department which has relied over the years on the co-operation of Electrical Supply Authorities and users of electrical equipment for co-operation in undertaking the necessary action to suppress the interference or to reduce it to a level which will remove cause for further complaint.

The extension of Commonwealth powers to cover the control of unwanted radio frequency radiation from whatever source raises very important issues with which the Post Office has been concerned for some time.

One of the most difficult problems relates to the determination of standards, including an acceptable level of radio frequency radiation, which should be met by apparatus which is a potential cause of interference. Considerable work on the development of suitable standards including those with which the measuring instruments should comply, has already been carried out by the Standards Association of Australia, but much more remains to be done in this direction.

Those concerned may rest assured that the Post Office has not overlooked this important aspect relating to the use of the radio frequency spectrum and that its endeavours to find a satisfactory solution to the problems involved, will continue.

Yours faithfully,
(s) H. Melling, Superintendent

ITEMS FOR INTERESTING REFERENCE: Noise Blanker in EEB, July 1970

Amateur Radio, May 1971, p. 2: "Federal Comment" by K. E. Pincott, VK3AFJ, on the subject of electrical noise pollution... and the rest.

Radio Communication , Oct 1969, "Television and Radio Interference Trends" by J. Pat Hawker, G3VA.

Ibid, Jan 1970, "Interference and the Amateur" by E. M. Wagner, G3BID. "If this power line interference is not checked before it grows further, it may well become one of the most serious menaces to amateur radio". etc.

Ibid, Jan 1972, "QTC" Comment announces a range of 9 radio suppression kits by Philips to cover various types of ignition and electrical circuit interference...

QST, July 1970, "Power-Line Interference Its Causes and Methods of Location", by R. G. Holloway, W4USQ. It can get complicated!!
Ibid, May 1971, p. 47:"Success Story, Riddance of Power-Line Noise" by V. Wallace, W7SJZ. CRO analysis helps, and a Transistor Radio to track it down. QST makes frequent reference to a classical article on this subject, by W. R. Nelson:
"Electrical Interference", QST 4-5/66.

Amateur Radio Techniques, 3rd Ed., by J. Pat Hawker, G3VA (RSGB). On p. 126+ and 169+ are discussed various methods for blanking or phasing out interference once you're stuck with it. Aside from the Noise Blanker (EEB July 1970, very good), he describes my old favourite, which appeared in older editions of Orr's Radio Handbook (but not recently) Take a look at A.R.T. p. 169 and 126; it is an absolute devil to adjust, but it can reduce an S-9 noise signal to S-2; if improperly adjusted it can reduce the desired signal too, but not necessarily. Its more fun than a crystal set, and twice as useful. I won't reproduce the diagram here, because anyone who is at all interested in radio will have a copy of this book (A.R.T.). (See Review, EEB, Feb. 1971). I am told that a new edition will be forthcoming very soon....

SEE EEB, Dec 1971, P.131

LETTER: Noise Figure and Commonsense

A subject which interests me considerably is the current controversy on receiver front end design -- valves vs. semiconductors- with emphasis on low-noise produced in the first stage.

From a practical viewpoint I don't see that all the tub-thumping is warranted. What is the point of having a receiver so quiet that one can hear the galactic noise, when man-made interference generators all around are putting in an S8 signal (with a 2.5 kHz receiver bandwidth)?

Over the past fourteen years the Sydney County Council has made my area practically birdproof with high tension lines, and the abovementioned S8 noise signal is quite common here.

So, quite frankly, I can't see a parametric amplifier doing much for me, nor for most VK amateurs, the great majority of whom live in cities or large towns similarly festooned with Supply Authority "decorations" -- all radiating with high efficiency.

I have, on occasions turned a 3-element 2 metre beam in the direction of a 256kV transmission line about a quarter of a mile away. The noise is invariably horrendous.

Some years ago I made up the late J. L. Reinartz's Carrier Level and Modulation Indicator (EEB, Oct '71, p. 88). It seemed to work OK, but I could never see much point in reversing the connections of D-1.

Incidentally, tell Rod that Lyndhurst is in Victoria (not N.S.W.), about halfway between Dandenong and Cranbourne.

-- Reg Fookes, VK2AKY, Caringbah, NSW.

((The reason for reversing the polarity of D1 is to allow measuring positive or negative modulation peaks. It is the negative ones which are relevant for overmodulation, but voice waves are usually asymmetrical. There can be advantage in switching D-1 to measure positive peaks, and switching the phase of your speech amplifier to obtain the highest positive-modulation level. If a peak-expanding system is employed, that measurement can also show how much expansion is being achieved.
((Incidentally, Reinartz was also responsible for an interesting peak-expanding system, essentially being the circuit shown on p. 88 in the second column,but with the resistor considerably less than 22K, e.g. half the P.A. load resistance. I want to reprint that article, but first I'll have to check it out, because I have heard from a U.S. Engineer that the reasoning behind the design is in error. But with the work load of EEB it may be some time until that happens. If anyone wants to check on this I'd be very interested to hear results. -- Ed.))

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TAPE RECORDER TRICK -- R. V. Anderson, KØNL
((Amateur Radio News Service Bulletin, 8/70))

Julian's book review in this issue prompts me to tell you about a tape recorder trick I've used for years. Its easy to do and the result is remarkable.

Pick a very slow, hymn-like, tune. My favourites are Silent Night, and Now is the Hour. From the regular music, write a single line melody backwards. On this music, add only the root note for the bass. This is all that is necessary to begin with; you can add chording notes later if you wish. Play this on the piano and tape record it.

Play this tape backwards on the tape recorder. Since you have not rewound the tape it will be necessary for you to thread the tape with the "wrong side out", and the tape will pick up the recording through the thickness of the tape (It will too work!). Since you have recorded the tune backwards, and have played it backwards, it will not come out forward, but what a difference! It will sound like an organ.

The reason: when a piano note is sounded, there is a thump and a fading away of the note. Played backwards, the note fades in, rather than out, making it sound like an organ.

After your first success with the simple notes, you can try adding more chording notes to the original, but the playing of the tape with the wrong side out destroys some fidelity and it may be found that additional notes cause more confusion than music.

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HOME MADE SMALL CLASS A TRANSISTOR OUTPUT XFRS.

The following information is drawn from an article in The Microphone (Journal of the Australian Tape Recorder Society), Sept/Oct 1970, by Vernon Kerr: "A mono/stereo Monitor Amplifier"

The amplifier itself is simple, with a BC108 (NPN silicon) direct-coupled to an AC128 (PNP Ge, 260mW at 25°C), and powered by 9V/12mA. The bias networks follow quite conventional design, though I have also seen another version of this simple system which took the bias supply resistor of the first transistor from the emitter of the second for negative d.c. feedback, rather than to supply. The load is fed from an output transformer in the collector of the second stage.

The main point is that, although such small amplifier designs are readily available from circuit books (or through simple Grandma's Transistor principles), for headphone monitors or even for good low-power speaker application the output transformer is not always at hand.

For those, therefore, who don't care to enter into the complexity of complementary symmetry amplifiers, here are the details for winding your own output transformer to run from the collector of a transistor giving about 100mW:

"The cores used were of Japanese origin and measured 3/8" by 5/16" approximately on the centre leg, being an E and I type of lamination. Make a small bobbin to fit the 3/8" x 5/16" section and wind on 415 turns of 30 gge enamelled wire; this is the Primary (400Ω). Run a strip of paper over this winding and then wind on a further 56 turns, which becomes the secondary or output winding (8Ω)." To run the output into a 3.2Ω voice coil instead, decrease turns on secondary to 35, or indeed for any desired output impedance (within reason), simply apply: $(N_2/N_1)^2 = Z_2/Z_1$. Also within reasonable limits this can be applied to other primary impedances, prorata.

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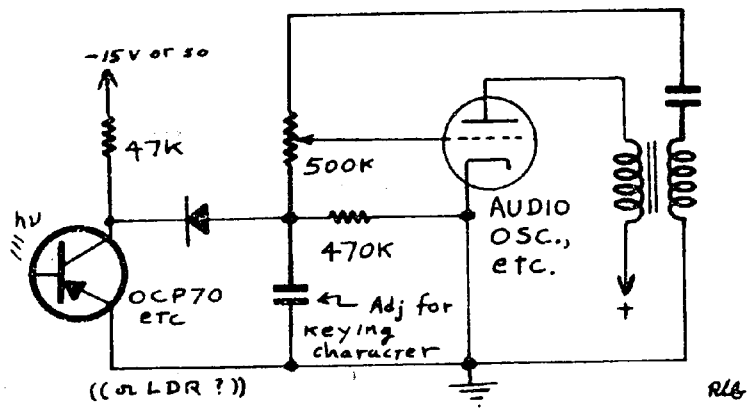
LETTER: Light Beam Keying, RTTY, and SSTV

I was interested to be reminded of the problem of keying without voltage on the key (EEB Sept 71, p. 67), and of course the beam of light is the answer I have used for many years in my paging transmitter. The circuit is shown below



The grid is biased off. When light falls on the OC70P (or LDR etc) it conducts, shorting the bias voltage, and the valve is allowed to operate normally. You can, of course, do the same thing uning a transistor instead of the valve (an NPN is a direct dual, or even better an N-channel FET), and arranging suitable voltages to cut it off.

This kind of system lends itself particularly well to automatic message sending. If the desired message is produced by cutting appropriate slits in a thin aluminium disc, the disc can be rotated slowly, and the slits used to allow light from a small lamp to fall onto the OC70P of the above circuit.

For even more versatility you can use more than one light, and for each a corresponding OC70P and set of slits on the disc. You can then choose the desired message simply by running power to the appropriate lamp.

Although this idea was used for an automatic paging system, there is no reason why it could not be employed for automatic message sending, e.g. for CQ's. RLG suggests that for the kind of QSOs so often found on the air, and particularly for contests, much effort could be saved by preparing a disc containing concentric lines having whole stereotyped messages on them -- containing the information about one's name, rig, location, and the weather.

Conversely, a similar system using a photographic negative on the wheel, might be hooked to an amplifier rather than oscillator, to give equivalent information directly by voice. (RLG)

I have just got hold of some PLLs and am hoping to be able to make good use of them as a RTTY demodulator; it sounds like the answer to a prayer, what with no fine tuning needed, and it will lock onto any shift by itself. Of course I will have to evaluate the problems of QRM where it will probably lock onto the interfering signal also. But it would appear that this may possibly be overcome by using a notch filter. I will be interested to see what EEB has to say about PLLs in ~~the next issue~~ due course.

((We have deferred discussion about PLL's themselves for several more issues, because of the considerable content which has evolved from consideration of detection systems and the relationship between Direct Conversion and other systems (e.g. Superheterodynes!). But the current literature is full of the subject, and can be investigated as per our Reference List in the State of Art series IV. -- Ed.))

I tried to use an active filter in the RTTY Unit, but without success. I am not sure why it did not work, but more on this anon.

I have just got interested in SSTV. Norm, VK4NP up here has one going, and the results are very good on DX; it was based on the recent article in QST which uses transistors. He found that he got better results with some slight modifications, notably dispensing with the IC multis, and using some 15c computer-board transistors...

I note that there are a couple of IC modules now which will circulate about 4000 bits, at a reasonable price, and would convert SSTV into fast scan pictures. That is to say, after one frame had been received and momorised in the system, it could then be fed to an ordinary TV set -- giving only stills, of course. Amazine.

The more common method is to use a long-persistence CRO tube, and same are available from Disposals for about $6, and are in a nice case with the EHT transformer which can be run from a 15 V d.c. supply with a power transistor.

If you have any great interest in this, I will get Norm to send you a photostat of his setup circuit, as modified from QST. He is at present playing with a 931A photomultiplier valve in a flying spot scanner.

-- K. M. Kelly, VK4MJ, Surfers Paradise,Q.

((Yes, certainly we are interested in everyting interesting, but since the above letter was received there have been several big articles on Slow Scan TV in Amateur Radio, and we would be interested only in information which did not duplicate that. -- Ed.))

((P.S. In the November 1971 HR, and in the Dec 71 through Feb 72 73 there are several articles describing automatic sending (and receiving!) of CW, and various memory systems))

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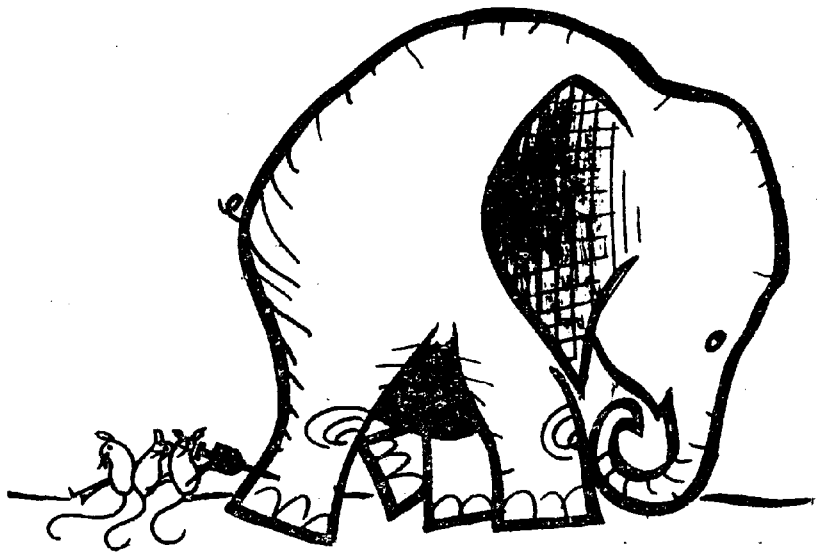
IF YOU DRINK A GLASS OF BRANDY EVERY MONTH FOR 1200 MONTHS, YOU WILL LIVE TO BE 100 YEARS OLD. ((W8QUR, ARNS Bulletin, 8/70))

XXXXXXXXXXXXXXXXXXXX

The woman opened the door of the refrigerator and saw a rabbit. Says she, "Rabbit, what are you doing in the refrigerator?" Says the rabbit, "Is this a Westinghouse?" Says the lady, "It sure is". Says the rabbit, "Okay, I'm westing"..... The lady had just stripped off her clothes and was ready to jump into the bath tub when the door bell sounded. Tip-toeing to the door, she asked, "Who is it?" Came the reply, "Blind man". Seeing no particular need to dress for a blind man, she opened the door and let the man in. After which the man says, "Okay, lady, where do you want me to put the blinds?" (A/C, 5/69)

EEB/ Feb 1972



LETTER:

THE ARRL HANDBOOK: A Rebuttal

-- by D. A. Blakeslee, W1KLK

It is indeed difficult for a reviewer to write about a book without injecting his own how-I-would-have-done-it ideas, even though he might not have had the experience of actually producing a text book. Such seems to be the trap that your reviewer of the ARRL '71 Handbook (EEB, Sept 1971) has fallen into. The new ideas and improvements embodied in this book have been lost in a series of theoretical I-might-have-done paragraphs.

The review contains significant errors of both omission and commission. Your reviewer states there are approximately 12 new construction projects, when in fact there are 25. The rewrites of the ssb and measurements chapters done for '71 are not mentioned. Likewise, the use of non-glare paper and the production of the book by 6 editors, rather than a single person, as with previous editions, are stories left untold. Nor are the facts recounted that the RTTY and receiver-chapter construction projects are mostly new material. No mention is made of the novel 6- and 2-meter power amplifiers with their unusual tank circuits that have been added for '71.

The ARRL Handbook has always been a practical book, which is the secret of its success. More than 50 percent of each edition is purchased by nonhams (sic) -- librarys, engineers, research and development organizations. Why? Because few books dispense with the theoretical possibilities and concentrate on how-to-do-it information useful to a person intending to make something! It is indeed strange that a publication which has the subtitle of Commonsense Electronics should suggest that a book for amateurs needs more on radiophysics. Indeed, your reviewer, in making the suggestion, seems to have missed the point that the RSGB Handbook, which he lauds frequently, contains 34 pages on basic theory, while the ARRL book has 43. One can only wonder at what the reviewer had in mind.

The EEB reviewer states that a new Handbook once every three or four years would be sufficient. It is true that about one third of the material in the Handbook changes each year. Yet, if this policy had been adopted in 1970, then an amateur would have to wait another year or two to read about the MOSFET, op amp, digital IC, PWRFET, linear IC, and solid-state power amplifier information which will be contained in the 1972 edition released later this week. Thirteen chapters have been rewritten for '72 -- personally, I wouldn't want to have to wait years to find out what the latest circuits and techniques are for my hobby...

In the review of the ARRL Handbook, your publication has reprinted a piece from 73 Magazine (May 1971 issue), apparently as a justification of your own reviewer's views. 73 has long made an anti-ARRL stand policy... ((the remainder of this paragraph has been omitted on the advice of our solicitors -- RLG))

COMMENT by R. A. J. Reynolds, VK7ZAR

Other than to note that to an unbiased observer the review by D. Stivison which followed mine, appeared to be a rather favourable view of the ARRL Handbook, I see little point in a detailed reply to the above letter.

The point at issue is not a matter of detail but of philosophy of approach. Is the emphasis on a superficially "practical book" the approach needed by the modern amateur? I suggest that the following article (written some months ago) addresses itself to the underlying approach needed to transform a practical Handbook into a good Handbook which unifies theory and practice.

We desire only to help authors to understand what the technologically aware amateur needs in this age of explosively expanding technology, much of which is excessively commercial!

COMMENT by RLG:

Mr. Blakeslee (who has contributed some technically admirable material to QST in these years) also included a number of comments on the 1972 ARRL effort, chapter by chapter. These will be printed here as space becomes available. At

that time perhaps one of our able readers (or more than one) may wish to buy said work, and comment on it with reference to that list and with reference to the material presented herewith?

OBJECTS AND REQUIREMENTS OF AN AMATEUR RADIO HANDBOOK, Part II. (c.f. P.110)

-- R. A. J. Reynolds, VK7ZAR

General dissatisfaction with the various handbooks which are available has lead me to consider what I expect within the covers of these volumes. At first I thought that I could write down a "formula for contents" in just a few lines, but now I am not at all surprised that editors have trouble keeping everyone happy.

My profession is in Radio Communications. Naturally I would like to see a Handbook which would contain information pertinent to my work. But we have available already any number of proper entineering reference works, and my interests as a radio amateur prompt me to ask about the requirements of a text which would be useful to engineers interested in radio as a hobby, and to amateurs who find the modern aspects of radio uncomfortably full of engineering.

Aside from the theoretical aspects of Handbook content, there is also the necessary matter of production economics: generality, saleability, and perhaps as well "Reviewer Appeal".

I am convinced that amateur radio has come to the stage where there is room for two handbooks. Over the years, the various editors have tried to cram more and more advanced information into the 600 or so pages that the publishers have apparently allotted. The result of this is that inadequate coverage has been given to most facets under discussion. One handbook will emphasize thoery whilst another will emphasize practical construction. But even if you have both of these books, less information will be available than would be contained in two complete books, because the compromise-books will have important areas of overlap.

If two complete books were available one could cover theory and the other, practice, this being the easiest way to split the subject.

I consider that the design and theory book should be revised every 5 to 8 years while the construction volume should be rewritten (rewritten, not merely revised) annually. More on this aspect later.

Suitable titles for the two books could be the subject of many hours of discussion, but one could be "The Amateur Radio Designers Handbook", whilst the other could be "The Amateur Radio Constructors and Operators Handbook".

The Amateur Radio Designers Handbook

I liken this book to the well known Australian "Radiotron Designers Handbook" edited by the late F. Langford-Smith, translated into the amateur field from the domestic field and of course, updated. Remember that the last major rewrite of the RDH was in 1952 -- and yet the relevance of this kind of book to our field is shown by the amazing demand for it in these intervening years, and to the high relevance of the basic theory even now, even though the original dealt only with valves.

In such a book I consider that specialist individuals should write on each subject since it is more than can be expected of one man to write authoritatively on all the facets of Radio theory and practice.

This book could consist of chapters as follows:

1. Basic electrical theory.
2. Elementary communications theory, including such subjects as information rates and qualitatively only, the effect of noise.
3. General principles of Modulated, and in particular, R.F. communication.
4. Propagation. A fairly detailed discussion of this subject, both quantitative and qualitative. Work of people like Bullington and the inclusion of the more important nomograms for 30 to 3000 MHz ought to be included, at least in outline.

I have noticed a tendency in many handbooks to mention ground waves and skywaves, and then go into quite some detail on the mechanism and prediction methods of 'scatter. This means that the average amateur knows very little of the path calculation method for intermediate paths and the odd k greater than 4/3 hop.

5. R.F. Transmission lines, plumbing, matching, etc.
6. Aerials, from short wires to horns
7. Transmitters. All types.
8. Receivers. All major types.
9. Modulation systems: AM, FM, NFM,

SSB, SSBSC, DSBSC, RTTY, TV, etc!

10. Power supplies.

11. Testing Methods.

Either in the above or in smaller chapters should be discussed the varieties of mixers, filter design, the relative stability of the various known oscillator circuits (e.g. how frustrating it must be to the reader to see presented a wide array of similar circuits, with scant indication of their relative merits!), noise suppression, speech compression and clipping, and even satellite technology. Other subjects would become self evident.

It is of primary importance that the intention of such a book be made clear: that is, that it be directed towards amateurs. Otherwise this handbook could be labelled as a very incomplete but general communications engineering handbook. In that form it would be read by neither amateur nor professional.

The relevant material could be put into one volume which would not become outdated quickly, as far as the amateur population is concerned, as it could be written covering state-of-the-art developments as they are available to industry.

I am afraid that it ought to be said out loud, and admitted freely, that amateurs no longer lead the development field. Trained and experienced men and women are developing systems and providing solutions to technical problems for industry in excellence and volume that no amateur organisation (nor individuals) could finance nor hope to achieve by sheer luck.

Given this premise, revision of this book would be necessary only every 5 to 8 years, if future developments progress at much the same rate as they have. If you take umbrage at this idea, merely scan the amateur literature of the past half dozen years and look at the volume of "new" ideas introduced into it, which have been standard industry practice for ages!

<u>The Amateur Radio Constructors and Operators Handbook</u>.

This book would be just what its title suggests. It could run along similar lines to those in "ARDH" and would serve to give examples of construction and operation of all the facets of amateur operations. Becauseof component development (e.g. new valves or semicons) and because of the changing attitudes of the amateur operators themselves this book would need to be updated annaully, and not necessarily superficially!

A by no means minor value of this procedure would be that variation in equipment design from year to year would promote experiment which ought to be a primary aim of the amateur. And, whilst retention of old circuits may not be avoidable economically, it should not be encouraged!

The book should aim at a great diversity of equipment types, and major items should lend themselves to variation by the amateur builder.

((Above all, this book should correct a silly situation now existing in present handbooks. It should present a thorough discussion of the principles of general equipment layout and mechanical design, as applied to amateur practice. And then in the actual constructional chapters there will be scant need to go into much detail about the many layout problems which so clutter current handbook designs. And much the same consideration should apply to "Adjustments". A screw-by-screw adjustment instruction admits only that the constructor is an appliance-builder. If the ARDH has been read and understood such detail will be unnecessary; and if it has not been so read, the amateur has no cause to attempt to build the equipment in the first instance! And of course the possession of nominal test equipment goes without saying -- or it ought to. How many times does one see in the literature (particularly American) statements of the type of such-and-such must be done, since a proper adjustment would require an oscilloscope. Indeed!! -- RLG))

Finally, this book should also contain the component reference section. Valves, diodes, transistors, and associated components are being produced continually, and in order to keep up to date they must be placed in the "annual". If this proves to take an excessive amount of room, at least the latest and best should be included -- noting that the best need not necessarily be the latest.

<u>Some Rebuttal in Advance</u>

How is one to relate the ARDH and ARCOH on one hand, and full engineering texts on the other? The problem here is the definition of "engineering". I am quite aware of the different categories of professional people and technicians who label themselves "engineer". As far as this discussion is concerned, engineers fall within the following categories:

(a) Pure theoreticians.
These are the exact engineers who are normally only corned with one partacular field, e.g. channel/information capacity in the presence of known noise.
(b) System design engineers.
These work with building blocks, e.g. Tx: Ae: Path: Ae: R_x, usually in an overall control of an installation group (my own case), or as consultant.
(c) Equipment designers.
Usually employed by industry.
(d) Maintenance engineers and higher order Technical Officers.
These people actually come in con - tact with the equipment on a day-to-day basis, but normally only oversee the work of others.
(e) Technicians.
The so-called "hands and feet".

The level of the average amateur is somewhere between the top and the bottom of this list, and engineering texts are directed at each level by various writers and organisations.

So where does the ARDH fit in? Certainly there are texts in great numbers for (a) but you need a full library to cover all facets that the amateur might encounter.

Whilst (a)-category engineers are usually University-research types, (b)-category engineers are more usually Uniqualified people with experience, who have made their mark as equipment designers, for example. I place myself in this category, and I find that I use nearly every text available, and my biggest problem is "where to find the appropriate book?".

Category-(e) are the "trained manipulators" and not engineers, in my opinion. So... I consider that the average amateur should be somewhere between (c) and (d). As such, he needs all the information available to this category of engineer without the tedium of deriving every equation, or the detail of much of the motivation. The amateur does not need general advanced mathematics, nor does he need to know all about wave mechanics in a waveguide ((though in these days wave mechanics are being taught in Matriculation High Schools)). If his experiments lead him into these details, then most libraries of a technical nature will have the specific papers and volumes that he requires.

Yes, if all amateurs knew all about communications systems, it would be a good thing, but it is too much to expect an amateur who at best can only spend a few hours each day on his hobby, to attain the knowledge and competence of a full-time engineer who has done four or more years attaining his B. Eng. degree, and more years of consolidation and gathering of experience.

Amateurs do, however, need access to the fruits of this information, and the ARDH would be such an authority (or should be). So, the aim must be as much information as possible in as comprehendable a format as possible, whilst keeping this information within the bounds defined by the experienced amateurs who are at the forefront of their hobby.

Professionals will have higher level references for their specialties...

A Summary

By way of a summary, consider the advantages of a two-book scheme as outlined above:

PRO:

Waste of theory reprint avoided.
Two books of 450 to 500 pages would be convenient to handle, when compared with the complete material printed in a single book.
Manufacturers would be kept happy by the promotion of particular components in the annual ((BUT components must be specified by actual value and content, and not merely by reference to a manufacturer's part number! -- RLG)).
The needs of a greater section of amateurs would be filled. We do not here consider the needs of "hams".
The introduction of more Radio Engineering in the theory book would provide needed technical education for amateurs and prospective amateurs.

CON:

The removal of theory from the construction book could mean that those amateurs who would buy only the construction book would no longer be "subconsciously educated". But do in fact such people trouble very much with the theory section of present texts?

There could be some sales conflict between the monthly magazines which concentrate on constructional articles, and the "annual". I leaveit to you to decide whether this would be a bad thing..
Since the ARDH would cover several years worth of theory, the total income to a publisher from the sale of the two books might be less than that from the sale of a single volume containing repetitive theory and a bit of new practice. Since no publisher would likely admit this in public the question cannot be resolved

-- except perhaps by the non-appearance of the two-volume scheme outlined here.

Many amateurs would ignore the ARDH on the excuse that it is too technical, and would turn only to the older style of handbook for the bit of theory they want. This group would fall behind, and would constitute the "hams" about which this discussion is not concerned.

The ARDH may not be sufficiently different from, say, Terman to command real attention from the buying public. Needless to say, this would depend on the skill of the Editor, who ought to be of the calibre of, say, Langford-Smith.

XXXXXXXXXXXXXXXXXXXXX

LETTER: Reviewing, a balanced view....

I would like to say how much I admire your approach to book reviewing and commenting on published material, since you obviously think about,

a) What the reader really needs, and

b) What the author is trying to achieve

--rather than the all too usual "book reviews" which are so often just revamps of the publishers blurb. I always get the impression that you take some trouble to go through the books before rushing into comment...

Anyway, keep up the good work of saying what you think about publications. Far too many people just take them for granted without questioning whether they are good, bad or indifferent.

-- J. Pat Hawker, G3VA, London.

YYYYYYYYYYYYYYYYYYY

LETTER: The Essence of Reality?

Thinking again of the EEB, while I agree that you should resist all attempts to let it become a Journal, with papers involving references to abstruse research in remote areas, I still feel it plays a part.

The picture EEB brings to mind is that of a sort-of scientific Ben Johnson and his cronies, with informal discussion and much ale -- something I feel should be much more evident than it is in scientific circles .

I can remember a Saturday afternoon spent at an Outpost of a University when a group gathered around a table with the odd dozen to discuss, of all things, the specs for a data transmission facility. I feel much more was achieved than at six preceeding formal conferences.

-- C. Pitcher, Northcote, Vic.

XXXXXXXXXXXXXXXXXXXXXXX

LETTER: The Postal Semice (?)

Being Secretary of the local Fire Brigate, two years ago I received notice in mid-February that fire restrictions were to come into force in mid-December -- of the previous year!! As it is normal to await official notice on these matters, we could easily have burnt out the entire country-side, been jailed for so doing, and fined thousands of dollars for so doing! Whacko the PMG Dept!

-- John, VK3---

XXXXXXXXXXXXXXXXXXXXXXX

LITTLE RED VOLKSWAGEN

((Florida Skip; QSP ARNS Bull.4/70))

Friends of Walt and Alice Linder, W4KTE went to the circus near their home in their red Volkswagen. They parked the bug near the circus and went in to enjoy the show. Afterward, on returning to the vehicle, they found the front end of the car was crushed in (the front of a VW is where the engine ain't). The pair were naturally concerned about this tragedy, so they went to the circus office to inquire about the mishap. "I'm glad you came in," said the circus manager. "I'm afraid that the accident is our fault. You see, some of the elephants are trained to sit on little red stools. The elephant manager was walking a line of elephants past your car when one of them broke from the line and...."

Well, after clearing up the mystern, the pair started home, when they noticed an identical red Volkswagen passing them at great speed. This VW had its right side crushed in. Another elephant? After a short while our heroes were stopped by a highway patrolman. Ensues the following dialogue:

Couple: "What's the problem, officer?"

Policeman: "You are under arrest for causing an accident and leaving the scene of that accident."

Couple: "Accident? We haven't been in any accident."

The patrolman smiled and asked, "Just how do you explain the crushed front end?"

Couple: "That's simple. An elephant sat on it." OH, NO! == Good news though; our owners of the little crushed red Volkswagen were cleared by the circus manager. We trust that their car is fixed.

XXXXXXXXXXXXXXXXXXXXXX

Quote without comment

"Take a man by himself and there is generally some reason to be found in him, some disposition for good. Mass him with his fellows in the social organism, and ten to one he becomes a blatant creature, without a thought of his own, ready for any evil to which contagion prompts him. It is because nations tend to stupidity and baseness that mankind moves so slowly; it is because individuals have a capacity for better things that it moves at all." -- Henry Ryecroft ("Private Papers")

SWOOP -- by Elise White (YF/KØCNV)

((From the Bulletin of the Amateur Radio News Service, January 1972, p. 8))

A young bride of our acquaintance recently became a member of the SWOOPs.

Her initiation was sudden and violent. In the daze of a new husband and house she quickly said yes when he suddenly came up with the idea of renewing his licence.

He found a receiver that looked like a boat anchor and proudly dragged it home. This was rather a soul-shattering experience, especially when there wasn't a table in the house that would hold it. Being an expert scrounger, he came up with a slightly damaged hollow core door and proceeded to build an operating table. It didn't quite match the decor but was big improvement over the card table swinging and swaying in the breeze.

Since their anniversary was approaching, she decided he needed a transmitter and through conniving got his dream. Of course, it had to be hid out elsewhere, but on the big day there it sat.

By now the cherished den looked like a typical ham shack -- you know, "I don't know what I'll use that for, but I might need it some day so I'll take it."

The next project was a tower permit, and two sections of tower erected. The neighbours started screaming about TVI, aesthetic values and the usual accusations. This can be soul shattering, especially when the neighbours on one side use your front lawn as a shortcut to his driveway, and the man on the other side believes the sidewalk is the only place to park.

So a couple of friends arrive and jack up the tower a couple of sections and hang the Inverted V at 20 feet. Friend husband comes home early and immediately rushes to the ham shack. He can't get ((a contact)) over the fence, so he decides that since its dark by now he is taking the antenna to 40 feet. He climbs the tower. He loves towers 50 feet on an 11 story building 100 feet from ground to top, nothing to it, a mere 40 feet is just easy to climb. No muss, but wait a minute! Don't tell me those little bitty lights are just 40 feet down. What's that light flashing down there? He clings to the tower like it was a bosom buddy and ignores the pleas of his bride waving a flashlight to return to the ground. All pleas failed so she resorted to prayer.

He finally returned to earth and has sworn off towers, but the improvements haven't ceased.

The next edition was a 4-foot wagon wheel electrified. It was sanded, stained and ready to hang. One slight problem -- the ceiling wouldn't hold it. This called for remedial measures in the attic.

At last our pride and joy is ready to be mounted. One step ladder and two people trying to raise the wagon wheel. Thereis only a difference of 2 feet in height and 3 steps on a step ladder. She almost got the fixture for a collar.

Yes, amateur radio is wonderful. Good Luck, gal, life has just begun.

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Quote without Comment

"Graduates will have professions at which they can expect to make a good deal of money."

-- Malcolm Fraser, Australian Minister for (sic?) Education and Science, March 1972.

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THE AUSTRALIAN EEB: Editor = R. Leo Gunther (VK7RG), Asst. Ed. and most draughting = Rod A. J. Reynolds (VK7ZAR), Assoc. Ed. = Rich H. Ferris (VK7ZDF), Associates = L. J. Yelland (Prahran), C. Pitcher (Northcote), R. S. Maddever (Geelong); Subscription Manager = Robert A. Walton, Secretary = Brenda Ford, Printer= Chris Wren (Advance Publicity Co; Hobart 341-817)....

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AN INFORMAL ELECTRONICS EXPERIMENTERS BULLETIN

APRIL 1972 vol. 8, no. 2 P. 25

SEX

NOW THAT WE HAVE YOUR FULL AND UNDIVIDED ATTENTION, WE SHOULD LIKE TO DRAW YOUR ATTENTION TO AN INTERESTING ANNOUNCEMENT ON PAGE THIRTY-THREE!

CONTENT:

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L: ARRL vs RSGB VHF Handbooks.
Q: Shielding in Commercial TXs
Responsibility in Science.
How to Kill Weeds...
43: L: Transceiver Decoupling
L: More abt Hot Carrier Diodes
44: Playboy Playmate, ugh.
A "Good" Beer Recipe from USA.

NEXT MONTH (June): A real beaut, with the remarkable new Reciprocating Detector, Light-beam communication, a New Look at FETs, more Rx design.

STATE OF THE RECEIVING ART, V -- RLG, +

-- Receivers in General, and Direct Conversion ones in Particular.... Continued directly from Part IV, December 1971.

NOTE-1: I regret that this series has to be chopped up this way, nor could it be completed this month, but receiver enthusiasts will appreciate that not everyone dotes on receiver design theory (at least not in large hunks).

NOTE-2: Drawings from previous sections of this series in 1971 are not reproduced here. Presumably if you are sufficiently interested you will consult the April and November versions for reference.

NOTE-3: The comprehensive Reference List for this subject is found on pages 132 - 134 of the December 1971 issue. It is for your convenience in pursuing further any special item which interests you, particularly for practical designs.

(But please do correct Reference 14d to read "4/72". Ham Radio did not publish that item in 1942!)

Front End Selectivity (concluded)

In reference to the argument about r.f. stages and the need for good r.f. selectivity in front of the mixer, I hope that my rhetoric did not cover the important point that even if you don't separate tuned circuits by a valve (etc), you can still obtain worthwhile selectivity by the use of one or more tuned circuits ahead of the mixer. In good sets this is done by doubly-tuned tanks at the front end (e.g. Ref 21b-3; 28, p. 88), and this is practical as long as the mixer has low noise.

Ref 14d manages to get amazing selectivity from a single tuned circuit by very low coupling to the antenna (thus requiring an extra 25db of low noise a.f. gain), and by the noteworthy use of an extremely high C/L ratio: 2 turns of wire and 13,500 pF on 80 Metres!

Good pre-mixer r.f. selectivity is essential to reduce adjacent-channel interference, and even reception of harmonic images (c.f. Nov, Dec EEBs). This is better achieved by good tuned circuits than by regeneration (or Q-multiplication) applied to indifferent ones*, because skirt-selectivity of the latter is worse (see EEB, Aug 1968). But commonse must prevail: r.f. selectivity will be better with regenerative feedback than without it. In direct-conversion receivers, an r.f. Q-multiplier can accomplish this flexibly (see refs 11b; 28; EEB, May and Aug 1968), though the feedback can presumably be applied within the mixer*.

MIXERS REVISITED: More uses of Linearity

I won't work this subject to death, but I have received an interesting note from Chris Pitcher pointing out how a 4-diode ring modulator (fig. 6) produces fewer spurious outputs than a 2-diode one (fig. 7); c.f. Ref 10. (p.28 for figs)

Very briefly the argument (from "Spectrum Analyser Circuits" by Tektronics) shows that the four-diode system halves the number of spurious products which appear in the output, and which must be rejected by subsequent selectivity filters -- particularly if those filters are not ideal.

The argument is also developed nicely by G8ENN in "A Mixer-VFO for 70MHz" in Rad. Comm of 3/72 (which came too late to include in the abovementioned Reference List), particularly with respect to mixing performance of FETs in balanced modulators (but note caution by G3VA in Ref 28, p. 83 and 88).

Now remember that mixers used as audio detectors are "Product Detectors" -- as are r.f. mixers! -- because the useful part of the output is taken from the mess of frequencies that result when the two signals are multiplied together (fig. 5, Nov; also in forthcoming RHF article). "A properly designed product detector should be capable of delivering an a.f. signal that is low in audio distortion and intermodulation products" (19b). And "The advantage of using a (more linear detector) is that it gets rid of the two original frequencies entirely, hence a quieter, more efficient mixer." (26h). That is why one prefers a more linear system like that of fig. 6.(p.28)

Linear mixing also increases the dynamic range, as mentioned in December.

Types of Mixers

Doubly balanced rings do make good mixers (particularly with Hot Carrier Diodes), but they need transformers, which can be a headache (26c), and which also have frequency limitations. (see p. 43, this issue)→

Balanced modulators (viz, mixers) of the dual differential amplifier type are in fact simpler and less frequency critical. But they are less linear, and they have a smaller dynamic signal range.

---

* Ref 14d comments on the Ten-Tec RX10 D-C Rx: "(R.f. selectivity is provided by) the high Q of the input tank circuit. The high Q is developed by regeneration; when regeneration is removed selectivity will be about equal to that of a galena crystal set."!

Typical IC units are the Motorola MC1596G or RCA CA3028A; Refs 16a-h, 17a, 19b,24b. Typical dynamic range for the differential IC is some 90db, e.g. 3μV-100mV (16e) vs 130db for the well balanced HCD Ring e.g., 0.3μV-1V! (13h, 26c)

Therefore you choose the system to fit your requirements. There is no ideal semicon mixer, some are more ideal than others. But it is not necessary to use a semicon if you wish to be effective albeit out of fashion. "Some of the better solid-state receivers use a diode-bridge balanced modulator for their mixers. The input transformer for such a mixer is very critical, however, if the best results are to be realised, so the (amateur) who isn't too proud to use tubes will find the 7360 (beam-switching pentode) can't be outdone." (26h) (See also 24a,11b,26b)

Square Law Front Ends?

I leave this subejct gracefully with a whimsical piece which appears to hold promise for Communications Enthusiasts. It comes from A. R. Techniques ((III)), Ref. 28, p. 78:

Square-Law Resistors for Front-ends

The problems of developing hf receivers having front-end dynamic ranges of better than 100dB have been underlined many times. One of the very few semiconductor techniques capable of this type of performance is the parametric up-converter (*TT*, April 1968 or *Amateur Radio Techniques*, pages 66–68). But this technique, as Walter Schreuer pointed out, poses many problems for amateurs. Such a front-end requires large pump powers to reach acceptable linearity; furthermore they are not suitable for high-ratio down conversion.

Two recent articles by Dr J. G. Gardiner (*The Radio & Electronic Engineer*, May and June, 1969) have indicated that a new device, still under development, appears to offer considerable promise for high performance front-ends. This is the square law resistor or space-charge-limited diode of which some experimental prototypes have been developed by Dr G. T. Wright at the University of Birmingham. These diodes have an *I-V* characteristic following an extremely accurate square-law over a wide range of forward bias voltages. The importance of square-law characteristics for mixers are stressed in all articles concerning field effect devices. Dr Gardiner suggests that these SCL diodes could be used very effectively in balanced mixers to achieve very low cross-modulation and intermodulation; resulting in significantly better performance than can be achieved with ring switching diode mixers under identical operating conditions; furthermore only a few milliwatts of oscillator drive power would be necessary. High-performance receivers seem possible if these diodes can be fully developed.

Application to receiving Code

Most discussions in these days tend to be directed toward systems to receive radiotelephony. But in fact good mixer linearity is essential for good results with CW as well, particularly when selective audio filters are used.

For an interesting application of mixers to CW reception I recommend you to Ref 17a, and for communication effectiveness to Refs 17b and 17d. I'm not yet sure what to make of the place of the Reciprocating Detector (17c) in all of this, but we'll see more of that in June.

USE OF A.F. STAGES in Direct Conversion

Add a lot of a.f. to a frequency-synchronous detector (e.g. "product detector") and you have a Direct Conversion Receiver. See fig. 5 from Nov. 71. I will not reproduce figures forever!

Since virtually all the receiver gain must be obtained at audio this places a substantial burden on the noise factor of the audio system, and as Macario says this is more difficult at a.f. than at i.f. (34a-l).

Pickup of extraneous audio is also rather a problem (13e), though pick-up problems are not restricted to Direct-conversion. "Birdies" in good-old i.f. systems show that either design requires good geometry for a given degree of amplification: Murphy's Law.

Since virtually all of the Rx selectivity must also be obtained at audio, this also places a considerable burden on the audio filter, and it is a source of wonder that selectivity at a.f. is somehow regarded as less important than selectivity at i.f. or r.f.; more on that anon.

Among much else, the success of the Direct Conversion receiver may be assisted by the fact that an enterprising manufacturer has produced one for sale. It works on batteries, and from reports it performs reasonably well (14c,e). Skip Tenney says, "... in all cases performance was well above the simple tube-type superheterodynes which beginners have traditionally used". De Maw (19b) says that performance of a simple DC system is "as good or better than that of the popular Command series of receivers". That's nice. See also Ref. 32.

The Uses of Selectivity

The selectivity of the Ten-Tec Rx is governed by an audio filter with a 2kHz bandwidth (-6db), but from the

"improvements" which have been suggested in the literature (14d,14e,etc) I deduce that the sharpness of the selectivity curve is not spectacular.

Selectivity sharpness is conveniently (?) measured by "Shape Factor": The bandwidth at -60db divided by the bandwidth at -6db; the better (i.e., closer to 1.00) it is, the better will be the rejection of QRM, for reasons self-evident in fig. 10: The dotted line represents an ideal shape (S. Factor 1.00).

Satisfactory selectivity is attained only with a good steep-sided bandpass response. The steep sides reject interference, and the flat top gives the best intelligibility for phone or CW (viz., reduces "ringing").

In Ref 28, Pat Hawker says, "The combination of a good product detector and a.f. filter cost less than a good crystal filter", but this applies more to CW (for which Direct Conversion systems have a distinct advantage for simplicity -- but then the old Regenerative Detector didn't do so badly either!).

For phone it is not quite so simple because of the need for a reasonable broad top with good shape factor. This is hardly achieved with the usual single section audio filter, and a 2-section (e.g. π) one still has a shape factor of some 2.5 to 6 or more (13e, 21c, 29c). Doubtless a suitable response can be achieved by active or passive filters*, but there has been remarkably little comment on the shape of such filters except for the very sharp requirements of CW.

The Attainment of Good Shape Factors

In 1971, Ed Noll (16d) said: "Presently the audio filters used in direct conversion receivers are relatively simple types. The inclusion of audio filters with a better shape factor is just a matter of time". Why?? Why has it taken so long? There exists no lack of of information about such filter designs in the periodical or other literature. Why haven't they been incorporated into DCs?

In April 1969, Pat Hawker (Tech. Top.) was suggesting that high gain low noise good bandpass a.f. amplification could be provided by cascaded tuned a.f. stages rather than " a block filter plus wideband a.f. amplifier". A permutation of this theme was shown recently by ZS6BT in Ham Radio (17b) where substantial improvement in S/N ratio was obtained when bandwidth was limited sequentially (in steps) throughout a (superhet) receiver.

Note the connection.

* 10c, 13e, 16d, 21cd, 24b, 28, 29abc.

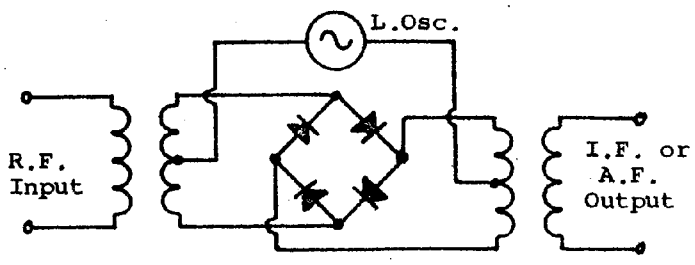


Fig. 6: Doubly-balanced mixer -- or "Product Detector" when output is at a.f. (c.f. 26a). Hot-carrier diodes work best (12,13). See also p. 43, this EEB for balancing....

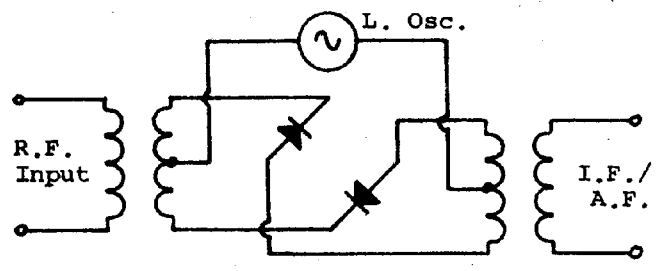


Fig. 7: 2-diode balanced mixer. Not as good.

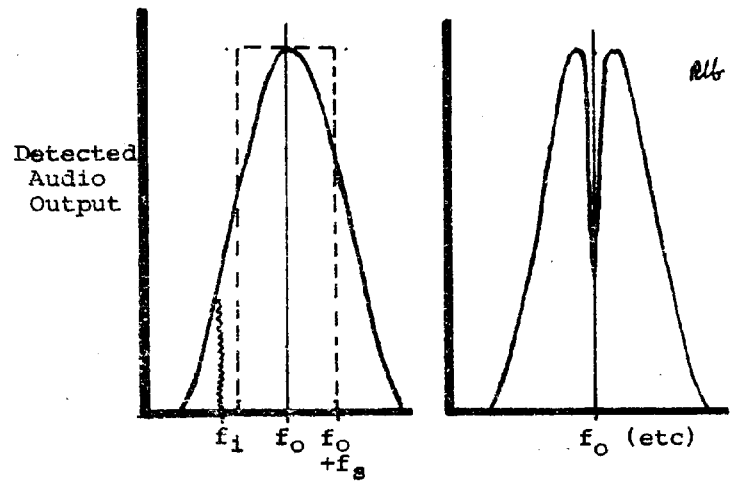


FIG 10: Left = RECEIVER RESPONSE USING AN ORDINARY LOW-PASS AUDIO FILTER. f_o = freq. of carrier (e.g. the suppressed one), $f_o + f_s$ = maximum (upper) sideband to be received (say, 2500 cps higher than f_o), f_i = interfering signal. The solid line shows essentially the receiver selectivity characteristic, as goverened by a simple audio filter. The dotted line shows a filter response with "ideal shape factor"; see text.

Right = RECEIVER RESPONSE USING A BANDPASS AUDIO FILTER. This is the more likely good design, with a low-frequency cutoff at, say 300 cps, which puts the big dip in the middle of the curve. The principles are essentially the same as for left-hand figure.

((CONTINUED, P. 30)) >>>>>>>>>>>

COUNTING WITH ELECTRONICS, Part I

-- by R. S. Maddever (VK3)

Herein is described a single counting stage, for which the parts would cost about $1.80. Such stages can be coupled to others to form a binary counting unit.

These units work in exactly the same way as sections of any large modern digital computer. They will not, however, count as quickly as modern computer circuits, some of which can handle many millions of counts per second. The unit described here will only work if the pulses occur less rapidly than about 50,000 per second -- quite fast enough for most applications.

Operation

The circuit is normally known as a "flip-flop" because, like a coin being tossed, when it comes to rest it has to be in one "state" or the other, i.e., with one side up or the other side up, but not together. In this case, one state is ON, the other is OFF.

The circuit consists of two simpler circuits, each having one transistor, called NOR gates, which are connected so that the output of each gate (viz., transistor stage) is connected to the input of the other.

In this way, in the diagram, when transistor Q_1 is ON it keeps Q_2 OFF. If you introduce a signal pulse which turns Q_2 ON, even for a brief instant, it immediately turns Q_1 OFF, and this transistor then holds Q_2 in the ON state... To understand this fully from the circuit diagram it helps to follow the sequence of currents and voltages which result when each transistor has applied to its base a "turn on" voltage.

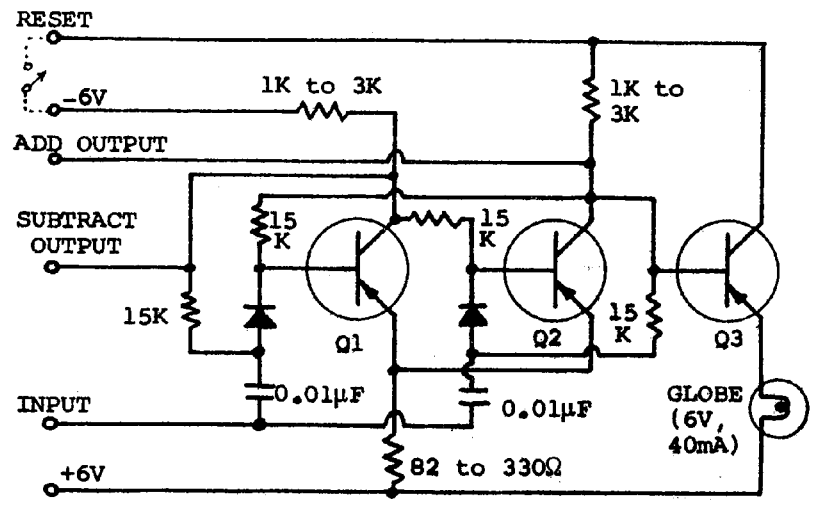
In order to be able to tell which side of the flip-flop is ON, a lamp is attached to one side through a third transistor, Q_3. Q_3 acts as a switch for the lamp, and reduces the load on the flip-flop transistors. The lamp could be connected in the collector load of one of the flip-flop transistors, but in that case the two gates would be unbalanced, circuit operation would be less reliable, and the components more critical. The globe used should be a low current one for the transistors suggested, e.g. to operate with only 40 mA.

The Circuit Diagram

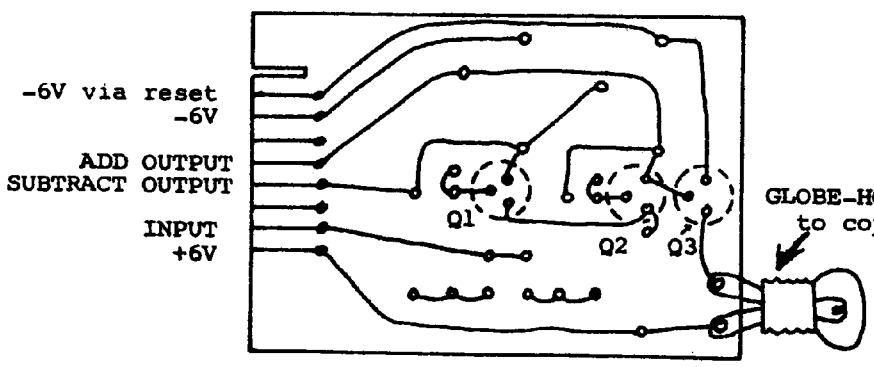
Q_1 and Q_2 form the flip-flop. Notice how the collector of Q_1 is connected to the base of Q2 through a 15 KΩ resistor, and the collector of Q2 is connected similarly to the base of Q_1.

The input pulse is sent through the two capacitors to both transistor bases (or "inputs") through the diodes, and to both collectors through further 15 KΩ resistors. The diodes enable the input pulse to get to and operate only the transistor which is ON, turning that one into the OFF state. The next pulse which arrives then operates the other transistor, turning it into the OFF state, so that matters are back to where they started when two pulses have been introduced.

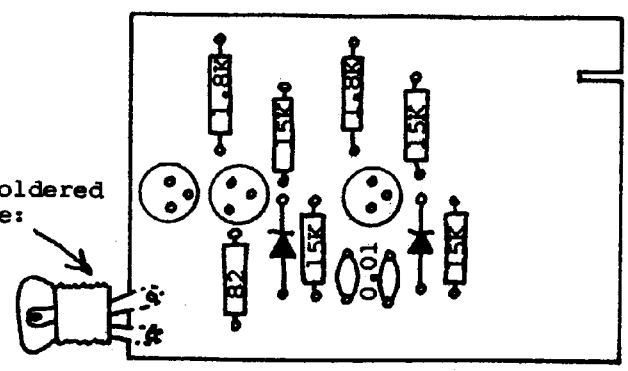
The diodes, capacitors and attached



THE FLIP-FLOP COUNTER. Transistors are the computer-board types 015, 034 or equivalent.



PRINTED CIRCUIT BOARD, half size
(Viewed from copper side)



PRINTED CIRCUIT BOARD, half size
(Viewed from the other side)

15 KΩ resistors are therefore, called the "steering circuit".

Adding or subtracting is carried out by connecting the following stage from one or the other side of the flip-flop, but more of that in Part II. (August)

Transistors used came from disposals computer boards, but nearly any small PNP transistors could be used.

The Printed Circuit Board

This is shown from both sides. The board is shaped with a slot so that it will fit into a special 8-way edge connector. If such a connector is not available (although it can be made up easily enough), wires can be connected to the holes on the left-hand side of the board.

If on the other hand, you do want to be able to plug the unit into a socket (facilitating multiple stage use), it is important to get the end strip connections just right.

The best way to do this, is to put the board into an 8-way socket a few times until you can just see where the socket has scratched fine lines on the board. The "resist" is then painted in strips to go accurately over these fine scratches, yet not to touch each other.

The two soldering lugs on the globe holder should be swivelled round so that they are close to each other, but not touching, and then bent down and soldered so that the globe holder fits where shown.

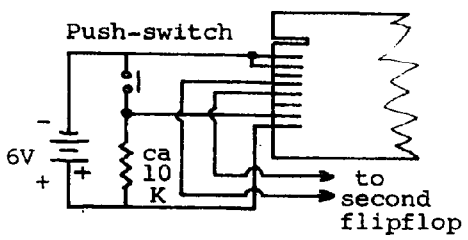
The input circuit

The input circuit shown is simply a test one to show the operation of the circuit, for interest. Any pulse source could be used, having sufficient power to drive this unit.

References

Some useful references are:

"Computer Circuit Projects you can build", by Boschen.
"Computers Self Taught through Experiments", by Brayton.
"ABCs of Computers" by Lytel
"Electronic Computers made Simple", by Basford.



A SIMPLE INPUT CIRCUIT (Each time the switch is pushed, the lamp should change state) (to be continued...)

STATE OF THE ART (Continued from p. 28)

Now, if these ideas are combined with the design of good square-top filters, to what heights might not Direct Conversion devices soar...?

But look: It should be evident now that the technology for providing a good shape of response allowing both good intelligibility and selectivity is not appreciably easier at a.f. than at i.f. And for the latter, mechanical or crystal lattices have been developed which can do wonders. Even I remember cascaded i.f. stagger-tuned tanks which were quite effective in the olden days -- and compared to 16 pole crystal lattices they were cheap, cheap.

I.f. stages also allow easier AGC and when properly proportioned they take care of "audio image" (to be discussed). For the same trouble, then, why not have the selectivity at i.f.? -- where lots of low noise gain can be produced, and with minimal problems of hum pickup.

Shape Factors and The Amateur's Dilemma

I am not making a molehill mountain. This matter of the design of the Filter in a DC or superhet is a fine illustration of the abiding problem overtaking the harried Amateur.

Consider the following: ↗p.28

The dotted line of fig. 10 represents the use of a selectivity filter with ideal shape (S.Factor = 1.00); the need for a good shape is self-explanatory in fig. 10, if you wish to obliterate the interfering signal, f_i.

A good shape is hardly approximated by the single section L-C filters often used (or by double ones used only to achieve broad bandpass), let alone R-C ones whose shape factor is conservatively, bloody awful.

By the use of several well designed L-C sections, a reasonably good shape (sharp or wide bandpass) can be obtained by active or passive circuits (see previous references).

Now, Dick Ferris has calculated that a simple 3-section low pass filter (with constant-k and m-derived sections) can be designed with a shape factor ofapproximately 1.2. Compare this with a shape factor of 2.5 for a 2-section π low-pass filter (13e), 2.5 for a good commercial L-C device (29b, 16th Ed.), 2.3 for a good mechanical filter (29a) or 8-crystal lattice (29b, 17th Ed, not 18th), 1.9 for a typical 9 Mc crystal lattice (Swan advert), or 1.28 for Swan's fancy ($100) 16 pole crystal lattice filter!

(CONT.: P. 32)>>>

THRESHOLD-OPERATED NULL-POINT AMPLIFIER

-- L. J. Yelland (VK3)

Last month EEB described a sensitive null-detector to indicate visually the approach to the null point of bridge operation. But it is also possible to use that null to operate other equipment automatically when the null is reached, e.g. through the action of a solenoid or relay. An obvious application of this is in sensitive automatic temperature control of a system, sensed by a bridge incorporating a thermistor.

With the usual type of amplifier so designed, trouble is often enountered by partial operation as the input approaches zero. This means that chattering can occur with a signal that is nearly zero, and becomes particularly troublesome when it is desired to allow some tolerance above actual zero -- or when extreme accuracy is necessary, viz, when operating very close to zero.

An Improved Amplifier System

In the circuit shown in the diagram, both inverse and reactive feedbacks are employed to make for maximum operation at exact zero, or at some set point adjacent to zero. It also discriminates against any attempt at operation at another point very close to this theshold value.

The high gain input amplifier (SE4001) is biased to near cut-off by the potentiometer setting. Its output is direct-coubled to a switching transistor (2N3646) and this, in turn is couple to another switch (2N3567).

Operation

Any voltage which is applied to the input terminals, raises the SE4001 base above cut-off, so that it conducts. The 39K resistance in its collector circuit drops the voltage at the base of the 2N3646 to below its cut-off value, so that it does not conduct. Consequently, no current is available for the base of the 2N3567, and it does not conduct either.

That is the quiescent condition, when the bridge or other device connected to the input is not at zero.

When the input becomes zero, the SE4001 will be cut-off. The base of the 2N3646 is now connected to HT through the 39K resistance, and current flows in its base. Current now flows in its collector circuit and via its emitter into the base of the 2N3567, which also now conducts to operate a solenoid or relay, etc.

The current of the 2N3646, which is the base current of the 2N3567, is derived, initially, from the 250 µF condenser on the HT, but after this is discharged, it comes from the Main HT thru dropping resistance (R).

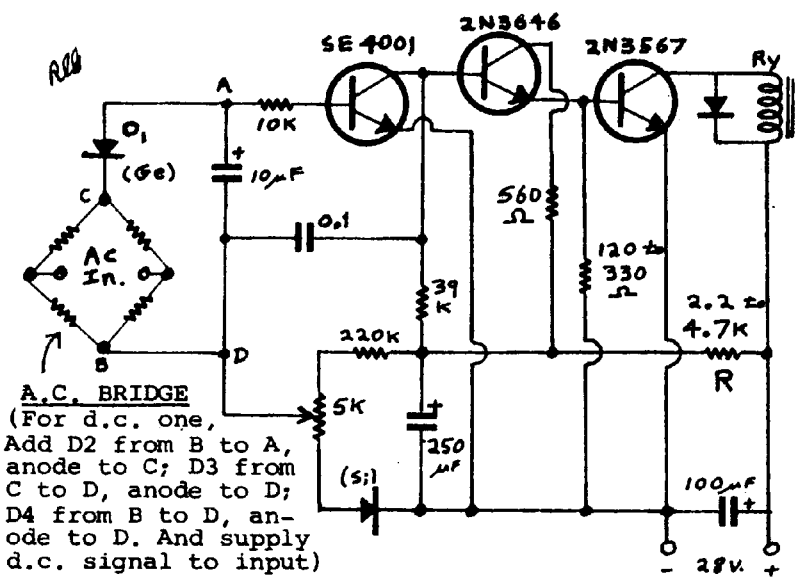
This reduces the available HT to abt one-third of its commencing value, with a corresponding drop in solenoid current. Its actual value will depend upon the function to be performed by solenoid or relay. If just one sudden impulse of solenoid plunger is required, then (R) may be high enough to drop the current to a very low value. Or, if a relay is required to remain closed, (R) should be adjusted to give that lowered value of current which will maintain the relay in closed position, after it has been operated by the first impulse.

Adjustment

In the active state, the pot is adjusted so that the voltage at its moving arm, plus any desired vestige of voltage across the input, just reduces base voltage of the SE4001 to point of cut-off. This is very critical and may be regarded as the crest of the "hill" of its base voltage curve, so that any slight increase will tip it over the "hill".

To maintain this critical voltage against variations of mains voltage etc, a silicon diode is included in the bias network, functioning as a forward Zener, and keeping the low end of the pot at 0.5 volt. This adjustment of the potentiometer is made with the other two transistor collectors disconnected, and a voltmeter on the SE4001 collector to indicate cut-off.

Normally, in the quiescent state, voltage will be available at the input to cause conduction by the SE4001 and the other two cut-off



A.C. BRIDGE
(For d.c. one, Add D2 from B to A, anode to C; D3 from C to D, anode to D; D4 from B to D, anode to D. And supply d.c. signal to input)

THRESHOLD-OPERATED NULL-POINT AMPLIFIER

Operation near Zero

Now suppose that the input voltage is reduced almost to zero. The SE4001 is not quite cut-in but a little current flows in its collector, reducing base voltage of the 2N3646 near to its cut-off, but so that a little current flows in its collector. This is insufficient to cut-in the 2N3567, but flows mainly thru the resistance across the base/emitter. This raises the emitter voltage of the 2N3646, and as its base is connected to negative by the slight conduction through the SE4001, inverse feedback occurs to prevent any build up. Thus the 2N3567 is not cut-in, and the solenoid is not operated.

But suppose that the input voltage is slightly lower than this. That would take the SE4001 more nearly completely over the "hill" and reduce its collector current to a value which enabled the 2N3646 base to be nearly right over its "hill". Sufficient current would now flow in the 2N3646 collector circuit, to cause a slight reduction in HT due to dropping resistance (R).

Such a drop in HT is reflected at the arm of the pot, where a much lower reduction takes place, but sufficient to make the SE4001 more nearly cut off. Thus a reactive feedback occurs, with current building up the the 2N3646 circuit until the 2N3567 is cut-in. Thereafter, considerable voltage drop takes place, the SE4001 becomes completely cut-off, and current rises to maximum in the solenoid until condenser is discharged.

The overall result is that operation either takes place or it doesn't. There is no partial operation, and the point at which operation will take place can be adjusted by the setting of the potentiometer.

XXXXXXXXXXXXXXXXXXXX

For the guidance of readers who may wish to make substitutions, the characterestics of the transistors used are as follows (From the Fairchild Cat.):

SE4001: NPN Audio Amp, 25V, 60-300β, I_{cbo} < 200nA at 5V, f_T 60 MHz. $V_{ce(SAT)}$ = 0.35 at 1mA and β of 10.

2N3646: NPN High Speed Switch, 15V at 10mA (LV_{ceo} roughly analogous to BV_{ceo}), 30-120β, I_{cbo} < 500nA at 20V, f_T 350MHz. $V_{ce(SAT)}$ = 0.2 at 30mA, 10β.

2N3567: NPN GP Amp/Switch, 40β, $40LV_{ceo}$, I_{cbo} < 50nA at 40V, f_T 60MHz, $V_{ce(SAT)}$ = 0.25 at 150mA, 10β

NOTE: "β" above is h_{FE} (d.c. current gain), not dI_c/dI_b; the latter can be found in the mfr's specs curves as a function of I_c. Fairchild are quite satisfactory as a source of technical information on such matters: Fairchild Aust P/L, 420 Mt. Dandenong Rd, Croydon Victoria 3146. (In Auckland: John Gilbert and Co P.L, phone 30839).

XXXXXXXXXXXXXXXXXXXXXXZ

STATE OF THE ART (Continued from p. 30)

Why don't we find good designs applied in the amateur literature?* The average engineer would regard the design of the abovementioned simple filters as an elementary exercise. Yet the average Ham appears to regard such as great obstacle.

Dick Ferris says: "This would appear to be the old question of what the amateur wants. He wants to build first class gear but without the need to become an engineer or to read technical books. Unfortunately with the advance of technology these points are now irreconcilable."

Ignoring Blakeslee's opinion (EEB, last month, p. 19) that the average Ham has scant need for radio engineering, the Amateur who does want to design good filters for Direct Conversion (or anything else) will find readable though superficial descriptions about them in the RSGB and Orr Radio Handbooks; a terse description also appears in the ARRL effort. If he finds that he needs a better background to understand such devices (particularly in predicting their performance) he'll have to consult an engineering textbook. If this requires the use of algebra and trigonometry, they will have to be used -- and this can be satisfying indeed. Nothing beats the thrill of designing your own gear, and having it work first go (well, perhaps second go)! ((CONT. IN JUNE, sri))

*Qualification: Fine designs for filters do appear, e.g. in 10c and 21c, with summaries in 29abc, but who uses them? Thus, most current DC designs use one section L-C filters for the broadband steep-skirt requirements of modern radiotelephony, or gawdelpus, R-C. Some go as far as two sections, but a good example of this problem is illustrated by Ref. 29c (the 1971 ARRL Hbk) where a DC Rx uses a primitive doubly tuned L-C tank audio filter. Yet a very nice 5-pole Chebishev thing (using 3-1/2 std 88mH chokes) appears a few pages earlier in "an Audio Filter for Phone and CW". This is rather the kind of selectivity needed by a modern amateur receiver. Why this kind of inconsistency?

"... but Testes are not responsible for producing mature male characteristics, therefore they should be eliminated." !
(Answer on a Matriculation Biology examination paper)

SEX: IMPORTANT ANNOUNCEMENT

On brooding over the hillarious machinations of the "constipated bureaucracy" in banning various books and Hindu-type mystics, it came suddenly to me that therein lies the answer to the EEB circulation problem: SEX.

I'd like to reach the 1000-subscriber level or more, just for my great ego, since I've about given-up on attracting a torrent of commercial advertising — and oh its nice to publish stuff without fear of offending advertisers! But in spite of magnificent publicity efforts by our Promotion Manager (me), we continue to lose subscribers who can't take RLG in doses, or who prefer communications from Communications Magazines (e.g. AR, B-I, QST, Rad. Comm, etc.), or who are interested primarily in electronics and fie on all that philosophy stuff and reviews of literature people will never read and discussions of new components people will never use --- etc.

Well, all right, but NOW you can tell your friends that EEB features SEX, and on the front cover too (but not in colour — costs too much). Since this pleasant activity is regarded with dismay by Elder Statesmen (who, one presumes, have no children), it is certain to draw their wrath. With luck EEB might even be banned, and we could set up with a hot duplicator in Rod's basement. This would surely do wonders for our circulation, and we could charge $1.75 p.a....

If, therefore, readers have any electronics applications related to SEX they are invited to contribute; we'll read them carefully. Heh. But they'll have to be a lot better than the stuff on p. 44 here.

In the meantime, in the abovementioned magazines (and the rest) you'll find plenty of transmitters and receivers & other useful items. Contribute your useless items (but interesting) to EEB -- and ask your friends to subscribe...?

To assist you in this endeavour, we are willing — for a limited time -- to offer you a free year's sub or renewal on present sub if you send us new subscriptions for two other people; if you prefer you could have about 20 transistors worth of computer boards (while they last) instead of sub — or any reasonable permutation or combination, etc.

(The only reason I'm willing to entertain such a programme is that promotion costs fiendishly much, and with a 10% or so yield on advertising, each new subscriber costs a fortune. Might as well let you have it as the big mags, PMG, etc)

GUEST EDITORIAL: By Chris Pitcher (on North Island)

Re your September and October 1971 efforts, I very much think you are fighting a losing battle against the Post Office. The basic tenet of Government in this country is rule by the majority. Put another way, the minority (the pensioners, people who read books, etc) have no rights and therefore can be exploited (I thought I heard someone mention National Service — must have been the wind!). Approximate percentages for direct and indirect taxation in this country a few years back were: DIRECT = 14%, INDIRECT = 36%. You really think the Government will let the PMG show a profit? Ha. Anyhow, must go now and post this; hope it gets to you. ((It did, 10 days later — Ed.))((from Melbourne))

ILLUSIONS REVISITED — back now to RLG: Reference Editorial, Dec 1971, p. 125, "Illusions and Commonse".

"AUTOMATIC MORSE CODE Copying Machine. Featured in Ham Radio Magazine November 1971. Copy up to 120 wpm without knowing Morse Code. Simply hook to your receiver audio and read printout. Send $14.95 for detailed construction plans....." — an Advert in the April 28th (1972) issue of "Ham Ads", an interesting new advertisement medium, issued every other week from P.O. Box 46-653, Los Angeles, California 90046, U.S.A., and "for a limited time we are offering a special introductory subscription rate: A years subscription, plus a free 75 word ad costs only $4.00"; available to subscribers is a special 10c/word advertising rate, too. Could be interesting for American gear or components.... Incidentally, the title of this section referred obviously only to the Quote. "Ham Ads" sounds like a good idea.

STOP PRESS: FOR SALE, Radio Transceiver, Heathkit SSB200, P/S, Spkr, Exciter 10 to 80Metres, Linear 1kW, 20M antenna, PTT mic, $650 ono. W. Coertse, 22 Treeby St., Coolbellup, W.A. 6163.

ADVERTISING

EEB still QRV, HR subs, $A8.50/3-yrs!

This Page: Personal = FREE Commercial = 20c/line or 80c per SIX LINES. We guarantee nothing.....

FOR SALE: High quality Automatic Coil Winding Machines: See December 1971 EEB for details. A beaut opportunity.

COMPUTER BOARDS FOR SALE: If anyone doesn't already know, these are assemblies out of obsolete computers. They use good germanium transistors with gains of some 30-100, voltages to match, frequency of operation up to BC (f_T typ 5Mc). The boards cost 10c per transistor (postpaid), and the diodes, resistors, condensers etc are free. We got these originally as a scheme to promote EEB, but response was not as favourable as anticipated. It seems that people are now willing to pay the 50c or 70c needed to get a good silicon transistor for their construction projects. But in fact these 10c germanium transistors are quite satisfactory for all noncritical, audio, power, etc, applications where high temperature independence or high frequency capability is not essential.

The Computer Board Notes are a compendium of unseful information about the boards: 20c extra. WRITE EEB at S. Bay.

HOT CARRIER DIODES: HP5082/2800 are again available (Ref EEB Nov 1971, p. 103ff), as advertised here in September, but this time they only cost you 1.00 each, postpaid -- but add 6c if payment by cheque, and 15c if you want the post to be Certified (i.e., if you want to be assured of delivery by our efficient PMG). This is less than you would get them from overseas, not to mention Customs!. Characteristics of these are even better than those mentioned in the November editorial: 70 volts breakdown "allows high voltages in sampling gates, and wide dynamic range capability" as mixers and detectors of all kinds. The diodes have "the high breakdown and temperature characteristics of silicon, the turn-on voltage of germanium, and the speed of a Schottky barrier, majority carrier device." With a 250 Megohm reverse resistance at -50V, and a phenomenal front/back ratio, these diodes can also find wide use in any application requiring high impedance characteristics. And their frequency response is astronomical. They are very good for linear operation in any mixer, balanced mixers being better, and doubly balanced ones being best — as discussed in this EEB.

Interestingly, even better are the HP5082/2835 Low Offset Schottky Diodes, with an even sharper switching characteristic, lower forward offset, therefore even more linear. BUT its PIV is only 5V, and in fact one would normally operate it well below that. Since, however, the voltage drop forward will also be less (so requiring less forward bias), considerably less driving voltage will be necessary, thus promoting linearity, lower noise, and reduction of crossmodulation in subsequent stages. The main amplification in such a system occurs after, not before the mixer.

On the other hand, you can only obtain advantage from the 2835 diodes if you know what you are doing. The average bloke will be better off with the 2800, which can also be used to good advantage as high impedance signal diode in place of OA90, or high voltage point-contact silicon in place of OA200 etc. And the HCD is cheaper!

Experimenters seriously interested in signal processing should request the relevant Application Notes from H-P: HP5082/2800, HP5082/2835, Appl. Note 907 (The Hot Carrier Diode; theory, design, and application), Appl. Note 923 (Hot Carrier Diode Video Detectors), HP5082/3080, Appl. Note 922 (Applications of PIN Diodes -- TR switches and the rest!).

These can be obtained (only) by request on Company Letterhead from: Hewlett-Packard Australia P/L, 22-26 Weir St., Glen Iris, Vic. 3146. BUT ORDER YOUR DIODES FROM US; H-P won't be bothered with orders for 4-off quantities, etc. ((Incidentally, we are making zero profit from this; just a public service to promote State of the Art)) — EEB.

PRINTED CIRCUIT BOARD MATERIAL: 1/16" G-10 Epoxy Board 2 ounce copper. Factory New:
3x3" = 45c; 3x6" = 85c; 6x9" = 2.75; 12x12" 6.00; P.C. Board Etching Solution, $1.25/pint.

TRANSISTOR SOCKETS FOR (round) TO-5 sockets. Standard 3-pin TO-5 type, or 5-pin universal to fit TO-5, MOSFETS, etc; 10c each, your choice ((I have found these extremely useful in construction and experimentation — RLG)).

ALSO: A wide range of 400mW and 1W zeners at 25c, rectifier diodes at low prices, 88mH toroids at 10/$2, and much

10c each, your choice ((I have found these extremely useful in construction and experimentation — RLG)).
ALSO: A wide range of 400mW and 1W zeners at 25c, rectifier diodes at low prices, 88mH toroids at 10/$2 , and much more. Send stamp for Catalogue: M. Weinschenker, K3DPJ, Box 353, Irwin, Pa. 15642, U.S.A.

((Ed. Note: Prices are in $US, but you can send him the same numerical amount in $A, and we'll buy them from him; do not cross out the "or bearer" on your cheques, but do cross them "Not Negotiable". Consult Customs before ordering...))

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EDITORIAL (continued from p. 33):

Second Quote from Amateur Radio, May 1972, p. 13:
"The unit I propose to describe ((fully)) has the following features:-

1) Fully solid state.
2) Use of ICs for simplicity.
3) Capable of having a full QSO without touching the key. ((EEB emphasis))
4) Capable of changing the programme at will.
5) Repeat and re-cycle operations.
6) Reset to start and reset at any stage." etc.

from "Programmable Digital Keyer" by D. A. McArthur, VK8KK. Most impressive.

In the April 1972 QST a bloke has made much the same point as I mentioned in December, and in the overseas article if it gets published, except that he made it with humour — and that's probably better!

This & That

Last month's EEB was modestly late, but an extra 3 weeks was added to it by the fact that our good printer is becoming shockingly successful owing to his good work and relatively low prices. So I reckon you will be reading this sometime in late June, but never mind. June may actually be published in July since I have typed out most of it already. Having a Secretary helps enormously; now if only I could teach her how to type rapidly I could give her EEB and go fishing!

If you're going to make a photocopy of the P.C. board fig. 3 from Maddever's article in the February issue, I suggest you fill-in the black a bit. The new paper we are using for offset does not take the ink too well in the larger areas, though I must say it looks lovely in all the rest. I suppose we'll have to solve the problem for the front cover of each issue by making up a metal plate (at expense) and doing a year's worth in colour.

WHERE THE DX IS AT! — by Greg Johnston, VK7KJ

These notes will be rather disorganised, owing to the fact that I am leaving tomorrow on the voyage described in the February EEB! I should get back to VK7 about the first week in July. In interim will be QRV 20Mx from about May 1st/MM around 14198 or 14225 when time permits on the way to Auckland and then on to the Kermadecs, Minerva Reef and Tonga (FB place I gather!) — movements from time of arrival there are uncertain. The following are from DX-press, with equivalent items in the Geoff Watts News sheet. (7KJ comments)

TONGA: VR5FX using his new PX and worked in UK 14035 CW 0818Z. QSL via ZL2AFZ. *NB: Also on SSB 14110 abt 0700.

GLORIEUSES ISL.: FR7AM/G often reported in low SSB part on 14Mc, also high end 21Mc. *Hrd here quite regularly arnd 1500Z just below 14200; the big pileups are the clue.

SSB DX: ((NB: Some additions, below, by RLG, current=26/5))
Sierra Leone: 9L1MF 14192. *Band es QRM bad.

CW DX: //WILLIS ISLAND: SOON TO BE ACTIVATED
Monaco: 3A0GA 14027// French Somaliland: FL8DA 21055
Jordan: JY6FC 14010. *OK but QRM fantastic!
JY6FC 14011. " " " " //JY9GR, Amman QRV
Alaska: KL7MF 14035.// North Pole: UW3HY/0 14016
VQ8AD: 14028.// Serrana Bank: KS4BA. *OK if u don't sleep!
Crete: SV1FD 14019// Canary Is.: EA8BK 21045
Gabon: TR8CQ 28024. *OK but band U.S. mostly.
Finland: OH1JN/OHo 14006. *FB.//Tchad Rep: TT8AC 14265-300 0430-530Z.

= =

ED NOTE: There are a pile of DX-presses here, and another lot of Watts News sheets are accumulating at Greg's place, but I can't make any sense of this DX stuff; enough for me to figure out what all those countries are. Is there any avid DXer out there who would like to receive the stack, and give us an idea which few items are of particular interest to Australasia, with perhaps his own comments? We need such for our June issue, because 7KJ will be off then on his own private DX-pedition! Ah, sigh....

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The March 1972 73 has a constant-current battery charger for Ni-Cd cells; reference p. 40 this EEB. Its simply a lamp in series with the half-wave diode, with a resistor across the lamp selected to draw 25-30% of the current drawn by the lamp. The idea is that Ni-Cds should be charged for 15-16 hrs at 10% of their milliampere-hour rating (but does that assume complete discharge?), and you can not conveniently calculate that with the usual fairly constant-voltage output of an ordinary pwr supply. Personally I'd find it easier and cheaper to use a computer transistor instead of the lamp and resistor. Transistors are (PTO)

inherently constant current devices y'know.

Heavens! I just realised that the title of the above-mentioned article is "Constant-Currant Charger..."; maybe my wife would be interested in it too for the kitchen?

Last September we ran a piece on the American phone band expansion. Since then the news has only been good. The Chief of the"Amateur & Citizens Division" of the FCC (Amateurs are not citizens??) said (as reported in World-Radio, 7 Feb 72): "if we have any sense, or concern for the future of Amateur Radio it would be utter folly to irritate those whose votes we need during international negotiations". In consequence of which they are not going to expand 20, 15, or 10 Metres, hooray!!

The event, or rather non-event has outraged a goodly section of amateur opinion in America, well represented by W5EYE, in Collector & Emitter of March 1972:

"Most certainly I share Mr. Walker's view that we must consider the opinions of other countries. But by the same token, I feel other countries should consider the plight of this country's 265,000 amateurs. On this point I fear the Commission, and possibly the League, have been unduly influenced by the aggressive lobbying of our Canadian neighbors."

Just to keep this matter balanced, lets close with a quotation from a Letter to the Editor in CQ, April 1972:

"... Well, as in all other conferences, decisions are not made at the conference table. Subjects are discussed and decisions are made in the hotel lounges or bars, and as none of the U.S. official deligates usually speak any languages other than English, surprises, generally unpleasant, come at the official meetings. See for instance, 40M and broadcasting." !

Ummm, shall we send from Australia some deligates who have a command of other languages, ummmm?

Only trouble is that that letter-writer's conclusion is that the answer is to dump restrictive licensing and open up all of all the bands to phone thereby, presumably filling every nook and cranny with Yankee twang at 1kW or more. Seems a stiff price to pay, but there you are.

Calculating Torroid Inductances (I mean: Toroid)

I was wrong (EEB Dec 1971, p. 122). The relevant formula for the inductance of a cranky toroid would be $L = KN^2$ — and not $L = N^{2K}$. The right formula makes it even easier, and no need to use the value of K given in the article in Ham Radio of Feb 1972, since that applies only to a commercial component available in America. For the locally-available material you can use high-power maths, or my simple suggestion of winding some turns, finding L, and solving forK, to allow extrapolation to new N from new L. Or ask Aust Mfr for value of K.

COMPONENTS AVAILABILITY

My spies tell me that there may be more to the situation than my simplistic view of supply in Australia, but I simply presented it the way I saw it. There are several degrees of complexity possible, depending whether you are a one-off experimenter, or an enterprising manufacturer...

We'll be following up the subject with some pregnant quotations next month, and eventually we'll present a list of selected transistors available from firms who have bothered to reply to us AND to furnish prices. This whole subject of component availability can be ambiguous. It can depend on how close you live to the main cities, and how willing you are to go to a bit of trouble investigating mail order supply, junk sales & auctions, etc....

I might note that in reference to the problem of Australians obtaining merchandise overseas, I have been making some enquiries, and it seems that there are several firms willing to deal with us. For example World Radio Corp, although they have a $100 (one hundred dollars) minimum order requirement. Barry Electronics Export Corp in N.Y. and Meshna in Mass. seem to be quite available, without obvious minima. There are several small suppliers of semiconductors noteworthy amongst which is Babylon Electronic Equipment Co, P.O. Box J, Carmichael, California 95608, U.S.A. On the other hand, we never did get a reply to several enquiries sent to Hal Electronics who have advertised willingness to sell to DX; perhaps the letters got lost.

BUT we have succeeded in finding a personal Representative who can obtain components — as available on the American market by one who knows where to make contacts— or commercial transceivers, instruments, etc. Markup over the American retail price is likely to be some 5% to 10%, depending on total value and how much trouble is involved, etc. Considering the 15% difference between $A and $US, and the substantial markup by middlemen here, that would result in the saving of quite a lot of money to you. I must stress that components availability here can be quite good compared to that in the U.S.A. or even U.K., but you would likely save more on large bits, even after Customs.

On the other hand, for esoteric components which have not come here yet, or for which Yankee Reps in Australia are awkward, or for surplus stuff available uniquely in the USA, our Rep could help you. Keep it in mind... See also the adverts for British merchandise in Rad Comm and W. World. The British are outstandingly honest, reliable & cooperative.

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THE ORDEAL OF MAIL ORDER

EEB P.37 4/72

BY D. J. HOLFORD*

HOME brew is a wonderful idea, for the ham near a large electronics store. But how about the man out in the sticks? He must rely on mail order for his parts, and that can be an adventure akin to tracking tigers. You never know what will happen next.

My introduction to the perils of mail order came several years ago when I moved away from the stores. I needed parts for a construction project, and blissfully ordered them from a large mail order house which promises shipment within twenty four hours.

Some six weeks later a few items arrived, including a number of substitutions, (I am surprised they didn't send one six meg resistor instead of the dozen half ones I ordered). The rest of the order was "back ordered", a new term to me then but one I have since become intimately acquainted with.

The rest of the order arrived within the next few weeks and consisted of a large collection of small components tossed into a chassis, and wrapped in brown paper. Needless to say confusion reigned supreme. The small parts were mangled and bent and some were missing having escaped through the gaping holes in the packing. The interior of the chassis was a sight to see. Among the shipment were a few tools which had made some beautiful dents (if you like dents) in the chassis.

In addition to all this, there was no invoice and since the shipment had come from New York it had to pass Canadian Customs. If you have a free day sometime, try to convince a skeptical customs officer that you are telling the truth about the values of unmarked parts. Eventually all the parts were obtained and the project completed.

Not having learned my lesson I decided to try again. This time I ordered in addition to some components, a set of pliers and a wireless intercom. The intercom and some parts arrived over a three month period. The pliers were back ordered (I now knew what it meant). When the pliers arrived some time later they were accompanied by a customs declaration form, unfortunately it listed the value of the full order. If you think I had fun the first time, you should have seen me trying to convince the customs officer that the pliers were not really worth fifty dollars. I think he was beginning to wonder about me.

I stayed away from mail order for over a year. But then the intercom needed a special part. There was no other choice, so I ordered it. After numerous back orders and queries a part finally arrived, it was the wrong part! I returned it and received a back order and a photocopy of my order. Eventually the right part arrived, over a year after my original order. Incidentally this particular house is big on photocopies. They answer queries by photocopying everything you sent them and stapling it to your letter. We ended up shipping a half inch of paper back and forth to each other. I don't think they own a typewriter, they must have spent their entire budget on photocopying machines. After pleading with them to write to me I came to the conclusion that they own a computer, the copying machines and a monkey to work them.

Being a glutton for punishment I entered the arena again a couple of years later when I needed a special item I could not find anywhere else. Off went my order accompanied by a prayer or two. Back came another back order slip advising shipment in a few weeks. A few months later I received a form letter apologising for not sending me the bill earlier. I replied that I was still awaiting delivery of the item. Silence for almost a year, when I received a bill for one cabinet. I wrote a letter

[*Continued on page 40*]→EEB

*RR 1, Enfield, Hants County, Nova Scotia, Canada.

 ← Reprinted from (with thanks)

FINDING COMPONENT PARTS? --RLG

The preceeding reproduction of the article from CQ started us thinking about the situation in Australasia. From correspondence and from several American magazines it is evident that the few experimenters who survive in the U.S.A. are encountering considerable difficulty in obtaining electronic components.

It appears that their parts market is facing primarily the needs of industrial and military consumers. Even if the trend to build had not diminished, the vast increase of the other services would still dwarf it in that Technocracy.

The American Literature does, from time to time, display articles and letters by amateurs who have rediscovered the experimental approach, although there is still a deplorable tendency to depend on published circuits for even the simplest functions, rather than applying basic and reliable principles of design.... But all the technological expertise in the world won't help much if you can't buy the parts with which to build.

And in Australasia, what?

Here we are perhaps more fortunate. On one hand the local parts availability can be terrible if one lives outside of the largest metropolitan centres. As a matter of course experimenters have developed their own methods for obtaining (or even making) parts, methods which are only now, it seems, being discovered overseas: canibalising old radios or TV sets, disposals equipment, ordering by post, or as a last resort -- improvise it yourself.

We have another considerable advantage: we do not depend so much on commercial specifications. If a diagram calls for a 2N174, say, we are not above using a 2N1100 if at hand, or perhaps even an OC26 or 2N301 or AD 149 or whatever, depending on the actual power (or voltage, etc) requirements of the circuit.

Or, if we have a similar NPN unit (e.g. 2N3055), and if it will handle the actual current (etc) we are not unwilling to change polarities, and perhaps add a bit of r.f. bypass if silicon.

Or, if a diagram calls for a 0.01 µF Ducon, we are not above substituting a 0.01µF Jap if we have it, or even 0.02 µF. Of course this requires the commonsense of knowing whether the higher quality of the Ducon is required (as for lower leakage, etc), or whether the capacitance is critical (as for determination of frequency).

It seems to be rather a problem in America that if a diagram calls for a 0.01µF Part No. 123X, you are in trouble if you have only 0.01µF part No. 123Y. If indeed one considers the monumental amount of radio parts and equipment available on the surplus market over there (courtesy of the latest War), and advertised copiously, it is difficult to interpret the widespread quandry over availability of small parts.

In Australia and New Zealand, electronic component prices are (now) often quite reasonable, and we also have a large body of suppliers who advertise in national radio magazines (but alas not much in EEB), and this is particularly important because of the above-mentioned difficulties which can be encountered with local parts availability. You are able to order material by post, and allowing for the usual Australian lethargy you can have them delivered anywhere, in due course. I am not, of course, considering the implications of the increasingly usurious postal rates, nor indeed the fact that commercial people have been finding it more reliable (and even cheaper) to send equipment by private carriers...

We have a sufficient number of mail-order houses that we are able to shop about and find which have the best prices. Beware!, such establishments no longer (necessarily) sell at "Wholesale" levels... In this regard it can also be valuable to see whether items can be obtained directly from the Manufacturers if same maintain retail or semi-retail outlets; we have often found their prices to be substantially below those of certain other firms. Needless to say we can't mention any names, nor will we supply them by post; you'll just have to use your ingenuity and commonsense -- and pool your knowledge informally in your radio club meetings.

We also have a number of disposals (surplus) equipment houses which advertise regularly. Although (in contrast to some experience with the U.S.A.) they tend to be honest, you do take your

chances -- but an interesting (and profitable) adventure it can be, if you are willing to test everything you receive. Although I didn't have very good luck with a CRO so obtained, I have been able to get a fine assortment of components.

But remember the cautions expressed in our Avalanche Diode article last February, that the purchase of a new component may well be preferable if you need the reliability or ratings of commercial items.

Finally, don't overlook the Classified columns in all the mags (including EEB); why pay more if you can pay less?

Keep our standards of commonsense and improvisation high, keep experimenting, maintain an Amateur Certificate of PROFICIENCY rather than a "Licence", support the mail-order suppliers. Then we'll never (or hardly ever) need to arrive at the technological impotence experienced Elsewhere.

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LETTER: A Different View of Availability?

Some months ago I sent over to the Sylvania Co. (in U.S.A.) for two copies of the Technical Data Manual (14th Ed); it contains a lot of information on radio tubes and a conversion list with thousands of transistor conversions to the Sylvania "ECG" range of transistors. The Manuals were priced at $1.90 each and I allowed 50 cents per copy for postage by surface mail. Twelve days later the books arrived in the letter box at home. They had been sent air mail from the States at a cost of $6.60. A couple of days later I received a letter in the mail from them saying that the books had been sent out free of charge to me and they returned my bank draft for $US4.80.

At the same time I ordered a neon lamp from a mob in (N.S.W.)... The lamp arrived in the mail yesterday. They probably had reasons for taking so long with supplying the lamp, but it is no wonder why the Yanks do well in business, hi.

-- L. L. Sharp, Chermside, Qld.

((Some American firms use Air Mail liberally, but you certainly can't depend on it, and don't request it unless you are willing to pay for it. I have even requested from a firm that merchandise be sent by sea, and it was sent by air -- with a postage bill! It is true that some Australian firms are slow to fill orders, but that is a price for the casual Australian Way. Surely we wouldn't want it to become as frantic as U.S.?-- Ed.))

Quotes without Comment

"One old timer was telling me how they constructed transmitting crystals out of spectacle lenses of the quartz variety. It makes one realise how fortunate we are with modern components being available."
-- ZL4TAA, Spectrum (NZ), 8/69.

"... (Big U.S. Radio Supply Houses) cater to the dabbler in novelty projects -- after you write off the 95% devoted to "music" and CB. And where does that leave the amateur of radio? Out in the cold! Do we really deserve this fate? Have we actually stopped buying? Did the buying stop before the source dried up??"
-- W5JJ, Collector and Emitter, 12/70.

"Even in the U.K. and U.S.A. home brewers are finding it hard to get the right ingredients. Presumably economic necessity is forcing retailers to discontinue items for which there is limited demand, which means high handling and postage charges on a one-off basis. Kit set providers seem to have the items, proving that they are still manufactured. Another nail in the coffin of the complete Amateur? Or would the formation of co-operatives to buy in bulk be a solution?"
-- ZL1HV, Break-In (NZ), 9/71.

"... $15,000 - $20,000 GETS YOU IN BUSINESS FOR YOURSELF... Joint Allied Radio Shack in a rare opportunity to capitalize on the zooming demand for everything in consumer electronics. We have over 950 stores nationwide but must expand to meet the growing market ($10 billion in 1971 alone!) and need energetic men and women to operate new or existing stores...."
-- ((From an Advertisement in QST, 1971))

"It is important that the workshop denizen realize the flexibility that exists when substituting for a given component found in the parts list of an article. Unless the constructor is attempting to make a 'carbon copy' of what he sees in the book or magazine, he need not use identical parts... ((examples)). Don't be afraid to make substitutions. After all, the (amateur) operator has long been known as an inveterate experimenter, and that's really the basis of the game... ((Follows various descriptions of opportunities available from the Surplus market, old sets for parts, importing, electrical supply and hardware stores etc...))"
-- W1CER, QST, 10/70, "The Ham Builders Nightmare".

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LETTER

I have meant to renew my Sub several times but kept putting it off, so this time I'm going to make sure of it.. I have over the past two years cancelled my subscription to two or three other magazines, and the only one that I have missed has been EEB...

Trusting that you and the other members of staff of EEB are able to continue publishing Australia's most informative Electronics publication, for many years to come,

-- Gordon Sutherland, VK2ZSG/T, Newcastle

DANGER! Explosive Batteries! ((RLG))

In the March 1972 issue of The Radio Bulletin*, R. Callander points out that rechargeable Nickel-Cadmium cells can, under certain conditions, explode with considerable force while being recharged. This is obviously important for all people in electronics

Full details are in the interesting original article and should be consulted by anyone contemplating the use of Ni-Cd batteries. But tersely, it is important to avoid complete discharge of the Ni-Cd battery, and to use a large enough cell rating to handle a given load so that cell discharge is not too rapid.

"It is better to recharge the battery more frequently for shorter periods of time than it is to allow it to become discharged completely and then to have to charge it for several hours. Shallow discharges will result in a much greater number of cycles over the useful life of the battery..."

Strictly speaking these cautions apply stringently only to the small "button" cells, and not, say, to the larger "Size D" types used for electric torches etc, because the latter cells incorporate a pressure-relief valve. But in our opinion the shallow-discharge cycle is a very wise precaution in any event, because on one hand the valve might be faulty (what is perfect?), and on the other the battery may incorporate the button-type cells in a deceptively larger case.

Nothing is simple.

THE EASTERN AND MOUNTAIN DISTRICT RADIO CLUB
-- with a note on Radio Teletype.

*The Radio Bulletin is the official publication of the Eastern and Mountain District Radio Club serving the Mitcham and Mooroolbank region of Victoria. From evidence of the publication it must surely be the most active radio club in Australia -- else it has the most dedicated Editor!

The Bulletin has some 30 to 50 duplicated quarto pages per issue, and is issued monthly or so. Here are some of the articles which have appeared in it since October 1971, beginning with the most recent (April 1972):

Novices, pro. The G5RV Antenna in 80 feet.
Slow-scan TV News and Developments, standards.
Transistor Parameters, explained thoroughly.
Speech Amp/Control for FM Base Station system.
Simple TV Camera using slide projector backwards!
The Moibus Loop, full details, including its use on a Tape Recorder to double loop length!

A very thorough examination of Novice Licensing.
Recharging Nickel-Cadmium Cells.
Crystal set design (RLG!)
Viten MTR-13 "Carphone" circuits/ 2M conversion.
Diode circuits; 33 of them over several months.

Wadley Loop Receiver availability
JLF Crystal oscillator

LM373 IC Multi-mode detector
Salvaging Saltwater-damaged radios
Design of regulated P/S (better than ours)
Outboard IF filters for valve receivers
Telegraph distortion in RTTY circuits
Simple transistor tester. Choosing replacement pots

Video Signals and Distortion
Clipper Amp; 160M Tx; Vinten BTR10 Base circuit
National Parks in Victoria (lovely)
Epoxy; changing car earthing; audio preamp.
Basic Radio Teletype: a clear and thorough introduction to RTTY, several installments, beginning in the October issue.

We had hoped to reprint this fine presentation of RTTY in EEB, but on one hand we won't have enough room for a while, and on the other Frank Merritt, VE7AFJ has promised us a good series of articles on the subject. He has just sent us a long outline of the items planned, and it ought to be nice. In interim we recommend you to the Radio Bulletin one.

Personally, I have an open mind on the value of radioteletype; it can't be any more inane or mechanical than many present voice QSO's and it is certainly unambiguous -- if receiver conditions are reasonable. Sensitivity can be quite amazing; see Kelly's article in the Dec 71 EEB.

I have heard quite a lot of rubbish on the air, but many good and lucid articles produced when electronics people sit down to a typewriter; perhaps the slower speed engages more of the brain before putting thought into deed? The same applies in large measure to code (CW) communication as well, though with significant and subtle differences -- e.g., involving the SKILL of copy -- at least in the days before automatic morse translators...?

There is, therefore, a good argument in favour of RTTY, and the abovementioned set of articles describes the technical background fundamentals; other publications also cover it well, e.g. the RTTY Handbooks by CQ or 73, and of course coverage by the regular Radio Amateur Handbooks.

Membership in the EM/DRC not only brings the abovementioned Bulletin, but also the availability of components and equipment at favourable prices, as well as various technical books and booklets.

For people fortunate enough to live in Eastern victoria, membership also brings the opportunity to attend meetings for good fellowship, family outings, barbecues, conventions, field days, technical lectures, and sales and auctions. Whether or not you live in Victoria I suggest that you write to the Club for a Membership Application Form and enclose, say, 25c in stamps for a sample copy of THE RADIO BULLETIN, to:

-- The Secretary, E/MDRC, P.O. Box 87, Mitcham Victoria 3132.

The cost of membership is $3 per year ($1 for Juniors), and includes the magazine (not available separately). There is a once-only joining-fee of 50c (25c for Juniors), in addition to the first Membership Fee.

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THE ORDEAL OF MAIL ORDER (Continued from P. 37)

the order I still have no cabinet. Mind you I get photostats once in a while. I am still talking to the photocopier with no hope of finding humanity. All this despite repeated pleas for a letter, or some other indication that there are still people in New York.

I should make it clear that I am not tarring all mail order houses with the same brush. Some of the smaller ones provide excellent service. But if you want unusual items the big ones are the only place to go, even if it does take a year or two. ■

LETTER: The 1972 Radio Amateur's Handbook (Published by ARRL, Newington, Connecticut, U.S.A.)

The '72 Handbook has been completely reorganized with the view of putting the sections on receivers, transmitters and modes (cw, ssb, fm, RTTY, SSTV, am, etc.) together in proper order. A full new chapter has been devoted to frequency modulation and repeaters, while the coverage of SSTV, ATV and space communications has been expanded. A number of chapters have been rewritten to include data on the newer transistors and all types of integrated circuits. And, a bevy of new construction projects has been added.

The chapters that have received the most attention are:

1 -- Amateur Radio: Update regulations and charts.

2 -- Electrical Laws and Circuits: Actual oscillograph photographs of modulation, heterodyning and beats added.

4 -- Semiconductor Devices: Eight new pages added to describe complex linear integrated circuits and the digital logic families.

5 -- Power Supplies: Text updated and rearranged, plus a new IC bench supply has been added in the construction section.

6 -- HF Transmitting: Complete rewrite of theory section to include power transistors, ICs, broadband circuits, PLLs, electronic dials, premixing, and network design. New construction projects include a 10-watt, 1-tube Novice transmitter, a 6-band cw transmitter, an 800-W sweep-tube linear amplifier, a 1-kW single-tube amplifier, and a 30-W transistor broadband amplifier.

7 -- VHF and UHF Transmitting: Rewrite of the theory section to discuss ssb operation, the use of transverters and vhf TVI problems. New projects are a 6-meter transverter, a 2-meter transverter, and a 500-W 432-MHz amplifier.

8 -- Receiving Systems: Major rewrite of the theory section for coverage of transistors and ICs, mixer and spurious-signal problems, plus i.f. noise blankers. A bc trap, an FET preselector, an IC active filter, an hf receiving converter, and a tunable receiving converter head the list of new construction projects.

9 -- VHF and UHF Receiving Techniques: Discussion of transistor selection for use in vhf receivers and a new 432-MHz receiving converter have been added.

10 -- Mobile and Portable/Emergency Equipment: Changes in this chapter include the addition of a new mobile power supply for ssb transceivers, a Transmatch for portable use, a 2-meter fm receiver, a 2-meter fm transmitter, and a 25-watt-output amplifier for 2-meter mobile use.

11 -- Code Transmission: Rearranged theory section, rewritten to provide additional information on break-in systems and cw keying. A keyer, relay driver and t-r switch are the new construction pr.

12 -- Amplitude Modulation: The theory section has been recast to show the use of solid-state devices. New spectrum-analysis photographs have been added, along with a hand-portable 2-meter transceiver and two solid-state modulator designs.

13 -- SSB Transmission: The theory section has been rewritten to include new filter designs, use of ICs, speech amplifier circuits, speech processing, and driver circuits. Construction projects include a transverter for 1.8, 21 or 28 MHz and a 20-meter transmitter.

14 -- FM and Repeaters: This is a new 28-page chapter covering all aspects of fm and repeaters, including seven construction projects (in addition to the 2-meter fm gear described in Ch. 10).

15 -- Specialized Communications Systems: Expanded chapter to cover ATV, SSTV, space communications, FAX, and phone patching, in addition to RTTY. An RTTY afsk generator and an SSTV receiving adaptor head the list of construction proj.

16 -- Interference with Other Services: Includes a new section on prevention of problems with rf getting into hi-fi sets.

17 -- Test Equipment and Measurements: Contains data on the new WWV format, and an outstanding new impedance bridge is described in the construction projects section.

20 -- Transmission Lines: Revised data on Transmatches has been added, including a description of an "Ultimate" built for this book and a 160-meter version.

21 -- HF Antennas: Expanded to include new data on Yagis, limited-space antennas, triband quads, a loaded quad for 40 meters, a 10/15-meter duobander, and a simple homemade tower.

22 -- VHF and UHF Antennas: Completely rewritten to be easier to understand and use.

-- D. A. Blakeslee, W1KLK, Newington, Connecticut, U.S.A.

((Reference W1KLK's Letter in the Feb. 72 EEB))

LETTER: The New ARRL Radio Handbook

I just got a copy of the 1972 ARRL Handbook this morning, and inside it has a few new projects, many old. An updated antenna chapter has been simplified considerably, with many detail drawings on how to put insulators on dipoles, build baluns and other beginners stuff.

In fact, in looking over the new edition, I get the distinct impression that they're shooting for the beginner and novice much more than the advanced operator. I don't know if that's a step forward or backward!

ARRL does now include a balanced beam-deflection mixer (p. 238), but they still don't appear to have a Vackar or Seiler oscillator, although those items have appeared widely in the periodical literature for some time, and in the RSGB Handbook and in Amateur Radio Techniques.

Finally, I notice that they no longer neutralize the Dual Gate MOSFET r.f. stage about which you people have been complaining for some time (e.g. Dec 71), but neutralization is still used in one of their VHF circuits. Perhaps they are trying to take care of indifferent construction technique possible with the fellows who build their stuff.

-- U. S. Kallam, Cardiac, New Jersey, USA

((EEB readers will recognise the renowned name of Kallam. It means "pen" in Arabic, or so I am told by one of our staunch authors who prefers to be known as "I. N. Kallam" ("INK" -- pen, see?). He seems to have relatives overseas, in this case a very real correspondent somewhere in the Eastern U.S.A. Hi. -- Ed.))

((See also: "Filter vs Phasing Exciters", on P. 42, this issue))

FILTER VS PHASING EXCITERS:

Some Quotations from the ARRL Radio Handbook.

1) 1971 Edition, p. 251:

"Generally the filter-type exciter is easier to adjust than the phasing exciter. Most home-built SSB equipment uses commercially made filters these days. The alignment is done at the factory, thus relieving the amateur of the sometimes tedious task of adjusting the filter for suitable bandpass characteristics. Filter type exciters are more popular than phasing units and offer better carrier suppression and alignment stability..."

2) 1968 Edition, p. 254:

"Properly adjusted, either system ((phasing or filter)) is capable of good results. Arguments in favor of the filter system ((are)) that it is somewhat easier to adjust without an oscilloscope, since it requires only a receiver and a VTVM for alignment, and it is more likely to remain in adjustment over a long period of time.
"The chief argument against it, from the amateur viewpoint, is that it requires quite a few stages and at least one frequency conversion after modulation. The phasing system requires fewer stages and can be designed to require no frequency conversion, but its alignment and adjustment are often considered to be a little 'trickier' than that of the filter system.
"This probably stems from lack of familiarity with the system rather than any actual difficulty, and now that commercial pre-adjusted audio-phasing networks are available, most of the alignment difficulty has been eliminated. In most cases the phasing system will cost less to apply to an existing transmitter..."

((Or to a receiver. See the "Two-Phase" System" section of our State of the Art article in June issue. The possession of some kind of oscilloscope is, of course, a reasonable assumption for Australasian amateurs and other builders of equipment. -- RLG))

XXXXXXXXXXXXXXXXXXXXXXXXXX

LETTER: A VHF Handbook Comparison

Recently I have had occasion to sit down for a good look through the RSGB VHF Manual as well as ARRL's VHF Handbook. I think that the best example of the difference in technique comes with the uses to which they put 4CX250 tubes.

RSGB use one, with the comment that two can be used, but it gets cumbersome, and besides who needs that power anyway. ARRL use three of the beasts on 60MHz, and complain that they can only get two to work on 144MHz.

And when it comes to construction, e.g. ARRL:"Use EIMAC Finger Stock, Part No.--- for connections". RSGB: "Take a strip of flashing copper, size ---, and cut slits with a fine saw..." etc. And of course RSGB usually have more than one alternative. Perhaps Americans hate indecision?

--- C. Pitcher, Northcote, Victoria

((Pitcher and Reynolds are preparing a proper technical Review of these two books, to appear soon in EEB. -- Ed.))

XXXXXXXXXXXXXXXXXXXXXXXXXX

Quote

"... Very few, if any, commercially built transmitters have adequate shielding to prevent harmonic radiation, particularly when the transmitter is operated in a fringe, or weak-TV-signal area. Most manufacturers put a metal enclosure around the final amplifier circuitry, but that isn't enough. Meter holes, inadequate filtering of leads entering and leaving the transmitter, open spaces on the cabinet, and lack of clean metal-to-metal bonding are all possibilities for the escape of harmonic energy. Even though a low-pass filter is installed, harmonics can reach the antenna to be radiated and cause interference."

-- L. G. Mc Coy, W1ICP, QST, 3/72.

XXXXXXXXXXXXXXXXXXXX

How to Kill Weeds

A sure cure is to place the offending morsels in a large pot, fill with boiling water and cook firmly for 15 minutes. The resultant soup is full of vitamins and minerals, and makes good "plant food" to use in the garden; with the flowers will come weeds which....

A caution: If you are tempted to sip the soup "just to see", make sure first it doesn't contain any hemlock or foxglove -- which grow abundantly in Australia as weeds!

XXXXXXXXXXXXXXXXXXXXXX

Quote

"It seems clear that, in considering a possible revision of its program and policy, the AAAS cannot responsibly, at this time, continue to say simply that it seeks to serve science.

"I think it must broaden and deepen that purpose, and affirm that it seeks to assist in the development of procedures whose basic purpose is to assure that the awesome power of science be brought to serve the cause of a humane rationality, emphasizing the importance of human, of natural, of spiritual values, difficult indeed to subject to analysis, but all of which must be given due consideration if we are to develop and preserve a culture worthy of our potentialities.

"Scientists can no longer hide behind the untenable pretense that they have no concern with values. Judgments on priorities must be made.

"I do not think that these judgments can be safely left to a few highly placed individuals..."

--- "Science in a Troubled Culture: A prescription", by Warren Weaver (past President, American Association for the Advancement of Science) AAAS Bulletin, February 1972.

LETTER: A Need for Transceiver Decoupling

Here is a problem which may interest you. When the Collins 75S3 receiver is tied to the 32S3 exciter for transceive operation, the exciter sometimes "sucks out" the signal from the heterodyne crystal oscillator of the receiver. This calls for a method for unloading the receiver oscillator, perhaps by some kind of emitter follower that will handle a couple of volts and pass it on to the exciter via the coax. This would allow sufficient drive to the exciter, without reducing the injection of the heterodyne crystal oscillator into the receiver.

Some ZL's have verified this on their equipment, and found that the 21 Mc and 28 Mc bands "came to life" when the heterodyne crystal oscillator coax (which looked like 19Ω at 19 Mc) was shortened to 16 inches, or even better the exciter's own crystals are used not in transceive. These require slight retrimming of the oscillator alignment.

What we need therefore, is a coupling device with Z_{in} of a few hundred ohms or more, to take a couple of volts to a 50Ω coax up to about 35 Mc. No gain needed. Perhaps one of those broadband r.f. amplifiers with FET input and emitter follower second stage would do it if the FET were not overdriven.

This is a world-wide problem that very few have recognized in Collins S-Line equipment. A nice little design jobbie for some chap in your area.

-- E. H. Conklin, K6KA, La Canada, Calif.

((What's wrong with a very ordinary transistor emitter follower using a bipolar with an f_T of a few hundred MHz, e.g. a 2N3642 or TT3642? A Z_{in} of a few hundred ohms ought not to be difficult to obtain at 35 Mc.--Ed))

((Fine, but my catalogs don't list 2N3642 or the TT3642. -- EHC))

((Those are Fairchild types in this country, but in any event any lower power transistor having suitable frequency response would suffice. There is no need to be a slave to transistor type numbers... To assist the experimenter in such matters, the big transistor companies periodically publish lists of "preferred transistors", at least in this country and in Europe. We shall be publishing a summary of them at the conclusion of the "Components Availability" series, in a few months. -- RLG))

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Every year it takes less time to fly around the world and more time to drive to work.... Recently, a ten year old wrote, on the Birth of Babies, a composition that went like this: "In France baby girls are found in roses and baby boys are found in cabbages. In England and America babies are brought be the stork. In all other countries, babies are born in the normal way." (W8QUR, ARNS Bull, 8/70)

XXXXXXXXXXXXXXXXXXXXX

LETTER: More about Hot Carrier Diodes

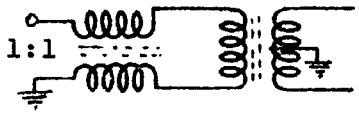
In reference to your Editorial in the Nov 1971 EEB on Hot Carrier Diodes, I would bring to your attention an article in QST, March 1970, "An Engineers Ham-Band Receiver" by DL6WD. It is a rather exotic piece of equipment, in fact complex. However, the Front End is relevant to your series.

That receiver uses two 3N128s in cascode, 4 hot carrier diodes in a ring arrangement, and manual attenuator on the r.f. stage. Points made were the "utmost importance of proper impedance matching in the mixer", measured conversion loss of 8db, receiver dynamic range of 80db, sensitivity on all bands better than 0.1 μV for a 10db S+N to N ratio for a 30% modulated a.m. signal.

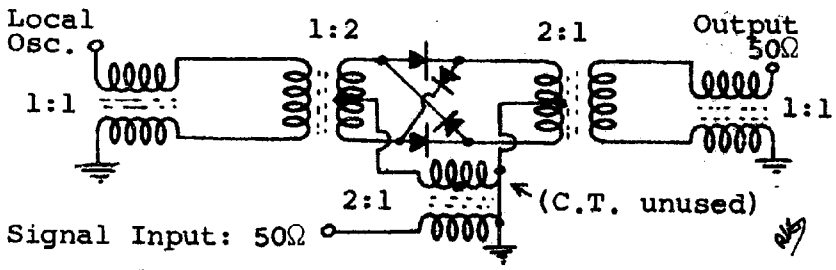
Another interesting reference comes from 73 Magazine, March 1969, "A Better Balanced Modulator" by WA1FRJ. The author claims that the "standard" ring demodulator using trifilar wound input and output transformers suffers limitations:

> "Due to the single-ended input, one side of the secondary has more capacitance to ground than the other. This unbalanced capacitance has increasing effects as the operating frequency increases..."

The easiest way to neutralise the effect of this unbalanced capacitance is to isolate the return side of the primary from ground:



He ends up by writing "The addition of a third trifilar transformer makes a well balanced mixer over the range 2-30Mc -- dynamic range 130db! with hot carrier diodes." Thus:



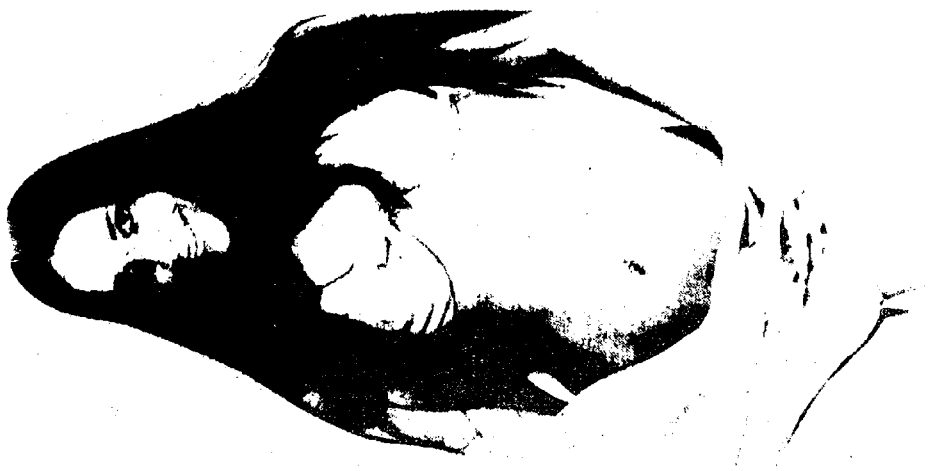
Unfortunately I don't have access to Ham Radio march 1970. Maybe W. Ress said all this and more...

-- Ken A. Harding, Sydney, N.S.W.

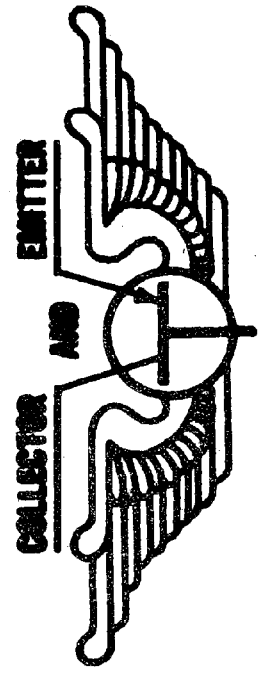
((No, Ress didn't show just that. He presents a converter circuit without the bottom xfr, though he does use input and output xrs which would be balanced if earthing were removed, but it is rather difficult to tell about this, because he injects signal and oscillator in different places than above. He says, "The gain compression point... is 1 volt rms."; if sensitivity were 1μV that would give a dynamic range of 120db, or 140db for 0.1μV. Performance in this respect is probably similar to that of the 73 article, but the latter would be expected to give better isolation between the two signals, therefore particularly relevant to sideband suppression as balanced modulator... We are grateful to OM Harding; this is the most useful kind of letter. -- Ed.))

XXXXXXXXXXXXXXXX

METRICATION is coming to Australia, and we shall be replacing the convenient unit of the inch (which could have been decimalised) with the centimetre (which doesn't fit in at all well with the length of one's knuckles). In keeping with our Theme this month we present the following to assist your endeavours in appreciating metrication, reprinted (if Chris's presses will take the burden) from an ordinarily staid (199% ARRL) electronics pamphlet:



Playboy Playmate is Texas-born Carol Willis, with vital metric dimensions as follows: 1.65 meter; weight (mass) 50.39 kg; 91-63-91 cm. All our readers know that this is the modern way to express 5'5", 111 lbs. 36" - 25" - 36".



EDITOR
Carl C. Drumeller, W5JJ

GOOD (sic) AMERICAN BEER

-- Ed Aoki (Sunnyvale, California)

EEB has boasted several reportedly-good beer recipies -- which must be diluted as needed to satisfy the queer laws of your land. Here is a good Yankee brew, which need not be diluted (at least not here):

Boil 9 gals water for 10 minutes.

Pour 1 gal hot water into crock.

Add 4 lbs corn sugar + 1 can malt.

Stir well until all sugar and malt is dissolved .

Cool remaining 8 gals of water to luke-warm temperature.

Add 8 gals of water to crock, and stir.

Allow to ferment in cool place for a week to until not more than 1% of sugar left. When using a beer hydrometer, 1% = 1^{o}B.

Put 1 tsp corn sugar in each quart bottle (designed to withstand at least 5 atm pressure, or a regular beer bottle of 1 qt cap)

Siphon ferment into bottle.

Cap bottle.

Brew ready in a week or longer.

Note: It is best to grow up a pilot batch first and use a tablesppoon or two of the bottom yeast to innoculate the main batch later. If the yeast is to be stored, keep moist and in refrigerator.

((Good Lord, no Hops!!! Now we know why Yankee beer tastes as it does. -- Staff.))

THE AUSTRALIAN EEB: Editor = R. Leo Gunther (VK7RG), Asst. Ed. and most draughting = Rod A. J. Reynolds (VK7ZAR), Assoc. Ed. = Chris Pitcher (Northcote, Vic), Associates: L. J. Yelland (Prahran), R. S. Maddever (Geelong); Subscription Manager = Robert A. Walton, Secretary = Brenda Ford.

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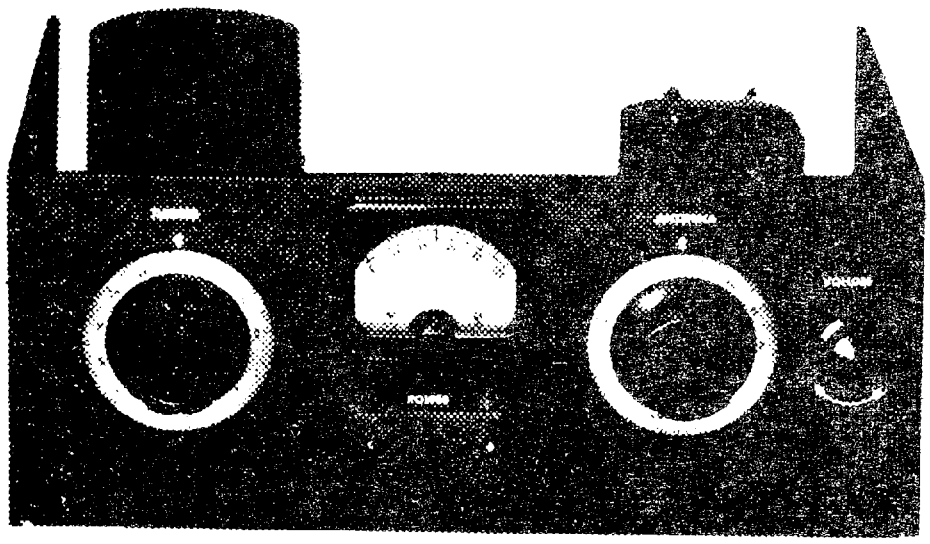
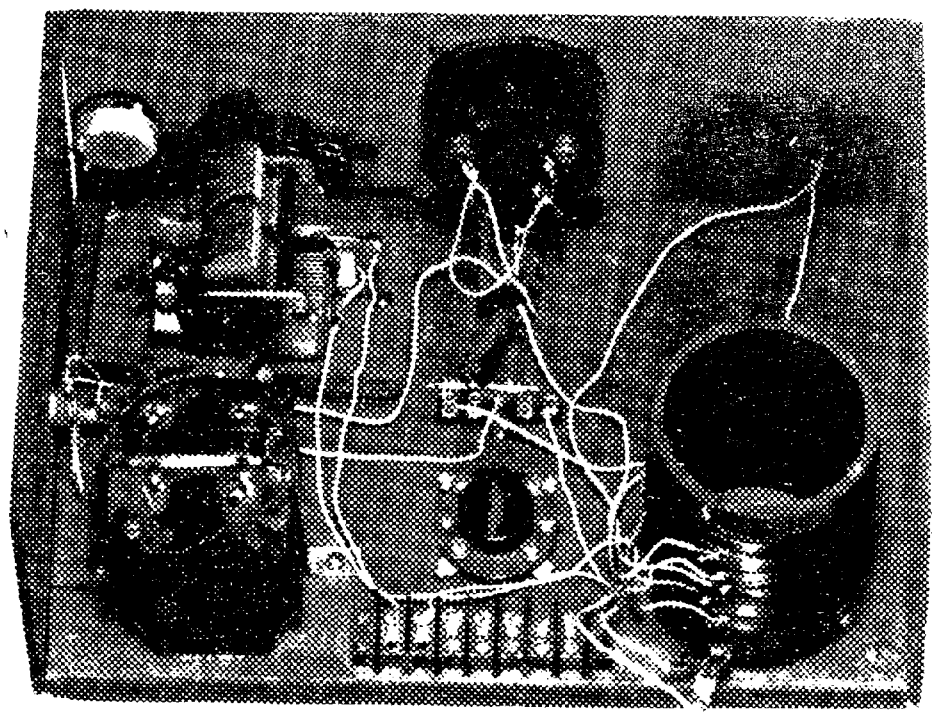
AN INFORMAL ELECTRONICS EXPERIMENTERS BULLETIN

JUNE 1972 vol. 8, no. 3 P. 45





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NEXT MONTH: (late, as usual!)

Apologies apologies for not including Burlinson's Light Beam Electronics as promised (see p.53). It starts in August. Together with A New Look at Old I.F. Amps, More (discrete!) Counting Circuits, and more on the Parts Crisis, etc etc.

STOP PRESS! 4th Ed. G3VA's A.R. Techniques, ~~£1.60~~ ~$3.30 that magnificent book (EEB Feb 71), now £1.60 +post. Order from W.I.A. or RSGB!

THE RECIPROCATING DETECTOR -- a new development in communications technology

-- by R. S. Badessa (of Damon Corporation, /W1)

-- Part I: The Basic System*

The Surprising Detector

The Reciprocating Detector (RD) was originally intended for demodulation of carrierless double sideband transmissions (DSSC). The first one, built several years ago, used only two transistors, so it was quite inexpensive. It was also an oddity, since it required no source of power other than the i.f. signal itself.

I put it in a closed box with the input labelled r.f. and the output labelled audio and found, surprisingly, that this "passive" detector of DSSC could detect SSB as well. But there were other surprises.

When I tuned the receiver to a selectively fading AM signal, the detected output maintained its intelligibility while the receiver's own AM detector garbled in the well-known manner. The reason for this, I surmised, was that the RD did not depend on the carrier nor upon the existence of the two sidebands simultaneously. Such portions of the carrier or the sidebands as existed, it made use of, but it could continue to to function even if only one sideband remained.

Another surprise was its performance against impulse interference. On AM the rejection of impulses was impressive. On SSB it was noticeable, but not as effective, which is one reason for the more sophisticated later design. (The sophistication included the introduction of d.c. power so that the device lost its mysterious passive character, but gained in dynamic range of input signal and in overall reliability.)

The Synchronous Reference

Before getting into circuit details, lets look at how the RD generates a synchronous reference for demodulation of DSSC through the use of regenerative feedback.

Waveform (A) of fig. 1 is an AM signal with sinusoidal modulation. Removing the carrier results in the DSSC signal at (B). Notice that the envelope of (B) is a full-wave rectified version of the original modulation, and that to recover the original from (B) we must "unrectify" the envelope using as a guide the phase information which the r.f. under it contains. For the example shown, the r.f. has the same phase as the original carrier during the positive part of the modulation cycle, and is 180° out of phase with it during the negative part.

As a first step in demodulation, the RD halfwave rectifies waveform (B) to produce the waveform shown at (C). This does not remove the r.f. component, nor the phase information associated with it. It has, of course, introduced an audio component, but not a useable one. It has also clipped off the negative half of the r.f. cycles so when I say "phase" I mean the phase of the fundamental.

Waveform (D) shows the result of "unrectification", i.e., the flipping-over of all portions of the waveform having an

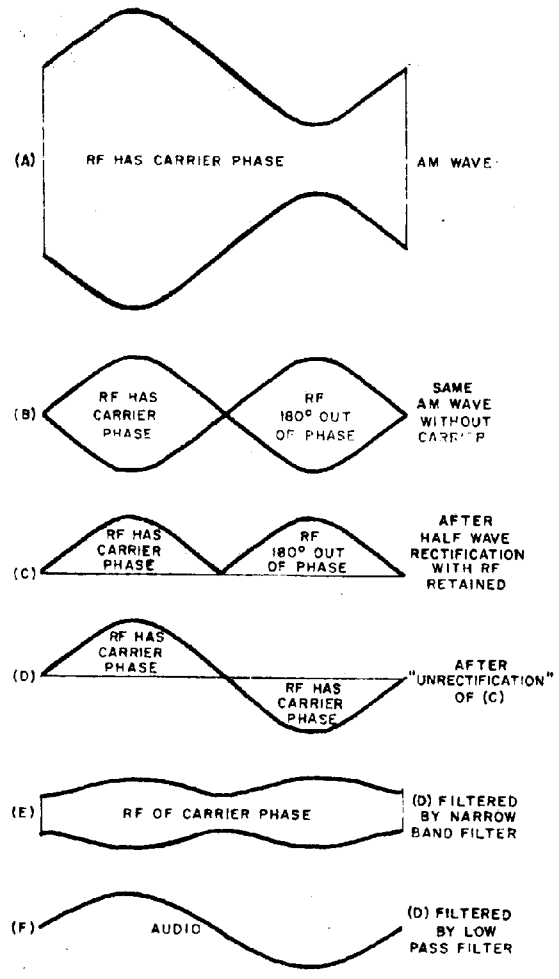

FIG. 1 RD WAVEFORMS

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* See also:
R. S. Badessa, "A Communications Detector with Signal-Synthesized Reference," IEEE Int. Conf. on Communications, 6/71.

S. Oldberg, W1SNN, "Reciprocating Detector: This novel circuit has many advantages over conventional detectors since it automatically adjusts its BFO level in proportion to the average signal level," Ham Radio, March 1972. Followup, late '72.

r.f. component 180° out of phase with the original carrier; of course this requires comparison of the r.f. with a local reference of carrier phase, which we don't actually have, but suppose for the moment that we do have such a reference. I will explain later how the circuit actually performs the operation.

For the present, notice that the flipping-over of the selected portions of the waveform has not only restored the negative half of the audio cycle, but has also polarized the r.f. components so that all parts of the waveform have the same r.f. phase. This means that a carrier has been restored. We can isolate it with a narrow-band filter (a bandwidth of 500 Hz or less is typical) and remove the audio with a low-pass filter. These components are shown in fig. 1 at (E) and (F) respectively.

As noted, the process of converting (C) to (D) requires comparison of the signal r.f. with that of a local reference, but since the narrow-band filter has inertia and its output is at the correct frequency, the r.f. of (E) can itself be used for this purpose.

This may seem like picking oneself up by the bootstraps, but its really no more so than any other form of regenerative feedback.

The process of taking a DSSC waveform and reversing its polarity at opportune moments to get the continuous carrier phase of fig. 1 (E) may suggest the conversion of translatory motion to rotory motion in a mechanical reciprocating system. Hence "RD".

The Basic System

Fig. 2 shows a basic RD system. Transistor Q3 is biased virtually at cutoff and serves as a half-wave rectifier for the incoming signal and also as a current source for the emitters of Q1 and Q2. The reference on the base of Q2 enables it to conduct on the positive reference peaks. Because the emitters of Q1 and Q2 are driven by a common current source, Q1 is enabled to conduct when Q2 ceases to conduct -- i.e., on the negative reference peaks. But since neither Q1 nor Q2 can conduct unless Q3 is also conducting (which it does only on positive r.f. signal peaks), it follows that Q2 conducts whenever the r.f. of the signal is in phase with the reference and Q1 conducts whenever the r.f. of the signal is 180° out of phase with the reference. Since the audio and r.f. outputs are obtained differentially from the collectors, a transfer of conduction from Q1 to Q2 or vice versa causes a reversal of output polarity, ie, the flipping action required to convert the waveform of fig. 1(c) to that of fig. 1(D).

The Question of SSB

So far we've talked mostly about the synchronous mode. Oddly enough, people generally have more difficulty understanding the non-synchronous condition. "How in the world", they ask, "does it detect SSB?"

The easiest way to understand this mode is to realize that without feedback the circuit of fig. 2 is basically a conventional detector; though I'll grant that the use of half-wave rectification of the signal in Q3 may be a bit unusual. In other words, if a fixed Local Oscillator is substituted for the reference presently driving Q2, detection of SSB signals occurs in the regular way. The question, then, should more properly refer to the generation of a reference to detect SSB rather than to the detection itself.

Suppose we were to replace the input signal presently driving Q3 by a d.c. voltage. This voltage would be converted to a fixed d.c. current in the collector of Q3. Transistors Q1 and Q2 would now become a differential amplifier which, because of regenerative feedback, forms a simple oscillator operating at the centre frequency of the filter.

In reality the "d.c." on the base of Q3 is the average of the half-wave rectified signal. The flipping action mentioned in connection with DSSC operation still occurs, but the operation is difficult to follow on a step by step basis because of intermediate phases resulting from the

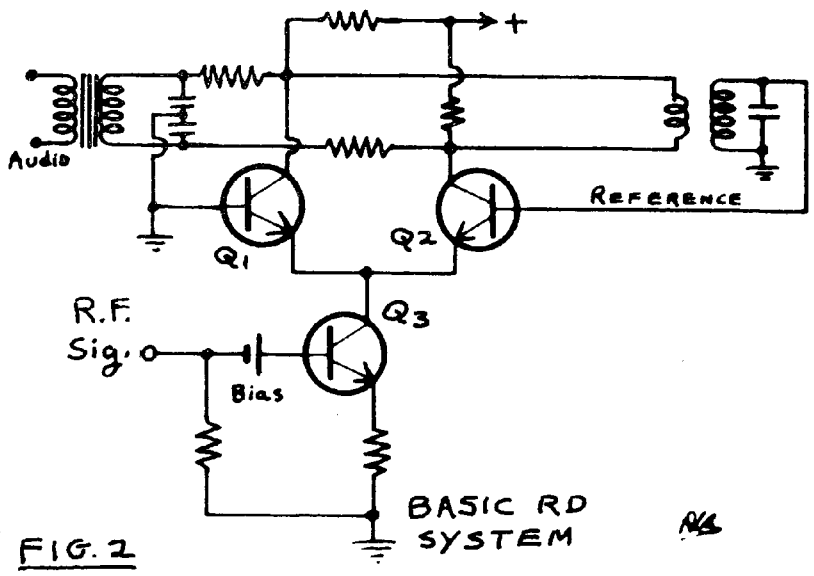

FIG. 2

frequency difference between signal and reference. In this non-synchronous mode the reference has a frequency that is no longer controlled by the signal, but it does have signal-induced phase fluctuations and an amplitude that is a filtered version of the signal envelope.

The Synchronous Bandwidth

When a DSSC signal is tuned in on a receiver equipped with an RD, synchronous detection takes place over a band about one-third the passband of the narrowband filter -- i.e., over a band perhaps 150Hz wide.

If the receiver is mistuned beyond these limits the detection becomes non-synchronous and DSSC operation is unsatisfactory. But for properly tuned signals the transfer from one mode to the other may occur without the operator being aware of it.

For example, an SSB signal that happens to have some unsuppressed carrier can by careful receiver tuning be detected synchronously. But if the carrier should disappear, as from propagation effects, the detection would become non-synchronous automatically, i.e., without requiring receiver readjustment.

The synchronous bandwidth of the RD is one-third the bandwidth of the filter only if the upper and lower sidebands of the signal are completely correlated. For example, suppose we are detecting a DSSC signal and an interfering carrier appears just outside the synchronous band (almost the centre of the signal spectrum). This interfering carrier causes an unbalance in the sidebands and a reduction in the synchronous bandwidth.

Eventually, of course, if the interference gets strong enough, the synchronous bandwidth is so small that receiver instability prevents synchronous operation. But notice that the reference never leaves the signal to latch on to the interfering carrier. This results from an interesting characteristic of the RD: the synchronous bandwidth is independent of signal strength. This is true over a wide dynamic range without reliance on any form of limiting. Since the interfering carrier is already outside the synchronous band it has to stay outside even after it has completely overpowered the signal!

Phase Synchrony?

You may question the usefulness of a reference that does not follow the traditional pattern of phase-synchronous systems; it has neither a quiver of phase nor a trace of amplitude modulation. Lets consider this further.

With regard to phase jitter, the peak deviation of a virtually unfiltered RD reference is incapable of exceeding 30°. This is not obvious, but remember that even a 180° phase jump in the incoming signal gets completely removed by the flipping operation.

So a filter with a bandwidth of 500 Hz or less will yield no significant jitter even if the "signal" is nothing but random noise! With regard to amplitude variations, the same filtering reduces fluctuations in the reference to such an extent that most of the drops to zero experienced by the signal envelope do not show up at all, and those that do show up occur at times when the effect is minimal. The maximum rate of these fluctuations is perhaps 250 Hz.

The Consequences

The consequences of having a reference amplitude that is a filtered version of the signal envelope deserves further attention, since it is the basis of the RD's impulse noise immunity. This will be taken up in Part II.

A parting thought: The circuit of fig. 2 is intended for explanation only and I wouldn't recommend it for actual use. You would probably get bogged down with problems such as insufficient gain, spurious phase shifts, etc.

Part II will present the schematic of a more practical arrangement with instructions for optimizing its operation.

XXXXXXXXXXXXXXXXXXXXXXXXXXXX

THIS MARVELLOUS AGE

-- ((W.A. VHF News Bulletin, May 1971))

For the last decade (or is it longer?) we have been getting brainwashed about the wonderous life we will lead when the computers really take over all the work.

Well, the day seems to have arrived!

Recently one of our members changed vehicles, and as the new one was somewhat more valuable, the cost of insuring it was some six dollars and twenty-seven cents greater. The usual interim arrangements were made, with the account to be sent along later.

From here onwards we sever our connections with the stupid old fashioned ways, and plunge headlong into the Computer Era.

In due course, the account for six dollars and twenty-seven cents arrived, accompanied by a cheque for precisely the same amount. Not only is this new method a positive step in the battle against inflation because it stops unnecessary spending, but it also saves all that work involved in running around to get change, writing receipts, posting in ledgers and all that outmoded nonesense.....

((see also "Swoop" on p. 68 here))

POLITICAL CONSIDERATIONS IN THE PARTS-AVAILABILITY CRISIS -- A. G. Adams (VK4)

It is on recent public record that men at the helm of the two largest Australian consortiums involved with manufacture and supply of consumer electronics (Philips and AWA) have bluntly put to Federal Cabinet the question, "Does Australia want an electronics industry with a much greater measure of self-containment or does it not? It must make up its mind -- and quickly". Attention was drawn specifically to the run-down state of the industry in terms of components production, due to failures in government policy to provide adequate local incentives, notably suitable protective tariffs applying to this area of business activity.

These manufacturers are, of course, concerned most immediately with Colour Television, for which tooling-up has begun. Firm advice is being sought as to how far this should be proceeded with, in terms of investment. Will subsequent imports of receivers, spares, and subsidiary equipments, make extensive tooling programmes unprofitable -- as has been happening within the U. S. A., the U. K., and some European countries?

Unless positive assurances to the contrary are received it is clearly innuendoed that the industry for want of alternatives will meet its manufacturing committments in the best interests of public and shareholders by obtaining a substantial part of componentry via import.

To this date (July), to the best of my knowledge, no concrete decision bearing on this matter has been arrived at or announced by Government or the Manufacturers, though it could well be that a pact twixt all has been settled but not announced, nor are we likely to find its exact terms.

I have grounds for the conjecture that all major companies, now few in number and including Philips and AWA, with international rapports will receive even more favourable treatment than they have been receiving in respect of Tariff and Treasury permissions. This will give them increased dominance in the electronic bits and pieces field.

Leaders in the industry openly admit to a commonly agreed-upon internal policy of greatly increased rationalisation in manufacture. In practical terms this would seem to mean a reduction of competition within specific production areas.

Now however you adjudge this, and you will do it according to your politics and the kind of information you have at your disposal, one outcome is certain. Big Business will tighten up its resolve to serve primarily Big Business exclusively, and small business (with the amateur and experimenter on the outer perimeter) will be even harder put upon to make shift for essential supply and service. The only chance for practical survival for these essential minority interests lies in the direction of pressing vigorously for treatment of similar kind to that being demanded by Big Business.

If locally made components are to become increasingly scarce, and locally-distributed imports are to increasingly be restricted in kind and availability, it is indubitably just and reasonable that the small consumer -- be he manufacturer, trader, amateur operator or private experimenter -- be given equitable access to markets outside Australia for his component needs. There are more of these external sources than many are aware of. Tariff policies, as now formulated, offer little encouragement of such awareness.

A Proposal

With some diffidence I submit a tentative suggestion for the relief of the P.A.C. ("Parts Availability Crisis"). Readers who are concerned by the P.A.C. should bring this matter to the attention of their local M.H.R., and require him to represent it to the Prime Minister and those Ministers of his Cabinet to whose portfolios it is relevant.

Amateur operators and experimenters might fitly seek an assurance from their local Member that he demand on their behalf exemptions from (or very substantial reductions of) sales tax and duty on yearly purchase transactions up to some stipulated amount -- say $1000. The 27.5 percent sales tax levied on much electronic componentry is quite exorbitant. It cannot reasonably be justified for what obstacle it places in the path of what is primarily a recreational interest, a healthily constructive one yielding real benefit to the nation from the skills and experience it stimulates.

Should your MHR show himself reluctant to press your demands, or in a non-committal way attempt to fob you off with Signed Form Letters, he must be told in polite but unwavering words (backed by honest resolve) that he is not doing the job he was elected to do. And that if he does not forthwith represent your valid and lawful interests you will be energetic in using all fair means at your disposal to remove him at the earliest opportunity.

Should your demands promote discussion, keep the matters of P.A.C. in sharp focus and precise context. Do not be led or provoked into lashing out at broader issues which you may believe, perhaps rightly, are relevant to the P.A.C. It may be suggested that what you are demanding is "Not in the National Interest" -- or you might be asked how a loss in revenue you are proposing is to be made up.

Do not be drawn by such routine persiflage. You do but need to remind the gentleman that a national interest includes you or it includes nothing, and that you do not presume to instruct the Treasurer (without pay) as to how he should juggle imposts. Do I get the parts I need on fair terms or don't I? Do I get the same preferential treatment as big industry or don't I? If not why not -- a written statement, please.

Concerted persistent action by a sufficient number -- not necessarily a large horde -- of individual amateurs and experimenters could produce worthwhile result. As in many predicaments that threaten genuine private enterprise on the homely plane, self-help and initiative is the only way out.

To do no more than grumble at "they", or to nudge the other fellow to come up with a solution, indicates a serf mentality. It will achieve all the deprivations that such people deserve, I guarantee it. There is no real scarcity of electronic components on this planet.

Not yet, anyway.

Editor's Note

My article, "Component Availabiltiy -- II" has been deferred in favour of the above proposal by an active small businessman. In that article I continued last month's theme on what to do if components are not available, but surely Mr. Adams' proposal should take first priority, since it is a practical programme for ensuring that the components are made more widely available for everyone.

Certainly, as Jamieson Rowe points out in his excellent Editorial in the June 1972 Electronics Australia, manufacturers have been finding it increasingly unprofitable to handle small orders, and that "this situation is reaching crisis proportions..." Mr. Adams' alternative of stimulating inexpensive imports seems a sensible alternative.

There are also other problems, but I shall discuss them in these pages in a couple of months. Next month's installment is reserved for Rod Reynolds, who analyses some of the deeper reasons for the P.A.C., and concludes by supporting Mr. Adams' basic idea.

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

((As relayed to us by our Assistant Editor, author not specified:))

I had eighteen bottles of whiskey in my cellar, and was told by my wife to empty the contents of each and every bottle down the sink.. or ELSE

I said I would, and proceeded with the unpleasant task. I withdrew the cork from the first bottle and poured the contents down the sink, with the exception of one glass which I drank.

I extracted the cork from the second bottle and did likewise with it, with the exception of one glass which I drank.

I then withdrew the cork from the third bottle and poured the contents down the sink which I drank.

I pulled the cork from the fourth bottle down the sink, and poured the bottle down the glass which I drank

I pulled the bottle from the cork of the next and drank one sink out of the next glass which I threw down the cork

Then I corked the sink with the glass, bottled the drank and drank the pour. When I had every thing emptied, I steadied the house with one hand, counted the glasses, corks, bottles and sinks with the other which were twenty nine, and as the house came by I counted them again, and finally had all the houses in one bottle which I drank. I'm not under the affluence of incohol as some thinkle peep I am, but the dunker I stand here the longer I get....

XXXXXXXXXXXXXXXXXXXX

Quote

... And their studies of 200 miles of coastline have unearthed a point of some significance. The only 'plague' concentration they found was in the most contaminated part of the most polluted reef area on the coast.

The conjecture is that contamination deters fish or other predators which normally eat the eggs of the starfish. And since the female starfish produces as many as 14 million eggs, this could have a dramatic effect on the population....

In the end he believes the problem of the starfish is part of a bigger problem, with deep seated consequences -- the conservation of the environment and, particularly, man's relationship with the sea.

"It all seems to come back to this mistaken feeling that the sea is limitless, that you can never pollute it, and you can never overfish it."

-- Report by Tim Radford, London, on the Crown of Thorns starfish which is now happily destroying the Great Barrier Reef whilst the Federal and State Governments debate whose fault it was. (Hobart Mercury, 21/8/71)

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CRYSTAL SET TECHNOLOGY, Part I -- RLG

I have done a fair bit of research into crystal set design, and a nice article is in preparation (time permitting!) -- a preliminary report appeared in the March 1972 issue of the Radio Bulletin (April EEB for Review of the R.B.). But for now the conclusions can be set out here for the benefit of the impatient.

The diagram shwn in fig. 1 will give performance as good as can be obtained from any crystal set, and better than most. In the Literature are innumerable designs for crystal sets, each claiming to be the "best". Many improvements they make are superfluous, others (e.g. various coupled coils) accomplish no more than the tapped system shown here. The capacitor often seen across the phones gives only marginal improvement so is omitted here (the phones seem to have enough capacitance). My design features a Signal-Strength Meter, and that IS unique! The fidelity obtainable with a good crystal set is marvelous, and I recommend such to HIFI enthusiasts; but if you are going to add a proper amplifier and speaker, you will need better selectivity than can be obtained with the simple system of fig. 1 here. This is possible by using twoparallel tuning circuits in place of one: capacitatively couple them with 5-20pF, and gang the capacitors. Details in Part II.

Essential points of fig. 1 are:

(1) The choice of diode taps is important, and should be adjusted for each situation. For most, the diode taps may be placed at about 30% either side of centre tap. Incidentally I should mention that when I specify some %, it is the number of turns represented by that fraction of the total number of turns on the coil. I do this because coils will differ.

This gives a good balance between selectivity and sensitivity. If a loud signal is more important than ability to separate stations, taps may be placed further out, e.g. ±50% either side of centre (viz, right across the ends of the coil).

(2) The antenna and earth taps will depend very much on the length of antenna. A 20-metre length will need about ±30% taps (either side of centre), but this also depends on selectivity desired vs signal strength (the two are in conflict). Running the taps toward the ends of the coil gives a louder signal at the expense of selectivity, and conversely.

As the antenna is made longer, the optimum A/E tap will decrease, i.e., both go closer to the centre-tap. When the antenna is $\lambda/4$ (eg 100 metres) long, the taps should be only about ±7%. Still longer antennas require more turns again, and give stronger signals; I had a glorious opportunity for some research on this recently when visiting a farm!

(3) The antenna tuning capacitor (C2) is necessary only when the antenna is non-resonant -- which will be most of the time for anyone except a farmer (ah, that farm; I could have set up a Rhombic on 600M!). C2 is adjusted with the tuning capacitor (C_1) for best balance between signal strength and selectivity: Start with C2 at max, tune C_1, readjust C2 for best volume or minimum interference from nearby signals.

(4) The diodes must be germanium, and preferably selected for best results, particularly if computer board types. To test, use only half of the balanced circuit, and substitute diodes until maximum output is obtained (e.g. as read on meter)

(5) High sensitivity earphones are best; the higher their impedance the further out the diode taps can go whilst retaining good selectivity. Crystal earphones would probably be best, but must be isolated from d.c. by a 0.01µF blocking capacitor, and the d.c. return must be provided, preferably by a choke.

(6) A good earth connection is essential! Do NOT use the mains earth. A water-pipe connection is bare minimum; a good counterpoise is even better -- See RSGB "Radio Communication Handbook", pp 13.46 to 13.48.

Where a large amount of space is available (e.g. 200 metres in a straight line), quite good results in lieu of an earth connection are obtained if wires are fed from the "A" and "E" terminals, and run in opposite directions, as high as practical. This is, of course, a dipole.

(7) The meter shown in fig. 1 actually measures signal strength; an S-meter on a crystal set! A 50µA movement will be all right for 20 metres or so of antenna, or 500µA for 100 metres (if room). If you want delicate tuning for weak signals without pinning the needle on strong ones, a 50 or 100µA movement can be used by inserting a resistor at "X" and a silicon diode as dotted in. Increase the R until meter reads only FSD on the strongest signal. This was quite necessary at our location, because 7HO brought in some 500µA (2000mV of signal!) while 7ZL developed only 20µA, with a 110 metre antenna.

(8) A simple transistorised amplifier may be fitted to give superior results from magnetic headphones, as in fig. 2. E may be anything from 0.3V upwards. A solar cell works well. A penny and six-

→ P. 61

"You won't get rich advertising here, but you'll see your name in print" — Wayne Green (73 Magazine)

EEB Staggers On

I had every hope of producing this issue moderately "on time", but I have been deeply involved with measuring the fallout freely exported to us by the French. There was fallout in Hobart, of course, but it was small. It will be even less in drinking water than in the rainwater measured, and the dose will be insignificant to ordinary body cells. But it does add somewhat to genetic effects, viz., damaging your children's heredity...

A rather interesting observation happened in the course of measuring background radiation. There was a considerable increase of cosmic ray activity about noon on July 7, and this coicided with an unusual propagation condition which allowed communication betweenTasmania and Queensland on 10 metres. It occurs to me that one could watch for band openings merely by connecting a simple radiation-counter to an automatic alarm system, arranged to give indication when the background exceeds a certain level. When the bell rings, jump up and turn on the receiver! Does anyone know anything about this kind of thing having been done before? Incidentally, in February we printed the circuit of a transistorised Geiger Counter preamp...

In preparing the various articles for this issue I simplyattacked the large stack of manuscripts etc and typed and typed without counting pages. When I put it all together I found that there was enough material for another year's worth of issues, at 15 pages of Offset copy per issue. I've been working harder than needed!

I don't know how we'll get everything printed. We could increase the number of pages per issue, but that costs money, and it doesn't look as though we've got much chance of getting much real advertising.

We contacted a number of potential advertisers (no I didn't really give it away completely) for this edition which is being printed in some quantity for promotion. We offered advertising at somewhat below cost level, to present evidence that there are indeed a number of useful component suppliers in Australia. The only one to take the offer was Kitsets-Aust, who have been advertising with us for several years. Kitsets' advertising has been a mark of confidence in EEB, and a recognition that Electronics Experimenters are the ones most likely to buy electronic parts -- and that my tirades against commercialism are directed merely against abuses of commercialism. If you buy from Kitsets, do let them know that you come from EEB -- and I'd recommend their thick Catalogue to you. It contains an amazing amount of stuff, and is well worth its price of 50c, likely about cost price for that item.

Omissions, etc.

In Yelland's "Threshold-operated Null-Point Amplifier" last month, p. 31, please note that the polarity of the diode, D_1 should be the other way about; please correct it now while you are reading this. Thank you.

As mentioned on p. 45, I must apologise for not having included Burlinson's promised article on Light-Beam Communication this month, but when everything was assembled there was no room left. But it will have an advantage that it will be presented in two instalments rather than 3.

I'm afraid you may be noticing some worsening of the quality of draughting of diagrams in EEB, but it can't be helped. Rod is now too busy to do our draughting, and I have been doing it myself, as possible. I hope to find someone who will do it for us, but the problem is, of crse that the pay is rather poor — but quality need not be exceptional either. Anyone in Hobart interested?

Ici Je formalise ("ICs Forever")
(or: "Leggo for experimenters")

Last November I asked whether you would let me know when EEB became Banal. We have, it appears, a candidate, who comments:

"I recall that some years ago the Editor expressed disapproval of the use of ICs on the grounds that they took the pleasure out of constructing things oneself, in amateur electronics. I never dreamt that that opinion would be put into magazine policy and have such drastic effect after so many years.

"Digital ICs are below $1, and Op Amps of incredible performance less than $1.50. On seeing two correspondents solemnly describing two devices (counter and null-detector amplifier) using several transistors when one IC would do a superior job in each case, I realised that the EEB had become quaint.

"If it is the magazine's intention to convey new ((PTO))

information, then the present policy will need to be altered. Alternatively, you don't mean what you write concerning picking up the circulation.

"A further point I wish to make is that EEB caters almost exclusively for the Ham (sic) or R.F. work. Many persons like myself are interested more in electronic devices and circuits which can employ the more recently developed components."

— G. N. Boyd, North Balwyn, Victoria.

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Looking back through Editorials I see that his accusation is indeed correct that I have not favoured the use of ICs, for reasons well stated on pages 68 and 76 of the 1969 EEB. But 1969 was also a turning point when we published our first IC circuit (p. 26), and when I began to state tht ICs may have their uses.

Since then I have described in detail some of the remarkable circuits available through the use of ICs (and a large part of them in the field of communications which our correspondent doesn't prefer*), and if there is such a thing as an EEB Anti-IC Policy it has certainly been modified by Progress. I would also note that I have never refused an IC article of good design, though we have turned back some which did not meet that qualification (c.f. Oct 71, p.79).

In December 1971 I questioned the value of packaged circuits on the basis of human values, but the fact does remain that ICs are becoming a greater part of electronics and if we are to have to live with them we must learn how to live with them intelligently.

In late 1971 I argued at length about the need to adopt a receptive attitude to new developments of every sort, and I must swallow my own medicine. I also note that in Nov. 1971 we published an IC Squaretable in which a variety of points was brought up pro and con, well illustrating my Editorial comment, "Let commonsense rule: use a semicon or IC where it can do a better job (for whatever reason), and only then."

It appears, however, that the time has come to examine further the conditions where that applies, and EEB's place therein:

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* We also receive letters telling us we have too many articles on power supplies, inductance bridges, transistor testers and automotive topics -- and not enough on Amateur (not HAM) matters... Jacque's son has the gout.

EDITORIAL - 2 — by Rod Reynolds, VK7ZAR (Asst. Ed.)
— The Place of ICs in Electronics and in EEB.

An EEB Policy

Some years ago the Editor spelt out a policy of avoiding the then relatively new integrated circuits on the basis that:-

1. From the educational point of view the discrete design of electronic units would be lost.
2. At that time circuits using recovered computer board transistors and components were considerably cheaper than the equivalent available ICs ((they still are, for the small-circuit ICs -- RLG)).
3. ICs generally available were of limited performance and of high susceptibility to transients etc.

Several recent letters and personal observations have shown that this policy could well be still in force. Certainly perusal of recent issues of EEB brings very little evidence of ICs being considered. But this is only partly true.

ICs have their place, of this there is no doubt. It wld be and is feasible to build complete systems using nothing other than ICs (as RLG has indeed pointed out in his articles on Receiver Design in recent issues) at a considerable saving of cost, reliability, and space compared to an equivalent unit using only discrete devices. There are, however, several other points that should be considered:-

Extenuations:

1) Many EEB projects are just that -- they are experimental, and are well suited to discrete devices. Discrete device practice is often excellent in illustrating design principles, and indeed such design principles must be understood thoroughly in applying IC technology. Would you have us describe an electronic counter stage to beginners in terms of Black Box theory? There's time for that later.

2) Most EEB projects are the result of the work of our contributors, and if these people choose to contribute discrete device articles, this is what we print. There is nothing particularly wrong with that, and it is not necessary to use ICs for simple circuits. In any event the fact remains that very few suitable articles have been submitted using ICs.

The last-mentioned point is, of course, no defence for not using ICs, but it does explain that we have not deliberately discriminated against IC articles.

Perhaps it is time to restate the policy ((cont. p.55))

of this magazine, if it can be said that we are well-enough organised to possess a policy, in regard to the proposed use of and solicitation of IC designs.

The Use of ICs

There is no doubt that a vast financial saving is achieved by using ICs in Industry. Consider the case of the desk-top calculator where performance and features can be provided for a tenth of the cost of a similar unit which uses even small-scale integration, and at a very small fraction of the cost of a unit using discrete components — to say nothing of the size. A modern hand-held calculator contains of the order of 30,000 equivalent transistors, i.e., if TO-5's were used this would occupy over 15,000 cubic centimetres (that's 15 litres!) of well-packed transistors alone, to say nothing of the rest of the equipment!

Most of the IC types normally considered by the experimenter will be rather different: there is for him a real place for the linear IC and the smaller digital IC (up to, say, BCD Decade converter) in his designs. According to RLG's "commonsense" rule, ICs apply best here because they can do a better job than anything else.

Or, consider Phase-locked Loops using a single IC. They are more convenient than those using discrete components, and some of EEB staff are considering the use of them in planned equipment — although one of us is still in favour of a valved PLL ("only 7 valves!"). Each to his own taste, but one would imagine that one Black Box would be simpler than 7 transparent ones (plus resistors and the rest).

As an Engineer I will use ICs where they are called for. But there are some areas where the use of an IC, even if available, is rather pointless, e.g. an HF flip-flop where high current output (say 100mA) is required. Two transistors will provide this, or one IC plus transistor driver.

Discretes are also preferable where there are special requirements for frequency, power or voltage; indeed valves may prove better for this than transistors — as is the fact in the new colour TV sets, which use mostly ICs and valves. Discretes may also be specially useful for other special requirements such as core-drivers, interfacing between ICs, or something particularly simple such as a single common-emitter stage for impedance transformation. But for most "ordinary" circuit functions the ICs win.

So — wheel out the designs that use linear amps, pwr amps, TTL, RTL, and eventually MOSIC (viz, IC FETs) where convenient, and they will be added to these pages.

((BUT PLEASE PLEASE SPECIFY WHAT THE FUNCTIONS ARE FOR THE VARIOUS PIN NUMBERS ON THE B.B., SO THAT OTHER PEOPLE MAY MAKE ALTERATIONS OR USE ALTERNATIVE ICs IF DESIRED!—RLG))

We leave it to you. The EEB staff have quite enough to do in putting the magazine together without leading the field in the development of these circuits and articles. The large periodicals and trade papers are available to these people who want doses of IC technology. And in magazines such as Electronics Australia or Break-In, QST, Ham Radio, or Wireless World you'll find an often balanced mixture of discrete and IC circuits, as well as articles on IC fundamentals. EEB has its own unique function — only a part of which is to present circuits.

A Logical Development

The apparently revolutionary changes being wrought by ICs is a logical development of electronics. We all assume that we can buy a 390pF (or whatever) mica condenser off the shelf, but it was only 50 years ago when the experimenter who wanted 390pF made it out of a couple of pieces of Bakelite, some silver sheet, and mica.

The time has come when the breadth of design need not deal with the detail of what components to use in a circuit, but with what circuit block to use in a system. One then arrives at the current state of system design in much the same way as our pioneers changed from component design and manufacture to circuit design and building during the 1920's.

It might be argued that modern design had arrived even a few years ago when the Editor of EEB stated his opinion on ICs, but the devices were not generally available, and those available were of relatively high price, dubious reliability and limited use. This no longer holds; price is low, reliability approaches that of passive devices, and each new advertising note announces new ideas for ICs which cost less

Why not give them a go?

Don't Panic!

These ideas need cause no distress amongst sincere discrete-electronics enthusiasts, and our good Editor can wipe that stricken look from his face. We will certainly accept articles using discrete components where relevant ((and for a long time even when merely convenient! — RLG)), but we now seriously encourage experimenters to stock up on ICs as you would have done for transistors when they first ((cont.,p.57))

((Anyone want to join a Baby-sitting Cooperative Club in the Sandy Bay area? Phone 237-670))

ADVERTISING

— we guarantee nothing

ADVERTS FREE TO PEOPLE (only)

((Cadavers emptied))

THE NEW SOUTH WALES DIVISION of the W.I.A. is pleased to announce the appearance of the Magazine "6-UP", dedicated to VHF, beer, and assorted useful comment and announcements. Good homebrew gear is featured. The article on FETrons in the July issue scooped all the Australian electronics journals. Current feature article is treatment of theory of Phase Locked Loops, to be followed by various applications. Subscriptions by post, $1.50 per annum; distributed free at the Sydney VHF Group Meetings (W.I.A.). Write, "Editor, 6-UP", 14 Atchison St., Crow's Nest, N.S.W. 2065.

WANTED: Old World War II portable type transceivers in unmodified or slightly modified condition, with the service & operator Handbooks — such as No. 62, No. 19, No. 122, FS6, No. 11, or any other types known in that period. I am willing to pay reasonable prices for the above. Should anyone know of other types made and used in Australia during WW-II, I would appreciate any information supplied./ R.D. Champness, 24 O'Dowds Road, Warragul, Vic., 3820. (VK3UG)

FOR SALE: BC221A frequency meter in very good condition. Best offer. — A.J. Van Genderen, 15 John Street, Ashfield, N.S.W. 2131.

WANTED: C.Ray Tube ECR30 or VCR139a. Write: B. R. Williams, 284 Rocky Pt. Rd, Kogarah 2217

WANTED: Old ARRL Radio Handbooks for Youth Radio Class. Cash paid. Books need not be in good condition. Write EEB

COMPUTER BOARD COMPONENTS: 15 transistors, 15 diodes, 15 resistors, $1.00; postage 10c for components; with 4x2½" board, 15c. Write: L. Mac Donald, Geelong Road, Buninyong, Vic. 3357.

COMPUTER CIRCUIT BOARDS: 10c per transistor, all other components free. Transistors are high quality germanium, PNP or NPN (specify). Data notes, 20c extra. All postpaid. EEB, 32 Waterworks Road, Dynnyrne, Tasmania 7005.

SUBSCRIPTIONS at very low prices, special EEB arrangement (for Australia only): CQ Magazine, $5 per year; Ham Radio Magazine, $8.50 per three years. These are the lowest rates in the world. For you, while they last. Write EEB at S.B.

BOOKS AT LOW PRICES: Obtain the best and latest U.S.-published books, as reviewed and referred in the EEB and elsewhere. When ordered directly from the USA you can save a lot compared to Australian bookdealers price, and the difference between $A and $US often pays for most of the postage. A small commission is charged. $US drafts can be obtained from any large bank. SEND your orders to:

HOOD's Books and Amateur Radio Equipment, P.O. Box 32064, Oklahoma City, Oklahoma 73132, U.S.A.

EQUIPMENT AND OVERSEAS COMPONENTS AT LOW PRICES: Some components are difficult to obtain in Australia, particularly the newer types. It can be worthwhile sending to America for them. Prices will generally not be higher than Australian, and often lower. Receivers, Transmitters, Test Equipment of American origin can almost always be obtained more cheaply directly from the U.S.A. than through middlemen in Australia — even after Customs Duties! We can put you in touch with reliable distributors of a number of makes of equipment (though not all), with special reference to the "DRAKE" line. Write EEB, specifying your requirements specifically as possible. Answer will be forthcoming in due course.

If you are considering this kind of importing, check first with your local Postal Customs Office. Orders under $A40 (about $US47)can always be handled with negligible red tape. Orders over $A40 require merely that you fill out some forms; by using a bit of intelligence in filling them out you can bypass the expense of a Customs Agent for all but the largest transactions. So, contact EEB if you need help.

EDITORIAL (cont. from p. 55)

became practical. Even RLG's desperate comment in brackets above (bottom p.55) may turn on him; when you have on the shelf an IC which will give you lots of gain or power or whatever, will you bother to construct the equivalent discrete circuit (and to troubleshoot it!)? Which will be more "convenient"?

Consider, for example, the Power Supply Regulator described in the June issue of Electronics Australia (a magazine which is shaping up quite nicely under the stimulus of competition). With one MC1469R IC and a transistor it gives 0.03% regulation at 400mA. You'd have to have something rather more elaborate than the usual discrete circuit to accomplish that. And it would cost more and wld be much more trouble to construct. This IC has only 10 connections. What could be easier?

If you are afraid of ICs, use transistors, FETs, or valves; we aren't going to force you into anything. But if your friends get the same (or better!) results quicker and cheaper with ICs won't you feel that you're carrying water in a bucket when a motorised pump lies nearby and you need only to press the switch? Eventually it will be as pointless to build individual circuit blocks as it is now to make your own condensers. After all, you are perfectly free to make your own condensers, no one will stop you, but who bothers?

((Ahem... In February we printed an article telling how to make your own condenser, when the home-made article could do a specific job better than commercial ones.--RLG))

When to do it

In any event, as I say, we shall for some time accept all manner of articles still using simple discrete components, but we will sometimes point out where these might more easily be replaced by suitable ICs. On the other hand we will take a rather hard look at complex circuits whose circuit elements could more profitably be replaced by integrated circuit blocks, e.g. complex d.c. amplifiers using discrete components when an Operational Amplifier ("Op Amp") could be used to better advantage.

As a starting point for this policy, we are going to do some surgery on the detailed circuit for Burlinson's Modulated Light Communication system in the third instalment of his article, presenting the simple amplifiers as noncommittal triangles, but specifying gain and impedances.

Even if you prefer to build your own amplifiers from discrete parts, basic transistor or FET amplifier design of the usual sort has become so cut-and-dried that there is hardly any excuse for us to reproduce it endlessly! Articles on the subject in the periodical literature (the OTHER periodical literature) are endless, and information on simple amplifier design can be found in all important handbooks and texts.

How to do it

If you've joined the throng, how do you find which IC you want? Easy, the same way you did for valves and semicons: consult a ready-made circuit, or (much better) make your own by consulting the "short form" IC catalogues. These are available from Fairchild, Philips, Rutherford, Motorola, STC, AWV/RCA, TI, etc. You obtain the unit you want, from your local parts distributor or from the several components retailers who advertise in the national magazines here or abroad; for overseas buying, see last month, p. 35, or the Advertisement here above.

If you want to modify an existing circuit you merely use the same technique and a bit of sense. For example take the Automotive Voltage Regulator in the July Electronics Australia. Its simply a voltage regulator like any other voltage regulator, but its output feeds the field winding of the generator. So, simply take a voltage regulator such as used in the abovementioned June E.A. P/S article, feed it into an AY8149 or 2N3055, etc, and thence into the field winding. Simple? If the sensitivity wants to be better, put a bit of series resistance in the sensing lead.

Of course an ordinary mechanical voltage regulator for a car is more effective, more reliable, and gives higher output — so why bother with the semicon version, discrete or IC?? As RLG would doubtless say, " a thing's not worth doing unless its worth doing better". Simple "comonse". Electronics is a tool, not necessarily a goal. ((PTO))

Courage!

Do you have the courage to enter this new age? Read RLG's "The State of the Art: A Crisis?" on p. 79 of the October 1971 EEB. And perhaps too the exchange of ideas by J. Fisk and O. Hello in the 1970 EEB (p. 130 and 150). Such ideas are the real value of EEB, not the trivial question whether we publish too much Amateur or too much non-amateur material.

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EIDTORIANLF No. 3 — RLG again: On the Making of and the Reading of Literature Reviews....

For this issue I had prepared a Literature Review of some interesting recent items with comment, albeit in the field of communications (perhaps thereby to interest some people who might not otherwise be?), but the above material took obvious precedence. But do take a look at July A.R.*

My reviewing activities tend to be fairly desultory, owing to lack of space, and to the fact that the kind of people who enjoy that are a rather small (but keen) group. For those people I would recommend as a steadier diet Pat Hawker's excellent monthly "Technical Topics" in the British Radio Communication; see your Library; State, WIA, or NZART — or (better) join the RSGB (35 Doughty St., London, England). A much shorter but interesting summary of a wide selection of literature is found in W5JJ's Collector & Emitter. These are, however, mainly concerned with communications. I'm not sure what equivalent service exists for The Rest, but I think it could depend on what interested one; there is rather a lot of electronics outside of communications! Anything from Practical Electronics through Radio Constructor, to Wireless World, thence to the Proceedings of the IREE. These named are British; the American equivalents aren't of much value, e.g.: Popular Electronics, Radio Electronics, etc. Proc. IREE is, of course, very informative if you are at that level, but on the whole I don't know of a good monthly summary of the general experimenters literature. Do you?

THE CANADIAN AMATEUR RADIO TELETYPE GROUP

We have been introduced to this group through Frank Merritt, VE7AFJ, an EEB subscriber. Their Bulletin, RTTY News is published monthly and contains information of technical and communications interest to teletype enthus. I have been more interested in this mode of communication, and it may even induce me to get on the air (anything is possible), particularly if Rod ever moves out of Hobart.

From the July 1972 issue, there are a couple of items I should like to quote here, the first one a point which I have wanted for some time to mention here, and the second is presumably relevant to Rod's IC orgy, above.

Tracks in the Sand — VE7AFJ

The notebook is a powerful tool to the electronics experimenter. It really does not make much difference what the notebook looks like, the important thing is to keep a notebook of pertinent station and experimental information.

One of the main reasons for keeping a notebook is to reduce the necessity of "re-inventing the wheel" from time to time. Very few operators/experimenters have a true protographic memory, so some form of written "memory" is a good idea ((It is essential — RLG)).

Another interesting aspect of the matter is that of taking photographs of the station periodically. A scrapbook can be used to collect scraps of memorabilia for future reference. The generous use of photos brings back many memories as the years roll by.

TTL all the Way — VE7AFJ

Most of us would use more of the developing IC technology with a better background and understanding of the concepts. For the most part, this knowledge is hard to come by. The EPD (Environmental Products, Box 406, Lafayette, Indiana 47902, U.S.A.) people have published a set of Application Notes that provide much of the basic background needed to use IC products. These Notes are available in Canda for $6.00; Investing in them is just about the best investment for the serious experimenter. The technology is reduced to a digestible point emphasizing the PRACTICAL use of these products. Get smart — it really does not hurt.

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

I'd say that thinking does hurt, but the rest sounds reasonable, save for Rod's murmur that the notes probably stress the use of the manufacturer's product, but I reckon they're probably still worth it. $6 in Canda can't be much more than $7 here, and our $ is worth 15% more, so...

For those who are interested, it costs $2 per year to belong to the CARTG and receive their bulletin; as long as you are getting a draft for North American dollars you might as well send for a subscription too: Canadian Amateur Radio Teletype Group (VE3RTT), 85 Fifeshire Road, Willowdale, Ontario, Canda, I mean Canada.

A very sane approach to circuitry, and not only beginners.

*particularly "Newcomers Notebook" by Rod Champness, VK3UG.

EEB Special Insert for June 1972

PETER S. VOGEL
5 WILSON STREET.
MAROUBRA. 2035
Telephone: 349 - 1741
8th Aug. 1972

Dear Mr. Gunther,

I have been a subscriber to EEB for a couple of years and each issue restores my faith in the electronic experimenters of Australia. Just as I am beginning to think that the next issue of EEB will never come the issue from six months ago arrives.I think it is this element of surprise which puts EEB so far ahead of the other magazines. I hope that I will never receive an EEB on time, as this would be a sure sign that the editor has nothing better to do than sit at a typewriter and is lost to the Sacred Brotherhood of Electronic Experimenters.

Unfortunatly I am in a state of financial disaster, so could you please put the following add in the next issue:

FOR SALE: A.W.A. T.V. CAMERA. Financial disaster forces me to sell my most prized possesion.This is a valve type camera, of studio quality. Ideal for ATV. Complete with vidicon, lens, long cable, remote controls including optical focusing by means of a motor which moves the vidicon. Complete manual and circuit diagrams,camera type 4R59084 and control unit 4P59074. Both as new.$160 or offer. Must

do than sit at a typewriter and is lost to the Sacred Brotherhood of Electronic Experimenters.

Unfortunatly I am in a state of financial disaster, so could you please put the following add in the next issue:

FOR SALE: A.W.A. T.V. CAMERA. Financial disaster forces me to sell my most prized possesion. This is a valve type camera, of studio quality. Ideal for ATV. Complete with vidicon, lens, long cable, remote controls including optical focusing by means of a motor which moves the vidicon. Complete manual and circuit diagrams, camera type 4R59084 and control unit 4P59074. Both as new, $160 or offer. Must go to good home. P.Vogel 5 Wilson St Maroubra NSW 2035 Phone: 3491741

Thanks very much , I know any EEB reader would treat stuff like this with the affection it deserves (you know how painful it is to part with gear like this!)

Let me know if there is any charge for this ad, and I will forward it.

Best wishes to EEB

73 P.Vogel VK2ZPV

Ed. Reply:
((No charge unless you sell it, and then you can send a few $ for costs))

Ed. Postscript to June issue: If you have ordered but not received "All About CubicalQuad Antennas", please write to EEB/7005. One order may have got mislaid in my ratsnest before Brenda took over as Sec! Tnx.

WHERE THE DX IS AT ! — Greg Johnston, VK7KJ

G.M.T.	CALL	NAME	FREQ.	QTH/QSL INFORMATION
From the home station log:				
0434	5X5NA	Roger	14170	via G3LQP
1409	7P8AC		14234	
0400	VP2VV/FS7	Yvon	14172	via F6AEV
0400	FH8CY	Yvon	14172	Box 438, Moroni, Comoro Is.
0330	5H3MM		14171	
0350	VP1BH	Bob	14171	
0404	LZ2WC	Vecso	14208	As per Callbook.
0400	5H1LV	Garth	14172	Zanzibar; via K3RLY
0430	5H3LV	Garth	14172	Tanzania; same op;via K3RLY
0540	ZK2DX	Jim	14178	Niue; via WB5BHN
0551	CR6GA	Guy	14178	Angola; via WA3HUP Is.
0718	VR4EE	Jacques	14183	P.O.Box 400, Honiara,Solomon
0408	JY6SE	?	14202	Jordan. Vy QRM es weak sigs
Per Courtesy Geoff Watts DX News Sheet:				
0330	SU1MI	Moona	14036	Via W3HNK
1625	TL8RD	Rene	21200	Box 22,Bangassou, Central African Republic.
1500	TRAF	Brutus	21270	Box 208, Libreville, Gabon
1450	XU1AA	Tony	14228	Box 262, Johore,Bahru,Malaysia
1000	XV5AC	Chester	14150	Via W1YRC;this one is legal!
1350	ZB2CC		14170	
1315	ZK1MA	Tuatai	14176	Manihiki
1200	ZS2MI		14220	Marion Island.

((Ed. Note: I have put it down as Greg gave it to us, and have not bothered to fill in the country of every listing. Presumably only DX people will be interested in this, and they will all have a list? Or does anyone object? Personally I find those faraway places and new nations interesting, just to know that they exist...))

Minerva Reef — Whose is it????

My own excursion around parts of the Southern Pacific recently has been mentioned in the past two numbers of EEB and the projected short stay on Minerva which at the time was one of the few remaining lumps of rock unclaimed by any nation, was alluded to therein.

A New York and London-based organisation calling themselves "The Ocean Life Research Foundation" declared the Republic of Minerva and said it would build a sea city some time in the early part of the year, but the detail is not forthcoming from sources available to me. All information up to time of my departure indicated that the place was indeed still not claimed in any official sense and was thus "open go" for a DXpedition such as I planned. Hence after something like 2600 sea miles aboard "Winston Churchill" (52 foot Aux. cutter) from Melbourne to Eden to Whangarei (N.Z.) a very hairy ride out to near the southern end of the Kermadec group in Force 9 to 10 "breezes" which effectively discouraged any landing attempt, we found ourselves 50 miles south of the Reef at 2000 GMT on May 21st. in heavily overcase conditions with very little wind but every prospect of some developing rapidly.

The baro had started a rapid descent from 1028mb and within a short time we had the leading edge of a good Southwester as well as a very confused and heavy sea.Dave, ZL1AV, was able to obtain an up to date met. report via land-line ex Fiji (the Suva coast radio station did not acknowledge our calls for same despite the fact that we were in contact with both Auckland and Sydney coast stations — this indicated that we were getting out quite well enough to get into them on the commercial channels used!) which was a bit more cheering than the aspect of the weather which was then confronting us with the wind veering around to the North East and making in strength (We all thought: CYCLONE!) with the baro. down to 1009 from 1028 in only 5 hours.

At this stage we were an estimated 25 miles south of the Reef (2400 GMT, May 21) and debating the advisability of attempting a closer approach in the absence of an accurate sun fix; the latter was not possible in the lousy conditions and overcast. The problem was crystallised by some anonymous "breaker" on 20M who tipped our likely arrest should we actually land on the place. This swung the day and we gave up the attempt and headed on to Suva where we learned that King Taufaahau Tupou of Tonga had laid claim to Minerva and that Tonga was exercising territorial rights over a radius of 12 miles north and south of the Minerva Reefs.

It sounds like our anonymous informant was substantially correct and in the light of yet further information I for one am very glad that we aborted the proposed operation from there. 'Nough said, but it does seem clear that any operation from Minerva will now count only as Tonga.

Apart from the all too obvious frustrations involved in the amateur operating schedule the balance of the trip was an experience which won't be easily forgotten, and about which one could easily write a book... The only catch wld be that my YF would refuse to have anything further to do with me!!

LETTER:

Enclosed please find a cheque... for a renewal of 3 yrs. I like your magazine and its informality very much — but I have noticed the trend lately from articles to reviews to now just bibliographies. If I had enough time I would be reading all these magazines to find out what else is in them as well, but to pick up an EEB to get a list of references interspersed with only a few "bon mots" is a bit disappointing.

The finer points of design I find very good.

— J. Mack, VK2BME, Cheltenham, N.S.W.

SOME INTERESTING COMPARISONS (1971 EEBs):

Subject	Note	FEB	APR	JUN	SEP	OCT	NOV	DEC	AVG TOTAL
Construct.	1	21%	11%	0%	14%	18%	0%	21%	13%
Design		21	36	0	12	16	37	24	25
PblcInterest	2	18	8	73	18	33	13	3	16
Letters		18	12	0	22	13	6	13	13
Reviews	3	15	14	0	15	3	13	5	11
Bibliography	4	0.2	1.6	0	0	0	11	12	5.1
Adv+Miscel.	5	8	19	20	21	18	20	21	17

NOTES:

1) Figures rounded off. Usually about three constructional articles per issue, a reasonable balance.

2) Mostly technical, but includes examinations of goals in technology, and often overlaps with "Design" or "Reviews" in the deeper sense of the word (Note 3).

3) This can be ambiguous. Some Reviews would be classified under Design, some under Bibliography. It may not be fully appreciated that our Reviews attempt to be analytical, attempting not only to tell you what is available in the best literature, but where and how it fits, aince nothing is perfect, nay not even me.

4) Similarly it is not always appreciated that our Reference Lists usually do far more than tell you where background literature for a subject can be found. Often we have made detailed comment on each article, telling its essential context, and allowing you to benefit from the coverage of a substantial amount of technical reading without having to go to the trouble of reading it yourself! This is a tremendous lot of work, and most of the comments about it have been complaints. Bah humbug.

5) Obviously this won't necessarily add up to 100% total, since figures are rounded off.

For the current year a similar analysis gives similar results. CONCLUSION: Coverage of the various subjects tends to be more or less even, with an emphasis on design — though this is fortuitous more or less, and varies from year to year — and less on Reviews. Reference Lists take a very modest fraction of space in our magazine.

Since, however, several other correspondents have also commented on the "extensive Reviews and Reference Lists" it would appear that a little of them can go a very long way, even with the qualifications embodied in Notes 3 & 4.

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

PUZZLE: (L.J. Yelland) Try, then see Back Page, this issue. A 240V series motor is geared 5:1 with pulleys and drives a load at 1000RPM. To obtain a higher speed the pulleys were changed to give a ratio of 2:1. Result was a REDUCTION in speed of the load. Why??

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

LETTER: Alas, poor Langford-Smith...

Tell Rod that I will have a copy of the "Amateur Radio Designers Handbook" as soon as he has it published. I think, however, that the book he describes in the Feb 1972 EEB is one which is too good to be true.

Keep up the good work.

— W. B. Ricketts, VK5ZWB, Cleve, S.A.

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

LETTER: Some Uses for EEB

Your little paper has done wonders for me with solid state. I have tried so many transistor projects and never had one of them work, even only very simple things. But I never understood what I was doing, and if it didn't work I was lost. So I stayed with valves; simpler to understand.

Then your encouraging magazine came to me... and you encouraged me enough to try again. My first project was a crystal detector and fed into the base of a transistor running from the test prods of my multimeter.

Contain your mirth! That gave me more encouragement thn any of the subsequent projects that have worked. It wasn't until I finally got down to first principles and understood what was going on that I started to learn anything... and now my electronic projects really work....

— Graeme R. Flodine, VK4FR, No.Tamborine Pt., Qld.

((Apologies for omitting the rest, but no room; we receive a large amount of mail, and it can't all be published. But we do seem to print much of the better part sooner or later))

pence (or any real silver* coin) work well; two pair of these work even better. A cent and 5c piece will work a bit less well, because there is precious little metal in coins these days. The coins must be sanded clean, wires soldered to one side of each, and the other sides of the coins pressed together on either side of a piece of vinegar-moistened paper (or use spit if no vinegar available!). An ordinary commercial small 1.5V dry cell also works magnificently, and no power switch is needed because of the tiny drain (= shelf life).

Incidentally, reference to my Electrochemical Series tables suggests that even more potential can be obtained from a simple home-made cell using silver* and zinc electrodes, compared to the silver-copper ones described above. But this could require proper battery solutions, and I'm not sure it would give any advantage for this primitive cell; why not try it and let us know?

*silver = + electrode

The amplifier of fig. 2 works better than any of the nominal common emitter ones used with xtal sets, because of the lower distortion provided by the common-collector configuration. Bias is provided by the diodes, and produces no overload until the signal becomes intolerably loud (my son had to detune C2 to attain reasonable volume, even without the amplifier!). With good quality phones, fidelity is magnificent! (THANKS to RHF!)

The amplifier of fig. 2 has high input impedance because of this inherent feature of emitter followers (analogous to cathode followers), so allowing the diodes to be tapped further out on the coil (e.g. ±40%), giving higher output for the same selectivity.

(9) A self-powered arrangement is indeed possible, powering the amplifier of fig. 2 from a fig-1 type P/S, but this is ONLY of advantage when using a stronger station to power a weaker one. Furthermore it is NOT practical unless you use two separate well-spaced antennas. It is, believe me, much more practical (and more fun) to power the amplifier from a photocell; ambient light is usually enough -- and the set should be off anyhow when the lights are off...

10) Here is something strange: Fig. 3. No earth connection! Tap at 50-100% of coil, depending on signal strength vs selectivity. Compare signal strength (On meter) with strength after earth is connected to point "X". The explanation is fairly obvious if you think about it, but has some unusual consequences which I'll explore in Part II here one day.

I should like to thank Stephen Gunther (13) for the fine job of construction he did on the crystal set chassis and parts shown on the front cover of this issue. And he did all of the wiring himself, except for the diodes. The extra socket and transformer are for a valved loudspeaker amplifier, not yet wired in. Stephen plans to build his own battery for that effort.

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

Postscript

→ Hot carrier diodes in the crystal set do not work as well as good germanium point contact types (OA90, 1N69, etc), but better than poor ones (e.g. some from the computer boards). But the HCD are magnificent at 1000Mc! -- and for high Z load

Incidentally, in our setup, a good balance between strong and weak station response was obtained by shunting the meter to 200μA, and using 2.7K series resistor with the silicon diode.

Postpostscript:

In the May (not April) 1972 issue of QST is reprinted an announcement from March 1920 telling how an ordinary crystal set may be made to oscillate simply by applying bias to the crystal (and the way the diagram looks, it is back biased -- some kind of negative resistance zener

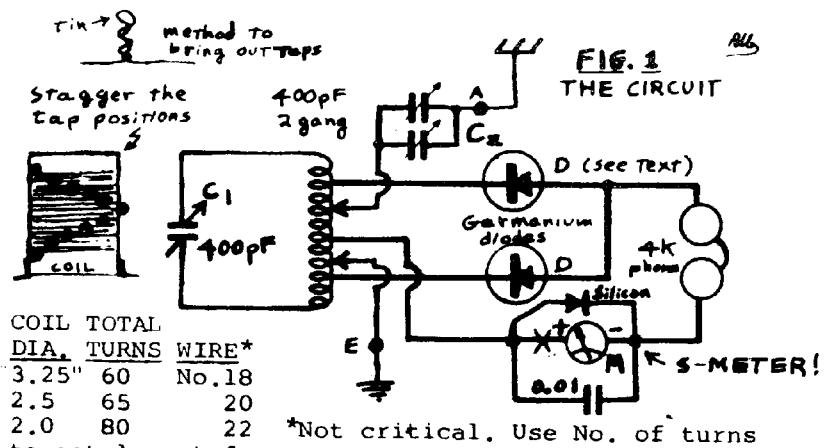


FIG. 1 THE CIRCUIT

COIL DIA.	TOTAL TURNS	WIRE*
3.25"	60	No.18
2.5	65	20
2.0	80	22

*Not critical. Use No. of turns to get lowest frequency signal when C_1 < max cap.

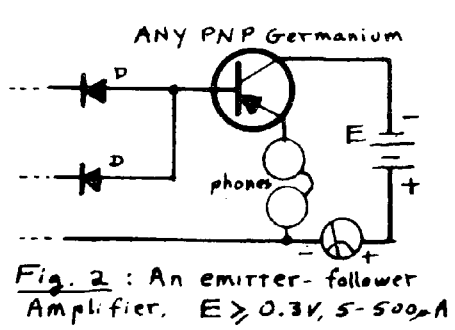


Fig. 2 : An emitter-follower Amplifier, E ≥ 0.3V, 5-500μA

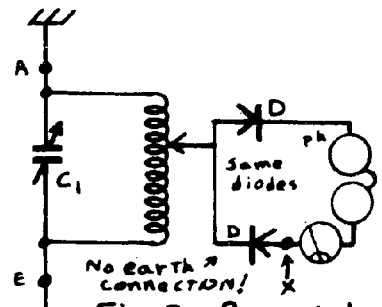


Fig. 3 : Rectabular Feedback Amplifier

effect?). But I doubt that the trick would work with ordinary point-contact germanium diodes (e.g. OA91). The QST correspondent (K2NP) said that the crystal was likely a blend of chalcopyrites and zincite; where would one find that??

Incidentally, point-contact diodes are widely available as suitable for the ordinary crystal set. If the diodes are used from computer boards you'll want to test a few to see which gives the best results on the Crystal Set's S-meter. Otherwise obtain an OA90 or OA91 from any suitable distributor (Kitsets has them for 17c, and local prices would be comparable though somewhat higher).

CHEAP ZENER DIODES?

While I'm talking about diodes, I might mention an article in the June 1972 issue of the WIA/VK5 Journal, by Rick Matthews, VK5ZFQ. He found several transistors having reasonably good zener properties when used between base and emitter, e.g. the 2N3638 ($dE/dI = 2\Omega$) and 2N3642 (6Ω). In the early days this used to be considered quite a good lurk, but after making a number of tests on a variety of transistors I gave it away because of the relatively high dynamic resistance of many types and the indifferent voltage at which they would regulate. In the present instance, the 2N3638 does sound very interesting because it has about half the dynamic resistance of an equivalent 400mW zener in the 6-7V range, but the 2N3642 is no better than a 400mW and the other types Rick mentions are worse.

The price of zener diodes (according to Catalogues by Philips, Kitsets, etc) has come down to the point where it is about as cheap to buy a zener as a transistor, and the results are far more reliable in terms of voltage rating and dynamic resistance.

For my own part, if I want a dynamic resistance of only 2Ω I'll use a one-watt zener (BZY96, 1N3785, etc.) -- unless, of course, I happen to have a 2N-3638A (high gain version) lying about (which I usually do because it is a good general purpose medium power item, from Fairchild), and no 1W zener at hand. Simple commonsense.

XXXXXXXXXXXXXXXXXXXXXXXX

Johnson came home unexpectedly from a business trip to find his wife in the arms of his best friend. He staggered back and said, "Max, I'm married to the lady so I have to. But why you?"

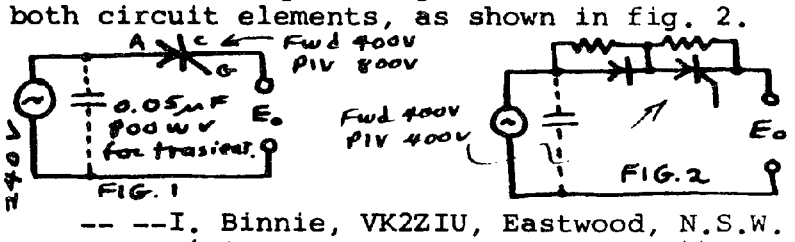
-- Isaac Asimov

XXXXXXXXXXXXXXXXXXXX

LETTER: SCR's in series, etc.

Here is a short item which may be of interest. When SCR's are used in a half-wave phase control for a capacitative load (or shunt wound motor etc, which generates considerable back EMB) the device must have a PIV which is twice the peak voltage of the supply. Thus, for use on 240V this implies an SCR with a working PIV of 800V, although the Forward Blocking voltage need only be 400V. This is shown in fig. 1 below ((and such SCRs with lopsided voltage ratings can be discovered by testing commercial units -- Ed.))

Essentially this may be accomplished, and a much cheaper 400V SCR may be used simply by including a 400V ((or more)) diode in series, with suitable equalising resistors across both circuit elements, as shown in fig. 2.



-- --I. Binnie, VK2ZIU, Eastwood, N.S.W.
(Vice Pres. VHF and TV Group))

P.S. You could at least pretend to be ashamed when EEB is late.

-- I.B.

((We discussed this matter in early EEBs, but it doesn't hurt to have OM Binnie repeat it here. The value of the equalising resistors is not critical, but should be proportional to the PIV's of diode and SCRs they parallel. As a rough guide, one might calculate a value of resistance to give a reverse leakage current of 0.5 to 1.0mA at max PIV. -- Ed.))

((P.S. Yup, I'd be ashamed, but I'm too busy preparing the next issue... -- L.))

XXXXXXXXXXXXXXXXXXXXXXXX

WHAT NOT TO DO ?

And then there was the chap who needed to vary the voltage from a battery of dry cells, and hit on the brilliant idea of fitting a series of switches to short out individual cells as required!

THE AUSTRALIAN EEB

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STATE OF THE RECEIVING ART -- VI (RLG)
(Final chapter -- for a while)

-- Some Elegant Method of Audio Processing

Last month I concluded our examination of Receivers, and Direct Conversion ones in particular, by ending logically at the a.f. stages. Matters of selectivity were discussed because in a D-C receiver the selectivity is primarily (but not exclusively) at a.f., but the same kind of subjects could of course, apply as well to superheterodyne i.f.'s: signal/noise, dynamic range, and the desirability of a square-top response.

Incidentally, a recent article in Ham Radio (3/72) points out that pot core inductors can be used to good advantage in cascaded parallel-tuned filters, and although that article dealt with FM application, the same principle could be used for other modes; pot cores can be obtained from Philips, STC, etc (or from WIA).

I do recall reading somewhere that a very squaretop selectivity response (fig. 10, dotted lines, last month) is not actually the best desirable, because of ringing or something. But no magazines have arrived here for several days, and I'm looking at no more of them, hurrying to finish this, or I'll never get it done! In any event, excess selectivity is rarely a problem in practical designs.

Interestingly enough, one of my students in the WIA beginners class asked my opinion about a transistorised receiver in the 1968 ARRL Handbook the other day. It was presented as a regenerative receiver, using a separate oscillator for the various benefits this obtained compared to including the regeneration in the detector stage. I thought that it looked familiar, and then I realised with a shock that it was in fact a Direct-Conversion receiver with primitive selectivity filtering; with a good a.f.-filter it could probably do a pretty good job.

Curious, isn't it, that the old old regenerative-detector receiver is really a Direct-Conversion receiver in disguise! Just advance the regeneration-control until it oscillates, and receive SSB.

We come now to the final portion of this particular effort, in which we discuss some particularly versatile and very useful product detectors. Unless you are receiving AM only (with an envelope-type detector), a product detector is essential in a modern receiver for SSB or CW -- whether it be at the front end (as in a D-C design), or at the end of i.f. stages (as in a superheterodyne).

TWO-PHASE DETECTION SYSTEMS:-

(Selectable sideband reception -- and the problem(s) of Audio Image.)

The "Two-Phase" system or "Signal Slicer" (31; see December 1971 issue) was introduced to EEB readers on p. 100 of the Sept 1969 issue, but at that time I had no idea it was relevant to the idea of Direct Conversion -- nor (let me be honest) did I have much of an idea how it worked!

The two-phase detector is able to select one of two sidebands and reject the other. If SSB (or CW) is received, interferring signals and noise are rejected from the other side of the carrier. If DSB (or AM) is received, the sideband can be chosen having the least interference. The system can be (and has been) applied to a superhet just as easily as to Direct Conversion ("D-C").

Sideband selection can also be done in a superhet by switching BFO either side of the i.f. This gives performance analogous to the phasing method for comparable circuit design, but cannot be applied to a DC system, because its i.f. is zero (See ch. 4, Ref 29a) (Thanks to Dick for straightening me out on this)

In a Direct Converter, an interfering signal can come in nicely on the other side of the desired one, because the r.f. bandwidth is twice the audio filter bandwidth; see fig. 10 (p. 28, last month)

It can be seen that the interfering signal will be received as happily as the desired one, and constitutes an "audio image". Under conditions of QRM it is a severe nuisance in DC. It (and the QRM) can be eliminated (at least by some -40db) by a Two-phase Detection system, which essentially chops off everything (in this example) below f_o. This can also be useful if used at the end of an i.f., but might not be necessary if the i.f. selectivity filters are really sharp.

With the signals below f_o, noise is also eliminated, thus increasing the noise factor by 3db for an SSB signal (8d), and that is pleasant, no?

The Audio Image

It should be noted that the concept of the audio image as shown in fig. 10 is not particularly new. It has been mentioned for some time in the ARRL Handbook, but only in reference to selectivity requirements for the i.f. amplifier of a

superhet. Radio frequency images have been attacked classically by the tuned circuits in the front end, abetted by the R.F. Amplifier.

In the DC system, however, I.F. Freq is zero, so all selectivity must be provided either at r.f. or at a.f. This places an impossible requirement on the r.f. tuned circuits (which still work to avoid images and adjacent X-mod) and leaves the job entirely to the a.f. filters. The latter accepts signals impartially from either side of the carrier frequency, and although steeper-skirt selectivity can reduce these audio images (effect of dotted lines in fig. 10) it cannot "eliminate" them. It is possible to obtain substantial discrimination against audio images by threshold gating techniques (17d), but although this has considerable advantage for CW reception, it is useless for phone because of intolerable distortion.

For radiotelephone (and most CW) reception it is necessary to phase out the offending side of the bandpass, as in the "two-phase detector". A typical one is:

The Simple "Signal Slicer"

This is quite analogous to the "phasing" process in an SSB transmitter where one sideband is selected by phasing out the other, but here it is turned about (24b-1, 19a, 26g, 30, 31). See the over-simplified diagram, fig. 11.

The received signal (A) and the local oscillator (B) are fed 90° out of phase (C) to two mixers -- as in fig. 3a, but the d.c. error signal (D) is not (here) used to phase-lock the oscillator. The demodulated sidebands (also at D) are thus 90° out of phase (or in "phase quadrature"). They are then fed to an audio phase shift network (AFPS) which advances them another 90°, with the net result that sidebands are either in phase or out of phase with each other. These are then summed up or cancelled out in a differential amplifier. The sum gives one sideband with the other cancelled, and the difference gives the converse.

The actual phase relationships can be seen clearly from the vector diagrams of Ref 16d or 30.

The circuit of fig. 11 is essentially that of the GE "Signal Slicer" (31c, 31d) and achieves impressive results with a modest amount of circuitry. This useful circuit has been brought into contemporary literature through Ref 19a, 30, and 31b, but for the unfortunate fact that the modern ARRL references to it omit to supply the details of the audio phase shift network (AFPS in fig. 11 here), either in the receiving or transmitting chapters of their Sideband or yearly Handbooks. Good solid amateur technology well summarised on p. 101 of the 1958 edition of Ref. 30: "This network isn't shown in the schematic, but J2 is the octal tube socket it plugs into. For anyone who has fears about the complexity of an audio phase-shift network, forget them; the --- is inexpensive, comes sealed in a metal tube envelope, and all you do is plug it into the socket". Presto.

More imaginative readers will, however, find the details of this dreadfully complicated device using four resistors and four condensers, in receiving or transmitting chapters of Refs 29a, 29b, or 31 (also in older editions of Ref 30!).

Adding Phase-Locking

With only modest increase in complexity the versatility of the fig. 11 type of circuit can be enhanced.

If the d.c. component of one of the mixers (at D) is made to control the oscillator (BFO) as in fig. 3a, the same result will be obtained for AM, FM, FSK, etc, but with the stability and inherent selectivity of phase-synchrony. Circuits for this appeared in the 1958 (but not later!) edition of Ref 30, and in 31d. Additionally, AM can be detected considerably more efficiently than with a conventional envelope detector (5, 6, 15, 33). It can be detected in a non phase-locked product detector, as I mentioned earlier, but only with considerable difficulty (15, 19b, 31c).

If, on the other hand, a balanced audio phase detector fed from the mixers (at D) controls the BFO frequency, a Double Sideband Suppressed Carrier signal

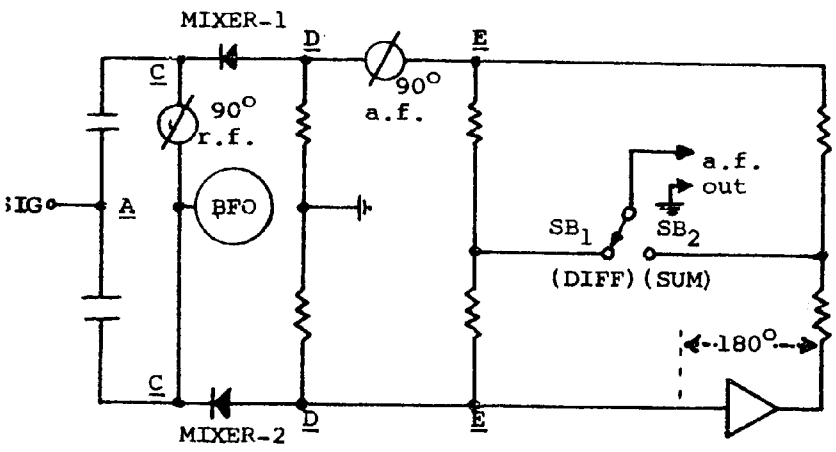

FIG. 11: OVERSIMPLIFIED TWO-PHASE DETECTOR

The r.f. signal is divided in two. Half is mixed with the Local Oscillator ("BFO") directly, and half with same shifted 90°. Further phase shifting after detection allows summation or difference signals to be selected. This cancels the undesired side, e.g. everything below f_o in fig. 10 (last month), with obvious advantage in rejecting QRM (and noise!).

(or AM, FM, etc) can be received*. Depending on the output phase and summation circuits we can then receive

a) Both sidebands (for a 6 db improvement over SSB!), or
b) Either sideband (with elimination of QRM or noise on the other side, and a 3db improvement of S/N for SSB).

These various systems will probably be considered in more detail eventually in these pages...

AGC

In all phase-lock systems, conventional AGC is not possible, because the detector produces no d.c. component proportional to signal until synchrony is achieved. But audio-derived AGC is quite practical. It is treated often in 24b, and in all Handbooks. For current application to PLLs see 24b-1 and 34a.

The Third Method

The "Third Method" of sideband phase-suppression is well discussed by Refs 26g, 29ab, 30, 31, etc. It is a rather elaborate arrangement where the balanced modulators of fig. 11 (the mixers) feed another set of balanced modulators which mix signal from a fixed audio oscillator, etc etc. This method is said to have the advantage of using only fixed-frequency phasing networks, not requiring the compromises of broadband ones. But I have never seen it applied to receiving; only for producing transmitting SSB, for which it is claimed to produce better sideband suppression than two-phase systems. Anyone have any ideas on this?**

?

* This is some trick: Phase synchronising on a non-existent carrier. Its easy enough when the carrier is there (31,33), but removing the carrier forces you to obtain all phase information from the sidebands. This is not possible with SSB because only one sideband is available, and that won't tell you enough. It is for this reason that DSBSC reception has all of the operational advantages of AM without some of the awkward properties of SSB. More, much more on this another time! -- RAJR

**Yes yes I do! Its simple! -- RHF.

-- Well, then build one for us, as you have been threatening to do for several years! -- RLG.

New Wine in Old Skins? -65-

Now, with few exceptions, the references mentioned above refer to circuits using the lowly valve -- and even include some pointed comments on the substantially better (lower noise) results to be expected from using diode valves than crystal diode semicons (though nowadays I should think that H.C. Diodes would surpass those by quite a lot).

I had been brainwashed by Handbooks etc, into believing that synchronous detection was infeasible becuase of its "obvious complexity" (29a* , 28). Yet I was amazed to find that a simple signal slicer of fig. 11 type used only 4 valves (31c, EEB Sept 1969).

With full carrier phase locking it needs 5 valves (only 4 if we use a varicap to control the VCO)(Ref 30: 1958 edition, not later). A deluxe version used 8 valves (31d).

Finally, deluxe audio-derived phase locking can be obtained from 8 valves. That is "obvious complexity" when a garden variety SSB exciter uses a comparable number of valves, a decent receiver uses a dozen of them or two score transistors (29a)? -- though come to think of it, who builds his own exciter or receiver nowadays?

It can't simply be the matter of valves vs transistors. For example, ARRL -- who can hardly be accused of having an anti-semiconductor bias -- are still using valves when superior performance is required (21b-3), as are RSGB (24a).**

* Describing rather concisely the block diagram (only) on p. 4.43, RSGB say: "The obvious complexity of this (phase synchronous) arrangement shows fairly clearly why it is simpler to generate a SSB signal in the first place than to attempt reception of both sidebands of a DSB signal". But this Argument From Simplicity flies in the teeth of the fact that as soon as Exciters started to become complicated owing to SSB, Hamdom made a mass exodus out of the workshop and into the commercial equipment showrooms. Admitted, we usually bought (and then thoroughly modified) our receivers, but at least most of us made our transmitters -- and ENJOYED it.!

** In 21b-3, Blakeslee applies to valves the previously lighthearted suggestion that only an Immense Valve would be the way to achieve good linearity; see our discussion of this as applied to FETs, EEB, Nov 71, p. 105. The results he achieves in immunity to strong adjacent signals can only be described as "spectacular", overworked as that word may be. SEE: Rad. Comm. 7/72, p. 453!

NO. I think that Synchronous and phased detector systems simply needed the rapid push of Progress to become popular (35), and the needed push was the resurrection in the 1968 QST of the idea of putting a product detector at the Front End.

Now, if the job can be done well with 5 valves at the end of an i.f., the introduction of an IC at the front end of the receiver has not necessarily been the reason for its popularity on the basis of simplicity alone -- ignorning the fact that an IC will generally use far more transistors-worth of circuit than would be seen in a discrete circuit. (See examples, 5, 16, 34a-2).

The IC simply triggered the widespread interest in the subject for an idea "whose time was ripe". Let us, then, not forget that there are some tasks which valves can perform more concisely and more efficiently, merely for the sake of a bit of HT and some beautifully glowing filaments. The argument has been very cogently stated by G3VA in Ref 24b-7 to which I recommend you.

A New Skin ?

My attention has just been directed to a new kind of Detector, the "Reciprocating Detector" described in the March 1972 issue of Ham Radio (17c). It appears to be a kind of triggered regenerated carrier system which achieves all of the advantages of phase-synchrony without a phase locked loop controlled oscillator. The oscillation level is self-adjusting, and the device is said to perform admirably on DSB, SSB, Phone, CW, etc. Hooley Dooley!

In considering the immense ease with which DSBSC signals can be produced (and a number of cogent arguments for its manifest superiority in several directions), could this be the beginning of a new era, where DSB becomes popular? And where transmitter-building becomes a recovered art?

A predominant feature of this inherently synchronous self-adjusting detector is the apparent simplicity of the circuitry -- requiring only a few transistors (and likely even fewer valves or FETs). No need for the vast elaborations of a conventional PLL system, nor therefore for the ICs needed to package it. Yet, as I have pointed out above, even PLL systems need not be unduly complex in terms of today's technology. In such matters it is important to keep from being blinded by Science.

Rod has looked over Badessa's Reciprocating Detector, and snorted that he had that idea long ago, but with.... etc. The difference is that he didn't publish it! Hi. Dick says that he has some reservations on Badessa's system, and that his PLL design ought to do better; but I'm still waiting for him to build it. Torque is cheap, as the saying goes.

Postscript

Since the above was written we have received Badessa's nice article on the Reciprocating Detector, the first part of which appears in this EEB. It looks quite fascinating. What do you think?

REFERENCES

A thorough summary of references and the way in which they are organised, was presented in the December 1971 EEB, to which the reader is referred. The July 72 issue of 73 reprints VK4ZFD's interesting Ref 8b.

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LETTER: FM and Phase Modulation

As FM and Phase (Angle) Modulation is the "In Thing" at the present, I for one will look forward to seeing something of the technique, presented in the RLG manner in future issues of EEB.

-- V. Kerr, VK4LK, Charters Towers, Qld.

((There has been quite a lot on this in Amateur Radio recently; why should we duplicate it? And every amateur in Australia should belong to the Wireless Institute, thereby to receive AR

On the other hand, this does remind me of some very interesting discussions I have had with Dick Ferris on this subject, and perhaps he will wish to give us a nice simple explanation of the real difference between AM and FM, on the basis of vector concepts??????? Its not as obvious as the Handbooks imply. We are told that AM sidebands (including SSB of course) are composed of sum-and-difference frequencies disposed about the carrier, but for FM too, "the modulation process leads to the generation of a new set of radio frequencies symmetrically disposed about the original carrier frequency". What is the difference? It is a fairly subtle matter. Wot say Dick?))

CORRESPONDENCE TO THE EDITOR

((Grid Leak, QSP ARNS Bulletin, 10/71))

Dear Mr. Ed:
I read with interest your advice to Mr. N.W. and so I did much the same. I traded my wife of 40 for 2 - 20's, only to find that I am not wired for 2 - 20's. Therefore, I got burned. Is this your fault or mine?
-- WW.

Dear WW:
I happen to be acquainted with your 2 - 20's. Consider yourself lucky that the only thing you got was burned.

((etc in same vein, then:))

Dear Ed:
How can I get extra copies of your club paper?
-- Bird Lover.

Dear BL:
Back issues are available for five dollars each. Send the money in cash.

REVIEW: The ARRL Handbook, 1972 -- RLG

Every four or five years I feel it worthwhile to obtain a new ARRL Radio Amateur Handbook, as a compendium of simple state-of-art technology. I don't get their Handbook more often, because that $7.50 per year (in Australia) is better spent on a magazine subscription or two, which keeps me up to date on the latest experimenter and amateur technology. Furthermore, I read the magazines; it is not easy to sit down once a year and read the Handbook through.

In fact I have now obtained a 1972 ARRL. Kallam's comments last month seem to be valid, but at the same time I would note that since my 1968 edition there has been a massive infusion of semiconductor technology, and since 1971 an increase in the number of ubiquitous square and triangular boxes representing packaged ckts.

It is evident that it would be altogether impossible adequately to put in one book all technologies covering fundamental, developmental, and applied subjects (but what about Rod's suggestion for a double volume with the Purposes he described?).

We may carp at poor old Blakeslee for omitting a Vackar, or neutralising his MOSFET, or giving away the whole subject of DSB communication (which is capable of substantial benefit) by the statement that DSB reception can be achieved without difficulty if your receiver chops off one of the sidebands!

The fact remains that his overall effort is, in my opinion, commendable; Rod and Dick are free to express their opinions as engineers, but I should think that my point of view would be closer to that of the harried experimenter and amateur. As Kallam says, the book tends to be shallow, but on an elementary level it is nothing if not comprehensive: a wide range of instruments and circuits is covered.

If a more thorough coverage is required there exists a wealth of books dedicated to that purpose, from the Orr and RSGB Handbooks, upwards. To do the job properly you would need several volumes of the calibre of Langford-Smith ("Radiotron Designers' Handbook").

Additionally, I am well in agreement with the increasing ARRL tendency to refer subjects to recent articles in QST (though other literature also exists), since this allows effective coverage of considerably more material than can be accomodated in the limited pages of the Handbook.

One hopes that Rod's plaintive call for another Langford-Smith will be realised (EEB, Feb 72 p. 20ff). In the meantime we have at least three main radio handbooks, and between them one ought to be able to discover enough good oil to satisfy the fastidious.

Now then, I showed to my class of young chaps in the YRCS, the three named Handbooks, and asked which they would prefer to use initially. The nearly unanimous opinion was the choice of the ARRL, with interest in RSGB and Orr when they knew rather more about electronics. The ARRL work obviously appeals more to the beginner, and it seems to be the answer to Kallam's query whether or not this was a "good thing". Fair enough, We'll get them the ARRL Handbook, and I'll fill in for them more detailed aspects from the other books, eventually encouraging the boys to obtain the other books as well.

I do not, however, want to obtain 1972 editions of the ARRL Handbook for these students. There are too many black boxes. It will do little for them to see a mixer represented by a rectangle with 8 connections, even though the discrete circuit has (still) been presented in a previous section. They'll have ample opportunity to embrace that kind of electronics later.

Could you, therefore, please help us? I want to obtain at least 6 copies of the ARRL Handbook in any edition from 1967 to 1971, in no particular order. Will you sell us your old copy? In return I am willing to order from America for you, the 1972 edition, at a cost of about $A4.50 postpaid -- a substantial reduction over the Australian price.

What say?

XXXXXXXXXXXXXXXXXXXXXXXXXXXX

Dandelion Wine

Put 6 cups dendelion petals, 2 lbs of sugar, 1 lb cut up raisins, 3 tsp acid blend, 1 campden tablet, 1/2 tsp yeast nutrient, 1/4 tsp grape tannin in a gallon crock or plastic container. Pour a gallon of hot water over the ingredients, cover with plastic sheet and add packet of wine yeast when liquid cools to 70°F. After three days, strain petals and raisins out, syphon wine into jug and attach fermentation lock to jog. Wait three weeks, syphon everything but yeast into new jug. Let stand three to six weeks (until liquid is clear) Put in bottles, let age six more months (or more). Why fight lawn dandelions? Use them!

SWOOP -- Elise White (YF/KØCNV)

((From: Bulletin of the Amateur Radio News Service, Feb. 1972))

I'm sick and tired of computerised, transistorised, miniaturised gadgets that develop squeaks, squalls, groans, and weird wails when something else is turned on.

It all began when I got an AM-FM radio that develops noises that sound like a Devil's Convention when the toaster, coffee pot, Joe's ham gear or electric blanket is turned on.

The coffeepot developed a stomach ache and moaned and squalled all the time it was perking like it was in agony. If I turn on the new electric blanket, the dog starts to howl and the cats swell up like disaster is about to strike. The telephone (one of those push button jobs) gargles, groans, and dings if you use the Dial-O-Matic sewing machine.

Joe has been called out 5 nights to inspect the transistorised gizzards of trucks because if the horn honks, the marker lights play "Bach's Fugue."

If you plug in the tape deck, the fuel system ceases and assorted other goodies too numerous to mention. This isn't the only problem. The new VW's won't run if you plug in your ham gear!!

The bank misplaces a bank deposit and it takes the computer three weeks to find the mistake. ((shux, we at EEB don't need a Computer to accomplish that*))

You pay a bill and the computer bills you for three months, telling that the account is overdue. The balance is $00.00. The overcharge is $00.00, and if you don't immediately pay the bill something drastic will happen.

Hams buy these mini-sets that it takes a magnifying glass to inspect its innards and they develop epazootic dumfugit and have to be repaired. Their little insides are so scrambled that someone makes a wild guess, pokes something in and prays like fury that they got the right part in the right place and when tested doesn't light up like a pin ball machine.

The color TV has had purple people for so long that I'm sure we've been invaded from outer space when I see normal people wandering around.

I'm just about ready to go back to a coal stove, kerosene lamps and an old crystal set. At least all they do is blow up, go out or not work, but a least they are predictable and that's more than you can say about the stuff today.

((Ah, Fair Elise, Australian colour TV isn't purple, its perfect -- or will be when we get it. -- Staff))

---

* You'd never believe it, but between the last line and this one this magnificent typing machine developed Epazootic dumfunus, just as Elise sez, and this being a very long "weekend" in VK there was no hope but to take the panels off and peer into its complicated obscurities. A few hours later a Thingee was constructed which went into its scrambled insides, and now it drives like a Bentley. When the typewriter man comes next week, though he's going to turn purple himself. You cain't win, just like the girl says! --RLG

ANSWER TO PUZZLE

The series motor is not a constant speed device. So it delivers maximum power in this instance, at 5000 RPM when turning the load at 1000 RPM. The motor current is inversely proportional to RPM, and power is proportional to I^2, so P varies as $1/(RPM)^2$. Now, the motor cannot produce more power at 2000 RPM than it does at 5000. Therefore it will not turn the load at 1000 RPM at 2:1 ratio. In fact at 2000 RPM , 6.25 times as much power is required to turn the load as at 1000.

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→ Commonse Electronics

AN INFORMAL ELECTRONICS EXPERIMENTERS BULLETIN

AUGTOBER 1972 Vol. 8, Nos. 4+5 P. 69

P. 69: This magnificent book was reviewed in Feb. 1971 EEB. It hasn't been re-organised as we'd like, but it would be a gem in any electronics experimenters library (Amateur or other). We recommend it most wholeheartedly. Order from WIA, NZART, or likely quicker from RSGB, 35 Doughty Street, London W.C. 1, England, U.K. Europe! $3.75 = £1.80; or send £ bank draft.

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97: What Not to Do..? ☆ ☆ ☆ ☆ NEXT MONTH (December, of course): Exhaust-gas Analysis, Pulse Width Generator, more Reciprocating Detector, a new look at FETs, Smoke-Ring Generator.

COUNTING WITH ELECTRONICS, Part II

-- by R. Fam and R. S. Maddever (VK3)

In the April EEB we described a simple single counting stage which could be coupled to others to form a binary counting unit. It may be mentioned, in reference to last month's Editorials, that we are well familiar with the use of Integrated Circuits, but simple discrete units of the type described here are quite valuable to illustrate circuit functions.

One of the disadvantages of a simple row of "flip-flops" for counting, is that as the inputs are switched from one side of the preceeding stage to the other (from ADD to SUBTRACT) extra unwanted pulses are formed by the switching. And if many stages are used a suitable switch becomes expensive.

A worthwhile addition to the counting board is, therefore, an electronic "switch" (or "gate") allowing the output from either the ADD or SUBTRACT side of the flip flop to be sent on to the following stage. In fig. 1 the switch consists of the two transistors, Q4 and Q5. They have a common collector load of 1KΩ. Whichever transistor is not wanted to send a pulse out has its base connected to a line which is made +1.5 volts and is therefore cut off. The other transistor has its base connected to a line left floating or merely earthed. The bases are connected via diodes so that one stage does not influence the other.

In fig. 1 the resistors, capacitors, and diodes are not at all critical in value. The transistors may be almost any types. Germanium and silicon types have worked quite well even when diodes were all germanium, but note that Q3 should be able to drive a 6V 40mA globe so needs to be a medium power type. The others must be of the same type (whichever is chosen). PNP polarities are shown. If NPN ones are used, reverse the battery connections and ALL DIODE polarities as well. Computer board types suitable are 033 or 034 for PNP, 083 or 084 for NPN; 015 or 018 PNP or 065 NPN (planar HF types) could be used for all except Q3.

Fig. 2 shows a printed circuit board suitable for plugging into an edge socket. It is viewed from the copper side, and components are drawn here with finer lines; the components are on the other side, and you are seeing them with "X-ray eyes".

Fig. 3 (p. 71) shows some of the boards connected together, and fed by a circuit suitable to make good pulses from a telephone dial. Without this amplifier-trigger system, the contact bounce from the telephone dial contacts would create spurious pulses, as shown by the waveform to the left of the dial in fig. 3.

The next article in this series (in December or February next) will describe "A Crystal-controlled Variable Pulse-width Generator", and will contain enough Integrated Circuits quite to satisfy the fastidious.

xxxxxxxxxxxxxxxxxxxxxxxxxx

< The beginnings of all things are small >
-- Cicero.

vvvvvvvvvvvvvvvvvvvvvvvvvv

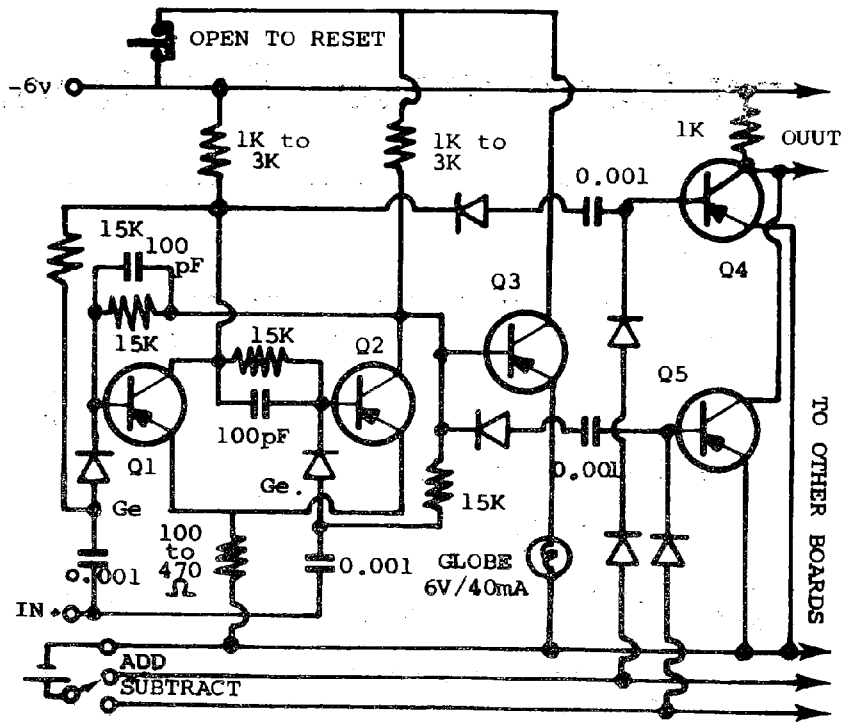
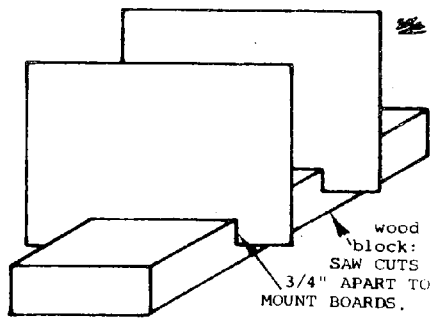


FIG 1: THE COUNTER



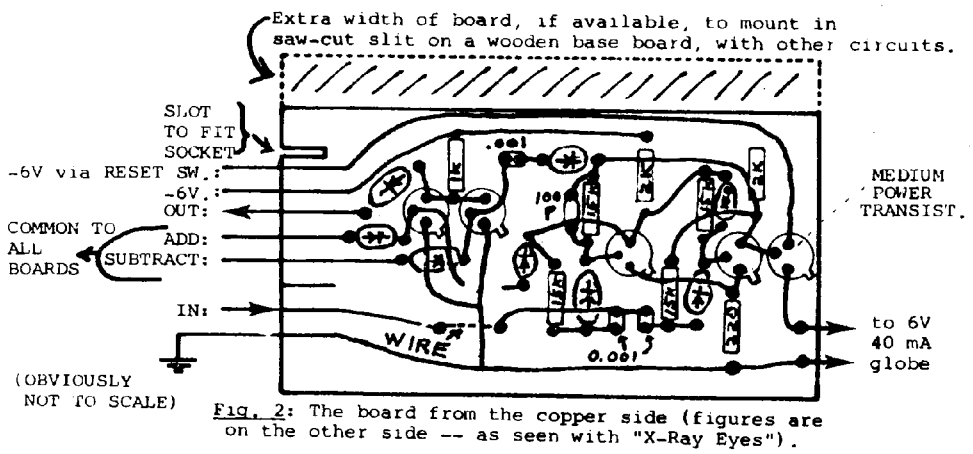


Fig. 2: The board from the copper side (figures are on the other side -- as seen with "X-Ray Eyes").

"HARD TO SPELL" WORDS ((ARNS Bull, 3/70))

Quite some time ago, Henry Pinot of the United Press compiled a list of words which he had observed were the most frequently misspelled words appearing in press dispatches which passed over his desk. While these are not words that would ordinarily appear in amateur publications it might be interesting to list them here:

uncontrollable	paraphernalia
changeable	likable
guage	judgment
naphtha	dietician
occurred	embarrass
discernible	indispensable
diphtheria	harass
permissible	rococo

Only one of these words duplicates this editor's favourite list which was taken from a newspaper over 30 years ago. You are guaranteed that the average person cannot get more than three of these right, and if you don't believe it, try them on your friends:

tranquillity	sacrilegious
naphtha	supersede
kimono	rarefy
paraffin	battalion
liquefy	ukulele

One more that can be added from personal observation is the simple "Davy Jones's Locker" which very few people can spell, because it defies usual laws of possessives, and because of this is defined separately in the dictionaries. Try this one too on your friends.

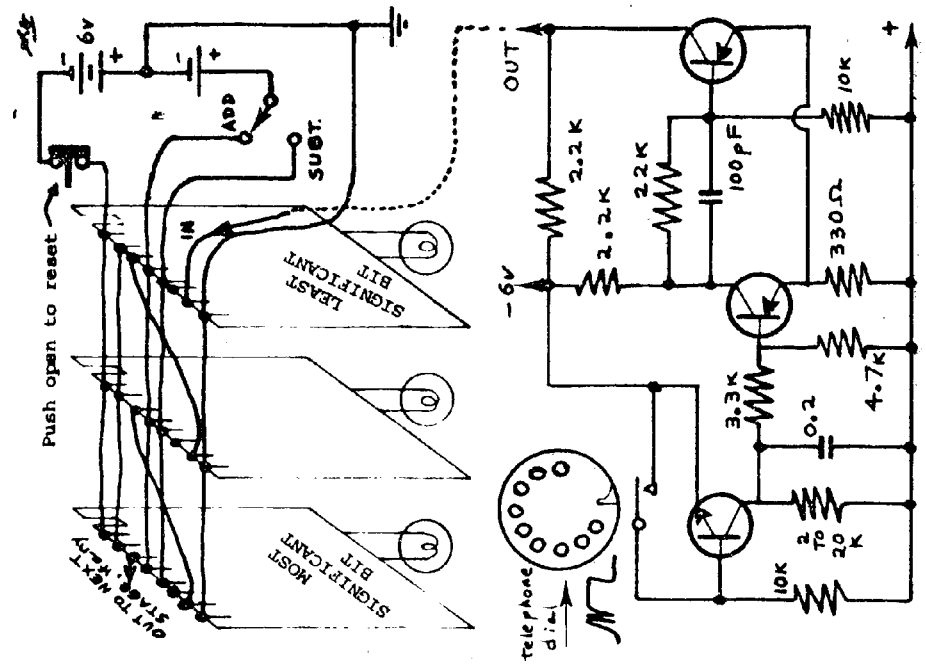


FIG. 3: Pulse Amplifier with fairly long time constant, followed by Schmitt Trigger...

LETTER: Automotive Dwell clarified

With reference to the articles on Dwell Meters in the Dec 1971 EEB there appears to be a lack of understanding as to what dwell in a distributor system means. I hope that this can put a little more light on the subject.

Dwell is the period of the spark cycle when the points are closed, and is approximately 60% of the full cycle spark to spark, on normal distributors. On such systems it varies in time with engine RPM, for example for a 6 cyl. engine with a cam angle of 60 deg,

R.P.M.	Spark Cycle	Dwell Time
1000	20 m.sec.	12 m.sec.
2500	8	4.8
5000	4	2.4

Now, the time taken for the average ignition coil to saturate, to produce an optimum spark is 5 msec. So it will be seen that, from the example, a 6 cylinder system in good order will have a loss of spark intensity above 2500 RPM. This is due to the fact that with increasing speed the coil has less time to saturate, as the dwell time decreases.

This condition is, by the laws of time and motion, 25% worse for an 8 cylinder, and 50% better for a 4 cylinder engine than the example shown. Which is one good reason to favour 4 cylinder engines and/or Dwell Extenders.

-- L. Chaplin, Tanawha, Qld.

((In the abovementioned article, my reference was to Capacitative Discharge Ignitions, which are so much superior to the conventional system, even when the latter has a dwell extender. The subject of Dwell is of little importance in C.D., which requires very short condenser charge periods. -- RAJR))

XXXXXXXXXXXXXXXXXXXXXXXXXXX

LETTER: CD Ign for Motorcycles

I have noted in that illustrious opposition magazine, Electronics Australia many enquiries on the subject of Capacitor Discharge Ignition for twin-cylinder motorcycles.

These use separate points and separate coils. Therein lies the problem: how does one build a CDI system for same without going to the cost of building two separate systems?

I have been thinking on these lines for some time (as I have a "sickle" to put CDI on) but have encountered problems with stray firing pulses -- i.e., one trigger circuit sets off both coils,or the wrong one. A commercial unit will cost in the vicinity of $80-$100!!? Maybe if you could include a suggestion of this in your columns, it could start the ball rolling, and maybe some reader will come up with a suggestion? Up to the present, CDI is mainly on cars, but I myself know of many interested in CDI for motorbikes.

Congrats on your attention-getter in the April 1972 EEB, front page. I also agree on the comments on "Yankee Beer"; dishwater would probably taste better! The Yanks should try good ole Aussie brew -- they don't know what they're missing.

-- Richard Wilson (VK2ZVX), Milthorpe NSW

((E.A. may indeed have opposition, but its not us! In addition to its usual interesting news about new developments, that magazine is again featuring quite a number of interesting electronic circuits of all kinds. It is instructive to see how the two Giants are shaping up.

Your comment on Yankee brew may have some point, but alas it is difficult to convince them of it. Good beer requires getting used-to... We have quite a nice revised recipe that Jim Coote has sent (from England, of course), but to keep peace in the EEB family I'll have to save it for next April's issue--Ed.))

XXXXXXXXXXXXXXXXXXXXXXXXXXX

LETTER: On Automotive Matters

I agree entirely with Rod Reynolds on his comments concerning the Dwell Meter (Dec. 1971) The value of a dwell meter with CDI is only to check wear and tear in the distributor. An automotive servicing oscilloscope would pick this up more readily -- at a price. The vacuum gauge certainly has merit.

Talking of automotive servicing oscilloscopes, has anyone really thought what sort of frequency response is required in the vertical channel? The pulse repetition frequency varies from about 5cps to 500 cps, depending on number of cylinders, speed, and 2- vs 4-cycle. Allowing for transients, the required response shouldn't be more than, say 10kHz!

I have been interested in fuel consumption meters (EEB Feb 1972, D. Brown) for many years. Unfortunately, few cars now have electric fuel pumps, from which triggering pulses can be obtained. It is not necessary to include the pulses from the speedo if the engine tachometer is used as the other input to the MPG meter -- as long as a different scale is used for each gear in use.

From memory, the electric fuel pumps only operate every second or so, which would mean that the pulse inputs from pump and ignition system would have to be averaged over a few seconds to prevent violent fluctuations in the readout meter. I should be very interested if someone could work out how to meter the fuel electronically (and simply).

-- Rodney Champness, VK3UG, Warragul, Vic.

((For metering the fuel flow, why not one of those gadgets which turn around as the fuel flows past it, as was used in olden cars, and in olden petrol pump meters? But for all this I wonder whether it is worth it to make a running measurement of MPG? The vac. gauge tells you most of what you want to know in actual running conditions, and the adjustment of the fuel jets does the rest. We have a very very nice article coming up on the latter subject, by Peter Ward and Rod Reynolds -- if I can extract it from Rod. He has been exchanging correspondence with Peter about it for over a year, and its about time... -- RLG))

THE RECIPROCATING DETECTOR -- A New Development in Communications Technology.

-- by. R. S. Badessa
(Damon Corporation, W1)

-- Part II: A Practical System

See also: Technical Topics in Rad. Comm 6/72, p.368

Summary of Part I (June 1972 EEB)

The Reciprocating Detector (RD) generates a synchronous reference from a carrierless double sideband signal (DSSC) by reversing the signal polarity in synchronism with the polarity reversals of the original modulation.

The process is made automatic by a form of regenerative feedback in which the generated reference is used to control the polarity reversals. This results in a synchronous band about one third the passband of the narrow band filter. The synchronous bandwidth does not depend on signal level, but for carrierless signals it does depend on the correlation between upper and lower sidebands. Signals with only partial correlation have a narrower synchronous range, and signals having no correlation, or having only one sideband are detected non-synchronously.

In no case (including the case of all random noise) does the generated reference have significant phase jitter. Its amplitude is a filtered version of the signal envelope and fluctuates at rates up to about 250 Hz. Part II will consider further the effect of these fluctuations and present some RD design guidelines.

The RD Reference Level

The output of a synchronous detector (or of a product detector) is independent of reference level provided the level is high enough to handle the largest signal excursion. In the RD the reference level is proportional to average signal level so that it is never necessary to operate with a large surplus of reference.

This has advantages. First, it minimises the problem of preventing a strong reference from being picked up by low-level circuitry. Secondly it results in impulse noise rejection, even on SSB where the action of the SSB filter tends to stretch out impulses and make them difficult to distinguish from signal peaks.

Impulse Noise Rejection (fig. 7)

Impulse noise rection here results from the inertia of the RD's narrow band filter, a characteristic that prevents an abrupt increase of signal level from resulting in an immediate increase of reference level. This lag between demand and supply has negligible effect on waveforms of the type normally encountered in speech communication, but an impulse is unable to muster the necessary large db increase of reference in such a short time, so it gets clipped.

The RD here acts as a rate-of-change limiter. The amount of impulse remaining after the clipping is a function of the gain of the regenerative loop. A high gain gives an abundance of reference and results in poor impulse rejection. But an insufficient loop gain causes compression of signal peaks and may cause voices to sound "tinny". (If the reference is almost sufficient for the signal, outright clipping of peaks does not occur because the current gain of Q_1 and Q2 of fig. 2 (Part I, June EEB) tends to increase with the drive from Q3)

The best gain is the one for which a moderate amount of compression occurs, since this guarantees impulse rejection without being so drastic as to have a noticeable effect on voice quality. If neither impulse noise nor stray pickup is a problem, there is no disadvantage in using a large amount of regenerative gain, since synchronous operation is not affected.

A Practical Design (fig. 3)(overleaf)

In fig. 3 is an RD consisting of a basic unit, a differential amplifier, and a narrow band filter. The filter is intended for operation at 500 kHz, but if operation at 50 kHz is desired the filter shown in fig. 4 can be substituted.

The two diodes D_1 and D2 are always forward biased and were introduced to offset the loss of regenerative gain at low signal levels resulting from reduced current gain in Q3 and Q4. Ideally Q5 would be biased to cutoff so that application of the signal gives a half-wave rectified collector current. In practice the curvature of the characteristic of Q5 in this region makes it desirable to have a slight biasing current flowing when no signal is present. This current prevents the reference from disappearing completely in the absence of signal, but the reference so produced is small compared to the level generated in normal operation. The operating point of Q5 is stabilised with temperature by means of transistor Q6 and diode D3.

A FEW PRACTICAL SUGGESTIONS:

1) Choice of Transistors and Diodes in the Basic Unit.

The basic unit is designed to permit a variety of silicon transistors and silicon diodes. The type 2N3415 transistor and type 1N252 diode were used in most of the experimental units. ((Ed. Note: Transistor equivalents are Motorola type MPS6515, Philips BC108 or BC109 etc, Fairchild 2N3565 or 2N3566 etc))((The OA200 etc is equivalent to 1N252))

2) Rejection of the Common Mode Audio

The audio output of the RD is obtained from the difference of the voltages appearing at pins 2 and 9 of the basic unit. These voltages contain a strong common mode component that must not be permitted to overload the differential amplifier used for obtaining this difference. Excessive amplifier gain would cause distortion when the input signal to the basic unit is at the maximum permissible level of 3 volts

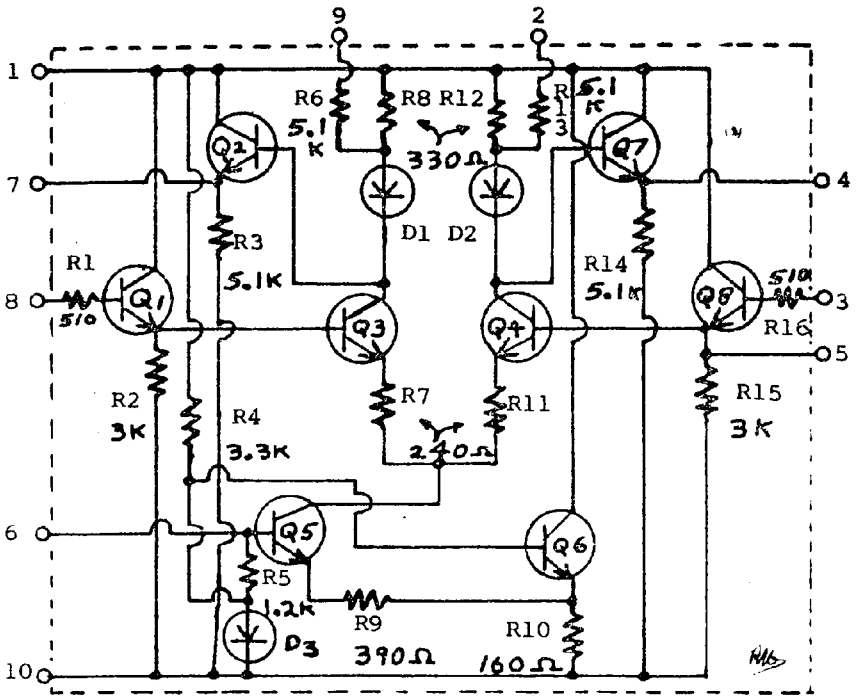


FIG. 3a: RECIPROCATING DETECTOR, basic unit

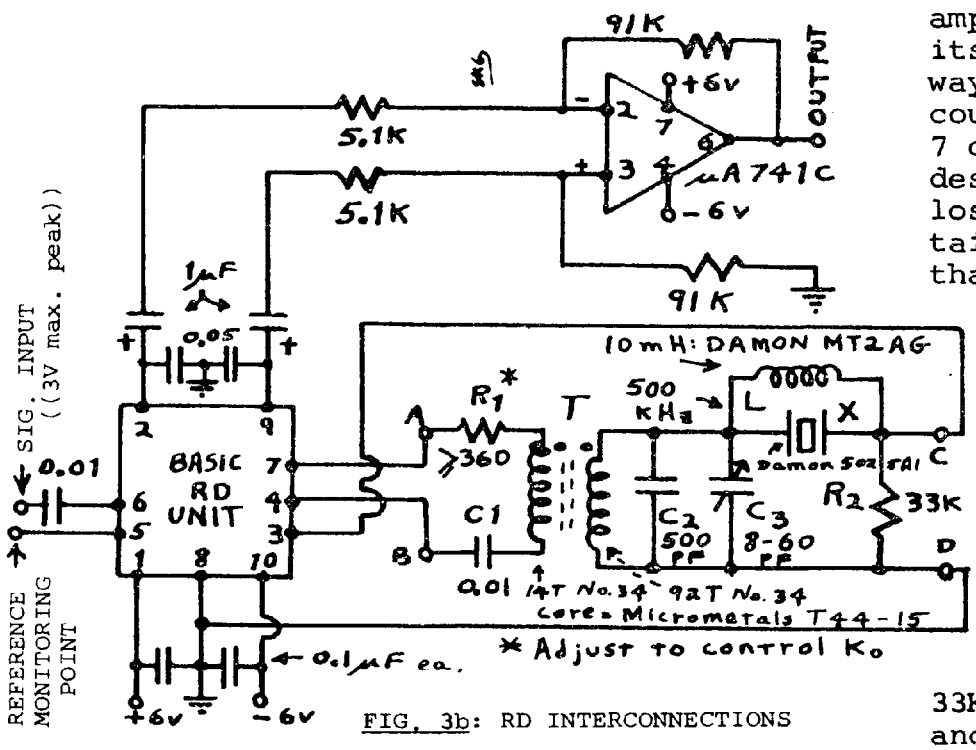


FIG. 3b: RD INTERCONNECTIONS

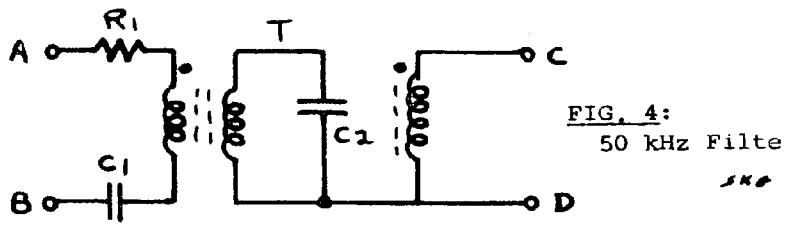


FIG. 4:
50 kHz Filter

R_1: Not less than 360Ω; adjust to control gain.
C_1: 0.1 μF. C_2: 3600 pF.
T : Primary = 5t No. 32; Intermediate = 109t No. 31.
Secondary = 43t No. 32; Core, Ferroxcube Number 1811CA250 3B7 (or Aust. powdered core equivalent)

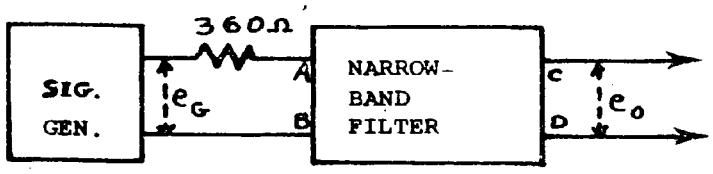


FIG. 5: FILTER TEST

peak. The amplifier of fig. 3a is recommended. Note that the gain of the two inputs of the operational amplifier has been equalised with respect to ground.

3) Measurement of the Biasing Current

For good dynamic range, transistor Q5 should draw some current (e.g. 250 μA) in the absence of signal. This no-signal current can be measured by noting the d.c. voltage appearing across the series combination of R9 and R10 of the basic unit with the signal from the i.f. disconnected. This voltage should be about 0.1 to 0.2 volt.

Too low a biasing current will cause distortion or even complete silence at low drive levels. Too high a biasing current will not cause distortion, but can cause loss of impulse noise immunity and synchronous bandwidth.

4) Specifications for the Narrow Band Filter

The narrow band filter, like the audio amplifier, is driven differentially, but its output is single ended. A convenient way to drive its input is by means of a coupling loop connected between pins 4 and 7 of the basic unit. If the filter is desired with a sufficiently low insertion loss, a loop gain of at least 3 can be obtained using no amplification other than that of the basic unit ITself. To prevent excessive loading of the basic unit, the input impedance of the filter should be about 360Ω or more. The filter bandwidth at the 3 db points should not exceed 500 Hz.

When the filter is connected to a signal generator as shown in fig. 5, the ratio e_o/e_g should be at least 3.5 . Here e_g is the voltage at the terminals of the generator, and e_o is the output voltage of the filter under no-load conditions. When a 33K load is connected across terminals C and D, the voltage e_o should not drop by more than a factor of two.

5) The Sense of the Feedback

The RD is a regenerative device. Consequently the sense of the feedback may have to be reversed if it fails to develop reference. This can be done by interchanging the connections from the basic unit to the filter input.

6) The Regenerative gain

Too high a gain can cause the RD to lose a significant amount of its impulse noise immunity, particularly on SSB. Too low a gain can cause distortion.

A convenient measure of gain is the amount of reference present at the reference monitoring point of the basic unit when a known c.w. input signal is applied. This test should be done with the signal source detuned well off the centre frequency of the

narrow band filter and with a signal level which is large, but safely below the maximum allowable. A signal level of 1.5 V peak is satisfactory.

For this case the reference level required to achieve good impulse performance on SSB is about 1 V peak. For DSB or DSSC a level as high as 2 V peak will still give good impulse rejection, but you may want to experiment a bit with this. The gain can be adjusted by controlling the attenuation at the input of the narrow band filter, provided it can be done without unbalancing the drive. Usually the resistor R_1 at the filter input can be chosen to provide whatever gain is required.

7) The Dynamic Range of the Input

The input signal level to the RD should not be so low that the reference level obtained with signal is not much greater than the level obtained in its absence. The maximum permissible signal level to the basic unit is 3 V peak. The average signal level should utilise a major portion of this available dynamic range.

8) The Balance of the Basic Unit

Rejection of impulse noise requires that in the absence of reference, very little differential output is available from the basic unit. This requires balance.

Balance can be checked by grounding Pin 3 of the basic unit while the RD is operating normally. This kills the reference and should reduce the audio output by at least 20 db. Note that a minor unbalance in the basic unit can be compensated for by trimming one of the 91 K resistors in the differential audio amplifier.

If you decide to build an RD, I hope that you plan to install an easily accessible switch so that you can make rapid comparisons with other detectors. The switch should have provision for disabling the reference oscillator normally used with the receiver product detector to prevent stray pickup from entering the RD.

Ed. Note: Figs. 6 and 7, below, have been added, as traced from a reproduction of the IEEE reference mentioned in Part I. I hope all the bits and pieces are there!

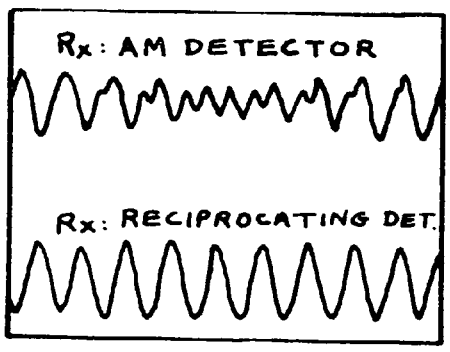


FIG. 6; (ABOVE): AM SIGNAL DURING A CARRIER-FADE.

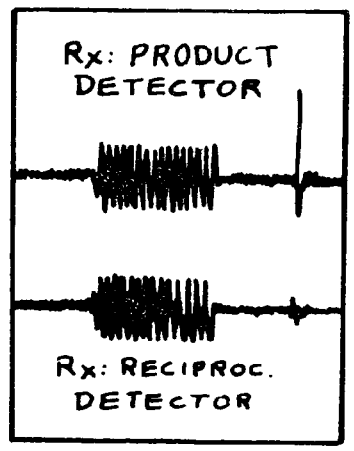


FIG. 7; (RIGHT): SSB SIGNAL WITH IMPULSE INTERFERENCE.

L'AFFAIRE EOLE -- a French Goof (Ballsup)
-- QSP "Zero Beat" Mag., U.S.A.
-- QSPP ARNS "Bulletin"/KØNL

Very few classic "goofs" in the scientific world seem to receive coverage in the scientific journals, but the fantastic French fiasco of September 11, 1971 was happily covered in the October 1971 issue of Science.

Seems the French have this weather satellite EOLE, in orbit about 500 miles above the earth. EOLE's job is to relay weather data from more than 100 weather balloons, which have been launced from points in Argentina.

On commands from the satellite, the balloons transmit a whole blast of data back to EOLE where it is stored, then relayed to the Bretigny centre near Paris.

To eliminate useless data from balloons which stray outside the area being studied, French engineers equipped the gasbags with explosive charges which EOLE could detonate on command -- singly, or all at once.

You guessed it! On the 346th orbit, French personnel (Murphy?) inadvertently sent up the "general destruct" command instead of the "interrogate" command. Seventy two expensive sophisticated weather ballooons augured into the South Atlantic.

We understand "procedural changes" have been initiated at mission control.

(ARNS Ed. Note: We note in the daily papers that the system used for (air raid) warning in the U.S. has now been discontinued since a fellow by the name of Murphy got ahold of the wrong tape and directed the radio stations of the U.S. to sound a general warning. The system has been discontinued.)

ITS TOO HOT IN THE SAHARA

"The nuclear weapons will be tested as far as possible from France because they are too dangerous. There is too much shipping and too many people around France; the Pacific area will be better for the tests".

-- The Consul-General of France,
Melbourne, 13th June 1972.

((I understand that recently the French have been most upset because some European countries have been wanting to bury radioactive waste from their atomic piles. The French are worried lest said waste leak into France; I wonder where the French dump their own radioactive stuff -- in the Pacific, perhaps? --RLG))

THE CAGE ANTENNA STILL LIVES!

((From: Collector/Emitter, April 1972))

Those who think the cage antenna died a natural death before 1930 should read about an antenna used by the Army for testing the immunity of equipment to the electromagnetic surge produced by an explosion of an atomic bomb. This little trinket is a thousand feet long, 65 feet high, and is a multi-wire cage 30 feet in diameter, tapering to a point at each end. The taper is on the last 100 feet. To simulate the effect of an atomic explosion, the Army slaps this antenna with 7,000,000 volts from a huge capacitor! Katy, bar the door!

A NEW LOOK AT OLD I.F. AMPLIFIERS; The Usefulness of Hybrids -- C. Pitcher (VK3)

Transmogrifying an Old Radio

I recently became the proud owner of an old Mantel-style radio. Being built in the '50s before obsolescence became the watchword ((1850?? -- RLG)), it is quite well-designed, particularly the mechanics and will doubtless provide the basis for an excellent radio.

Instead of just stripping it down and rebuilding it, I decided to learn a little along the way, and replace things a bit at a time, trying to improve (or evan match!) the original performance. The results so far have been rather interesting.

The Audio Amplifiers

Naturally, the A.F. amps went first, to be replaced by standard transistor versions with lowish power output. That doesn't bear comment except that it gave me an amp or so of heater current to run everything from, and blew the filter capacitors up from the lack of HT load. When things returned to normal, and I coaxed the wife out from under the bed, I started on the I.F. Amp after taking a look at the Converter.

The Converter

The original circuit was fairly standard: a converter valve, one I.F. amp and two audio valves. Under Melbourne conditions on the Medium Wave band, there was just barely evidence of cross-mod. at the top end. Replacing the original aerial coil with a ferrite affair cured that, so presumably the converter was at fault. So much for the converter.

FET-ising the I.F., with good AGC

My first attack on the rest was to wire in an FET in place of the original pentode I.F. Stage; see fig. 1. After adjusting the neutralisation the gain appeared to be much the same as before, but the crossmodulation made most stations unreadable. By detuning the input transformer, it was improved some. This was probably due to reduction of the AGC (Automatic Gain Control) voltage, since the gain was reduced.. So I went looking for a better AGC system. The "hybrid" method was tried, with a transistor in the source lead. Like magic the cross-modulation dropped to nothing. This was lesson No. one.

Still pottering around, I next tried the cascode circuit, with an FET and a transistor, and reverse AGC to the base of the transistor ((If you need background for this kind of thing, take a look at the excellent summary of theory in the front pages of the RCA Transistor Manual -- RLG)). This was better than the FET alone, but cross-modulation was still there on strong stations (i.e., high AGC voltage). The hybrid method again provided a solution; see fig. 2.

At this stage I was able to dispense with the neutralisation (thus saving one capacitor!), but more important was that the gain was higher (as evidenced by improved performance with weak stations) and the selectivity noticeably improved (viz., less highs in the audio). I presume this was due to reduced loading on the second I.F. Xfr, and ——→

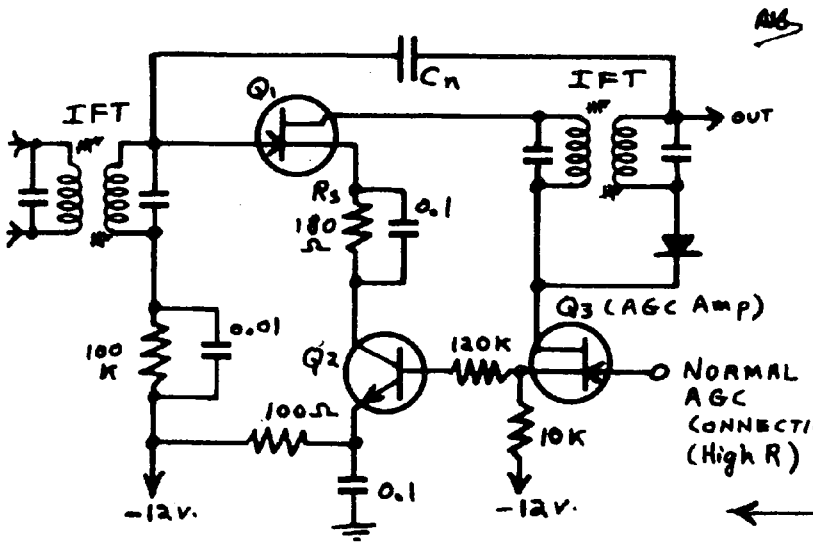


FIG. 1: FET Amp. with hybrid AGC (To feed from low-R, Q3 may be omitted). Q1 = National NF 501 (I_{DSS} ± 8mA), MPF102, etc. Q2 = Any silicon NPN. Q3 = Q1 (V_p ± 1.2V: AGC delay).
(ALL I. F. TRANSFORMERS, "IFT", ARE SHIELDED AND EARTHED, of course)

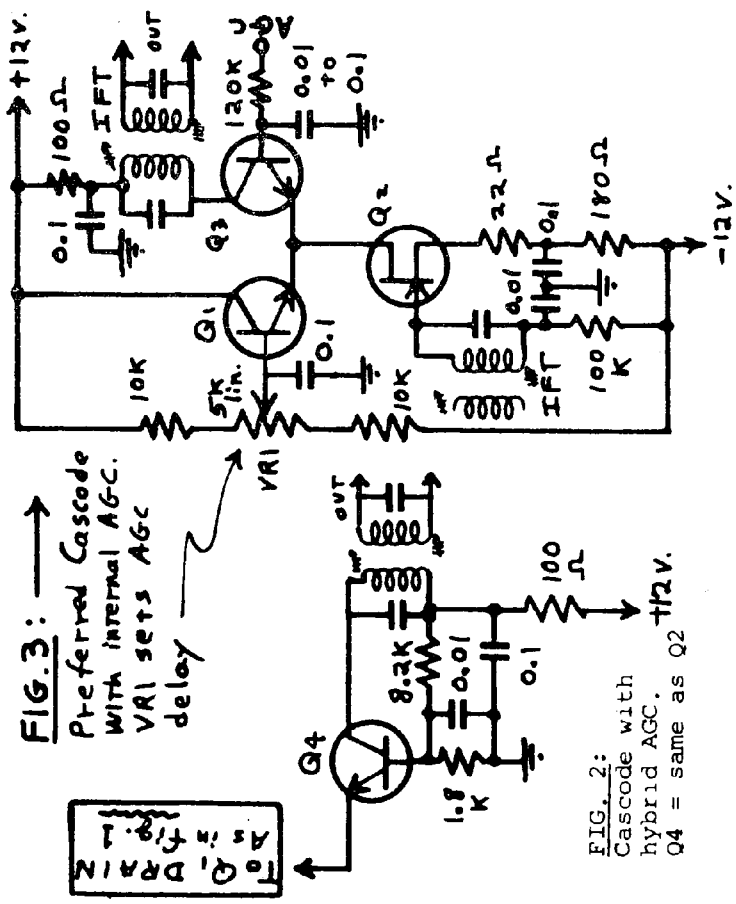


FIG. 2: Cascode with hybrid AGC. Q4 = same as Q2

probably due to imperfect neutralisation beforehand. To prove or disprove this, I interspersed a buffer between the I.F. XFR and detector. It didn't prove much, although the selectivity may have sharpened slightly, so feel free to draw any conclusions you wish!

A Useful Rearrangement

The final step was to take the AGC transistor from the emitter of the FET, and place it in parallel with the other transistor; see fig. 3. There was no noticeable improvement in anything. In this case, however, the transistor could conceivably be replaced by a diode, and it was possible by adjusting RV_1, to set the AGC delay rather nicely.

So there it is. I think I have improved the original; one day I will measure it and find out. But at least I have removed any nagging doubts about the superiority of valves over transistors. To my mind, anyway, it is not the device so much as the way it is used. But it is true that the transistorised A.F. stages did allow a more efficient use of power.

Editor's Note

I have a M/S about a somewhat similar conversion I made to an old farm radio, but Chris's is probably better. But the fallout from it resulted in our set of articles in 1970 about the proper design of complementary-symmetry a.f. output stages, because my initial power output attempt was with Fairchild's 3W design -- the one using no bias between the transistors. It sounded terrible, and some liaison with a friend here and in Victoria yielded the improved designs of 1970.* → See Editorial

In a previous radio, the transistorisation of the a.f. output stage was vitally necessary, because without it the power transformer ran stinking-hot; enquiry to the (American) manufacturer revealed that (after the doubletalk) that was supposed to be the operating temperature of the transformer! Presumably, complete with the smell of burning insulation.

Chris had considerably better results than I with the i.f., but one useful thing I found was that an untuned r.f. stage could be added to good advantage. An FET with 10K in the drain and a few K in the source worked fine. I used 100K in the gate; Rod said this introduced noise, but lowering the value of that resistance only reduced signal level without improving any thing. With the r.f. stage, quite a lot less aerial was necessary.

In this particular case, however, the farmer was plagued by fierce mains noise, and the r.f. amp allowed the use of a home-made ferrite-coil antenna. This performed every bit as well as a long wire (Melbourne stations at night, no difficulty), but featured a greatly improved rejection of the mains hash. That's a thought to keep in mind in noisy locations. Rod says its no good for short wave, because its mainly affected by ground wave transmission -- but those Melbourne stations must have a long ground wave!

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THE HUMAN SIDE OF TVI

-- by Al Fischer, W7UV

((Reprinted, in part from the Bulletin of the Amateur Radio News Service, May 1972))

... I have no TVI, but I get into the phono hi-fi sets of most of my neighbours. So far, all the neighbours are nice, but they won't be nice forever. Now, this is a problem as old as amateur radio itself.

Some amateurs ignore the neighbours, some buy parts and install same on the hi-fi, still others simply tell the neighbours to call their service man. BUT WHAT WOULD YOU DO? The answer to my problem is the prime number one factor governing public relations images created by amateur radio (in the absence of an emergency) with the general public. The WRONG answer to the problem destroys years of good public relations efforts, and the greatest mistake any amateur can make, public relations-wise, is to use the incorrect approach.

We have been told NEVER to touch a neighbour's installation ourselves. We have been told NEVER to take an arbitrary approach with a neighbour or to ignore him. On the other hand, it takes the diplomacy of a professional (which few of us are) to convince the neighbours that it is a fault of their own hi-fi installation.

The neighbour only understands that all was peachy keen until THAT amateur moved into the neighbourhood, and so why should he hire a serviceman to bypass the speaker leads and the AC line on his Japanese solid state Hi-Fi?

If any of you have an answer that yours-truly has not heard of nor read after 43 years on the air (and I have not heard all theanswers or know them), well, let me hear from you and I guarantee the editor will print them in the next Bulletin.

EEB Ed Note: The Amateur Radio News Service is an association of editors of radio publications of all kinds. They and their interesting Bulletin aim to help other editors improve the quality of their publications. We have received a considerable amount of help, advice, and useful ideas from them. If you are involved with any kind of publishing activity, you will undoubtedly be interested in the ARNS. Enquiries may be sent to the Secretary: Rose Ellen Bills, WA2FGS, 17 Craig Place, Pennsville New Jersey 08070, U.S.A.

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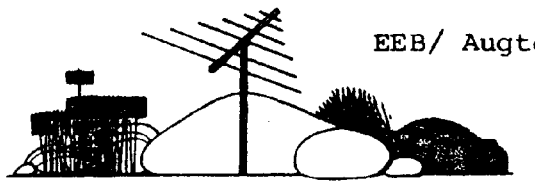

TRANSCEIVER RECIPROCITY AND RECEIVER COMPLEXITY

A SQUARETABLE

((Being a Discussion between Winston Henry (VK 7WH) and Leo Gunther (VK7RG) with asides from Richard Ferris (VK7ZDF).))

Phasing-Exciters

W: I'm building that neat improved version of the Tucker-Tin SSB phasing exciter which appeared in the August 1971 Break-In* ((The original, rather simpler version of this was reproduced some years ago in EEB (valves, 1968; transistors, 1969))). I'll follow it by a transistor linear amplifier with perhaps some 15 W PEP output.//*Followup 10/71, 5/72. Summary in "Tech Topics", Rad.Comm., July 1972, p.451.

L: Why not use valves in the final? Simpler, less worry about nasty parasitics, transients, neutralisation, etc?

W: No, I want this to be portable as necessary.

L: Carrying the battery in a Back Pack?

W: Well, I can use a reasonable dry battery, and simply not modulate so heavily.

L: Why not just put the exciter on the air?

W: Its only milliwatts.

L: All right, but say you take 2 W from your final, thats only two S-units better than 100 mW, for ten times the power drain.

W: Well -- its only peak power.

R: Peak power or not, its still a stupid argument. Why not use only 10 mW? After all, it will "only" be 2 S-units down from 100 mW...

L: Arguments by themselves are never stupid! A couple of S-units may not be major, but double that might be significant.

I admit, however, that I am simplifying the picture. For a home-installation where power is no object, 100 W are 3 S-units "better" than 1 W, and valves do the job easier and cheaper than transistors. On the other hand there exist the "QRPP" enthusiasts who maintain that "power is no substitute for skill" and who delight in achieving 1000 or even a million miles per watt. It all depends what you wish to make out of amateur radio.

For Winston's portable system, however, performance must be balanced against weight and size. It takes rather more batteries to deliver 100 mA than 10 mA, and obviously a 1A load is not as portable as either.

Empirically, some 100 mW will give quite a lot of coverage if it feeds a reasonable antenna. If the antenna has to be carried on the back, that figure might go up to 2 W so that those two S-units are not lost. If, say, the average level of your signals received at the other end is about S6 (or say, "10db above S9" in modern language), you might be willing to reduce power 20-fold to bring it down to S4, but below that you would get into difficulties unless you were operating CW.

Thus it resolves down to the amount of batteries you are willing to carry/afford, to antenna efficiency, to the band used, and perhaps to your diligence with low power!

With Direct Conversion Receiver

L: What about the receiver?

W: I thought I might use a Direct Conversion receiver. Its simple, and I could use the same oscillator for BFO as I have in the exciter (with a bit of conversion).

With Good Audio Selectivity

L: Ummm, perhaps. But of course you'll want to use an audio filter with a good bandpass shape factor, as we've been discussing in the EEB articles. The Chebyschev response one in the 1971 ARRL requires only 4 88mH toroids.

W: Well, yes, all right.

And Phasing-Detection

L: And then there's the problem of audio image -- nasty if QRM is heavy within a few kc* of your signal.

W: Yes, but that can be phased out, can't it?

L: Just so, and in fact we're talking about that in the EEB (if it ever gets published); I'll show you the relevant books on the two-phase system, or "Signal Slicer" (EEB, 1969, p. 100).

W: Very interesting: No reason why I couldn't use the same components for the receiver phasing detector, as for the transmitter phaser, is there?

L: That's right. In the transmitter, audio is stripped from a sideband by opposite-phasing, and transmitted as a signal. In the receiver the signal is detected and turned into audio stripped of a sideband. Just the same process.

Not only does this eliminate half the QRM in your bandpass, it also increases S/N ratio of a SSB signal by 3db (every bit helps, Dick) It also allows painless reception of DSB, and even AM by the exalted-carrier principle. Receiving both sidebands of AM on a product detector is awkward because of the need for the L.O. to be in phase with the received carrier. That this can be done at all implies only that the Local Oscillator is being locked by "pulling" from the received signal. This is in fact done deliberately in Ref. 33 of our current series of articles.

Phasing for both Tx and Rx

W: It sounds like a good idea, and from these valve circuits you're showing me the "Signal Slicer" doesn't look too complicated. No reason at all why the same circuit can't be used from the exciter, run backwards.

L: Yes, but you can't really do that literally. The inputs and outputs would have to be switched around and that could be awkward. In addition, the requirements for linearity of the receiving product mixer would be rather more stringent than for the transmitting one because of the greater dynamic range needed.

This might suggest the use of a couple of Dual Gate MOSFETS for the mixers (replacing the diodes of fig. 11 in my State of Art article) You could use the same L.O. and r.f. and a.f. phase shift networks as for the Tx, but you'd either have to switch to a different audio amp or switch input and output of the Tx one. I shouldn't advise the latter, because of the high a.f. gain needed. High a.f. gain can be

EEB, June 72

*In conversation I refuse to use hertzeses!

attained easily enough nowadays with an IC.

W: All right, but those phase-shift networks are tricky, and it would be well worth switching them from Tx to Rx. And the same oscillator stability can be achieved on Rx as for Tx -- and that is important.

L: Ah so, but remember that that oscillator should have a clean sine wave output, or you may be receiving 7Mc Peoples Radio on top of 80M signals (or 20M California KW's on 40M).

And an R. F. Stage

W: Why not merely add another tuned circuit at the r.f. input?

L: It increases the complexity of ganging the tuning. And in addition it is really quite a lot more effective if you pop an FET between the tuned circuits. And you could improve results even further by using an r.f. Q-Mult. or controlled R.F. Stage regeneration (harder).

W: More r.f. selectivity would also help to reduce crossmodulation from adjacent strong signals, as long as r.f. gain is kept low.

L: True, but that r.f. stage will also introduce a little noise, and even more if regeneration or Q-multiplication is added.

R: Regeneration may increase noise, but it also increases signal: The SNR is not affected unless you operate very close to oscillation.

W: In any event, a good FET introduces low noise. And it allows good AGC control -- otherwise how would you get AGC on a Direct Conversion receiver?

L: Audio AGC.

W: But that won't keep strong signals out of the mixer.

And a Linear Mixer

L: Use a linear mixer, like a beam-deflection valve, 7360 or similar.

W: This setup can't use valves, so I'll have to use the best available semicon mixer.

L: Then use Hot-carrier Diodes, though they have the disadvantage that they require balancing transformers for a doubly-balanced configuration, if you're to get the lowest amount of harmonics and feedthrough.

W: The DG MOSFETs might be simpler, and if r.f. gain is kept very low as Dick suggests, the mixer should be able to take the normal range of signals on the bands.

And a Buffer

L: A further refinement could be to add a buffer stage between oscillator and mixers.

W: Why?

L: To reduce the effect of "pulling" on the L.O. by incoming carriers.

W: But the only signals will be sidebands, no carriers.

L: No, a sideband is just a carrier whose frequency and amplitude are varying at a certain rate. You can have pulling of a L.O. by a strong adjacent-signal sideband, with the consequence that the L.O. frequency is modulated by the audio of the QRM. You can imagine what this does to the desired signal!

R: That's what I said.

L: Yes, certainly, where do you think I get all these bright ideas?

W: Perhaps the buffer might be useful, we'll think about it. Simpler first to try it without the buffer and see what happens. After all isolation ought to be pretty good between the gates of a Dual Gate MOSFET.

And a Good Audio

L: Perhaps. Try it and see -- and let us know the results. I might add only that you will need to be very cautious about avoiding internal transistor noise and external audio pickup, because of the very high a.f. gain needed. You can take care of the circuitry by using an I.C. for the audio amplifier, but G3VA (in "Technical Topics")has suggested that superior results might be achieved by using discrete amplifier stages having bandpass filtering on each stage. This can also do wonders for the shape factor of the audio response, if intelligently designed.

W: The result of all this should be a pretty good receiver.

So what happened to the Simplicity?

L: Indeed, but what has happened to all that "simplicity" the Direct Conversion Receiver is supposed to have? For comparable performance you need comparable complexity. Simple D-C simply has the advantage that you get somewhat better performance for the same number of components than you would obtain, say, from a good Regenerative Detector (and on CW they could be comparable!).

W: But D-C would appear to have the advantage that the (audio) selectivity is placed very early in the receiver, right after the one and only detector.

In a Superhet the maximum selectivity is obtained only at the end of the i.f. strip, so allowing the possibility of i.f. overload within the r.f. passband. Pat Hawker has quite a lot to say about this in Amateur Radio Techn.

Back to the Superhet?

L: All right, but its not fair to compare the two circuits unless you do so under comparable conditions! In the D-C, the pre-selectivity gain is kept low, and highly linear mixing is used. As Pat Hawker mentions, you get the same results when r.f. and i.f. gain is kept low in a superhet using similarly linear first mixer(s). See also the fine discussion on this subject by Peter Martin in early 1971 issues of Radio Communication ("Plagiarise and Hybridise")

W: In a superhet you have the problem of r.f. images (and 2nd harmonic images). If you use double (triple, even!) conversion to avoid images you invite a lot of "birdies" from the harmonics of all of those oscillators.

L: Modern technique is returning to single-conversion, with lots of selectivity (from mechanical or crystal lattice filters) at high i.f., and right after the first mixer. This avoids both the images and the birdies, and also avoids i.f. overload. Additionally, up-conversion (converting to i.f. higher than the signal)(see Am. Rad. Techn. for interesting application via varactor diodes) renders oscil-

lator harmonics harmless.

The picture is completed by low noise low gain r.f. stages, and mixers biased for good compromise between sensitivity and linearity (See QST for Jan and Feb 1972). Thus, superheterodynes having good performance are becoming simpler (and better), while good Direct Conversion is getting more complicated.

Murphy wins.

A Direct Conversion set is simply a superhet with zero i.f.: I.f. amplification is replaced by a.f. amplification. It is "better" only if it is easier to achieve high gain and low noise in a.f. stages than at i.f.

It isn't.

But Direct Conversion is still better -- sometimes

W: You've presented a pretty convincing argument for the superheterodyne, but you've overlooked something: A simple D-C will give quite satisfactory performance, and we have seen this in Ron Brown's (VK7ZRO) neat little unit. A simple superhet will give terrible results because of r.f. images, though I'll admit that it is worthwhile to use good selectivity filters for either.

A simple D-C is not troubled by r.f. images (the L.O. freq same as signal freq), and for the sake of simplicity it would be worth a little trouble to build a L.O. with low second harmonic content.

L: I suppose so, say a push-pull oscillator, or an ordinary Vackar or Seiler with some degeneration; the latter are reported to have "amazing stability" as well. A typical good, low harmonic Seiler Osc appeared in the Jan 1972 Ham Radio.

W: The main point is that I want only a simple set for my mobile operation, one which is compact and easily portable -- and reasonably easy to build.

The D-C fits this requirement better than the superhet, and I'm willing to accept a few limitations on performance. On the other hand I see no reason why I shouldn't be able to use the phasing components of the Tx on the Rx, and for only a little extra complexity add the "two-phase" detector. It will slice the bandpass in half, and thats impressive. With that one refinement it is certainly going to perform as well as most superhets, and better than many.

L: But surely not better than a superhet also endowed with a "signal slicer"?

W: Perhaps not, but that addition makes the already complicated superhet even more involved. With the D-C without an R. F. Stage I can still get good results if I have a linear mixer. Superhets without R.F. Stages are useless for serious work. And to get good results from R.F. Stages you have to go to a lot of trouble, as Blakeslee shows in the Feb 1972 QST.

Under dire conditions of strong signal QRM I could still pop in a switched r.f. attenuator. One of the big advantages of the D-C system is this flexibility: the basic receiver is good, and complex ones are even better -- with a wide choice of refinements. The superhet has to carry a lot of baggage merely to work.

R: It seems to me that Winston wins this argument on the basis of simplicity. A D-C can be more effective when simple than a superhet for the sole reason that the i.f. of the former is zero, so if there is no serious QRM within the audio passband, there is no problem of images even without an r.f. stage.

If there is serious "audio image" the use of the Tx phasing network on the Rx will phase it out, as he suggests. This results in reasonably high performance for a portable mobile system.

L: Why should the question of portability be so relevant here? Surely a couple of small i.f. transformers hardly impose a crushing burden?

R: One of Winston's requirements was that it "be easy to build". If it gets too complicated that requirement is not filled -- and better a simpler set that gets built than....

L: All right. You build into a system the degree of complexity consistent with your requirements for performance, and with your ambition. Life always involves "tradeoffs", and the argument here is quite analogous to the one about power levels, at the beginning of this article. But let us be disabused of the notion that by use of some magic design we can get "something for nothing".

W: A bird in the hand is worth two in the oscillator...

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TELL THIS TO YOUR XYL ((VHF News Bull, 5/71))

"Wireless World" for March 1914 reports that "The demand for female domestics, both in Australia and New Zealand, appears to be imperious and practically unlimited. In some cases, before a ship carrying women migrants sights the land a large number of its passengers have been engaged by wireless telegraphy."

The writer concludes with this punch-line which is worth quoting out-of-context:

"To the colonial housewife wireless is, therefore, a boon which she probably never contemplated."

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Quote

"It seems to me that our mail service may well be headed for extinction. As the rates go up and the deliveries go down, something else is bound to take its place. Of course I feel that the post office could easily be automated if they had the inclination. By standardizing on an envelope size and authorizing a simple addressing machine which could be read by a computer ((directly)), they could get most of the mail in shape so it could be sorted and handled entirely by machine. A special low postage rate would force all commercial users and prudent private persons to use the new service. ((EEB emphasis))

"The addressing machines could vary from a $5 Dymo type contraption, to regular typewriters. I'll bet they could turn them out to sell for $2..." (etc etc in same vein)

-- Editorial, 73 Magazine, October 1968.

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THE PARTS AVAILABILITY CRISIS --- Part III

-- R.L. Gunther (Editor)

We have recently received a Catalogue from "HAL Communications Corp" and from "Babylon Electronic Equipment Company", also mentioned on p. 35 of the April EEB.

HAL offers several kits of special interest to RTTY enthusiasts, and both of these typical "basement electronics" firms offer a wide range of components of all kinds, from ICs to transistors and small components. Both solicit customers in the USA and abroad. Both are typical of several other firms abroad, as advertised in the various magazines.

A. G. Adams' assertion here last month certainly seems to be justified that the parts are available if one looks abroad. Yet there is a consistent complaint to the contrary. We read about it in the Yank magazines, and it is sent to us in personal correspondence. We reprint a typical one herewith, from the USA, and some contrasting information from the U.K.:

USA
((From a Prominent Amateur))

"With the demise of ... there has been an abrupt end to high-level electronics kit building and experimentation in the USA. It doesn't sell advertising..."

"...The IC-makers, the transistor manufacturers and electronic component distributors are making it more and more difficult for the experimenter to tinker around the shop. As you probably know, old reliable --- has been taken over by ---, and the industrial electronics division has dropped several important manufacturers (or probably more likely the manufacturers, notably --- have dropped them). Nevertheless, it is getting very difficult to buy parts to do any construction. This has resulted in a whole new batch of basement electronics distributors like HAL Devices and Semiconductor Circuit Specialists, Babylon Electronics, etc. They take care of many of the special parts, but what happens when the average experimenter wants to buy a --- IC, --- SSB/CW/FM i.f. strip IC, or some other bit of exotic hardware? He's up the proverbial creek without a paddle!/.."

"Darn few beginners build their own equipment, in the USA at least. And how many hams build their own receivers or transceivers? Many build linear amplifiers but only a very few build receivers, exciters, transceivers, etc. And with the explosion of Japanese 2-meter FM gear, the interest in building VHF equipment approaches zero. It is a sad spectacle. To make matters worse, even if you wish to build something, it is nearly impossible to purchase parts. More and more distributors are only handling industrial accounts, as over-counter sales are time-consuming and hams are a pain in the neck anyway. ---, one of the greatest outfits in the world for mail order, has been taken over by --- and is going out of the mail order biz... I may be over-pessimistic, but amateur radio in the USA is going through a profound revolution. Between the influx of appliance operators and the flood of cheap Japanese gear -- aided by the general inability to obtain components -- I see that the home builder of electronic gear will be as extinct as the home builder of automobiles or fridges or TVs. If you want to build (you eccentric, you!), why just order from your Friendly --- Kit Catalog."

From a recent QST Editorial

" 'You fellows aren't amateurs any more,' the comment went. 'An amateur is supposed to be primarily an experimenter, to build his own equipment, to try out new circuits, to develop ideas. You did this years ago, but no longer. All you do is lay out a few hundred dollars and buy station equipment entirely commercially made. When something goes wrong, you even send the unit back to the manufacturer for repair! You are not amateurs; you are just communicators. We can't afford frequencies for such activities.'"

-- A deligate to a frequency conference
((See also EEB Oct 1971 p. 85 upper left))

((I am tempted to quote from O. P. Ferrell's Editorial in the Feb 1971 Popular Electronics, but by a coincidence Mr. Ferrell is no longer editor of that august journal, and I'd better not... -- RLG))

U.K.
From R. F. Stevens, G2BVN:

"I have discussed the availability of components with several of our members who are in the professional field but unfortunately none of them would commit themselves on paper on the question.

"Those to whom I have spoken all agree that at the present time the supply of components in the United Kingdom does not present any problems. One of the factors affecting the position has been the entry into the market of large distributors who hold considerable stocks from all the main manufacturers. Not only are they prepared to supply in large numbers but will also supply in small quantities for development and prototype purposes.

"I gather, however, that the position has not always been as satisfactory as at the present time, and up to as recently as a year ago there were considerable hold-ups in production due to the delay in the supply of components. I understand that this applied particularly to certain types of capacitor."

From G. V. Haylock, G2DHV; and from G2BVN:
((We have received from G2BVN, extracts from "Electronics Weekly" ("The Technical and Business Newspaper of Electronics and Communications", Dorset House, Stamford St., London SE1 9LU, England), and from G2DHV an entire issue of that newspaper. It contains news about the electronics industry (of the sort one might read in the financial pages of The Australian), together with adverts for equipment and components, and a precious section marked "Prices and Deliveries", a "single source of information showing prices and delivery times for a cross-section of commonly-used (components)" of various types. G2BVN wrote:

"There has been considerable concern here at the lack of available supplies to back up manufacturers' promises. As a result of the debate Electronics Weekly now publish a series of availability charts..."

From "Radio Communication" (RSGB)

((This magazine regularly announces various items under the "Catalogue Received" listing, and in the editorial "QTC News". Thus, to take a couple of items from my files, in the Dec 71 issue, it was the "Home Radio Catalogue"; "The purchase of components... is an ever increasing problem. Manufacturers are unwilling to sell in small quantities where the overheads are said to be uneconomic. To try and overcome some of the problems, Home Radio has formed a buying group with other component dealers..." etc, with numerous advantages (240 London Road, Mitcham, Surrey CR4 3HD, England).

((In the August 1972 Rad. Comm. the Catalogue was that of Electroplan Ltd (PO Box 19, Orchard Road, Royston, Herts SG8 5HH, England) supplying various accessories.

((I would note, however, that in marked contrast to the American radio amateur magazines (where the Parts Availability Crisis is said to be worse), out of 35 advertisements in the August 1972 Radio Communication, 23 were for commercial-amateur equipment, 6 were for modules, and 6 were for components, with a slight amount of overlap in some instances--Ed))

AUSTRALASIA

From an Australian correspondent

"Even here parts have begun to become scarce, though rather more in lines of merchandise handled by Australian outlets of the big American firms. Still, from the whinging overseas it looks as if parts are still more abundant here than over there. Why don't you suggest to your overseas readers that they import their parts from Australian suppliers?"

From an advertisement

"Fed up with temperamental home brew gear? Then now is your chance to clean up the shack and join the DX hunts" ((by buying a good commercial transceiver)).

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NOW BACK TO RLG

This is a strange picture? Parts are available parts are not available, advertisements show an abundance (see the pages of Wireless World) while manufacturers are said to have difficulty supplying, the situation has improved compared to a year ago but retailers are being forced into cooperatives to survive...?

What is the truth? Is there any point in importing components from a scarce market overseas to a reasonably abundant market here? And the market in New Zealand seems to be about as well supplied as in Australia, to judge from adverts I see in Break-In and in Electronics and Communications -- and from a lovely "Directory of N.Z. Electronics" kindly sent to us by the publishers of the latter-mentioned magazine.

Will the present availability of parts here dry up soon in reflection of overseas trends?

It appears that the question is not that simple. One reason for the apparently better situation here may be the greater resourcefulness of Australasian experimenters in adapting components available; this seems evident by comparison with the American experience as described by Doug De Maw in the July 1972 QST ("The Ailing Emporium"), and Yankee affluence may have affected the British as well.

Additionally, Rod has pointed out to me that there are still distributors here who are small enough to be willing to handle merchandise on the limited scale we require, whereas De Maw points out (in the QST article) that

> "It is ironical that we live in a time when state-of-art components abound, yet they are earmarked for the high-quantity commercial buyer..."

A further problem exists seemingly in an opposite direction, the large variety in type numbers of components having similar or identical components; this has been summarised by Jim Fisk in his Editorial of Feb. 1972 (in Ham Radio). Again, however, our experience is more favourable in this regard, since on one hand we have a smaller range of material available, and on the other Australasian experimenters use common sense in adapting available material to recommended material; otherwise how could they make sense of the overseas literature?

Lastly and not at all leastly, some new information just available has altered the Australian,and indeed world, position in these matters -- affecting not only components but the electronics industry in general. In the past week or so (early October) that Industry has been in an obvious and agonising state of flux. These developments will be considered by some of us in the next EEB.

Indeed, I have had to rewrite much of this page just before going to Camera, because a detailed analysis of the Parts Availability situation by Rod Reynolds here will need to be rewritten, and I don't want to delay publication on that account. By the time the next issue appears, matters should have stabilised somewhat, and a more accurate prognosis of the parts-availability situation will be feasible.

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QUOTES (Perhaps relevant to matters on p. 75 ...)

"Sir John Masterman is a distinguished author and historian, former Provost of Worcester College, Oxford, and Vice Chancellor of that University. He was wartime deputy chief of MI5 -- academics, it seems, were found to be eminently suitable for the work." -- Newspaper report reviewing the author of "The Double-Cross System of the War 1939 - 1945"

"A laser beam is being developed with 'death-ray' potential. A strange technology indeed, where the defence against such a weapon would be a polished mirror 'reflecting the laser ray back where it started -- with devastating results'... But research is going ahead at a 'healthy rate', and scientists are confident that the main difficulties will be overcome.... "But the scientists in New Mexico -- and their Soviet counterparts at Novosibirsk in Siberia - must all be hoping that the 'death ray' will never be turned against anything more deadly than the pile of oil drums in the foothills of the Munzano Mountains." -- paraphrased somewhat from a newspaper report, 25/3/72.

"We can make this country into a quarry to serve the whole world... Pollution is important, but not as important as a million-dollar industry." -- Sir Henry Bolte, Sometime Premier of Victoria (Australia, where else?)

This & That; droll humour

Nearly as funny as Sir Henry is the suggestion made seriously this month, that to solve the recurring Problem of the French nuclear weapons tests in our backyard, Australis ought to send a Task Force into the Test Area to daunt the dauntless Gauls. Can't you see it? I reckon the possibility is slight that there will be civil war between the French and their military customers here....

Less funny, maybe, is the progress toward the establishment of a uranium-diffusion plant, probably in electrically-operated Pederless-Tasmania. I suppose that the peace-protesters will miss the point of that too. It seems rather more likely that the principal nuclear weapons targets would not be the factories (which would already have produced their nasty load), but the people responsible for them: Me and Thee. Wot a world.

Blow Here to Inflate (or: How Pleasant it is in Canberra, heigh-ho, how pleasant it is....)

Whilst we're considering absurdities, the Inflation flames afresh, fed by blind self-interest on every side (but oh its still better than the 10% per month being enjoyed in a South American country at present!).

This hasn't inhibited our national Representatives in Canberra either, who have cunningly managed to promise the earth AND to reduce taxes. I reckon it will get them elected again (and again and again...), but I'm willing to bet that the First Law of Thermo applies even to politics: "You never get something for nothing". The Second Law says, incidentally, that "Geese never lay Golden Eggs -- or hardly ever". We'll see.

How to get Something for Something

In welcome contrast I am struck by the lucid treatment of the TBA651 Multipurpose IC, as described (probably by Tony King) in the August 1972 issue of The Radio Bulletin (Reviewed here in April 1972, p. 40). This is somewhatrelevant to our big discussion of IC-technology last month -- about which reservations may...

In any event, here is a presentation of an IC and its functions in EXACTLY the manner I have always admored (but rarely seen). Instead of the usual Black Box producing 16 pins to a Model Circuit, here we see a thorough analysis of the circuit functions in the B.B. -- one by one -- showing how they can be appliedto specific functions using discrete component analogies. This allows us to understand how the IC works,and thus apply it to a variety of circuits -- not merely the pet one chosen by an author. Would that the Handbooks adopted this approach too.

The TBA651 is the whole front end of a receiver, and when combined with another STC unit (e.g. TAA611/B or TAl0)is an entire receiver! Gadzooks. Tony not only describes each circuit function (including a P/S regulator), but supplies curves and quantitative date with performance figures. Lacking, however, is some indication of strong adjacent signal rejection capability, called to question because of the exclusive use of bipolar circuitry (though degenerated by f.b.)

In that same issue of the RB, incidentally, he also shows a nice design for yet another unneutralised Dual Gate MOSFET r.f. amplifier stage; ARRL please note. The widespread availability of the protected DGMOSFET, MPF121 at low cost now makes such r.f. stages (and the rest) very practical. I note, for example, that in the April 1972 73, K4DHC (reprint in the July AR) uses a similar DGFET as mixer feeding an LM373 multipurpose IC i.f. etc, but unaccountably he prefers a nasty JFET as r.f. stage. I wonder why.

Use of a MOSFET tends to take care of nonlinearity leading to annoying crossmodulation, but where are the MOSFET ICs ? On the other hand it still doesn't compare to a good valve -- as discussed by G3VA in "Tech. Topics" (Rad. Comm.),7/72.

Further news about linear ICs in receiver design etc occured in the May 1972 "Tech. Topics" (and often generally in that Column), and in Aug 72 Radio Comm.: "Consumer Integrated Circuits in Amateur Design. In that same issue, TT showed the use of the RCA CA3028IC in a Direct Conversion front-end, and the NE562 in an "Infinitely-clipped" Phase-locked SSB!

In the July 1971 Wireless World there was a circuit for an SSB receiver using ICs entirely (Ref. 34a-1, EEB, 12/71), and the Apr 72 issue of the WIA's W.A. Bulletin tells that those ICs are available through Plessy Ducon P/L (Box 2, Villawood, NSW 2163). The lot comes to $34 including tax, but it would certainly be easier than using discretes... The Bulletin also specified an overseas supplier for a 9Mc Xtal filter for $35, but considering Customs etc I should think that you'd do better with a local firm, e.g. Sideband Electronics Eng. (Box 23, Springwood, NSW 2777).

((No more computer boards available, but we do have a few copies of bound EEB volumes, 1970, left -- at $A3, $C/US4.30, etc.))

ADVERTISING

STOPPRESS: Sale, Butterfly Capacitors, Jackson Type C.713. 25pF 0.015"A/G ((Screwdriver adj. New, in box, $1.50 ea, PP. P. Vogel, 5 Wilson St, Maroubra, 2035.........

This Page: Personal = FREE (for reasonable length). **We guarantee nothing................**

FOR SALE: COMPONENTS, mostly from breakup of an analogue computer. 10K ten turn pots with dial $2.50; Neons, lens tip in holder, 5mA: 30c ea; High precision (0.1%) WW resistors: 1Meg, 500K 250K, 200K, 100K, and 90.9 ohms, 25c each. Relays, P.O. type mostly 1000 ohm coil and 4-pole CO, pull in on 12V, 30c ea. PMG-type key switches with fixing scrws 4-pole; up-down-centre, 30c ea. Carpenter polarized relays and socket (ideal for RTTY), $1 ea. BA-nuts and bolts: 6 & 8 BA, ⅛ and ½ inch; 200 piece mixture, 50c. HIGH Q AUDIO FILTER: containing 3 toroids and capcitors in metal can 4x4x2 inches; f_0 = 1120 cps when Z_0 = 600 ohms (Z_{in} low, e,g, from cathode follower), insertion loss only 2.5db; characteristics likely two-pole: -6db ±40cps, -30db ±75cps, sharp nulls at -45db then back up again: $1.50 each (heavy). ADD EXTRA FOR POSTAGE (any excess refunded, of course). R.S. MADDEVER, 5 Cameron Close, Corio, Victoria 3214.

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COMPONENTS OR EQUIPMENT PROBLEMS? Advertise in HAM ADS. A years subscription plus a free 75 word ad costs only $4.00 Subscribers also obtain a special 10c/word advertising rate. Tap the enormous American market, or just look, for your own interest: HAM ADS, P.O. Box 46-653, Los Angeles, California 90046, U.S.A.

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WORLDRADIO, the radio amateur's own international newspaper -- featured in the December 1971 EEB, is now pleased to offer a special low subscription rate to our DX-friends, $US4 per year. Send to: 2509 Donner Way, Sacramento, California 95818, U.S.A. A free sample available on request. Try it! ((Or send $A3.00 to EEB for a sub. — RLG))

= =

EQUIPMENT AND OVERSEAS COMPONENTS AT LOW PRICES Prices are often lower overseas, and availability can be better in some cases. You lose by going through middlemen in Australia. You'll lose a lot less by going through middlemen in the USA! Import problems can be minimised; see June EEB, p. 56. Try it for parts or whole Transceivers etc. Write EEB.

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HAM RADIO MAGAZINE: Owing to the usual pace of Inflation this excellent magazine with the execrable title will be raising subscription prices substantially, beginning January 1st. We shall continue to maintain our usual unusually-low rate of $A8.50 for 3-yrs sub to HR, until December 25th 1972. After that date we recommend you to "WIA Magpubs" who have announced in AR that they will hold their existing rates for HR mag without change "as a service to members". Namely $5.50/yr, $11.50/3-yrs. This is a tribute to the good sense of the Wireless Institute of Australia and to the sane policies of Jim Fisk in promoting a first-class technical magazine without a spot of politics. The Institute also handles at exemplary prices all RSGB publications, the fine Orr books, all ARRL publications, and the major magazine subscriptions of the world — not to mention a variety of components at wholesale prices, Hamfests, fellowship, and the rest. Can you afford NOT to join the Institute? Contact them at 474 Toorak Road, Toorak, Vic. 3142.

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OTHER SUBSCRIPTIONS AVAILABLE for lazy readers or who are too far from a bank to buy $US: 73 Magazine, $6/yr, $14/3-y. Or/and CQ Magazine for $5 per year. Also available are CQ publications (advertised therein) for =$A. Write EEB.

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EDITORIAL (continued)

Nasty Audio Amplifier Designs (ref. p. 77 here)

In the November 1971 issue of Break-In (N.Z.), Bert Shuttleworth, ZL4IO presents an elegant transceivor, the "Southland Companion", very pretty (no ICs though...). But I looked twice again at the audio circuit on p. 389; that looked familiar, its the same nasty non-bias audio circuit (viz. Class C!) by Fairchild we pulled to pieces in 1970. ZL4IO comments: "This is another well-known

now to be one of Australia's major Club publications. 6-UP in VK2 recently suffered massive political hemorrhage; it has been replaced by Tuned Lines, the first issue of which featured SSTV subjects and others... I was going to describe the other things appearing in the Radio Bulletin, but if you are an experimenter you'll want to subscribe to it yourself anyhow. Membership in their Club costs $3.50 (subsequent years $3), and although that's a bit steep for a publication it also entitles you to discount prices on their

circuit (viz. Class C!) by Fairchild we pulled to pieces in 1970. ZL4IO comments: "This is another well-known circuit previously described at some length, and needs little further comment. Its virtue is in its low cost... However the "transistor" type of quality is not too serious, and it may be noted that although the 2-metre set has the same effect, nobody seemed to complain. Presumably, many operators have become so used to this with small and compact equipment, that they scarcely notice it."! He was referring to the quality he presumed was caused by the loudspeaker, but its the amplifier that does the injury. From which I may tentatively conclude that amateurs (1) are masochists, and (2) are sometimes blind to the elementaries of design. As we mentioned previously an unbiassed complementary audio stage can be improved substantially by providing a bit of forward bias in the form of a resistor (4c) between the bases, or even better a resistor plus diode (44c).

That same issue of Break-In also had an important announcement, SEMICONDUCTORS CAN BE DANGEROUS. ZL3TGI describes how a diode in his receiver exploded and damaged his eye. Moral: always provide a protective cover over operating equipment, or wear safety glasses (or safety-glass spectacles). You can't be safe anywhere these days. Glasses are also useful when soldering, no joke.

Finally while I'm on horrible-subjects, another one appeared in the April 1972 73, p. 51, where J. Weir gives us a regulated power supply in which the feedback signal is firmly shorted out by a 500uF electrolytic from base of the series-transistor to common. Its the kind of thing about which we warned in our 1970 series on P/S design, and this is just to let you know that such things still happen. Beware. Look for errors.

Stephen Gunther

I'm pleased to announce that Stephen has taken on the job of Draughtsman for EEB. Its hard going sometimes as he learns, but he learns rapidly and is beginning to produce some quite professional-looking work. With his mother's artistic abilities and his father's capability for hard work Stephen should become quite a satisfactory man.

I might mention further that from Stephen's crystal set (last month's EEB) an output transformer feeding an 8-ohm loudspeaker produced astonishing volume on the local teenage "music" station, perhaps only 6db or so less than "normal". Just as well, perhaps, considering the type of programme material involved. I shudder to contemplate the result if we ran the present 100 metre wire over to the other side of our valley.....

Australian Publications

The Radio Bulletin, mentioned above, certainly seems (subsequent years $3), and although that's a bit steep for a publication it also entitles you to discount prices on their radio equipment and components..

We were saddened to learn of the demise of Don Reid's publication, Zero-Beat recently. This was a fine beginners magazine published in Melbourne. It is being discontinued because of"lack of finances and support", a pity. So far in the past few years the Australian Experimenter and Coryra have also fallen victim to this malady. EEB next?

Only if you don't help to publicise EEB. Our formal promotional efforts just keep us where we are, because a number of subscribers don't renew, each month....

Amateur Radio Techniques, IV

Although this book (c.f.p. 69 here) hasn't been reorganised as we'd like, its still well ahead of anything in second place. The reason I am so enthusiastic about it is the fact that it is a unique and badly-needed review of the major amateur/experimenter electronics literature worldwide. This is a valuable service indeed; far too much material is being published without considering the whole picture, and without sufficient analysis.

I won't take the space to review it here again; for those who are interested it was described here in Feb 1971, and Rod has written a review of it for a current Radio Bulletin. I'll quote only two paragraphs of his/our review: "There is one further feature of this book: you sit down to read it as you would a novel. It grips you, and once you start reading you find it difficult to put it down again. How many Handbooks can boast of this?
"This 4th Edition is some 50 pages longer than the 3rd. The main areas of increase are the semiconductor and aerial chapters. If you already have the 3rd edition, give it to a new amateur and buy the 4th. If you don't have either, this is a book you must not miss."

Obtain from RSGB, WIA, or bookshops (dearer).

I'm sorry if all this talk about amateur radio and its publications annoys you who prefer non-communications topics, but you'll still find those scattered through EEB, and likely more so in coming months. You may also find yourself becoming interested in Something New, and that won't harm you either. In the radio amateur publications you'll often find much material of general electronics value, and it must be recognised that in the purely-experimenter field the most progress is being made in these days in amateur radio subjects. You can appreciate this if you look at the non-amateur magazines and see them representing the same tired circuits you can find in numerous circuits books, when they are not bringing something in from Industry. There are some exceptions to this, and you find them in the pages of magazines like Electronics Australia and Wireless World, but I

WHERE THE DX IS ALL AT! == Greg Johnston, VK7KJ

TIME (Z)	FREQ	CALL	NAME	QTH & QSL INFO.
1100	3660	YJ8GH	Gordon	Tanna Is., New Hebrides
0830	7085	XE1IX	Peter	QTHR (viz: OK Callbook)
0700	14268	TU2DO	John	Ivory Coast.
0700	14157	ZB2A	Ian	Gibraltar
0700	14157	9H1BX	Norman	Malta/QTHR
o&oo	14268	EA6BH	Teo	Balearic Is., QTHR
0700	14187	FB8XX	Maurice	Kerguelen, via F2MO
0745	14252	4U1ITU	Ted	I.T.U: Hq, Geneva QTH R
1100	14148	VK2BCV/9	Sandy	Norfolk Is, VK2 QTH.
0730	14187	XE1J	Pepe	P.O. Box 200, Colima, Mex.
1500	14242	TL8LI	Andre	Centr. African Rep., via F6BFH.
1500	14242	ET3JH		Ethiopia.
1&00	14253	3AØAF	Monaco	Bill. via W6SAI
1100	14176	TF5TP	Thor	Iceland. Via DL7FT
1030	14208	XV5AC	Don	non pirate VIETNAM.v.W1YRC
1100	14202	KP4AST	Pedro	20 ObispadoSt., Ponce, P.Rico
0730	14206	VK2BQQ/2	Karl	Lord Howe Is, GPOBx3209, Sydney

All the above taken from the home station log, those below come from home log entries during the VK/ZL Contest both CW and phone sections, but all on 14Megs ((Megahertzesesses))

1117	VR1AA (via K3RLY)		
1119	UA1CS	1204	CR7IZ
1123	KH6IJ	1211	UH8AE
1130	OZ6RT	1217	OH2BO
1133	VR1W	1332	LA1KI
1149	UK3AAO	1339	EP2BQ
1152	OH2BBR	Ans do on..	
1158	C21AA		

With the summer VHF DX activity just around the bend it is hoped that next time we can drag out something of interest from there!

At present there's some surprisingly good DX about, considering the sunspot cycle right now.

=-=

Ed Note: VK3YHA and several others have mentioned Maurie Batt of Victoria who is a first-rate SWL, and has won numerour awards therefore. Maurie contacted us himself when we needed temperary replacement for Greg, and offered hisservices. By the time we finally got around to printing the "June" issue Greg had returned from his DXpedition! so all was well. But we thank Maurie for his offer, and his many admirers. Maybe one time, if Greg does on another Xpedition!

=-=

EDITORIAL (continued from p. 85)
do not discern therein the real excitement over the new developments which are sweeping through amateur circles...... Now this is one man's opinion. If you have an opinion on this matter let us know. EEB is yours too.

ETC

If you received a current issue but missed a previous one to which you were entitled, complain NOW!, don't wait until the missing issue is out of print! And when you complain to us, send a few cents for stamps, AND complain to the PMG or USGPO or whatever for their miserable costly service. They lose first class mail too, the very devil...

Recently we sent out some enquiries with renewal notices asking why people don't renw. Well, I asked for it, and we got some very interesting and some very crisp answers in reply. Makes good if depressing reading. Next month.

Les Yelland, EEB author, answers his critics in re the use Of ICs for his circuits: "I think I've used as many IC's as anybody in recent years and I'm getting heartily sick of them. Pieces like the 9914, dual two-input gate. Small item containing four trs and assoc. resistors. Rated at 4 to 5 V, but I've had to reduce to max of 3.5 to be safe. Same with the flip/flops and decades and they are supersensitive to transients. F/C admit that their 9958 decade is prone to such interference and say that improved ones are on the way; but they've been saying tht for years"

Les has also discovered that medium frequencies sound better than squeeks & squawks of HIFI, but I've cautioned him not to divulge this well-known fact, or the Industry will collapse -- and then who would buy enough components for us to ride along on with our small custom, ummmm?

Ade Weiss, Editor of The Milliwatt (EEB Review, 9/71) has written in picturesque Yankee style that his QRPP DXCC award is still available, and he even offers a trophy for the 100 country mark; "K4OCE gets his next week. It's a beaut! About 2 feet tall with this busty statuette of Lady Victory, arms up and outstretched to show off her charms to best advantage..." She is being held by his pretty Editorial Assistant Karen, in a photograph on the cover of his excellent amateur experimenters magazine. As we said last Sept, send us $3.50 and we'll enter your name for a sub. He is losing money on this for us, but will consider himself rewarded if you contribute something to The Milliwatt: QRPP DX news, anything: to MECKLING, South Dakota, U.S.A. Do help him pls.

L'affaire Australienne

And finally, last week the British Home Office ruled that Australians will still be able to visit Britain on holidays even after the UK enters the Common Market in January 1973. One can stand in awe of such broadmindedness; perhaps the French spoke out on our behalf?

MODULATED LIGHT COMMUNICATION -- Part III

-- Further Experiments (c.f. EEB, August 1968 and February 1970) --

BY: K. BURLINSON, VK6ZEA

Over a period of three years a system of light modulation has been evolved which enabled one-way communication over a distance of 3.5 miles. The development of the system, a description of the final system and some suggestions for further development are outlined here.

The author regrets that he is unable to supply circuit details, as an interstate transfer has prevented access to the equipment for the past few years.*

The experiments were conducted in conjunction with R. Averay (VK5ZGE), whose assistance was invaluable.

Choice of Light Sources

Our initial experiments with modulated light communication were aimed at the development of a system capable of being used for communication between the residences of the author and his colleague. As the project continued we decided instead to continue our experiments merely to see how great a distance we could cover.

Because of our limited budget we immediately ruled out such comparatively expensive light sources as lasers, junction lasers and other semiconductor sources. (It may be noted, however, that prices of these have since dropped drastically, and could merit evaluation.)

Similarly, expensive semiconductor detectors were also excluded; we were able to acquire a photomultiplier very cheaply, and this was used in later experiments.

Our initial experiments were therefore made using an incandescent lamp and a vacuum photodiode detector. These preliminary experiments did not give good results, due mainly to restrictions imposed by the thermal inertia of the light source. During these experiments we found that fluorescent room lights created serious interference because their light output varied with the instantaneous a.c. mains voltage. We decided, then to try to use a fluorescent tube light course, which we hoped would overcome thermal inertia problems.

Our hopes here were confirmed by experiment and we also found that modulation depth and frequency response were considerably improved. A further benefit was that the spectral output of the fluorescent tube better matched the spectral sensitivity curve of our 929 vacuum phototube, giving a more efficient system.

No further experiments were made with incandescent light sources, which are at a great disadvantage compared to gas type light sources in the important subject areas of modulation percentage and frequency response.

The Fluorescent Light Source

A description of our equipment using a fluorescent tube light source was presented in EEB in August 1968. The fluor. tube used was an 8-watt unit, primarily because physically-larger tubes posed even greater problems in designing a reflector. The tube was mounted in a parabolic polished aluminium reflector which was made by bending a flat sheet of aluminium around parabolic wooden end-pieces. The unit is reproduced here in fig. 1, because the original article is now out of print.

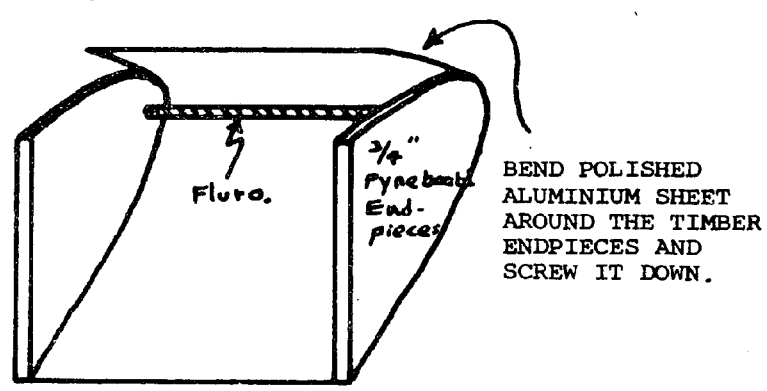

FIG. 1 : Parabolic Reflector

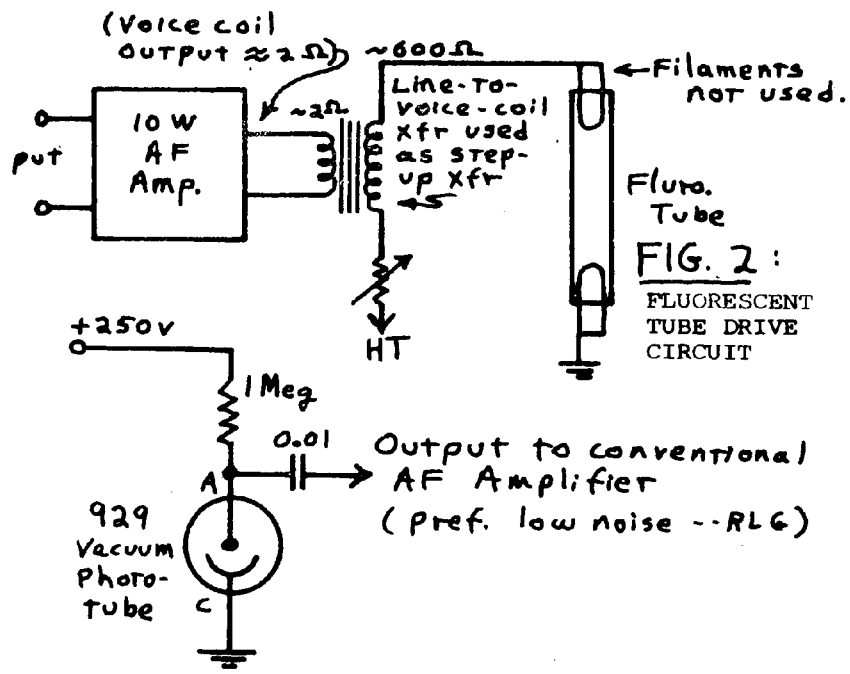

FIG. 2 : FLUORESCENT TUBE DRIVE CIRCUIT

FIG 3: Vacuum phototube Circuit.

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* It should be noted, however, that the considerable detail supplied here should enable any serious constructor to duplicate a similar or better unit, when nominal circuits books are available to provide conventional circuit blocks. --Ed.

The tube was driven by a 10-watt valve power amplifier via a step-up transformer from the voice-coil output; see fig. 2. A 600Ω to 3.5Ω line-speaker transformer with the 3.5Ω winding connected to the 3.5Ω voice coil output of the amplifier was found to be as good as any. The fluro. was biased such that maximum negative modulation peaks almost extinguished it. The bias required was approx 50 volts at 50mA d.c. and was derived from the amplifier HT via a variable series resistance, as shown in fig. 2.

Experiments using this transmitter were generally restricted by the need for a mains supply for the transmitter (although we later obtained some genemotors and ran the equipment from a car batt.).

The Receiver System and Photomultiplier

Our receiver at this stage consisted of either a vacuum phototube and valve amplifier (fig. 3) or an OCP71 phototransistor and transistor amplifier. Our maximum distance covered was about 500 ft, using the transistorised receiver, the main limitation being excessive receiver hiss caused by the OCP71. The valve receiver was not used for distances exceeding 60 ft because of power supply problems.

We then modified our receiver to accept the photomultiplier. Our first attempts to use the photomultiplier detector resulted in covering a distance of over 3000 ft, without modifying the transmitter. This sixfold improvement in performance was limited only by very severe interference problems caused by an inadequately filtered 1000 V supply to the photomultiplier. It was obvious, however that the photomultiplier was a much more sensitive detector. The only other light sensitive device known to us which claims similar sensitivity to photomultipliers is the photoFET, but we have not used one in our experiments.*

The decision to use a photomultiplier detector imposed further limitations on our transmitter light soucre. As the type 931A photomultiplier has maximum sensitivity at 4000Angstroms, we were committed to using light sources which emitted efficiently in the blue to near ultra-violet range; incandescent lights were, therefore, useless. This is the reason we chose to use blue to near UV light rather than infrared as have all other current experiments we know of.

A Redesign

Our next step involved complete redesign of the system. This arose from a desire to improve upon the fluorescent tube light source used up to this stage. The main disadvantages of the fluroescent are:-

1) Difficulty in making the transmitter portable because of the need for high audio power drive and high bias voltage for the fluoro.

2) Very hard to drive, as it is essentially a constant voltage device. Modulation percentages were low.

3) Poor approximation to a point light source, and hence reflectors were very inefficient.

The new light source chosen was a 24 V mercury vapour lamp of approximately 5-watts output. The arc of this lamp is a sphere of less than 3/8" diameter, and lends itself to the use of more efficient reflectors than could be used with the fluoro. Because it operated on 24 V it was convenient for portable equipment.

Pulse-width Modulation

We also decided to change from ordinary intensity modulation, where light intensity is proportional to the modulating voltage, to pulse modulation. The following advantages were envisioned:-

1) Very simple drive circuits using relatively low power transistors in switching mode circuits.

2) High modulation percentage, as the light did not have to be biased to extinction.

3) Driving circuitry need not emply accurate matching to the load impedance of the light.

4) Possibility of using digital techniques in the receiver to achieve high signal to noise ratio. A weak signal could be reformed before being detected and hence interference would be reduced considerably, if not eliminated.

The modulation method chosen was thus pulse-width modulation, as it required the lowest bandwidth of the pulse systems (excepting pulse amplitude modulation -- but this was no improvement over ordinary intensity modulation), and would be easiest to decode.

*The photoFET has a higher dark current, and probably more noise. It has high amplification, but the PMT can work at a much lower signal level. For interested parties, Siliconix makes photoFETs P-102 and P-236 through 238, available from Jacoby Mitchell Co. in Sydney (tell them we sent you). -- Ed.

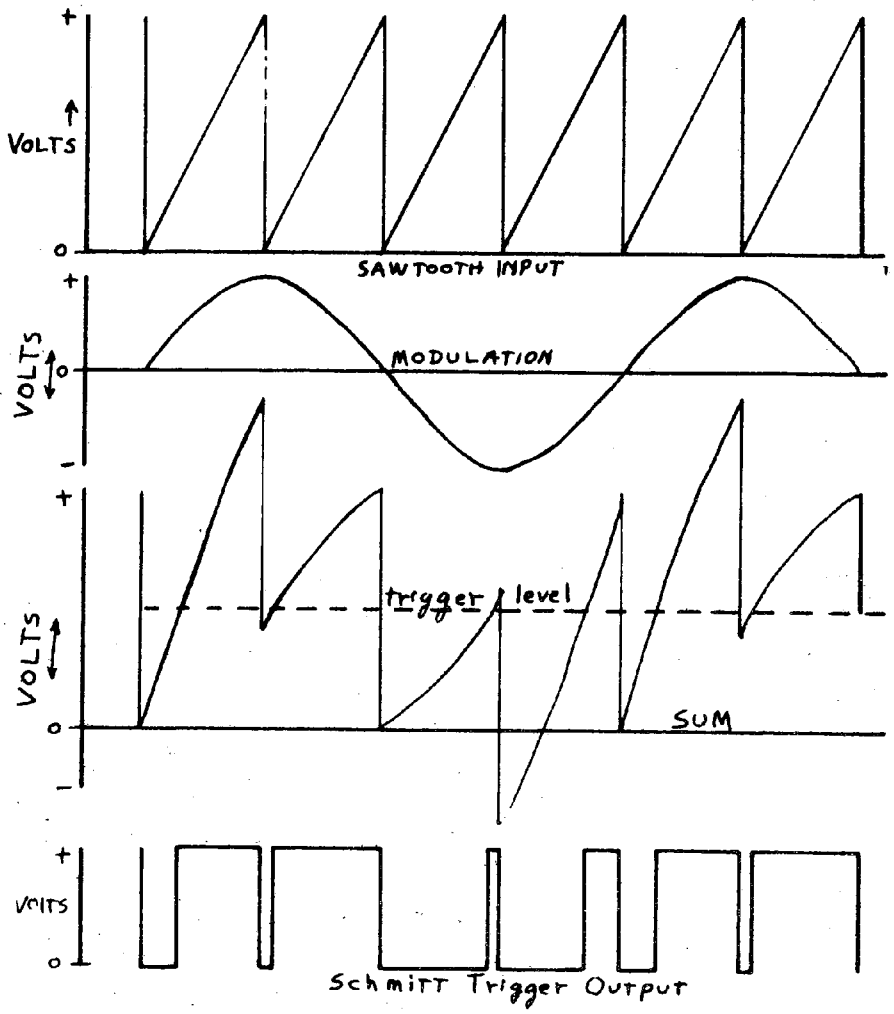


FIG 4: Pulse-width Modulation Waveforms

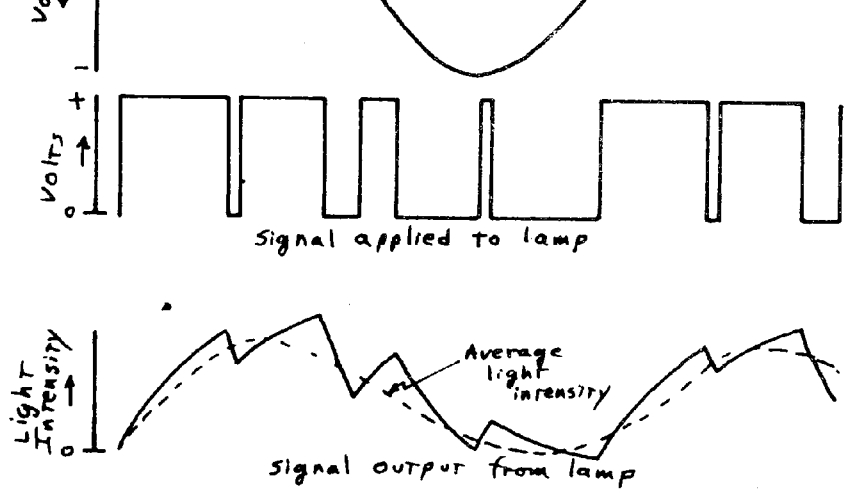


FIG 5: Light Output Waveforms.

For our system, when no modulation is applied the lamp is driven by a 10kHz square wave. When modulation is present the pulse duration during each cycle is dependent upon the modulation voltage present; see fig. 4

Increasing positive voltages result in larger on-times of the light, while increasing negative voltages result in shorter on-times.

The receiver was redesigned to accomodate the change in modulation mode, and a new d.c./d.c. converter to power the photomultiplier was built, incorporating adequate filtering to eliminate converter whistle from the receiver.

A substantial amount of work was involved in these modifications which took nearly a year, but experiments with this system proved that the effort was justified by the considerable increase in distance covered, this being 3.5 miles, with a signal report of 5 by 8 ((viz, perfectly readable, and quite strong at that distance)).

Generation of the Modulated Pulse

As mentioned previously, this technique involves the variation of pulse duration according to the modulating voltage at some particular instant. This can be done easily by mixing a sawtooth waveform with the modulation, and then using a Schmitt trigger to generate the output; see fig. 6. Waveforms are shown in fig. 4.

It should be noted that the sawtooth amplitude (peak to peak) should just exceed the maximum (peak to peak) amplitude of the modulation signal. The trig-

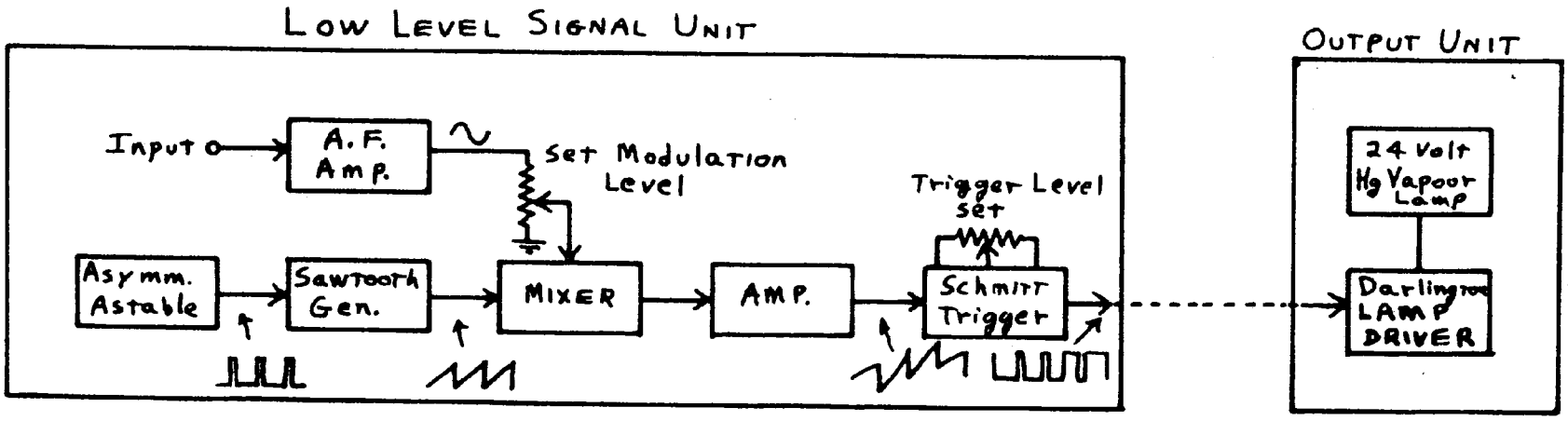


FIG. 6: Transmitter Block Diagram

ger level of the Schmitt trigger should then be set above the maximum positive (or negative -- depending on whether you use a positive or negative-going sawtooth) level of the modulation, but at less than the sum of the maximum positive (or neg.) sawtooth level and maximum negative (or pos.) modulation level. Do not ignore the signs when adding!

Under these conditions a trailing edge will occur in the pulse-modulated output each time a trailing edge occurs in the sawtooth waveform and in the absence of modulation the Schmitt trigger output will be a symmetrical square wave -- see fig. 7.

Theoretically one could use a triangular waveform rather than a sawtooth to generate the sum waveform fed to the trigger. The only difference resulting in the output would be that both the leading and trailing edges of the pulses will shift depending on the modulation voltage.

We chose to use a sawtooth, as the occurrence of a trailing edge in the pulse train output at regular intervals (depending on the sawtooth frequency) is expected to be advantageous in future decoding methods.

In common with other methods using sampling techniques to encode analogue information, the sampling frequency should be greater than twice (and preferably three times) the maximum modulation frequency. Consequently the sawtooth frequency(which determines the sampling frequency) should be a minimum of 10kHz for most speech systems.

Transmitter Requirements

Having chosen to use a small mercury vapour light source it was necessary to ensure that its frequency response was high enough for pulse-width modulation to be used. Tests revealed that the light output from the lamp varied approximately - 50% from the maximum peak output at 20kHz, reducing to - 1% at 50kHz; fig. 5.

It was decided to use a sawtooth frequency of 10kHz which would enable us to modulate with audio frequencies up to a theoretical maximum of 5kHz. Calculations show that for a modulation percentage of 50%*, the minimum frequency transmitted is 6.7kHz and the maximum is 20kHz.

* I.e., the difference between the minimum and maximum-on times of the output pulse is 50% of the duration of one cycle of the sawtooth waveform. -- KB

To transmit a square pulse of 20kHz, the frequency response of the transmitter should extend to 60 or 100kHz. Consequently the output from the light (whose frequency response is not this good) is not a good square wave. The waveform of the output from the light is shown in fig. 5.

This poor response of the lamp was useful in that all we had to do to detect the signal in the receiver was to put in a low-pass filter to remove the 10kHz components of the signal. In other respects the signal was effectively an ordinary intensity modulated light beam.

Transmitter Circuitry

A block diagram of the transmitter circuitry is shown in fig. 6. Although, as mentioned previously, it is not presently possible to present the circuit in detail, circuit elements can be fabricated from standard designs available in any good design or circuits book.

The transmitter was constructed in two units, one containing the low power stages, the other containing the lamp, built-in reflector and the darlington pair drive transistors. A sheet of perspex ("lucite") was attached to the front of this unit to protect the reflector when not in use, but was removed during transmission. The whole transmitter operated from two 12V car batteries.

The astable multivibrator generates a highly asymmetrical output which consists of a short-duration pulse at a repetition frequency of 10kHz; fig. 7. This is fed to a circuit where the pulse is used to trigger the discharge of a capacitor otherwise connected in a constant current charging circuit. The sawtooth obtained did not have a very fast decay time, and was not very linear, but

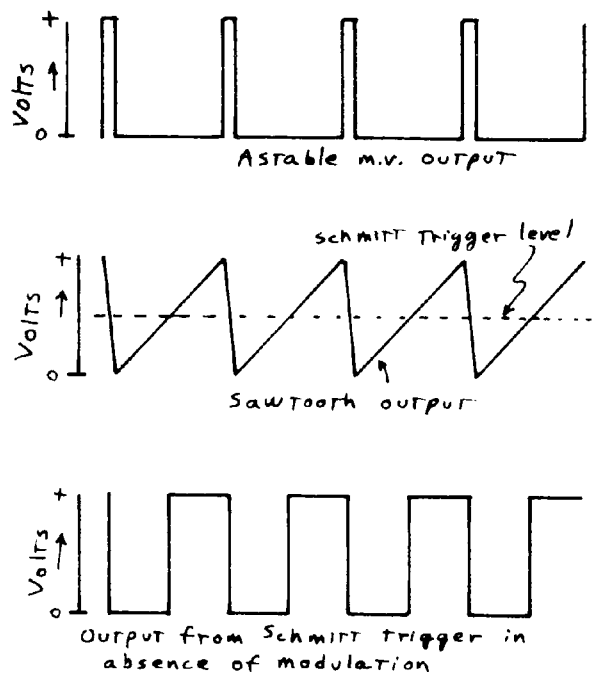


FIG 7: TRANSMITTER WAVEFORMS

neither of these characteristics are critical. Any sawtooth generator circuit could be used in place of ours.

The modulation (from a microphone) is fed into a 2-stage audio amplifier. A volume control is necessary to allow setting the modulation at the proper level for triggering. No form of dynamic compression of clipping was used, either of which would enable more efficient modulation.

The modulation and the sawtooth are fed into a mixer, the output of which is amplifier prior to being applied to the Schmitt trigger. This amplification stage should have a frequency response extending to approximately 50kHz or so.

The triggering level of the Schmitt trigger was adjustable to enable setting at the correct level. It should be set, with the aid of a CRO, to give a symmetrical square wave when no modulation is applied. The modulation level is thus set so that the previously mentioned conditions are satisfied.

The pulse-width modulated signal obtained from the Schmitt trigger is d.c. coupled to the darlington-pair output transistors. The switching transistor in series with the lamp is rated to withstand the maximum current and voltage, but because it is always either in cut-off or saturation (provided it is driven by fast rise and decay time pulses) the dissipation is minimal. A comparatively small heat sink can thus be used.

The Lamp

The lamp was operated according to the application notes supplied with it as far as the series resistors were concerned; I believe the lamp is made by MAZDA. A press-on, release-off switch was used in the filament circuit to warm up the lamp for starting. A bypass switch in parallel with the series transistor was used to allow d.c. operation of the lamp when the modulation was disconnected and for starting.

It was found that connecting both ends of the filament together during operation of the lamp resulted in a smaller, more uniform arc. This function was wired onto the filament switch so that when it was released the filament ends were connected together. By operating the lamp in an inverted position a brighter and more stable arc resulted. The lamp was therefore mounted in an inverted position on a fixed mounting in front of an adjustable 8" diameter polished aluminium reflector. The lamp was set at the focal point of the reflector; fig.8. The reflector was not of optical grade, and was merely spun and polished by a metal spinner with a die normally used for making frypan lids. As such it was quite cheap ($1.50), and a similar reflector was used in the receiver.

The Receiver

It was necessary to match the output impedance of the photomultiplier to the input impedance of the transistor amplifier and also to include a low pass filter to remove the 10kHz component of the signal. Aside from these considerations the receiver was an ordinary high gain audio frequency amplifier.

Considerable time was spent in developing a 12V to 1000V d.c./d.c. converter to supply the photomultiplier.The 1000V output was made free of all ripple so that it did not cause receiver interference. This was done by extensive filtering and careful layout.

The receiver was built in three sections:

1) The d.c./d.c. converter.
2) Photomultiplier and resistive divider.
3) Audio amplifier.

It operated from two car batteries.

The output from the photomultiplier is capacitatively couple to a BC108 impedance matching stage with an input impedance of approx 1MΩ and output impedance of approx 10KΩ. This matched the photomultiplier impedance to the transistor audio amplifier.

The audio amplifier should be of high gain and use low noise transistors for minimum background hiss. The gain in our amplifier was limited by instability. It is necessary to arrange the construction in a way such that feedback between the input and output of each stage is minimized by keeping the input circuits remote from the output circuits. Judicious use of

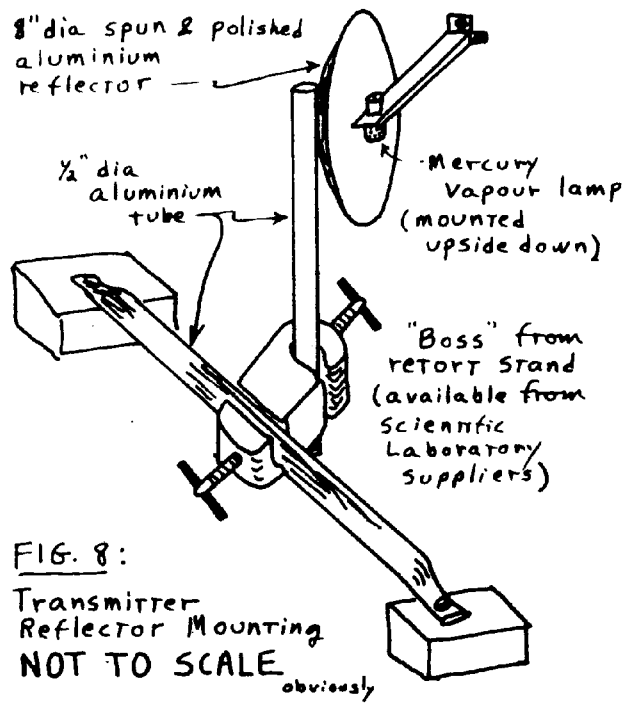


FIG. 8:
Transmitter Reflector Mounting
NOT TO SCALE obviously

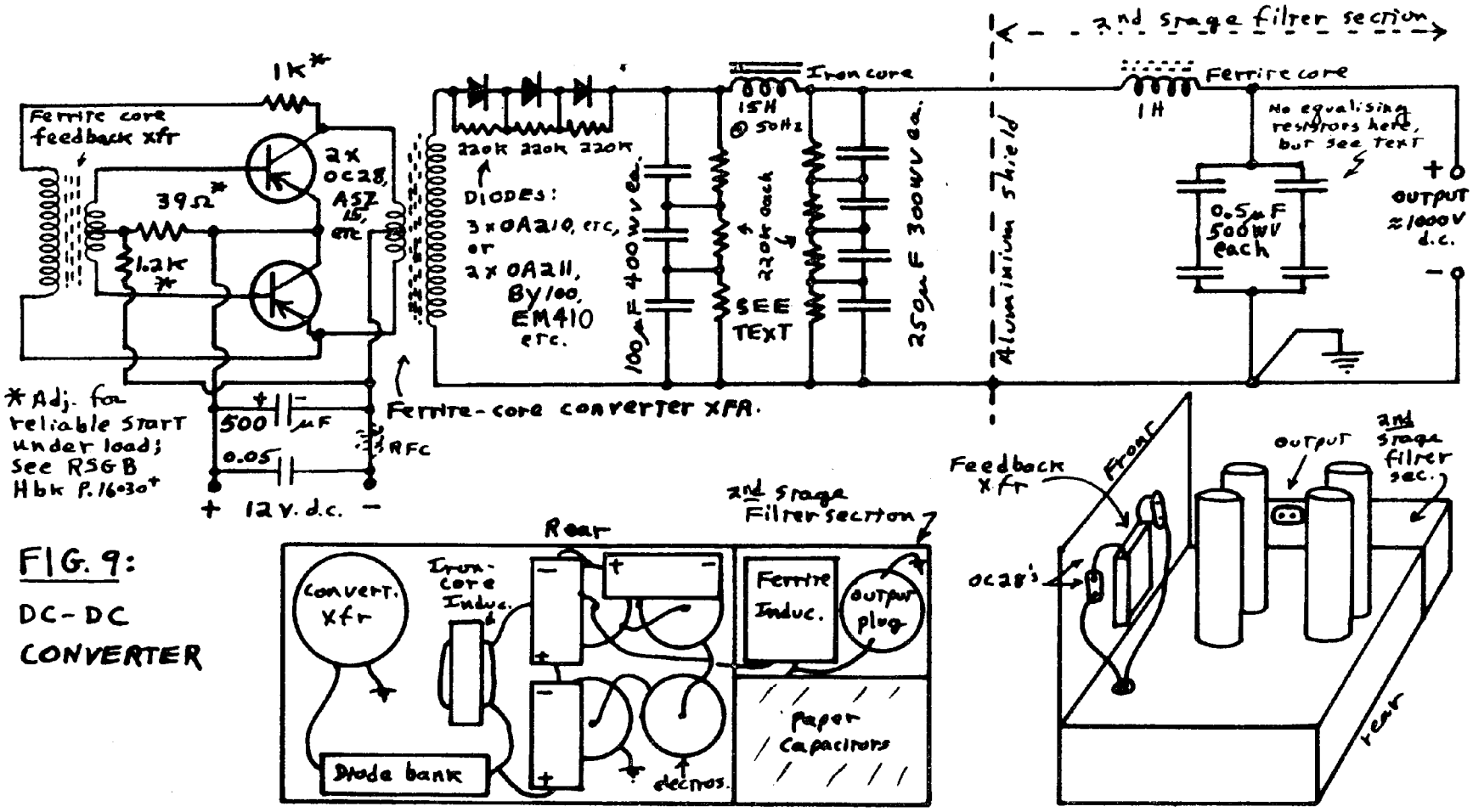
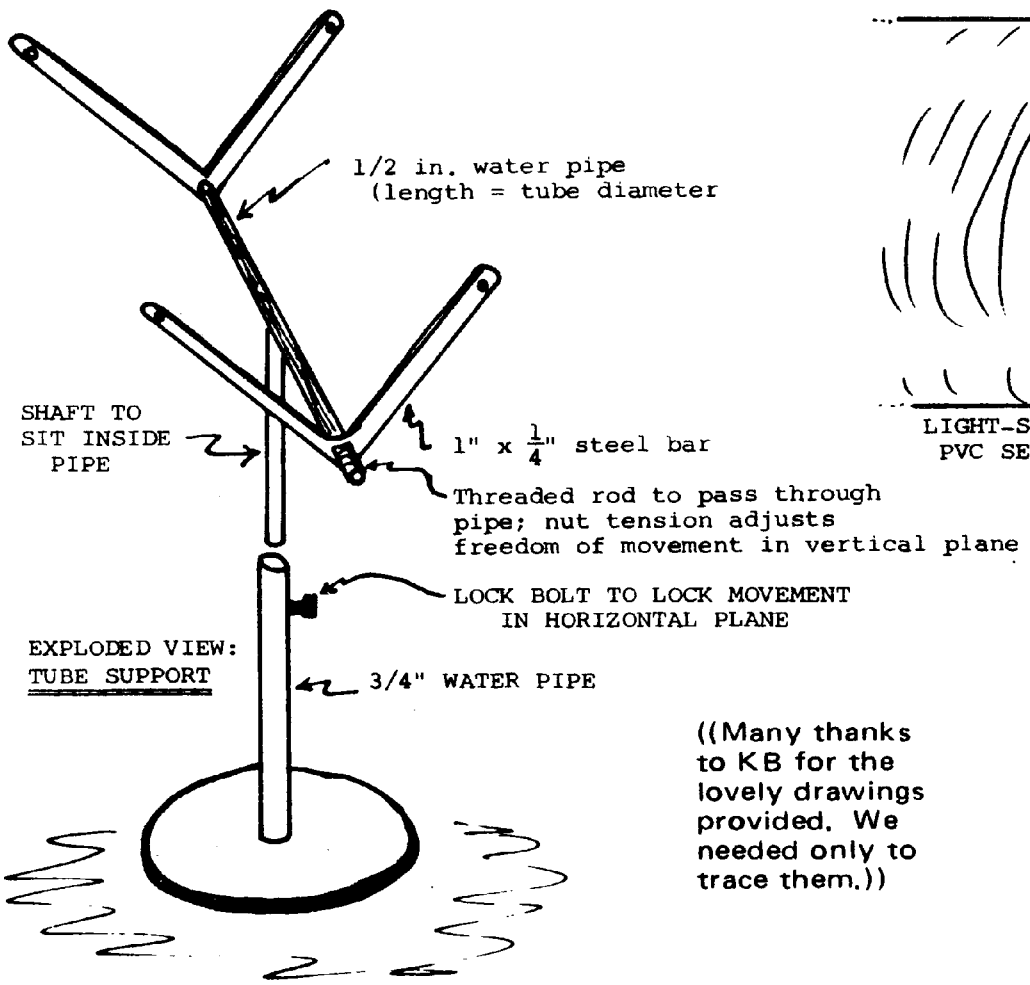


FIG. 9:
DC-DC CONVERTER



((Many thanks to KB for the lovely drawings provided. We needed only to trace them.))

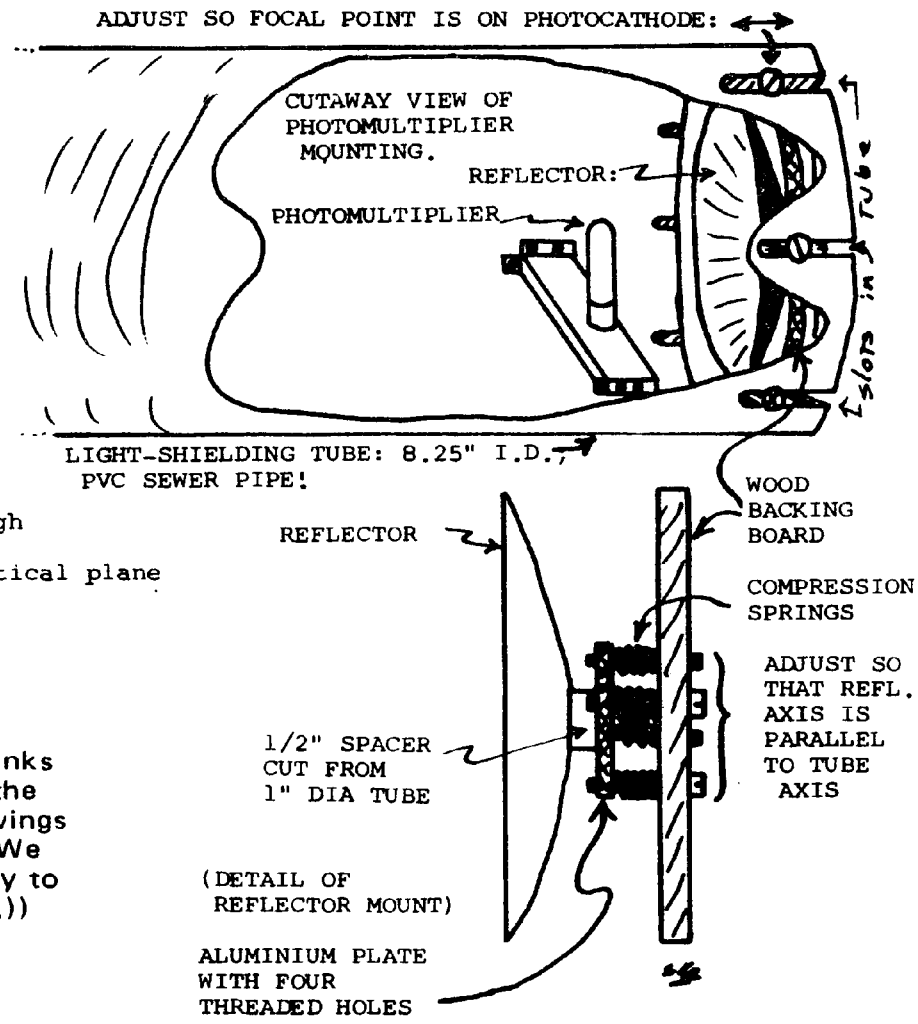


FIG. 10 : RECEIVER OPTICAL CONSTRUCTION

decoupling and shielding between stages will also improve amplifier stability.

Our output stage used two OC72's driving a loudspeaker, however the amplifier can be simplified by using a headphone if desired.

A low-pass filter with an attenuation of 6db per octave above 3kc was inserted in a medium level signal line (after the low level input stages) to remove components of the 10kHz sawtooth waveform from the signal. This filter used a small ferrite core inductor available from disposals sources ((lots of ferrite and much else is also available through the Wireless Institute, to members.--Ed.))

The D.C-D.C. Converter (for photomultiplier)

The major effort in receiver construction was expended on building a ripple free d.c./d.c. converter to operate the photomultiplier. This gave an output of approx. 950V at approx. 5 mA for an input of 12V.

For our experimental work it was not considered satisfactory merely to operate the d.c./d.c. converter at a frequency outside the passband of our receiver. The final design is shown in fig. 9.

Both of the transformers used in this unit were home-wound on disposals type ferrite cores. The judicious filtering employed enabled us to reduce the ripple level below the hiss level of the audio amplifier, and no converter whistle can be heard in the speaker during operation, even with the photomultiplier completely shielded from all light.

Although the complete converter was built on one chasses 6" wide, 14" long and 2" deep, all the components of the second stage filtering are in a separate shielded enclosure (Shielded only by aluminium. Magnetic shielding was not necessary as the oscillator transformers and the second stage inductor were at opposite ends of the chassis.).

The high value electrolytics were made up by arranging low-vooltage units in series. If this done with can-type electrolytics, remember that the cans of some of the capacitors may be at a high voltage, and should be very well insulated both from the chassis and from stray fingers.

Matched 220KΩ resistors are placed in parallel with the capacitors to equalize the potentials across the capacitors of each series string. If this is not done the total voltage will not divide evenly between all the capacitors unless they all have the same leakage currents (which is unlikely). The presence of an excessively leaky capacitor in the string may then cause the voltage across other capacitors to exceed their ratings. It is advisable to check the capacitors before use.

Equalizing resistors are also required across the diodes, or at least the older (non-avalanche) type which we used, for similar reasons.

The filter capacitors used in the second stage filter were high quality paper types and hence no equalizing resistors were required.

It is important to ensure that the output from any one section is not near its input, as ripple may be induced in the output wiring. The output plug from the unit should be remote from and shielded from the oscillator section.

RAJR NOTE:

I question certain aspects of Mr. Burlinson's d.c. converter design. For one thing, it would be desirable to use 1000WV capacitors available in these days either new for not-impossible prices, or oil-filled from disposals sources. This would reduce the nuisance of series-parallel connection, and above-all, of equalising resistors. The latter can draw quite a lot of power at 1000V, and that is power taken from the input battery.

Furthermore, if the oscillator frequency is low, the 15H iron core choke is pointless, since its reactance will be negligible compared to the load resistance. If, on the other hand, the oscillator frequency is high (as appears to be the case here) the many microfarads in the first section filter appears to be far more than necessary for effective filtering. Conventional designs use only a few µF for photomultiplier supply filtering, and for extra capability 10µF should be ample. That this order of capacitance can be achieved easily (e.g. two 5µF ones either side of the choke -- if indeed the latter does any good), and makes the non-equalised capacitor system more practical, as mentioned above. The ferrite core inductor probably is a quite good idea, because of the large amount of r.f. hash these supplies can generate.

We have added to the 12V line two capacitors, for r.f. and transient filtering purposes, and an R. F. Choke as well (if any other equipment is to operate from the same battery), wound with a number of turns of No. 12 enamelled wire. The 500 µF electrolytic will probably ensure against transients, but if difficulty is encountered (e.g. shorted transistors!) it could be worth considering the use of protective zener diodes as described in the various radio handbooks. RLG sug-

gested a 0.0005μF across the EHT winding, the design suggested (cautiously) in Stoner's Transistor Radio Handbook (E/E), but this is of doubtful utility; although it would tend to protect against transients, it would reduce oscillator switching efficiency. Now back to Burlinson:

The Photomultiplier and Optics

The converter was connected to the photomultiplier by a 10-ft length of heavily insulated wire. In use the converter was placed as far from the receiver box as possible, generally on the other side of the car. A separate battery was used to supply the converter. It should not be supplied from the car's battery lest the car body radiate converter whistle!

The photomultiplier was mounted at the focal point of an 8" spherical reflector fixed at the end of a 4-ft long 8-1/4" internal-diameter PVC pipe, which served to reduce the amount of stray light reaching the photomultiplier; see fig. 10.

The photomultiplier was fixed to the pipe and the reflector made adjustable so that the focal point could be shifted onto the photocathode. The whole pipe was mounted in a frame which allowed aiming of the unit at the transmitter. Lock-screws were incorporated to hold the unit steady after it has been correctly aimed. Ordinary shielded wire connected the photomultiplier to the receiver.

A 1000V isolation capacitor was put in the photomultiplier in lieu of very high quality coaxial cable; most shielded cables won't like having 1000V between their conductors. The circuit of the photomultiplier wiring is shown in fig. 11

Receiver Layout

The receiver was constructed on matrix board and completely enclosed inside a 6" x 6" x 12" aluminium box. The speaker should be placed in a separate enclosure to minimise instability. The box should be connected to the ground rail of the amplifier. During use the box should also be earthed to a metal stake. If this is not done, whistle from the d.c. converter will be a problem.

Earthing the box is conveniently done by connecting it to a one-to two-foot length of 3/8" steel rod (as used for concrete reinforcement) which is hammered into the ground. This may be watered often, to improve the earthing ((and even better with some rock salt? -- Ed.))

WARNING

According to the PMG Radio Branch, operation of this and other modulated light systems constitutes a breach of the Wireless Telegraphy Act unless the equipment and operators are licensed. We found that the Adelaide branch were willing to grant us an experimental licence on condition that they were allowed to inspect the equipment to make sure it would cause no interference with other radio transmissions.

((Ed Note: In February 1970 (p. 50) we pointed out that our enquiry into the Wireless Telegraphy Act shows that the PMG has an Absolute Monopoly on any electromagnetic energy communication whatsoever, and that the provisions of the Act are sufficiently vague to provide control over all communications whatsoever. This obviously includes torch lights and crystal sets, and appears to include loud-hailers, car headlamps, and shouted instructions when these messages pass across common boundaries, and certainly when they cause interference with other (licensed?) modes of communication.))

Operation

In operation we found that incandescent street lights caused negligible interference (to us), but that all varieties of gas-filled lamps (fluorescent = mercury), Xenon, Sodium, Mercury Vapour, etc -- caused very serious interference. For these experiments we therefore located a barren stretch of country road about 30 miles from Adel.

We found that we could not aim the receiver towards Adelaide, even though the city was obscured by hills, as the haze and smog over the city scattered enough artificial light to cause serious interference*.(overleaf footnote)

In view of the Editor's comment above, it seems reasonable that we ought to have considered reporting the Electricity Trust of S.A. for breach of the Wireless Telegraphy Act by operating unlicensed street lights, modulated with a 100 Hz subcarrier, and without announcing the callsigns of the equipment originating the carriers at the regular intervals required by the PMG.

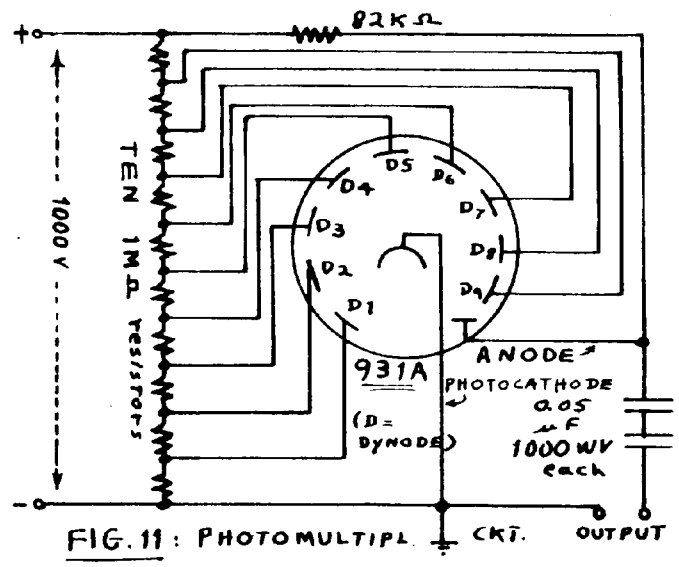


FIG. 11: PHOTOMULTIPL. CKT.

Our equipment was designed to be portable so that we could operate in areas of no interference. Both the transmitter and receiver operated from a multitude of car batteries. We also carried a transistorised CRO with us, for testing in the field,, which operated on 2 more car batteries ((viz, a battery-operated field. Hi. --Ed.))

After the author obtained his AOLCP we converted some ex-taxi transceivers to the 144Mc amateur band for 2-way communication during our experiments. These also ran on car betteries; it will be remembered that we only set up one way communication using modulated light.

Along with various lighting arrangements and 6V car batteries for the soldering irons, we carried a total of 13 car batteries -- hence the need for 2 cars! -- although this could be reduced to 3 or 4 if necessary. We did not use either of the cars' batteries lest we accidentally flattened them. The car batteries were all obtained from a friendly local garage, where we purchased his trade-in batteries at scrap value of approx. $2 each. Most batteries were found to be satisfactory for our fairly light loads. Some, indeed, were better than the batteries in our own cars -- and we soon remedied that! At the completion of our experiments we sold the batteries to a scrap merchant. As the value of scrap batteries had risen in this period we actually made a profit.

Our experiments were generally conducted along straight stretches of road late at night (often until 4AM). Setting up the transmitter was fairly simple and took about 10 minutes. Setting up the receiver generally took 15-20 min. (including tea break and watering the earth connection). The 2-way radio link was an invaluable aid, especially over the longer distances.

Our normal procedure was to commence with the receiver and transmitter about 1/2 mile apart and then move the receiver at intervals down the road if the equipment worked satisfactorily.

The transmitter was aimed by having the receiver operator issue instructions over the radio link to the transmitter operator while observing the light intensity by eye.

NB: IT IS ADVISABLE TO WEAR DARK GLASSES (GLASS, not plastic) WHEN LOOKING AT UV LIGHT SOURCES ! ! ! !

The receiver was aimed merely by adjusting for maximum audible receiver volume. Considering the low optical quality of the reflectors used, no greater aiming accuracy was considered necessary.

Special Notes

1) The photomultiplier should never be aimed at bright lights, the sun or moon, as saturation will occur. Repeated saturation of the photomultiplier will cause deterioration of its performance. When not in use, place the photomultiplier in a light-tight container.

2) For transmission distances < 1/2 mile or so it is generally necessary to off-aim the receiver so that the transmitter does not drive the photomultiplier into saturation.

3) We found it necessary to operate only at night time because of our crude optical equipment, as daylight caused the photomultiplier to saturate.

4) It is also necessary to keep well away from all but incandescent street lights.

5) Operate on moonless or overcase nights only. For some strange reason moonlight causes severe hiss. Even on moonless nights there is a considerable amount of hiss from the sky. This hiss level was several times the hiss level of our receiver.

Determination of the receiver noise was made by covering the light entrance of the photomultiplier pipe assembly, while all systems were turned on and operating at normal listening level.

6) Beware of haze and smog in the transmission path. They will reduce considderably the maximum transmission distance.

7) Put helper springs in your car when you carry your 13 car batteries, or else rent a truck!!

= =

Ed. Note: There's another page of "Future Possibilities"; look for it next month.

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* Ed. Note: I can't imagine a better place to insert the following filler:

Quotes without comment

"Adelaide yesterday became the first city in Australia to issue an air pollution potential alert, covering the metropolitan area" (7/7/71)

"In Los Angeles they have started to abolish classes in Physical Education, because the air is becoming too dangerous for children to breathe deeply. Yet adults there will tell you that 'its good to see the stuff you breathe' and that yellow should be the normal colour of air in a 'Great' city." -- Paul Ehrlich, ABC Radio, 1971.

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A SECOND OPINION: The 1972 ARRL Handbook

-- by Rod A. Reynolds (RLG Translation)

My general impression of the book is similar to that of RLG as described last month. There seems now to be a sensible reorganisation of the whole presentation. Although some of this may well be the final impact of cumulative changes I feel that there has been a qualitative change from the practice of years past.

For one thing, the advertising section at the rear of the book has gone completely! It has been replaced by more pages of text. My initial comment about the 1971 volume (EEB Apr 1971) does indeed apply to the 1972 one, whatever my later reservations may have been about the 1971: ARRL have expanded theory and reduced superfluous matter. And, much to their credit they have reduced greatly the duplication of superfluous high power transmitters; these were replaced by some good transistorised material.

The order of chapters has been changed about, and transmitters and P/S come early rather than later in the book. I'm not sure that this is an improvement for the Tx, but it certainly is for the P/S. Semiconductors have, for the most part, been incorporated throughout the text, and the section "Semiconductor Devices contains some updating, e.g. ICs.

Needless to say, some improvements are possible. One could mourn the demise of the section "Testing Unknown Rectifiers" which appeared in some earlier editions; there is still a large number of disposals diodes which merit such testing!

It is a pity that there is no "Integrated Circuits" section in their "Semiconductor Characteristics" chapter; the material presented in the text is not nearly adequate in this regard. For amateurs who (like us) do not necessarily have specific ICs at hand, or for others who might wish to make substitutions, it would be most desirable to know which pins served what function.

On p. 520 there is an oscilloscope circuit for monitoring modulation. For the Tube they specify: "V1 - Electrostatic-deflection cathode-ray tube, 2- to 5-inch. Base connections and heater ratings vary with type chosen." But there isn't a single CRO tube listed, either base diagrams or characteristics in the "Vacuum Tubes and Semiconductors" characteristics chapter. It is well worth keeping older editions of the Handbook.

Finally, one must note the quality of the paper which has deteriorated steadily for several years, and which is now an aged newsprint yellow. Surely it would be possible to improve this paper whiteness a bit -- and charge another 50c? But the non-glare (matte) finish should be retained; it is most worthwhile.

Overall, ARRL are obviously making considered progress with this 49th Edition, and we have every hope that they will produce a really first class Handbook for their anniversary 50th one, when the remaining redundancies will have been eliminated, and their crisp prose will be presented on reasonably clean-looking paper.

WHERE ANGLES TREAD: a squaretable, of sorts.....

PART I:

The ARRL Handbook; A Rebuttal, by D. A. Blakeslee, W1KLK. EEB, Feb 1972, p. 19.

PART II:

RLG to DAB, 28 Feb 1972:

Dear Sir,

Your comments of February 14th regarding our review of the 1971 edition of the ARRL Handbook are noted, and are being referred to the Reviewer for comment and publication.

I may, however, note that your comment in respect to the review of the Radio Handbook by Orr was uncalled for, and I do not intend to print it in the form submitted. That book was examined in meticulous detail by a communication engineer and by a radiophysicist -- both radio amateurs closely concerned by the future of amateur radio technology -- and every effort was made to provide constructive comment which might be of value in maintaining the standard of that fine Handbook.

These matters have been communicated in some detail to the Author, only a small portion of which appeared in our review.

Our Solicitors advise us that most of the last paragraph in your letter, involving your opinions of 73 Magazine, are libellous, and that we are not at liberty to print them.

Yours faithfully, etc.

PART III:

"Objects and Requirements of an Amateur Radio Handbook, Part II", by R. A. J. Reynolds, VK7ZAR, EEB, Feb 1972, p. 20.

PART IV:

"The 1972 Radio Amateur's Handbook"(Published by ARRL, Newington, Connecticut, U.S.A.) -- being essentially a Review of that work by D. A. Blakeslee, W1KLK, which was included in the same Post as the item in Part I, above. EEB, Apr 1972, p. 41.

PART V:

DAB to RLG, 28 March 1972:

Dear Mr. Gunther:

Quite frankly I didn't expect any of my letter would appear in EEB. I find it interesting that you will allow your reviewer to comment on my letter. I understand fromprivate correspondence from Mr. Orr that he wrote to you before the review of his book appeared, but I didn't see any of his comments in EEB along with the review. Apparently reviewers have privileges not accorded to authors in your publication.

My letter was a comment on the way that EEB does its book reviews, and thus I feel my views on the review of the Radio Handbook were quite germaine to the subject at hand. I don't doubt the qualifications of the gentlemen who did the Radio Handbook piece. In fact, their professions were quite visible via their words. But, I also have a background as a communications engineer, having designed systems in England, Germany and North Africa. Later I worked as Vice President and Director of Engineering for a five-company group that manufactured telephone and audio equipment. The Australian government recognized the value of our designs and favored us with a number of orders. Now I have given up commercial enterprises and am devoting my life to amateur radio. I frankly cannot understand why your reviewer's opinions should rate the better part of an issue, but a paragraph from me is labelled "uncalled for" by you.

I fear your reviewers have lost sight of the purpose of a review. This weekend I am writing a book review for publication in Spectrum, the

journal of the Institute of Electrical and Electronic Engineers. I have examined the book for several weeks trying to analyze the purpose the author had in mind, how well he covered his subject, and of what value the book might be to a reader of Spectrum. I have no doubt that if I went off on a flight of fancy about how I would write such a book that the IEEE editor would place my review in the dust bin, and rightly so.

If one wants to write an article on what a handbook should contain, fine. But it should appear as an article, not as a book review. I get some 1000 letters of comment per year about the ARRL Handbook, most of which are very useful. You may think that your Radio Handbook review was constructive, but as a working author I can tell you that most of the comments were so vague as to be of little value. What has happened is that your readers still do not know very much about the new edition of RH.

Ah, I appreciate the concern of your solicitors. Guessing that your laws on libel probably follow the English, rather than those of this country, it would appear that by publishing a review which the author has retracted in public as being untrue, EEB has already been close to libel. I can understand your solicitor's advice not to touch the subject again, as solicitors are the most cautious of men.

Sincerely, etc.

PART VI:

A Comment by R. H. Ferris, VK7ZDF, author of "Objects and Requirements of an Amateur Radio Handbook, Part I -- and a brief discussion of the Radio Handbook, 18th Edition, by W. I. Orr..." :-

This trivial argument appears to arise from a conflict of fundamental goals, and a failure by Mr. Blakeslee, the ARRL Handbook's Editor, to take at face value what we have clearly stated in print: The Review of the Radio Handbook was an examination of the philosophy of handbook writing, as in fact stated in the title (as above), the leader, and the opening paragraph.

We do not draw the fine distinction between an article and a Review in EEB. For us a Review must examine not only the "purpose" and how well the author covered his subject, but whether or how the subject covered was worth covering.

Thus, the Radio Handbook by W. I. Orr was considered in its entirety with relevance to the requirements of the subject. This approach contrasts sharply with the rather pedestrian practice simply of listing a selected portion of the subject index, which can (at the whim of the Reviewer) be meaningless or misleading.

I can, indeed, be in general agreement with Mr. Blakeslee's expressed ideas about the book review for IEEE without fear of contradicting what I have stated, recognising merely that the task of making a review for IEEE is different than one of making a review for EEB. The philosophy of approach is different, the audience and their requirement is different, and thus the review cannot be provided in the same context.

PART VII:

A Comment by R. Leo Gunther, sometime editor of this magnificent publication:

Our Solicitor's veto of a portion of Mr. Blakeslee's Letter (Part I, above) was not based on the validity of the Review taken from 73 magazine (which was rather a favourable view of the ARRL Handbook -- which the author later retracted? -- hi). It was based on the indisputably strong comments made by Mr. Blakeslee on the integrity and honesty of the publisher of 73 magazine. Quite aside from our own opinions on that matter, it would be dangerous to print such material. We got into a fair bit of trouble last year on a statement which was substantially tamer than the one Mr. Blakeslee submitted to us!

As for fairness in reviewing, well, as I said we'd do (Feb EEB, p. 19), we printed Mr. Blakeslee's comments about the 1972 ARRL Handbook. I reckon we are being reasonably open-minded to allow an Editor to review his own handbook.

PART VII:

((Since we have afforded Mr. Blakeslee the abovementioned Privilege, it seemed only reasonable to extend same to Mr. Orr, whose reply is presented here below.))

WIO to RLG, 12 April 1972:

Dear Leo,

Thank you for the privilege of letting me review the Handbook. Well, I would start out by saying that the Radio Handbook, in its small way, compensates for the burning of the Library of Alexandria in the year 640 by Hadrian and that it fittingly plugs the cultural gap of the ages. That seems to cover things pretty well.

Yours, etc.

PART VIII (concluded):

Call it off, Doug! I think you've done a fine job in QST, and even the 1972 Handbook isn't so bad for a change. And lo! Rod agrees with me, so it must be true.

Cheers, Leo

XXXXXXXXXXXXXXXXXXXXXXXXXXXX

FILTER VS PHASING EXCITERS -- Revisited

Please consider the following item to be added to the material in EEB April 1972, p. 41 -- which should now be reexamined.

A quotation from the 1972 ARRL Handbook, P. 391:

"... and alignment stability. It is still practical for the builder to fabricate his own crystal-lattice filter by utilizing low-cost surplus crystals. This possibility should not be overlooked if the builder is interested in keeping the overall cost of the home-built exciter at a minimum."

XXXXXXXXXXXXXXXXXXXXXXXX

WHAT NOT TO DO ?

I once made a 5V filament transformer for a chap who wanted to isolate rectifier filaments. He explained that he had one with tappings of 1.5V, 2.5V, and 6.3V. He found that by short-circuiting the 1.5V winding the 6.3V one came down beautifully to 5V. He actually used it for a while until it turned odd colours and stopped working!

HELP! We're running out of "What Not to Do ?" items. How about you good readers sending us some -- annonymously, of course. -- Ed.

HIDDEN ANTENNAS

-- a Squaretable, between K. A. Harding of Sydney, and the Editor

KAH: The article by Lionel Sharp in the October 1971 EEB on the "Motorola Semiconductor Data Book" will probably result in Dresser of Corinda being inundated. I did write to Motorola Sydney but got no reply. On the other hand, I wrote to Motorola informally asking for application notes, and back they came with no trouble. So you take your chances?

RLG: You've had better luck than we had.

KAH: All right, but here's an interesting problem possibly more amenable to solution:

Local regulations forbid roof-top antennas, or anything like a permanent structure in my little courtyard. So, the thing to do will be to build a relatively simple receiver and try it out on some sneakily contrived vertical antenna. There is little point in my trying to tackle a good general coverage receiver unless I can bring in the signals.

That antenna could run up the outside wall to about 20 ft high, but reading leads me to believe that the building itself will cause big losses. The only other alternative that comes to mind is a permanently fitted antenna base near the back of the courtyard (only about 12 ft from an aluminium roofed patio), and going out there to set up and/or take down the "pole" when necessary. It doesn't sound very satisfactory.

Still -- i've heard of amateur operators working out from 2nd floor flats in multi-story towers, so there must be a way -- even if efficiency is down.

RLG: Maybe you could try a vertical antenna on a baloon filled with helium -- or hydrogen if you don't mind explosions? Trouble with this is that if the baloon is lightweight the helium will diffuse through it, necessitating occasional replacement, and helium is expensive.

On the other hand you can pick up just about as much signal with a short antenna as with a long one, IF the short one is suitably matched to your receiver input (or transmitter output) circuit. This is not generally realised, but is the cornerstone upon which very short high-performance antenna systems are based -- just run your antenna into a source follower (into the receiver) and tune out the reactance. Aside from this, the main reason to have an antenna out in the clear is to get away from noise (or to avoid r.f. getting into the power lines, telephone, etc if transmitting)

For a suitable short or long antenna you might try the old trick of using a thin wire (e.g. No. 26); the neighbours won't likely see it, but keep it above head level! Maybe use a nearby tree as Sky Hook. Or even the eaves of the house of a cooperative neighbour??

I should like to repeat that we don't ordinarily conduct a consulting service, but this is a problem which interests me. I have dug into the Files, and came up with the following relevant references:

"Using a T-Network", W2EEY/1, CQ, May 1968: "The Pi-network is familiar to all as a circuit used in most transmitter output stages and unbalanced type antenna tuners. A 'T' network tuner which employs the same elements as a pi-network but in a different circuit arrangement, has definite advantages over the pi-network when a match to a very short antenna is required."

"The Apartment Dweller's Dilemma", by W1ICP, QST, Oct 1971: "How to use Random-Length Wire Antennas". "There are some exceptions to the following rules but in general, they can be depended upon.

1) An outdoor antenna will work better than an indoor one.
2) An antenna inside a frame building with wood exteriors is better than the same antenna in a steel-and-concrete building.
3) The higher above ground, inside or out, the better the antenna will work.
4) The bigger (or longer) you can make an indoor antenna, the better -- even if it means running the wire around corners.
5) Even a poor antenna should produce some contacts."

"Sky Hooks" by GM3SIY, Rad. Comm, Jan 1969: How to make your own hydrogen and fill a baloon with it; for heavens sake be careful!

"An Indoor Aerial", by G3NXM, Rad. Comm., Jan 1972: A trap dipole loaded about in the centre of each leg, and mounted in the attic.

"The Window-pane Simple Quad", "8AP, from QST Sept 1971 and reported in "Technical Topics", Rad. Comm, Jan 1972. Tape aluminium foil to a window!

"Using Thin-Wire Antennas", W2EEY/1, 73, Nov 1968: Thin wires can be used, but present various problems, particularly if transmitting. Ideally it should run at right angles to the building, to reduce losses. And the resonant frequency, reactance, and directivity of a thin wire are not likely to be the same as thick. Best idea is to cut and try. "Almost any type antenna placed outdoors will work better than an indoor type...."

"How to Fly Your Kite", EI4R, 73 May 1969: The design and construction of a suitable Sky Hook; scale up a "kiddie kite", use lightweight braided wire, and run full wave on 160 M!

"Twin Bisecting Loop Antenna", W9JBM, CQ, 2/72, If you put two loops in series, bisecting each other at right angles, you can get a full-wave antenna with no single leg longer than 1/8 wavelength. See article for details.

XXXXXXXXXXXXXXXXXXXXXX

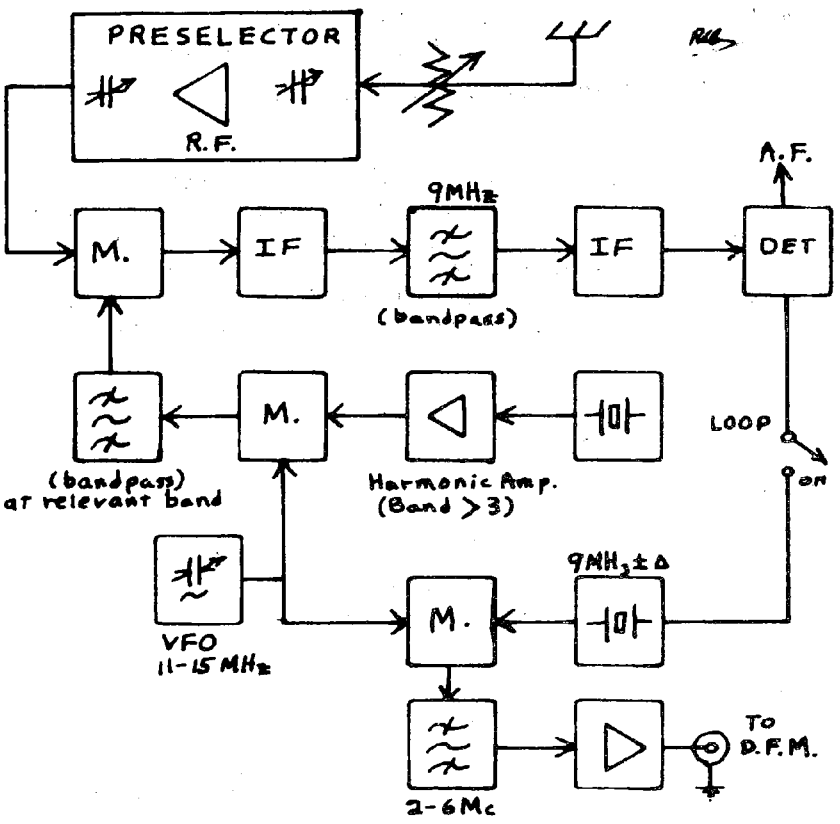
How to tell a Mouse from a Rat

If you are troubled by wee scamperings, set a mousetrap. If it is a mouse, a suitably baited mousetrap will work inevitably, and with less grief than one of the fancy modern chemicals. If the trap is overturned a couple of times without quarry and then is not disturbed, good chance its a rat. In that event use a suitable mixture as described in EEB 1970, p. 80 or buy a proper rat-trap. If this fails there is no alternative to the use of a chemical poison, but these tend to have the disagreeable effect of allowing the creature to die in the walls, creating a fearsome stink for a while....

LETTER: General Coverage Receiver Design

Some time ago I mentioned about a digital counter. Well I never got round to writing an article about it, and now its out of date, that's how fast the State of the Art progresses. Nonetheless its still doing a good job and I hope to add a divide-by 20 unit to extendits range to 160MHz.

I note with great interest the discussions re cross modulation in receivers, using FETs, etc. I am in the planning stages of a general-coverage receiver, 2-20 (+) MHz, all transistor using 9 MHz Xtal filter I.F. Basically it will have 4 Mc bands if it works out as I want it, the main VFO covering 11-15MHz and then mix that with 4 MHz Xtal and its harmonics for the higher bands. This to save band-switched VFO. Maybe its a hard way to go about it, but worth a try. Thus:



((D.F.M. = Digital (or other) Frequency Meter))

BAND	MIXER VFO INJECT.	
2 - 6MHz	11 - 15 MHz	
6 -10	15-19	(11 → 15 + 4 MHz)
10 -14	19-23	(11 → 15 + 8 MHz)
etc	etc	(etc)

The V.F. Osc. dial to be calibrated perhaps every 50KHz or so and provision to mix VFO with 9MHz Xtl to give a 2 - 6 MHz output to feed the Digital Frequency Meter for accurate readout if required. 9MHz osc. to have 9MHz ± Δ (3kHz) Xtals also to read SSB, this being used as BFO injection.

The biggest problem at the moment is the Band Pass Filter between VFO mixer and signal mixer. This is to keep the injection free of spurious and unwanted mixer products from 4 MHz harmonics, etc. But this shouldn't be impossible.

Now with all your talk for and against FETs, especially dual gates (e.g. 3N140 etc) I am not so sure what to use as mixer, but am in favour of a ring of diodes as we use in telephone carrier work. Anyway I intend to try this.

Another problem, does anyone know where to get hold of a LINEAR FREQUENCY LAW tuning capacitor? Single gang will do, for the VFO tuning. Its nice to have a linear frequency scale, but where to get such a capacitor nowadays? The old HRO Receiver had something like it, but in 4 gang. Maybe someone knows someone who makes thses still!

Incidentally, crossmodulation problems are especially severe here, as most towns have HF communications with the rest of the world, and up to say ten HF transmitters on at once from 100 watts to 1kw (++) each and all in the 4-8MHz range.

Your mention of unintentional mixing outside the receiver ((due to rectification by roofing iron, plumbing, etc, and reradiation of the mixed signals to the receiver, which can thereby do nothing to separate them)) is also interesting, as this is something we run into a lot. One very common one is guy wires and fittings at the Tx or Rx aerials themselves. And often it is not just a plain mixing but the second harmonic of one Tx with the fundamental of the other. But you can't receive the 2nd harmonic! Its strangebut true.

An example:- an F.S.K. Tx on 7.3MHz approx, an AM Tx on 6.8MHz say, will produce interference on 6.3MHz (2 x 6.8 - 7.3MHz), but you can't hear the 2 x 6.8MHz signal. Just some of the frustrations of radio communications, but most interesting.... The only real cure for us anyhow is to find and eliminate the offending "diode" external to the receiver -- sometimes a long and tiresome process.

-- C. S. Schulz, VK9ZEV, Goroka, T.P.N.G.

((This chap has some good ideas on receiver design the most important of which is actually to get around to it. However, I can see one basic problem in the system that he proposes, and that is his choice of 1st I.F. frequency. Yes, it would be nice to use one of those 9 or 10MHz Xtal filters, but stability around 9MHz would leave something to be desired. Why not use a 40MHZ I.F. or at the other end of the scale an I.F. around 1 MHz, in order to get better stability. And there is a lot to be said for going a little bit further and using a 1 - 2 MHZ VFO and a 1 MHz Harmonic Generator. This gets more and more like the RACAL, and most modern wide range receivers, but it is very convenient, and very little extra trouble.

((As far as the first converter injection filters are concerned, there is no easy way of getting around this. Good harmonic selection,and good injection filtering are a must. See circuits of RACAL for example, for some ideas.

((No comment on the absence of the second harmonic of that "down-pipe mixing" interference. In this game, anything can, and does happen! Best of luck! -- RAJR))

xxxxxxxxxxxxxxxxxxxx

Ed. Note:

Mr. Schulz's reference to unintentional mixing outside the receiver came from our article in EEB, Aug. 1969, p. 89, titled "Effortless Cross Modulation". The cure lies in bonding or tightening all loose roof surfaces, and this could be awkward if they are on your neighbour's roof. A year or two ago I also wrote a Letter to Break-In, pointing out some absurdities in the attitudes of Officialdom on this subject....

Most tuning capacitors have a certain amount of offset to improve linearity; the rest can be achieved by restricting frequency range by padding -- as described in several periodical articles.

Article on optimising Front Ends, EEB 2/73.

LETTER: Antennas as Noise Source?

Could it be possible that much of the noise coming into receivers could be due to galvanic action in the antenna, and not merely caused by internal noise in the valves?

For some time I have been of the opinion that much of the noise in receivers is caused by using much aluminium construction and incorrect fixing material -- e.g. steel, brass, copper, etc, since the components contained therein could be at an entirely different electrolytic potential.

-- F. W. Chapman, Ekibin, Qld.

((Only in a strong wind, perhaps, when materials rubbed together, but that would only give a "static" noise, not the kind of "[illegible]" noise characteristic of electron movement in valves, resistors, etc. -- Asst. Ed.))

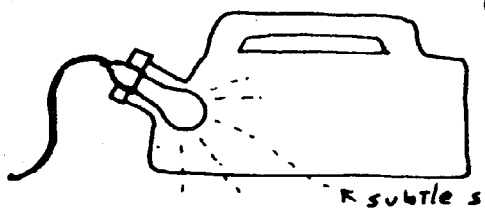
XXXXXXXXXXXXXXXXXXXXXXXX

LETTER: Artful David

Here's an idea which is, I think, a suitable sequel to the Super Wormturner (EEB, June 1969). It is an artistic piece which anyone can make and hang in their loungeroom with pride.

Recipe: One coloured plastic water container, Jerry-can style (some 60c at Coles),
One BC Socket,
2-core 240V flex-plug
240V light bulb.

Method: Cut a hole in the screw-on lid which is the right size to fit the socket through. Wire up and insert light bulb (whatever size you can get to fit through the hold). Put in a suitable place and switch on; then enjoy the admiration and envy of your friends. The drawing follows herewith



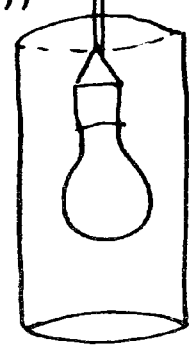
The same sort of trick can be used with many translucent coloured plastic containers. Perhaps if enough staunch socialists build these kind of things, the "art lighting" people with their schizophrenic price tags (i.e., prices entirely divorced from reality) might be driven right out of business?

On an ecological tambourine.... Electric power supply is ultimately the greatest pollution problem..... ((etc etc)).

Would you like an article on sources of power supply? ((YES!))....

An interesting point concerning marihuana research in Australia: a psychology student wanted sponsorship to do toxicity research on marihuana. He was advised by the Honourable Customs Minister to approach the breweries, which he did, and they sponsored his research. Considering.... ((I think we won't carry David's discussion much further here. Don't want to tweak the Lion's Tail too hard at a time...))

Do you want an article on marihuana too? ((NO!))



Before I go, here is another rather effective light source, shown at the left. You have lots of ways of attaching the lamp; think up one yourself. The shade is a piece of Cirenoid coloured filter rolled into a cylinder. This gives a diffused coloured light from the sides, and a strong white light downwards, increased by reflection from the inside of the cylinder...

Now these two ideas are original, with a friend and me, and are NOT TO BE MADE FOR SALE BY YOU (but ok by me). If you give them away that's OK, but no rake-offs please!
(Put that bit in if you ever publish them)

-- D. Brown, Gosford, N.S.W.

((I don't think it will drive the "art lighting" people out of business. I've noticed that when the YF wants a nice light fixture there is talk about how easy it is to make a nice one, but eventually the retailers furnish the merchandise, at a healthy price. -- RLG))

XXXXXXXXXXXXXXXXXXXXXXXX

THE AUSTRALIAN EEB: Editor = R. Leo Gunther (VK7RG), Asst. Ed. = Rod A.J. Reynolds (VK7ZAR), Assoc. Ed. = Chris Pitcher (Northcote, Vic.), Associates: L. J. Yelland (Prahran, Vic.), R.S. Maddever (Corio, Vic.). Draughtsman = Stephen K. Gunther. Subs Managers = R.A. Walton, F. Merritt, or N.Z.A.R.T. Brenda Ford is Secretary, and ensures publication of EEB notwithstanding.

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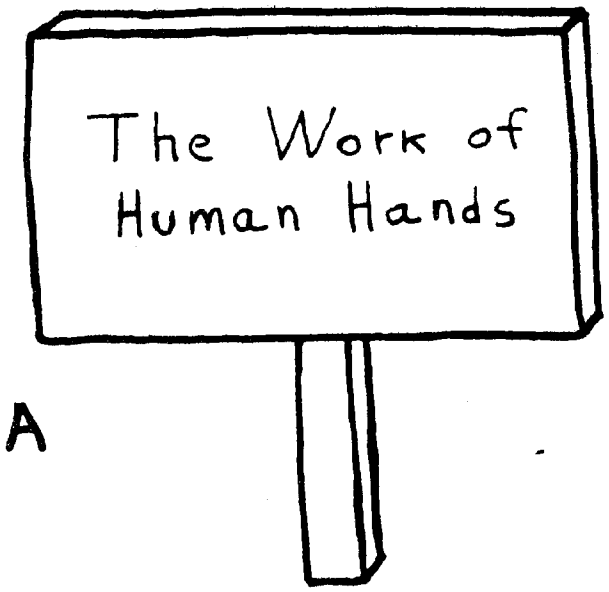

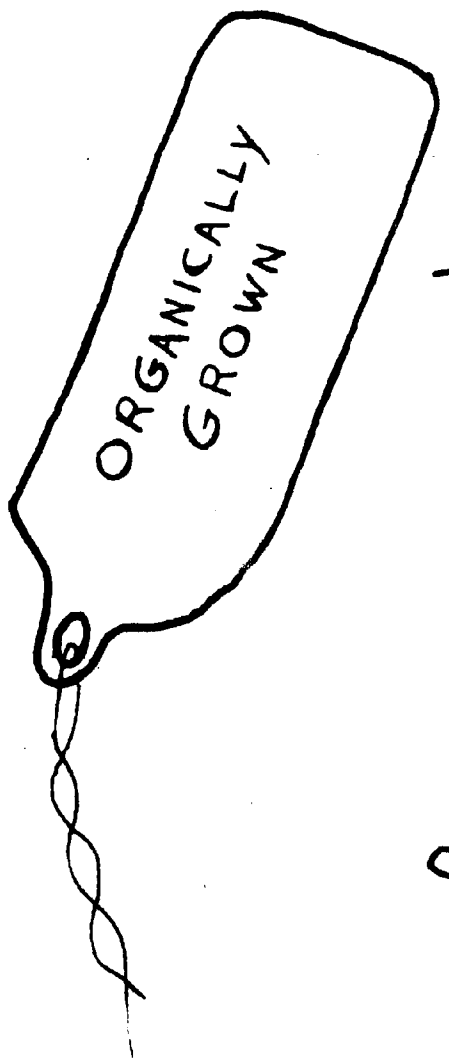

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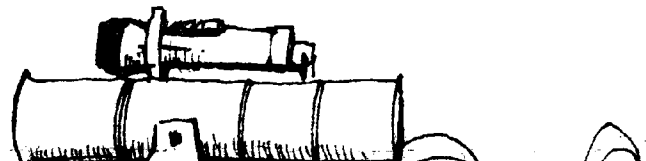
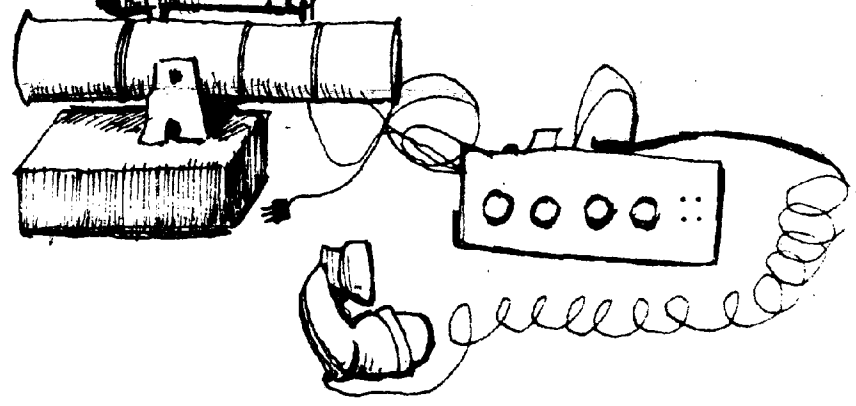
INSTALMENT One

SURPRISE! → WELCOME TO EEB, the only non-magazine which publishes



SURPRISE! → WELCOME TO EEB, the only non-magazine which publishes at leisure, or in any event sporadically. You see, its like this... I got a bit involved with work at Work and at Home and got a bit behind on eeb, and well -- there you are! Never mind, its not worth a coronary for you or for me.

NEEDLESS TO SAY, all subscriptions to eeb are automatically extended for six months -- from last December. I reckon Oy ought to be able to get on top by June.



MURRELL'S MODULATED LIGHT COMMUNICATORS (described elsewhere, this EEB)

EEB FIGHTS THE "ACCELERATIVE THRUST" (Toffler, "Future Shock" for details). These months of quiet have helped to provide for you (and me) a "Zone of Stability". Be of good cheer.

NEW SUBSCRIBERS : Don't be disheartened, nothing is ever normal at eeb. Wait patiently until June (or July...) and see what happens. We have a great bulging file of stuff to put into eebs, some of it really quite good. Don't be startled by the apparent renewal date appearing beside your name on the address label; all present subs will be extended six months, or I'll put out an extra 3 issues sometime, whichever happens first.

I must note that this moratorium will apply onto to me, and I am the bottleneck at eeb. Brenda will now process all outstanding BAck Orders for all stuff as soon as possible. A frightful number of them has accumulated, and I'm afraid to open new mail -- I reckon its full of complaints. Well -- please accept my apologies, but you'll receive what you have ordered, never fear. Those who have ordered 1972 Bound Volumes will have to wait for June for it to be completed.

FRANK MERRITT, our patient North American Rep. writes in

(PTO → P.103)

---

*"The extra Post is a bit slow this year" - Leo

we wrote him a nice letter telling all the boney facts, and here is the result!

MINISTER FOR CUSTOMS AND EXCISE

Parliament House,
CANBERRA A.C.T. 2600

02 MAR

Dear Mr Gunther,

I refer to your letter of 2 February concerning the legalising of the home brewing of beer with an alcohol content above 1.15 per cent by volume.

I feel sure you would now be aware of the approval of the Government, announced on 20 February, that action be taken to legalise the home brewing of beer by individuals for their own consumption.

Action will be taken to introduce the necessary amending legislation as soon as practicable.

Yours sincerely,

Lionel Murphy

(Lionel Murphy)

CONTINUED FROM P. 101 (All readers over 30 please put on your spectacles. Thanku):

answer to my harried query to him about what we were to do about the violently plunging value of the Yankee dollar & the recklessly inflating Aussie one. Thus:

"Dear Leo,

This money thing is becoming increasingly serious from all angles. I have some thoughts that I will offer in a constructive attitude.

Above all, EEB is WORTH the effort. Your approach is reasonable and is worth more money. That is, with one proviso. In order to justify a higher subscription rate the publication schedules should be kept. I do not say this to criticize. In your shoes I doubt that I could do as well as you are doing. However, facts are facts. In my opinion, most subscribers ((in North America)) would be willing to pay more money in return for reliable publication.

Very often in life our 'light' is kept under a bushel due to a lack of real appreciation of our true worth. With respect to EEB I would suggest an increase to $4.00 US or Can. would be reasonable. Anyone with a half grain of sense is aware of the problem with money ((in international transactions)). Fortunately, virtually all of your North American subscribers have enough sense to realize these facts of life...

I would suggest that you might care to include in the next copy of EEB the rationale for the increase in the North American price. But again I offer that regular schedules will make a great deal of difference..."

Well! Out of a US cheque for $2.80 (the previous rate) we would now recover $A1.90 which is not quite enough to cover a foreign sub. And what happens when we get our next 100% postal increase, not to mention our steadily increasing costs of about 10% per year, and what if the $US and £ continue to drop? EEB is perhaps worth $1.50 for the occasional good issue, but surely not $5! Where will it all end? Maybe we ought to publish the magazine in Japanese or in German to reap the prosperity of our former Enemies? With such enemies who needs friends?

I jest, of course. We have, in any event, one Japanese reader, a nice bloke I met aboard a fishing boat in Hobart. His English was not impeccable, and my Japanese was worse, but we both spoke Electronics, and also managed to convince each other that we had negligible desire to breathe radioactive air.

French subscriptions, by the way, are not being solicited.

Well, I think we'll make the North American sub rate

with our time than to read stuff (ho ho). Well, look, if you subscribe to a magazine, you'll have at least to look through it when it arrives, and you won't really miss the time, particularly if you only read in detail what interests you most. And if you start reading A. R. Techniques you won't be able to put it down, so that solves that. Simple, no?

PUBLIC NOTICE and WIA squabbles.

Incidentally I wish to go on record here as saying that I endorse both Tuned Lines and 6UP strictly for their technical value (which is considerable), but that EEB does not take any official position at all in any political disputes which may have arisen in New South Wales.

There are enough Real Problems in this world without looking for warts in our neighbour's eye. Can we all resolve to act like gentlemen, and to fight the evils which really do matter?

I am willing to take the lead in this matter, and to forgive all parties their sins. Wot say, chaps?

Current Literature Review

Going through the mountain of folders awaiting treatment the above-titled one is bulging with goodies, all kinds interesting things to mention, from The Milliwatt with mention of the availability of good VHF transistors at reasonable prices (contact AWV and Motorola here), to QST and Radio Communication with much information on using ICs. Of special interest to us is J. M. Bryant's (G8FNT) "Using the Plessy SL600 Series Integrated Circuits in Transceivers" which appeared late 1972 in Break-In and in Radio Communic. Mr. Bryant does, in fact, address himself to the question we raised in our 1971-2 series on Direct Conversion Receivers, with the use of ICs for practical D-C Rx, specifically the design of an SSB Transceiver, and block outline of the RF/AF phasing system (Vix, "Two-phase" or "Signal Slicer"). In a way this was unfortunate, because there has been no end of SSB Transceiver designs, but no detail about the other other than in valves (in out-of-print publications by CQ). The two-phase system with proper audio phase discriminator will make practical the use of Double Sideband Suppressed Carrier communication. Until the development of good and simple DSB receiving techniques SSB has had it all its own way. But now is the time to reopen the question of DSB — which possesses a wide variety of advantages, and few disadvantages indeed. Dick Ferris resurrects this next month in his discussion of the Reciprocating Detector, which may be even more effective than PLL detectors for DSB; wait for that before you fly up in the air over this one!

solicited.

Well, I think we'll make the North American sub rate $US or $C 3.50, and see what happens. That makes the U.K. rate £1.40 or so. Thats not $5 or even $4, but we may yet publish an occasional issue late..... hi.

On the other hand, I agree with Frank completely, and I hereby vow to turn over a new leaf and not to publish EEB more than a month late at a time; I couldn't very well vow to publish it on time, for that would break a tradition established since earliest days at EEB...

In the forthcoming issue (yegad I'd better get to work on it right away!) I promised Ward's long-delayed Exhaust-gas Analyser, Maddever's Pulse-width Generator, Pitcher's New look at FETs done in his usual commonse manner, and more on the Reciprocating Detector. The latter will be of particular interest to technically-minded readers, because we have had a significant exchange of technical correspondence with our fiery Dick Ferris and the inventor of the Reciprocating Detector, Steve Badessa. I'm happy to report that Mr. Badessa came out of it very well. Incidentally, our 1972 series on the Reciprocating Detector was published in the Jan-Feb 1973 issue of The Radio Bulletin of the Eastern and Mountain District Radio Club (the same Club associated with selling the lovely receiver advertised elsewhere in this EEB). I have had quite a lot to say about The Radio Bulletin in previous issues of EEB, so here I merely take the opportunity to remind you that this is one of Australia's fine non-commercial experimenters publications, others being* 6-UP and Tuned Lines -- the latter two devoted to VHF but often of general interest to HF and general electronics enthusiasts. The Radio Bulletin (P.O. Box 87, Mitcham, Vic, 3132) costs $3.50 for the first year, $3 p.a. after that; send them 17c for a sample copy if you want to see. 6-UP published by the controversial Roger Harrison (the report of his Demise in the last EEB was premature) is $3 per year, from ACA, 47 Ballast Point Road, Birchgrove, NSW 2041. Tuned Lines is available from the NSW Division of the WIA. Since EEB publishes about half as often as these other magazines, I reckon our $1.55 is about right.

*There's also Vic. VHFer, Zero Beat, etc. Sri.

Unfortunately the review of G3VA's Amateur Radio Techniques mentioned in the last EEB was not published in The Radio Bulletin, which is a pity, but you can't win 'em all. Never mind, both publications are very worth reading. ART is some $3.75 from RSGB, $3.95 from the WIA, and likely a bit dearer at bookshops.

People have written to us complaining that it is all very well and good for us to recommend this or that book or periodical, and presumably we have nothing more to do

be even more effective than PLL detectors for DSB; wait for that before you fly up in the air over this one!

In any event, I'm not going to go much further into the Literature now so you anti-literature literates can relax! I just want to mention two more things:

First, I found those references for the chap (can't remember who, at this moment) who wanted to know how he could obtain a variable condenser which would give linear tuning. Rod says that people have worked on this problem for about 50 years, but I note that there are various ways of achieving a reasonably linear frequency scale. Relevant references are: "A Solid State Permeability-tuned VFO with Digital FREQUENCY Readout", PY2PE1C, CQ, Oct. 1970, pp 18-22.

"A Linear, Stable VFO with a Tracking Mixer", 73, September 1971, pp 86-88, author W8RHR

"Considerations for Solid State Linear VFO's" by PY2PE1C, CQ, September 1972, p. 62-5.

The general concensus of opinion is that you can get linear coverage of frequency if you want negligible range of frequency coverage. Murphy wins again -- but you could always heterodyne it up to what you want? Incidentally, in the last-named reference you'll want to bypass the base-blocking capacitor with a resistor. Otherwise the VFO has no base-bias stabilisation; no wonder it drifts with temperature!

The other item I want to mention is from QST for October 1972, where C F Hadlock (W1CTW) observes something relevant to the Parts Availability Crisis we have been describing (and which Rod will again take up):

"Some time ago the writer read a statement in a contemporary ham (sic) magazine to the effect that the use of fm by amateurs owes its very existence to the availability of obsolete commercial equipment. If this statement is true, it is a sad commentary on amateur radio of the seventies. Have we reached the point where any aspect of ham radio is wholly dependent on discarded commercial gear?"

-- No, it is also dependent on new commercial gear.

In that same issue is also another answer for the PAC: You can build your own dual-differential capacitor if you have trouble buying one. Maybe the PAC will again stimulate us to return to constructing our own parts? ((You'll have some little difficulty making your own IC -- RAJR)).... And in that same issue, a nice simple treatment of a potentially-nasty subject: "RF Matching Techniques, Design and Example" by D. K. Belcher (WA4JVE). Wot, you won't need RF Matching, your little QRP transmitters work just fine without it? Hoho.

EDITORIAL -- R. Leo Gunther (VK7RG)

"Doomsday: Friday, 13 November, AD 2026. At this date the human population will approach infinity if it grows as it has grown in the last two millenia" -- H. von Foerster et

al, Science, 132 (1960)

Let me introduce myself properly at this point for the benefit of new readers. I'm RLG and I teach Advanced Chemistry at our Advanced College when I'm not publishing EEB, which helps to explain how it is that my knowledge of electronics is tenuous and pragmatic, and probably explains why EEB gets published in the first instance. My various knowledgable Associates shaketheir heads, but nonetheless I notice that they don't mind seeing their names in print too.

Are Radio Amateurs interested in Electronics?

Here is something curious. For the past several years virtually all of our promotional material has been going to new radio amateurs, because that is the only source of likely subscribers available to us (anyone know of another source?) other than advertising in the big glossies -- and of course I do have some amateur interests myself.

Yet we have received consistent complaints that we have been featuring too much radio amateur material in our pages. Of course we receive complaints too that we don't have enough, but the majority of our subscribers must be amateurs?, yet the majority of letters want more non-communications topics.

Well, as always, EEB will continue to go its way as it goes, sometimes more in one direction or the other -- and a given trend can go on for several issues.

But I wonder whether this comment trend indicates that radio amateurs really aren't interested in the technical aspects of their hobby, and would rather experiment with ignitions, timers, highfi, and such? Or:

Might this possibly be a result of the revolution which has placed into a majority of amateurs' hands nice shiny transceivers with inscrutable insides? Yes yes, I know that that is the kind of comment which has been responsible for keeping advertisers away from our hallowed pages*, but I must still ask the question. Is the King naked? or is he merely sunbathing?

Hint

Don't give sample copies away to a Friend unless you are prepared to lose them. We have heard hair-raising tales, so to speak; show EEB to your friends casually, & if they want a copy send us their names etc and we'll be happy to comply. Indeed, if you wish to send us two new subscriptions for other people (include money), you can request from us an extension of your own sub and we'll probably comply -- because of the high cost of promotion.

If you do loan copies, you might find that we can't supply more to you and you'll have to buy a whole Round

written:

"I have received only a few written comments and quite a few verbal comments on the subject of interference from the multitudinous mobile and fixed transmitters which abound the countryside these days -- quite apart from the amateurs... Most of the comments seem to be of the opinion that colour will suffer much less interference than black and white due to many factors but mostly associated with the phase reversal of the colour system.

"With these thoughts in mind I wonder if you have a but of spare space in a forthcoming issue to query your readers on this subject?"

We won't enter this field, but we do encourage our readers to contact Tony King directly:

the RB: 16 Banksia Court, Heathmont, 3135.

NB: PLS CORRECT MISPRINT, GRAPH P.106; should read 2500% !

VISUAL READOUTS -- R. Hanna (W8QUR)

((From Bulletin of the Amateur Radio News Service, January 1972, p. 7))

Modern electronics has brought us many devices to change data from analogue to digital. To be able to use this new type of information, digital readout devices are necessary. The uses to which digital readouts are being used seems to have no end.

Figuring counters, VOM's, clocks, depth sounders for boats, remote marine compasses and Toledo Scale computing scales are just a few of the things that come to mind. There are so many types of digital devices available from electromechanical to electronic or electrical. A few of the latter will be discussed here.

The Nixie Tube

The most familiar type to us is the "NIXIE" tube. This is a cold cathode tube and is a glorified neon-bulb. It contains at least one anode and a cathode for each numeral and character to be displayed. The individual cathodes are formed in the shape of the character to be displayed. These tubes require 170V which puts quite a demand on the switching device ((particularly if a semiconductor --RLG)), and requires a separate power supply. The colour is red-orange. A red filter is normally used in front of them to give a better display.

Other Tubes

Most of the other readout devices are of the seven-segment type where all of the numbers can be displayed, plus eleven other letters (A,C,E,F,G,H,J.L,P,U,& Y). Others can have more segments and can show just about any

probably comply -- because of the high cost of promotion.

If you do loan copies, you might find that we can't supply more to you and you'll have to buy a whole Bound Volume, if it is still in print!

I am becoming more impressed by the fact that although our circulation has not yet reached 1000, it is a remarkably loyal and creative one. "EEB is not for Everyone" said one of our adverts in Electronics Australia a while ago, and this would alas, seem to be true.

But the subscribers we do have are a pleasure, and I should like herely (that's supposed to be sincerely) to reciprocate the admiration you have expressed in your many kind notes and letters.

Mentioning EEB to friends on the Air

If we still have any radio amateur friends left after my pregnant remarks above, I might speak to them in this wise:

One notes that it is prohibited to solicit "business, propaganda, or advertisement" on the Amateur Bands, but of course you are permitted to discuss "Technical investigations, research into or instruction in or radio communication techniques without pecuniary interest." hi.

Without pecuniary interest indeed; this issue, free for you, is going to cost me a fortune.

Parts Availability Crisis, one further Note

Although I'll save Rod's comments on this subject until the next issue, I would note that one curious "spin-off" of our coverage of the matter was that we were contacted by a major manufacturer and a large parts distributor, both in the USA, enquiring whether they might be of assistance. Unfortunately the main answer at present seems to be "no", because on one hand much of the Australian (and even New Zealand) market is covered quite well in some instances -- and one deduces even better than in America? And because import duties make the importation of a lot of stuff very expensive. But we are continuing negotiations on the latter aspect, and we'll see what happens.

Colour vs B/W Television Receivers

The PAL colour TV system is coming to Australia, and soon. It will certainly be an improvement over the American NTSC system ("Never Twice the Same Colour"). The October 1972 issue of The Radio Bulletin (ibid) discussed various possible problems which might arise, but Rod answered them in the Jan-Feb 1973 issue of that magazine. Other than that, Tony King, their Editor has

* But quite without reason. We have never been against commercialism, only against its abuses! Please note.

segment type where all of the numbers can be displayed, plus eleven other letters (A,C,E,F,G,H,J.L,P,U,& Y). Others can have more segments and can show just about any letter designation.

The segments are made up in many ways. RCA Numertrons are made up of 7 separate filaments arranged on a dark background. These tubes fit a standard ninepin socket. The voltage is about 5V with rather high current.

Tung-Sol makes one which is unique in that it is a low voltage vacuum fluorescent devoce which is also a 7-segment type. It has a heater on 1.6V at 45mA. The segments glow with application of 10-15V d.c. on the anodes.

Several of the 7-segment devices use separate neon bulbs for each of the segments.

Light-emitting Diodes (LED)

One of the latest and still quite expensive* is the LED. For the most part the LED puts out a small point of light so quite a few of them are grouped together to make characters like the time-temperature signs at the banks. Most of the displays are quite small, usually less than ¼". Larger ones are, however, available.

Liquid Crystals

One of the newest things which show lots of promise is the liquid crystal. This is a 7-segment device. Several companies are working on this and at the present time the cost is high. By applying a.c. to the leads, the liquid crystal film can be made to appear either transparent or opaque. The size can be from 1/10 inch to 10 inches high.

* Individual diodes are not so dear now, but an array of them as needed for figure-readout can amount to dollars, compared, say, to a Nixie. -- RAJR

RLG Comment: Details on liquid crystals appeared in Electronics Australia of a few years ago or so. The whole field of Optoelectronics is covered briefly but well by Blakeslee in "By the Light of a Diode", QST, May 1972, pp. 30-37. Discusses LEDs, Liquid Crystals, Photodetectors, Opto-couplers, and Light Conductors.

Incidentally, Yelland has submitted to us an article on a Digital Clock using Nixies, and Anderson has sent us a design for a low-cost frequency counter using ordinary neons for readout. More details of the latter will be printed in QST, and at the rate we're going the QST article will appear first. Its a nice idea for saving money if you have a cheap source of neons; in this case he makes a counter "for under $20", though he uses nixie-drivers to drive the neons. Andy sent us a working model of the Counter! and Rod has put it to excellent use on the air. Rod promises to have this article vetted for our June issue, hooray, with some additions of his own.

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SOME INTERESTING COMPARISONS (We do love Qld & Tas!)

Australian District	% POPULATION	% AMATEURS	% EEB SUBSCRIBERS
1 + 2	37.0	32.1	30.4
3	26.7	31.6	25.4
4	14.2	17.0	17.4
5 + 8	9.7	11.6	9.6
6	7.9	7.9	6.0
7	2.9	3.5	10.1
9	1.6*	16.3	1.1 !

*Relative to city population over 2000 people

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

LETTER: Modulated Light Communication
((See also our Augtober 1972 issue; Burlinson concludes that Mod Light Comm article in our next issue))

I was interested to read your advertisement in... Electronics Australia and was intrigued by the reference to Modulated Light Communication.

As you know, I experimented in this field some years ago and finally produced equipment which gave "telephone" quality two-way communication up to one mile using a total power of 1.8 watts for both units.

I had thought that a market might have been available for this equipment but was laughed at and the equipment evaluated as a mere schoolroom novelty.

My last experiment some two years ago was to fit the light source (a torch globe) into the 20 inch mirror of a wartime searchlight. That gave reproduction of speech and music over a distance of two miles but I gave up before I got the beam properly focussed. It was over two chains wide at two miles ((viz, 40.2 metres — RLG)) but the mirror is capable of much finer focussing than that. I did not have time to carry the experiment further as it meant "hit-and-miss" adjustments with 4 miles of travelling each time to check it. I am sure that a greater distance or higher fidelity could have been obtained but what was the use of carrying on with something no one was interested in?

Over the years — since 1942 in fact — I experimented with many types of light sources, from a 40mA push-bike tail-light globe up to 100 watt 240V household globes but found they all had "dips" in the frequency response curve. These "dips" were as deep as 6 db but confined to very narrow frequency bands. Some had more than others but all incandescent lamps had them in varying portions of the audible range.

((One of dozens. For a real cheapie see Wireless World, November 1972. A couple of 50c TTL chips — and it works for NBFM!! — RAJR))

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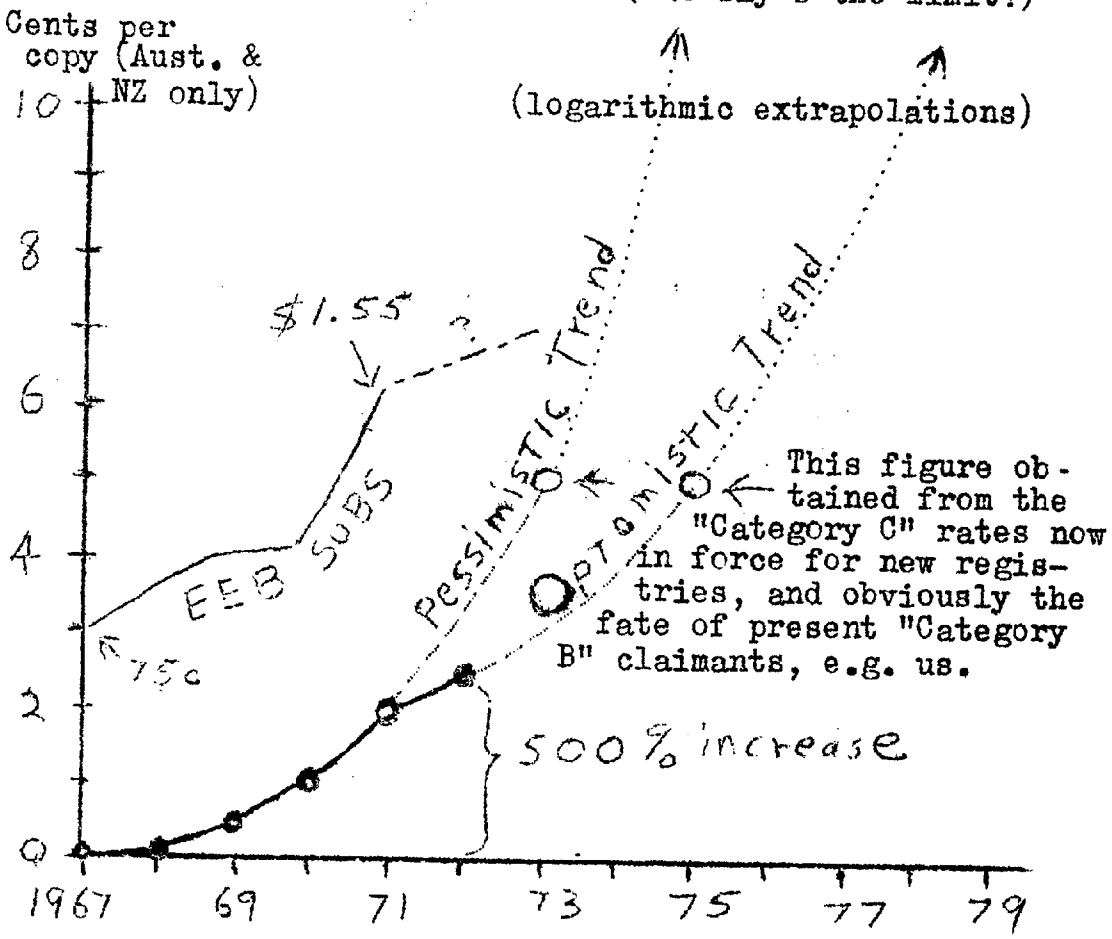
EEB POSTAL COSTS (Bulk Rate): (the sky's the limit!)



This figure obtained from the "Category C" rates now in force for new registries, and obviously the fate of present "Category B" claimants, e.g. us.

QUOTE: "More than 270 million direct mail items posted in Australia over the past 12 months mean that Australian advertisers are swinging dramatically to this form of advertising as a most effective means of winning customers and sales... If there is a need to saturate a target area, addressing costs can be saved by using the Post Office's 'Householder' Service. The simple address 'The Householder' is all that is needed for delivery to all houses in a specified area.

"Direct mail comprises a large proportion of all bulk pre-sorted mail which is carried at special rates. Items charged at full rate are those which are usually posted in batches too small or too infrequently for pre-sorted rates. They include club circulars... ((etc)).. or extremely specialised advertising or promotional material."

— from Australian Post Office News, Oct. 1972, p. 1

IN OTHER WORDS, WHEN EEB NEEDS TO SEND OUT 1000 PROMOTIONAL CIRCULARS THE POST IS 7c each, WHETHER OR NOT THEY ARE PRE-SORTED. WHEN AN ADVERTISER WISHES TO "SATURATE" THE MARKET WITH A VAST ("junk") MAILING IT CAN COST HIM AS LITTLE AS

than others but all incandescent lamps had them in varying portions of the audible range.

I also used a variety of light-sensitive cells, ranging from "Lumitron" P.E. Cells as used in Talkie sound equipment before the war, through germanium light-sensitive diodes and Phototransistors, to Photo-voltaic cells -- but without eliminating the problem.

This ruled out my original idea of HI-FI reproduction and was the reason I dropped the whole thing in 1961. I have a tape which I recorded at that time over a distance of 75 yards using a mirror (with home-made recorder too).

Seven or eight years later I went back to experimenting with the idea of producing a "field telephone" type of unit using as little power as possible and this was described in the March 1969 issue of Electronics Australia. A photo of one of the two units is enclosed ((See p. 101 here for our Artist's rather free adaptation of it -- RLG)). The useful range of the equipment pictured was about 300 yards and the distance of one mile was obtained by using car head-light reflectors behind the torch globes.

I do not intend to carry the experiments any further, but am interested to know that others are doing ...

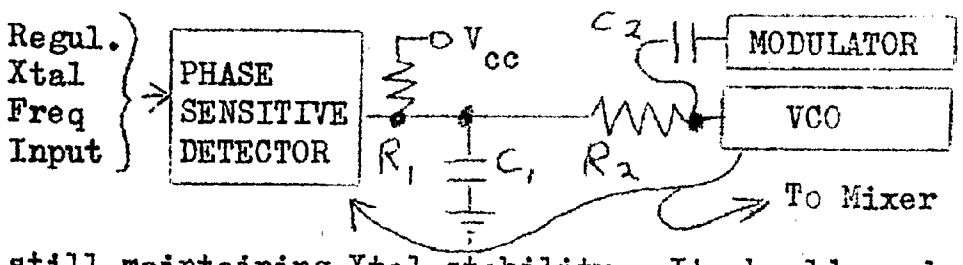
-- A. G. Murrell, P.O. Box 18, Penola, 5277

////////////////////////////////

LETTER: Experiments with ICs in Phase Locked Loops

I am experimenting with PLLs both in receivers and in transmitters for 2 metre FM. I am currently using the Fairchild uA780 IC, which is a PLL made for colour sub-carrier regeneration. This only costs $2.50, instead of $8.50 for the Signetics equivalent.

An idea I have had for transmitter use is shown below, and it should give good FM deviation, while



still maintaining Xtal stability. It should need only one stage to heterodyne up to 6 or 2 metres. Note that R_1C_1 time constant is much greater than the period of the lowest modulation frequency. R2 and C2 isolate the modulation from the PSD. What do you think?

-- Geoff Cohen, VK1ZUG, Holt, ACT

((Pls see next column for EEB comment ----------))

CIRCULARS THE POST IS 7c each, WHETHER OR NOT THEY ARE PRE-SORTED. WHEN AN ADVERTISER WISHES TO "SATURATE" THE MARKET WITH A VAST ("junk") MAILING IT CAN COST HIM AS LITTLE AS 4.5c EACH! The rich get richer and....

CONCLUSION: The Australian P.O. is a blatant source of tax money for the Government, a tax which falls most heavily on those of us who distribute worthwhile information in this democracy. The only places where Printed Matter still bears a reasonable postage is in communist countries!!!!!!

POSTscript: Air Mail Postage, Australia to USA: 30c
USA to Australia: 18c. Aust to UK: 35c. UK to Aust:19c.

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

A COMPRISON REVIEW: ARRL vs RSGB VHF MANUALS
-- by Chris Pitcher (VK3)

The difficulty with Manuals such as these, is that everyone who reads them is looking for something different. This can, in fact, be taken as a measure of the "success" (or otherwise) of thepublication: its ability to cater for the individual.

From my subjective point of view, the RSGB version is better in this respect. This leads, however, to the obvious criticism that they give a sketchy picture of a lot of topics, whereas the ARRL cover a limited number of popular topics in detail. This may be true, but to satisfy yourself any further I'm afraid you will have to read them yourself, the question of "sufficient infrmation" being entirely subjective! The obvious implication is that you should have both works for reference about VHF matters.

There is a fairly close chapter by chapter correlation between the two books, with some exceptions. One point is clear: a great deal more time has been spent at ARRL HQ in planning and layout than at the RSGB establishment.

To point to this, consider the sections on Receivers. ARRL is split into two sections: Theory and Construction. In both sections they tend to stick to topics of interest to the majority, with slightly more emphasis on the communicator rather than the experimenter. There is no such planned layout in the RSGB effort, but there is something there on virtually every aspect of receivers, with definitely more emphasis on construction and the experimenter.

In fact I think it fair to say that the two books are complementary in approach as well as in subject matter. There are differences, of course. RSGB have not considered BCI/TVI of sufficient importance to warrant a section on their own. On the other hand they do have two valuable chapters on Tuned Circuits and Filters. The RSGB section on Sideband is not duplicated in ARRL (although partially covered under Transmitters & Transverters), nor are their fascinating bits of British Craftsmanship, like making a Coaxial Relay!

The biggest difference is probably in the Propagation

sections. ARRL give a pretty comprehensive rundown on all modes, and the requirements for using them, plus a valuable path-loss/station gain calculator for reliable "line-of-sight" work. RSGB, however, mention in passing the usual modes, then concentrate on calculation of tropospheric anomalies and their effects. While this is very interesting reading, it is not of much value unless you have access to extensive meterological data (vix weather).

The best advice I can give to a prospective buyer is that if you can only afford one of them, take a good look at yourself, and decide whether you are primarily a communicator, hence ARRL-bent, or an experimenter, hence to the RSGB. But if you can afford it, and you want the whole picture, by all means get both. They are available from the WIA, from technical bookshops in major Australian and New Zealand cities (and of course from NZART), or from ARRL or RSGB directly; see magazine adverts.

RAJR Comment: I agree with this. The ARRL is a well-presented elementary book by engineering standards and must satisfy the needs of a section of amateurs, and not unreasonably those whose taste runs to American practices. And RSGB caters to British tastes. Since there is something of both in all of us we can profit from having both ARRL and RSGB manuals and handbooks.

-XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX-

LETTER: In defence of the Appliance Operator"

Please don't knock every "appliance operator"; I'd just love to have the time and money to be one! I feel that there must be a proper balance somewhere. What is the use of spending all your time experimenting and making untold discoveries if you never get on the air to tell somebody about them?*. Nobody else learns anything from you; unless they read it in EEB they may have to blunder around until they reach the same conclusions.

— Graeme Flodine, VK4FR, No. Tamborine Pt, 4272.

((* Well, you could publish a magazine instead..? —RLG))

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

WHERE THE DX WAS AT ON 6 METRES!

-- by Greg Johnston, VK7KJ

As something of a change from my usual EEB Report, and also because my recent activities have been heavily biased towards the 52 Meg band, a review of happenings

very good strength throughout, and 0150 to 0230 Z on Jan. 12th with sigs to S7.

After a very good opening into all VK call areas except VK9 starting at about 0100 on December 19th and ending at about 1100 with VK5's the band opened up rapidly at 1320 into the Sydney area with tremendous echo on the incoming sigs and some buzz; this lasted until after 1400Z (I went to bdd then!), although there was plenty of signal on the direct path I strongly suspect that they were coming in off the back of the beam since when rotated into the southwest the signals peaked up considerably but still with the echo and buzz noted earlier. The mode of propagation here is likely to have been auroral, but with the geographical location of the stations involved, no confirmation was possible. Backscatter seems to be the only other likely mode although a 650 mile path does seem to be stretching things a bit.

Another noteworthy opening on Dec. 17th saw VK2 and 4 along with ZL1, 2 and 4 all coming in at the same time frm abt 0000 to 0200 Z with lots and lots of dogpiles which made me very glad that I have a selective and crossmodulation/overload-immune receiver; more anon on that.

A few more words about the VKØ operation. Contrary to what appears in "Amateur Radio" the Macquarie Island beacon signs VKØWI (not VKØZVS) and is slightly lower in frequency than 52.160. During the first of the openings into there, two operators were on the Island; Ron, VKØWW is still there but VKØZVS has now returned to Australia. The beacon set up is such that the frequency cannot be monitored between keying sequences so it is no use trying to break in. Lets hope that this can be changed. It would ease the frustration of hearing the beacon for hours on end quite a bit just knowing that someone might walk past the Rx as you break.

One relevant suggestion in this regard: When on the air Ron will usually be found around 14130 and unless involved with a sked to the folks at home does not seem to mind doing a quick QSY to 6 if the band is open. Another comment from "A.R." (Feb 1973 VHF Notes) does not seem to be correct in regard to the path length between Adelaide and Macquarie -- the 3000 miles quoted seems to be very nearly double the actual length which according to my own estimate is approximately 1500, with Hobart almost in the middle of it. For the benefit of anyone who would like to work the whole thing out, Macquarie Island is located at 54°30' Sth, 159° East.

Without doubt one of the longest VK/VK contacts this year would have been from Hobart to Exmouth Gulf, VK7ZIF to VK6-ZDZ; the path length for this one would have been well in excess of 2000 miles!

and also because my recent activities have been heavily biased towards the 52 Meg band, a review of happenings on that band, undoubtedly some of the best in years, will be attempted here.

Things started moving here in southern VK7 on Nov. 7th 1972 with a nice but pretty short opening into JA1 at 0400 GMT followed up by a weak VK3 opening at 0530 on the 53.032 AM net -- no sigs heard down-band. The JA's again broke through at the same time on the following day with sigs again peaking to S9 both ways. Some of the mort prominent sigs were JA1LZK, JA1JAC & JH1HFE, all of whom were operating in the lower part of the VK band, mostly around 52.050. That little lot finished things off as far as long-haul went, scattered and short openings into VK2, 5, and VK4 (one area at a time) then were the order of the day until Dec. 10th when in the middle of a good opening into VK2 (Sydney area only) the VKØWI beacon on 52.160 with a very slow A1 ident. came in at 0740 Z and stayed in at good strength until 0815 Z when it faded.

The VK2 bods had been hearing the beacon (its on Macquarie Island) for some little time and around fade-out time here Rod, VKØWW cut the beacon and came up on frequency in person for what I think to be the first-ever 6 M QSOs out of Macquarie Island, the path length into Sydney being about 1500 miles. At about this time also the path distance from southern VK7 shifted out to the 1100 mile mark into Brisbane and after losing the Sydney boys, into areas north of there such as Tamworth about 840 miles.

The pileup on Ron, VKØWW when he manned the Tx in person was one of the worst I've heard on any band, and I've been in plenty myself as a VKØ on 20 M when the band was open into Europe and the USA. Its a darned good thing that Ron is a keen and very patient operator. Many others would have gone QRT rather than put up with as much lack of thought and consideration as was evident on this and subsequent band openings.

After this, the Macquarie Island beacon was very regularly logged here usually around the 0700 to 0800 Z mark until the 14th Dec. when it was logged in at 0530 until 0800 peaking at times to well over S9. During this opening when the Tx was manned nearly all the active amateurs in the south of VK7 managed to work Macquarie for the first time and it is also of interest to note simultaneous reception of the Macquarie sigs in VK7, 5, and 2 -- a spread of from approx 750 to 1500 miles in path length at the same time. Double-hop and single-hop ES all at once???

Outside the normal (?) VKØ openings were the beacon loggings from 1145 to 1335 Z on Dec. 15th -- ZDZ; the path length for this one would have been well in excess of 2000 miles!

A Technical Note on 6 Metre Gear

All in all 6 has provided quite a bit of interest over the present summer although the New Year hardly brought forth much to enthuse about. With the activity level now being what it is and with the degree of SSB transceive operation noted it is not surprising to hear comments very like those heard in the "early" days of SSB predominance on the HF bands about lack of receiver selectivity etc etc.

All this boils down to the fact that many 6 Metre enthusiasts are becoming more discriminating in the equipment they use. No doubt commercial gear availability is a large contributor in this regard, but of course the whole subject is a big one. So, just in passing, a comment for the home-brewer of gear: How about a MOSFET front end (MPF 121 RF & mixer) coupled into an LM373 IC IF module along with a 4-pole crystal filter (homebrew or commercial) into one ofthe many audio ICs -- to keep up with the "State of the Art"?

Last but not least -- Andy, VE1ASJ is in his own words a 6 M FANATIC and has expressed more than a passing interest in setting up some tests VK/VE on that band. How about some of you blokes in VK2 and 4 taking him up on it? VK7 seems a bit too far south!

Postscript

Given a bit more time and maybe a successor as QSL Manager I'll finish off a project half underway now to build up a solid state transceiver using one or maybe 2 LM373's and a XTAL filter. I have had a breadboard Rx going and the results were FB. Could make an article on its own for EEB when I get the project finished. Heh.

++

LETTER: State of Art Component Availability

In reference to your recent series of items on component availability, here are a few items from the June 1972 Electronic Engineer which may be of interest.

The first is from an article, "Schweber on Distribution" describing an interview with Seymour Schweber, a leader in the distribution industry (located in New York).

"Before the end of the 70's, Schweber predicts, the distributor will become the final assembler of many electronic products. Manufacturers, as he puts it, have embarked on a 'shift-the-labor-to-the-distributor' program because they can't afford to do it themselves. 'As the industry becomes more complex, there are an increasing number of specialized products so orders often get smaller. Manufacturers have realized that it costs them $100 to process an order, so that they're losing money on small orders, so they've passed the labor to the distributor. Now we're assembling more

switching, marking more capacitors, selecting more resistors, programming more memories and so on.' "

He goes on to describe how this kind of handling may not always be profitable even to the distributor, and that the only answer will be to raise prices. In any event, the distributor will not only handle parts, but even technical information formerly available only from the manufacturer. And finally, Schweber himself says:

"When quality-minded companies like Allen-Bradley, Amphenol, Cannon, Harris, and Intersil trust the distributor to complete the final assembly on their products, my God, that's like Golda Meir playing golf in Egypt!"

From EEB I gather that Australian trends will follow American ones eventually, so your readers may also be interested in these Product Life Cycle Curves; they are pretty relevant to Rod's Editorial on ICs in the June 1972 issue. Look particularly at the 1977 curve. In the 1980's I suppose that most present Integrated Circuits will be obsolete, so that will pretty well solve the problem about using discrete components, won't it.

Incidentally, the Urchins at EEB will be happy to know that the 19th Edition of our Radio Handbook will not be a "smoothed over" version of the 18th; much of it has been completely rewritten ((c.f. EEB Nov. 1971 p. 110 et seq.))

— Wm. I. Orr, W6SAI, San Carlos, California.

((Most unfortunately we appear to have mislaid the quite remarkable curves Bill furnished with his letter, but in essence they show that within a few years transistors will be obsolete, not to mention valves!! -- RLG))

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

THIS ELECTRONICS EXPERIMENTERS BULLETIN IS PRINTED AS A LABOUR OF LOVE ABOUT SIX TIMES PER YEAR EXCEPT WHEN IT ISNT. THE BLOTTER PAGES ARE BEING CRANKED OUT ON RLG's ANCIENT DUPLICATOR, BUT THE PRETTY FRONT PAGE WAS DONE BY CHRIS WREN, THE BEST PRINTER IN HOBART, AND HIS PRICES ARE MOST REASONABLE. GIVE HIM A RING AT Hobart 341-817 TO SEE!

EDITOR: R.Leo Gunther (VK7RG). ASSISTANT EDITOR:Rod A. J. Reynolds (VK7ZAR). Associate EDITOR: Chris Pitcher (VK3). DRAUGHTSMAN (for normal issues): Stephen Gunther. SECRETARY: Brendy, I mean Brenda Ford; none of this is her fault!

SUBSCRIPTIONS:

Aust, TPNG: $1.55/yr to R. A. Walton, Subscription Manager for EEB, 115 Wilmot St., Huonville, Tasmania 7109 — Oh Lord I just saw the misprint in our Augtober 1972 issue where it says his Postcode is 7005. Gah!

New Zealand: $1.55/yr to N.Z. Assoc. of A. R. Transmitters, P.O. Box 1459, Christchurch (in N.Z. Funds). NZART have been MOST patient with us and our erratic publication sked.

Canada, USA: $3.50/yr to Frank Merritt (VE7AFJ), P. O. Box 309, Parksville, B.C., Canada. I reckon I'll have to send all North American issues of this EEB to Frank by Air and have him repost them or they won't arrive there before Xmas.

Elsewhere: £1.40/yr to Bob Walton, as above. Send £ cheque.

BOUND VOLUMES: 1971 (1972 not until next issue completed): Aust & NZ: $2.50; Can & USA: $4.50 -- sorry, but the North American dollar isn't worth very much these days.

RENEWALS: No renewal notices with this issue, but if your renewal fell in October or December 1972 (according to the date next to your name) you may wish to renew EEB if you haven't yet done so. Yes yes I know I don't deserve it, but you can't win 'em all. Please renew, huh?

ADVERTISING: In normal (Offset) issues, $10/pg, $6/half-pg. Personal adverts of reasonable length will be FREE on the centre blotter pages of each issue.

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ARE TRANSISTORS OBSOLETE (or in immediate danger thereof)??

-- by Rod A. J. Reynolds (VK7ZAR), Asst. Ed.

NO! (... at least, not yet)

If you will remember, some time ago in EEB I suggested that if valves were developed with the same effort as used for semicons, we would have some pretty incredible valves — of which the beam-deflection mixer is a hint.

Now we have seen the development of FETs as the ideal semicon to solve all electronic problems. BUT in the backrooms of some manufacturers engineers dedicated to bipolar transistors have been quietly producing units of exceptional performance. They are relatively easy to drive, they have incredibly low Noise Figure, and their linearity is quite adequate, e.g. 30-40 db of gain con-

better.

For example, only this past month or so there has been announced the development of a solid-state "Travelling-wave Tube" made from GaAs (used for amplification at very high frequencies), and which has the advantage over the vacuum device in that it is extremely small, has no warmup time, can be used repeatedly!, and promises to cost only some 1 - 2% of the valve counterpart. At present it cannot compete with the valve at high power (e.g. 10W), but semicon technology has been renowned for performing such unlikely tasks. Who, for example, would have imagined a few years ago that semicons would be commonly available delivering watts at Gigacycles? Indeed, some can now go up to 30GHz, at say 100mW — which isn't bad!

exceptional performance. They are relatively easy to drive, they have incredibly low Noise Figure, and their linearity is quite adequate, e.g. 30-40 db of gain control. And they're cheap.

Furthermore, the low impedance of the bipolar is more useful for modern tuning circuits than is the high Z of the MOSFET. The reason is easy to see if you remember tt a high Z requires appreciable L, e.g., ideally $Z = QX_L$. But in these enlightened days we enjoy miniaturisation. And a coil ¼" diameter just doesn't develop much X_L.

So, use small coils, and nice efficient bipolars to match them. Or use FETs with nice new ferrites. BUT: Beauty is in the eye of the beholder. I have a friend who says:

"I don't know anything about bipolars and anyhow I can't get them to work. So I'll continue designing FET circuits -- even including moving-coil microphone preamps."

This attitude is commendable amongst those who have never resigned themselves to leaving valve technology, but in these days one must be flexible.

Furthermore, we should disabuse ourselves of the idea that an FET with an input resistance of some 10^{16} ohms is still 10^{16} ohms at r.f. It suffers catastrophically at a.c., e.g. Z goes down to a few kilohms at 100MHz. But a well designed bipolar Z stays quite constant up to f-beta (the f at which beta drops 3 db). And to show you that this is no joke the other day I bought a BF194 for 32c (+ tax) with an f-beta of around 200MHz. For upways of a dollar you can start talking about gigacycle performance.

Furthermore these transistors are rated for some 2db N.F. near rated frequency (e.g. 200MHz+).

On the other hand don't think for a moment that I am suggesting that bipolars must be better than MOSFETS. A good MOSFET has the same sort of figures when correctly applied, but as I say, Beauty is in the eye of the beholder. You use the component you can get working best. But this can't be done blind. You know something to begin with about what a semicon can do, even if its only because its the only one which works for you.

NB: Even a Protected FET (e.g. MPF 121) will complain when fed from the output of a 25W mobile, notwithstanding the changeover relay. A bipolar under such abuse might smoke slightly, but will not blow up (as quickly)....

Transistors Forever??

In reference to Mr. Orr's comments(above), I'm not suggesting that transistors will NEVER become obsolete. Lets face it; an OP AMP IC is about the same size (and cost!) as a transistor and can do a lot more. On the other hand, let us not overlook the fact that semicon technology is developing continuously, and that new devices are likely to appear to perform special functions watts at Gigacycles? Indeed, some can now go up to 30GHz, at say 100mW -- which isn't bad!

When Industry demands a unit one notes that Technology seems to be able to develop it. This is in striking contrst to classical technology where gadgets were discovered, and then uses found for them. Consider the Transistor!

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

((EXTRA COMMENT ON ORR LETTER, by RLG: We have indeed examined the 19th Edition of his Handbook, and are most pleased to report that it is a substantial improvement over the previous edition. At present, Chris Pitcher is preparing for us a Comparison Review of that Handbook and of the ARRL effort. We hope to have it in hand for our June issue -- don't we, Chris....?

QUOTE: Are Valves Obsolete???

"... Far be it for TT to appear to have developed any form of anti-transistor bias ((this is subtle British humour; G3VA has been in the forefront of presenting the latest in all forms of semicon technology, and the rest -- RLG)), but it is worth emphasizing that people are at last beginning to weigh up the pros and cons of semiconductors a little more realistically than in the rush to solid state of the 'sixties. What we want to do is to encourage the use of semiconductor devices for those applications for which they are really most suitable -- and in some other respects to thank goodness for the good old valve! It is often said that if the valve had been developed after the transistor, it would have been hailed as the answer to all our problems; as Cuccia puts it ((in The Microwave Journal)) in a microwave context: 'I can't help but wonder what would have been the impact of a reversal in technology histories -- with the solid-state pump coming first, followed in recent years by the announcement of the development of the klystron. I personally feel that a rush to the latter as the glamour device would have occurred.' "

-- Pat Hawker, G3VA, "Technical Topics", Rad Comm, 1/72

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

LETTERS TO THE WELFARE DEPARTMENT

(((From the Journal of Irreproducible Results, June 1972))

-- I am forwarding my marriage certificate and my six children. I have seven but one died which was baptized on a half sheet of paper...

-- Mrs. Jones has not had any clothing for a year and has been visited regularly by the clergy...

-- I can get no sick pay, I have six children, can you tell me why...

-- I am glad to report that my husband who was reported missing is now dead...

-- I have no children as yet as my husband is a bus driver and works day and night...

THE AUSTRALIAN EEB

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FOR SUBSCRIPTIONS, ETC, See. P. 127

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→ Underground Electronics

AN INFORMAL ELECTRONICS EXPERIMENTERS BULLETIN

DECEMBER 1972 Vol. 8, No. 5b P. 109

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ISUE FREE.

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NEXT ISSUE:

More Exhaust Gas Analysis.
Low-priced Digital Frequency Meter.
Parts Availability -- So. what?
"Is Amateur Radio Necessary?"
-- A pregnant Interview...

THE RECIPROCATING DETECTOR: A SQUARETABLE -- between R. S. Badessa (of the Damon Corporation, Massachusetts, USA) and R. H. Ferris (of the University of Tasmania, Hobart, Tasmania) -- with an occasional quip by the Editor. Ref: EEB 6/72, 8-10/72.

RHF

This is a unique type of detector, quite distinct from Phase Locked Loops and "carrier regeneration" systems, and these latter terms should not be associated with it.

We are most grateful to Mr. Badessa for giving us the opportunity to present his system in these pages. The following comments might be made:

In its "non-synchronous" mode (SSB) the detector is simply a modulated oscillator, with modulation recovered as the lower sideband as in any normal product detector.

In the synchronous mode (AM, DSBSC), the detector acts as a synchronous envelope detector, similar in principle to that used in chopper-amplifiers, but with an automatic phase reversal cunningly inbuilt to cope with DSBSC. The reference gating is performed by a resonant system maintaining forced oscillations at the carrier frequency.

The "noise limiting" function is not quite so nice as it sounds, as it is essentially a low-pass filter mechanism, and limiting must be compromised with audio bandwidth.

The great value of this device lies in its ability to demodulate the three major H.F. modes with the same, simple circuit. On the other hand it does not have the flexibility of the PLL, specifically the ability to handle doppler shift, detect FM, coherent AGC etc -- but that's the old story about eating cakes.

Note that although Mr. Badessa emphasizes the significant bandwidth of the synchronous mode, it is implicit that the output is a definite maximum only when tuned "spot on". Note too, that the presence of the latent synchronous mode while receiving SSB makes the detector very vulnerable to interference from adjacent carriers.

RSB

With regard to the noise-limiting function of the detector, it can indeed be categorized as a low-pass filter mechanism (RHF Para. 5). But I think that it should be emphasized that this filtering action shows up solely as a factor controlling the speed with which the generated reference accomodates itself to changes in signal.

I hope that readers do not conclude that the audio output is itself constrained by the 500 Hz passband of the reference filter. As in any detector the audio cutoff is determined primarily by the characteristics of the i.f.

Mr. Ferris brought up a very important point when he referred to the "latent synchronous mode" that is present when receiving SSB, and I'm sure some readers share his concern that a detector of this type might try to lock to every stray carrier that happened to be near. What it basically comes down to is this:

1) In order to have any pulling effect whatever, an interfering carrier must fall within half a synchronous bandwidth of the receiver tuning -- i.e., within perhaps 75 Hz. This is true regardless of how strong the interference may be.

2) The most that an interfering carrier could disturb the reference frequency is also 75 Hz, but it can only do this if the interference is the much stronger of the two. If the strengths are equal, the presence of the signal in its non-synchronous state reduces the synchronous bandwidth to only about 20% of its normal value. Hence, the most that the interfering carrier could change the reference frequency is 15 Hz, and this figure would be further reduced as the signal-to-interference ratio improved.

3) It could be argued that the ability of the detector to give a perfect zero beat with an interfering carrier that happens to fall very near, even provides a degree of countermeasure.

Regarding the use of the R.D. for FM, very little experimental work has been done along these lines. I did try briefly a system in which an FM signal is put through a null network (the null being at the signal centre frequency) before applying it to the R.D. If the synchronous bandwidth is made wide enough to include the full FM deviation, the R.D. acts very much as though it were detecting a DSBSC signal. I don't know what advantage, if any, this might have over regular FM demodulation. But if it does have an advantage, it won't be the first time the R.D. has surprised us!

RLG

((Before RHF composed his reply to this piece by RSB, RSB sent us a followup concerning FM:))

RSB:

I thought you might be interested to learn of some further work which was done recently using the Reciprocating Detector to demodulate FM.

As you know, I had suggested the tech-

nique of broadening the synchronous bandwidth to include the full FM deviation, and preceding the detector with a null network. This cheme has proven to be unreliable with any practical FM deviation, since the "narrow band filter" is is no longer narrow and allows the reference amplitude to drop virtually to zero whenever the r.f. frequency traverses the null. The result is a curious form of distortion in which an incorrect flip of sense is liable to occur within the audio cycle.

It is, of course, possible to rearrange the component parts of the R.D. into what is essentially a conventional FM discriminator. This can be done with no change in the basic R.D. unit (see diagrams, bottom of this column).

As an FM detector the two 430 pF capacitors take the sum rather than the difference of outputs 4 and 7 of the basic unit. This suppresses any tendency toward positive feedback and also introduces a phase shift of 90°.

Stirling Olberg (W1SNN) has used this arrangement successfully under realistic operating conditions, and the result s appear in Ham Radio for March 1973.

RLG

Serves me right; if I had got this article (and the Rest) into print earlier we would have had a scoop, but never mind. Olberg's March HR article does indeed verify RSB's admission that the R.D. won't work inherently as an FM-detector, but only if it is fluxed about to work as a discriminator of garden-variety type. I can't see what this achieves, except that it would be useful for versatility when the R.D. was used for other modes too.

RHF

It does achieve just that, but then Olberg's statement in the HR article is rather misleading: "A recent investgation on fm, revealed that the reciprocating detector is a satisfactory fm discriminator... and... produces essentially a conventional fm discriminator". -- in fact of the Foster-Seeley variety. From the point of view of experimenter interest it could have been more useful for the author to add a bit of discussion telling why it won't work as an R. D., per se.

More to the point, such a discriminator detector should be preceeded by a proper limiter, and one might assume that his MC1550 i.f. amplifiers achieve this but for the fact that they are fed an a.g.c. signal, and there is nothing to indicate that the a.g.c. is reduced on f.m. mode to produce amplifier saturation. This reduces the noise immunity of which an f.m. system is capable.

((RHF goes on to comment further on Olberg's article, concerning non-esistent non-BFO hiss;and a possiblexl mistake in the circuit of the Vackar oscillator. Conclusion about the former was:))

What Olberg's comment about the lack of BFO hiss does indicate is that there is a tendency towards some squelch action by the R.D. (when rigged for AM,DSB,SSB).

RSB

I understand that a clarification by Mr. Olberg of some of these points will be made in future issues of (Ham Radio).

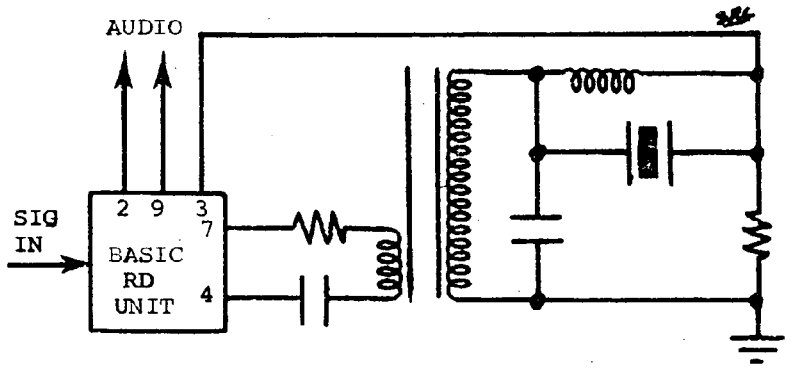
RHF

Back now to the proper use of the R.D. I shall admit that RSB is basically right and that most of the queries raised with you the other night can safely be attributed to Mr. Henessy's fine brew.

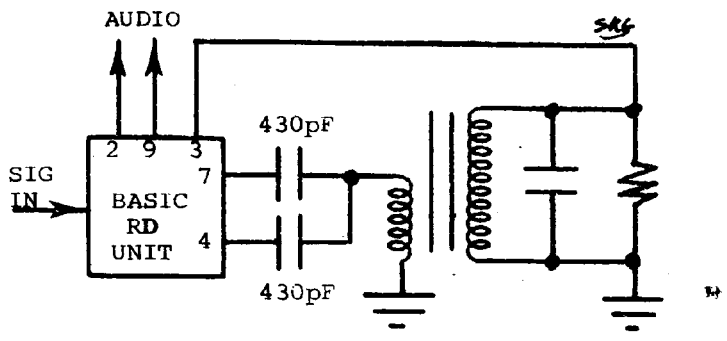
I have one technical point remaining, however, in respect of the noise limiting but otherwise not of fundamental import. On the other hand there is one very significant matter which sould be considered first and it is rather a philosophical point.

There is a familiar Principle which painful experience has taught us all to respect, designated as the Principle of Life: "You can't get Something for Nothing", invidiously disguised as the /First Law of Thermodynamics.

Now, RSB has come along with the R.D. and has apprently rolled the previously inviolate P of L, thus raising some sus-



RD (WITH 500 kHz FILTER)



RD MODIFIED FOR FM

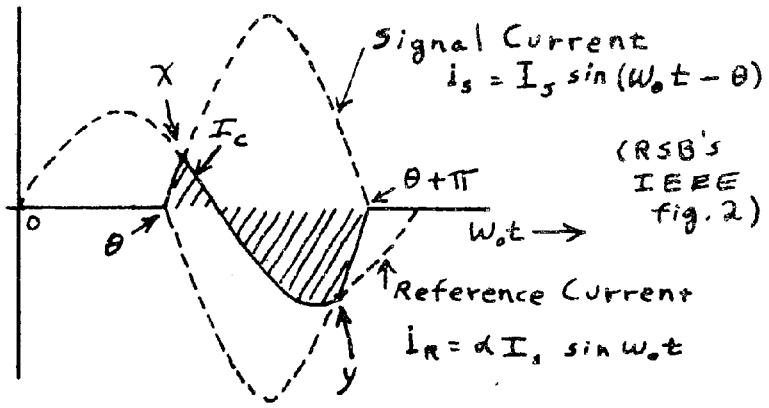
picion in the mind of your Scribe. After much Thought the following relationship is revealed, and I may add that it is derived from RSB's proper original IEEE paper.

The demodulation process is fundamentally NONLINEAR. If and only if the phase error between signal and reference is zero (or 180°), i.e. the signal is tuned right on the nose of the filter response, the output will be proportional to the amplitude of the input -- in respect of AM and DSBSC signals. This then, is the price that must be paid.

The nonlinearity can be seen directly from equation 10 (p. 41-3 of the IEEE Report):

$$A = I_s/2\pi \left[\alpha(\cos x - \cos y) - \cos(x-\theta) - \cos(y-\theta)\right]$$

remembering that x and y are both dependent on I_s, or more easily from fig. 2 on p. 41-2 ((showing signal vs reference current waveforms)). The audio output is proportional to the net shaded area on the graph ((oh all right, I'll include it:));



above the x axis will be positive, below is negative as usual. Let the signal amplitude I_s increase indefinitely. If the detector is linear the shaded area will increase proportionally. However, all that will happen is that x —> θ and y —> $\theta + \pi$ and the net area converges rapidly to the limit

$$A = \frac{E_R}{R_e} \int_{\theta}^{\theta+\pi} \sin\phi d\phi \qquad (\phi = \omega_0 t)$$

$$= 2\,(E_R/R_e)\cos\theta$$

since $i_R = \alpha_s \overline{I_s} \sin\omega_0 t$, and $\alpha_s \equiv E_R/R_e\overline{I_s}$.

This is to say that the thing limits at a level determined by the amplitude of the reference, which does not follow the modulation, by definition. This after all, is the very mechanism used for noise-limiting and illustrates the point that the noise-limiting is <u>not</u> a rate-of-change type as stated, but a rather squashy <u>peak limiter</u>. Only if $\theta = 0$ or π will the demodulation be linear and the limiting sharp.

((<u>RLG</u>: You non-engineer-types will please remember that there are all kinds in electronics; this is good stuff, so just go along until you understand it again))

<u>RHF</u>

Stop interrupting!

By the same token, for SSB,

(1) θ is never 0 or π since it is changing all the time, leading to great distortion unless the reference level is increased greatly above that of the signal. In this case x —> y —> π and the demodulation becomes linear. This

REFERENCE >> SIGNAL affair

should ring a bell in our minds, just like demodulating SSB with a BFO and AM detector as in the old days! In fact a careful look at the circuit (see last two EEBs) will show that as far as the demodulation of SSB is concerned the system simply becomes a pair of diodes driven by a rather crazy-type BFO, so its not surprising that the old rule applies.

(2) Since the mean level of speech, and hence onan SSB signal is well below the peak levels (statistically-distributed of course) the reference signal must be maintained at a fairly high level to avoid peak limiting. Note that the circuit already has an audio filter in it which will tend to remove nasty harmonic components caused by that clipping which does occur.

Notwithstanding all this, it should not be overlooked that the R.D.'s performance has been found satisfactory for usual communications purposes (at least according to Oldberg in HR), and its multimode virtues cannot be denied. For HIFI signals, however, or weak signal detection (where linearity is a <u>must</u>) there is no escaping the rather more complicated alternatives. The P of L wins again?

((RLG: A rather messy mathematical <u>Appendix</u> follows; if anyone is interested please send an SSAE and I'll send you a photocopy.))

((after much further discussion between RLF and RHF, the following emerged:))

<u>RHF</u>

For your own edification (no need to print this!) the Rate of Change-type limiter chops any modulating waveform whose rise time is faster than that of a component of the highest acceptable modulation frequency, regardless of its actual amplitude, whereas the peak limiter here described will chop any waveform whose amplitude exceeds a level proportional to the mean signal. In the first instance

the limiter discriminates between signal and noise on the basis of their respective spectra; in the second the discrimination is on the basis of the statistical amplitude distribution of the desired modulation.

Finally, now that Steve Badessa has produced a very simple and presumably effective DSB demodulator, it is worth digging up an old question, "Which is the best Mode"? This matter szems to have been well suppressed since SSB took over the bands (or the markets?), with minor exceptions such as Pat Hawker in Technical Topics (monthly in Radio Communication).

Looking at Haviland's table of "Relative Communication Efficiency", a factor which includes both the "Communications Potential" of a given mode (i.e., the ability of a given transmitter power level to cause the desired information to appear at the output of the detector) and "Interference Potential" of the mode -- I see that DSBSC and SSB are rated EQUAL, both being 13.2db superior to the a.m. Since DSB can be generated at high power levels, at the output frequency, the relative simplicity of a DSB Tx is undeniable and is desirable.

RLG: Haviland's paper is discussed briefly in the RECEIVERS chapter of Pat Hawker's Amateur Radio Techniques (RSGB see cover EEB of Augt. 1972), and will be the subject of considerable further discussion in these pages sometime.

Previously the only argument against DSB was the fairly complicated detector needed, but that no longer applies what with ICs and such. Though we can note that an effective PLL published by Cowan some time ago used only seven valves, not a blinding display of complexity!

RHF: Furthermore, if DSB should become popular (therefore "practical") and if one is prepared to put a little time into a Phase-locked detector and go Biaural, there's an extra 6db bonus over SSB available. The previous argument against DSB that it took up too much room in the band is neatly included in Haviland's RCE factor which takes this into account.

RLG: Add to this the fact that many amateur spurious sidebands are only imperfectly suppressed (producing substantial QRM from high Yankee power systems!) and consider the increasingly common pratice of netting -- and it will become apparent that the principal factor which keeps DSB from regaining popularity is inertia and the commercial markets.

As far as I can see, although the R.D. is a cunning system it cannot provide the Biaural feature of a PLL-with-audio-phase-discriminator, so the latter would seem to be on its own for maximum effectiveness of DSBSC. In either event DSB is now an idea whose time is (again) ripe. Perchance could some enterprising commercial firm be persuaded that there is a potential market in it (that 6db advantage ought to go over well?) this could happen? In interim here is a real opportunity for experimenters to get fine results with simple equipment!

Lets give Mr. Badessa a word edgewise! and we invite comment on the above. (from readers and the world).

RSB: I have read Dick Ferris's comments on the R.D. and feel that he has raised some good points, but some qualification is desirable. For example, it is true that an increase of signal smplitude, I_S in fig. 2 (of the IEEE paper) will not result in a proportional increase of shaded area (holding the reference constant) and that therefore this represents non-linearity. But fig. 2 was drawn for the purpose of deriving the equations and illustrates a condition of fractional α, i.e., a condition in which the signal current already exceeds the reference current. Far from being typical, a condition of fractional α occurs only at the instant of a noise impulse. An R.D. could not be built in which α remained fractional, since the value of α for an unmodulated carrier is equal to the loop gain, and with fractional loop gain no generation of reference could occur. So, although nonlinearity does indeed occur when the reference is low compared to the signal, fig. 2 tends to give an exaggerated view of the problem. I don't mean to imply that all non-linearity would disappear if α were not fractional, though it would be very much less at an α such as 2, a typical value. The question is whether the nonlinearity that does occur as a consequence of operating the R.D. at unconventionally low reference levels is great enough to offset the improved impulse noise rejection that results.

There are a couple of reasons why the R.D. can get by with such low reference-to-signal ratios. One reason is the fact that the reference increases with increasze of signal level, and more reference is developed as it is needed, at least for the slow (250 Hz) fluctuations in envelope. So, although the reference-to-signal ratio may be low, at least it has a tendency to remain put.

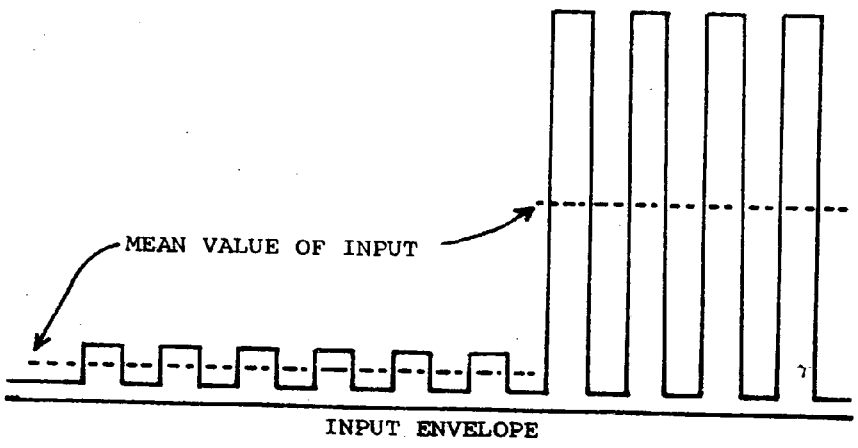
But another reason for this performance is probably the tolerance of the ear for certain types of distortion. To illustrate, suppose a single sideband signal is demodulated by a simple two-diode detector in which the reference is somehow made to have an envelope that is an exact replica (in level as well as in shape) of that of the signal. If the signal envelope happens to be flat, as it would be if a single sinusoidal tone were were being transmitted, a triangular beat waveform results. If the signal is a speech-modulated wave, the triangular beat becomes modulated in frequency while its amplitude follows the signal envelope faithfully.

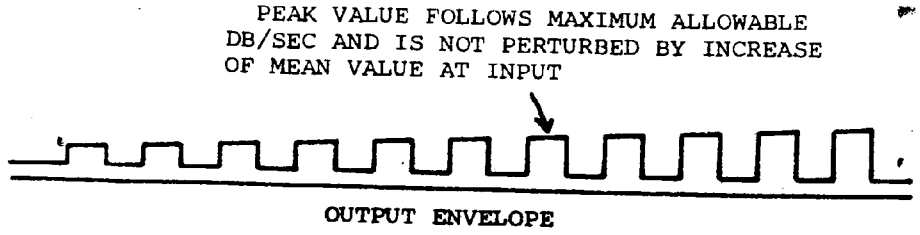
What would such a waveform sound like? Surprisingly natural if you have a filter at the output to get rid of some of those "nasty harmonic components". Remember that the harmonics of a triangular wave start with the third and that this third harmonic is already almost 20 db below the fundamental before any filtering has been done. This, plus the fact that the audio band in SSB starts at 300 Hz, just doesn't leave much room for distortion. In the r.d. the triangular waveforms that do occur exist only momentarily.

I was surprised with Dick said the R.D. was not a rate-of-change limiter, but after studying his definition I had to admit that the R.D. does not satisfy the requirements precisely. And by the same token its unconventional mannerof responding to changes in the mean signal level makes it difficult to classify as a peak limiter.

First of all let's think of α as being the factor by which you can increase the signal level, while holding the reference level constant, before you run into a reference-limited condition ($\alpha = 1$). If α has a value of 2 and you double the signal level abruptly, α momentarily drops to 1 (the triangle) because of the lag in the narrow band filter. But eventually the reference level also doubles and α is restored to its steady-state value of 2; the steady-state value is preferably designated α_s, to distinguish it from the variable α. If the time required for the filter to respond is T, you can double the signal again after T seconds without causing α to become fractional, and you can double it T seconds after that, etc. If you keep this process up you are increasing the signal 6 db every T seconds for an average rate of increase of 6/T db/second (or 20 log α_s/T db/second for the general case). This rate of increase is the maximum of which the reference is capable and occurs whenever α is less than α_s. It is the familiar upward-swooping buildup associated with positive feedback. It is also the maximum <u>sustained</u> rate-of-change that the input signal can undergo without being clipped. I emphasize the word sustained, because as was just noted, the signal was able to double abruptly without bieng clipped (it tolerated an infinite rate-of-change!). Yet if the delay had been only T/10 seconds before doubling it again, the clipping would have been severe. So although the R.D. may not satisfy Dick's definition of a rate-of-change limiter it does utilize a rate-of-change principle to govern its operation as a peak-limiter.

According to Dick's definition of a peak-limiter, it is one that will chop any waveform whose amplitude exceeds a level proportional to the mean signal. In other words, if the mean signal increases, the waveform will be chopped at a higher voltage level than it would be if the mean signal had not changed. In the graphs shown here below is shown the envelope of a signal consisting of an unmodulated carrier upon which is added a repetitive pulse. If the repetition rate is sufficiently high, the pulse contributes significantly to the mean value of the signal. Consequently when the amplitude of the pulses (but not that of the unmodulated carrier) is increased 20 db as shown, the mean value of the signal undergoes a drastic increase. But there is no change in the level at which the waveform out of the R.D. is clipped that can be attributed to this increase!





Why is this so? Because the reference was already rate-of-change limited during the pulses of low amplitude. It would not build up any faster than this when the pulses became ten times as large. The reference derives its power from the input signal subsequent to the clipping action (and hence is protected from false buildup in the same manner as the output signal). The reference is not aware of the existence of that portion of the pulses above the clipping level.

RHF

I am quite in tune with Steve about the R.D. -- and would only like to comment briefly (ha ha) as follows:

a) Distorition. Quite happy to accept that the R.D.'s performance is satisfactory in this regard under normal operating conditions. It just goes against the grain a bit to use something that is inherently nonlinear ... It's nice to think that at least in theory ideal operation is possible. And of course there had to be a solution to the Principle of Life problem mentioned a few pages ago. If I get time I'll feed that horrible formula for A(t) into the moron (("computer" -- RLG)) and plot a few graphs of said transfer characteristic and see just how linear detection is. Our old friend Fourier will also tell us how much harmonic distortion and intermod we get for typical signals too.

RLG

Bah! Academics.

RHF

You're a fine one to talk. To continue,

b) Noise Limiting. That Steve had anything further to comment about this is due only to my rather sloppy expression in the "postscript" (which was intended for information of RLG, not a scientific statement). When I said, "... the peak limiter will chop any waveforms whose amplitude exceeds a level proportional to the mean signal", I was not intending to refer to the instantaneous mean, but rather to the integrated mean, as it would in fact be in practice.

Twit: It is a simple fact of life that any real mean-detecting circuit will have a fairly long time-constant associated with it for the express purpose of eliminating modulation components. This same time-constant will prevent the output of the circuit from changing rapidly, even if the instantaneous mean of the input signal does so. Hence the clipping level will only change slowly, as in Steve's illustrations, although ultimately it will arrive at the true mean level. The time-constant is, however, usually chosen to be much longer than the expected noise-pulse duration so that this situation does not arise.

What all this guff amounts to is that by implication of normal circuit practice I correctly described the essence of noise-limiting action in the first instance, and did not intend to raise any question about it at all, even if I didn't say so very explicitly.

RLG

Magnificent hindsight.

RHF

Shaddup. It has, however, been a worthwhile exercise insofar as it prompted Steve's further elucidation on the dynamic operation of the circuit. So far as noise-limiting is concerned this might well be summarised as one rather interesting, if academic, point: that the clipping level increases linearly with a rate independent of the amount by which the noise exceeds the signal, instead of exponentially and proportional as in most other "automatic peak limiters". It is foreseeable that this could give rise to improved performance under some circumstances.

RLG

To come down out of the Clouds a bit, Chris Pitcher in Melbourne has actually built one of these Reciprocating Detectors and according to my translation of his voluminous scribble the Device is undergoing extensive tests, and hopefully that will be the subject of further communications in these pages. I'll have a long natter with him on the subject when I go to Melbourne in a few days -- hoping that I can put these manuscripts in the hands of our Printer first!

Many thanks to Steve Badessa and to Dick Ferris for their patient correspondence. EEB is particularly suited for this kind of interchange. If anyone (including the Authors) wish to carry these discussions further we should be pleased to hear from them. Particularly needed are actual test comparisons between the Reciprocating Detector and Product Detectors under actual field conditions of signal and noise.

A CRYSTAL-CONTROLLED VARIABLE-WIDTH PULSE GENERATOR

-- R. S. Maddever (VK3)

-- being Part III of the series "Counting with Electronics", a Reasonable Discussion of practical sort which will surely satisfy those who look toward ICs.

A crystal oscillator produces a train of 10 µsec pulses. These are summed in a counting section until a total predetermined by switches has been reached. Thereupon an output flip-flop changes state, the counter is reset to zero, and counting again takes place until the predetermined total is reached. The final flip-flop has thus a square wave autput with mark-to-space ratio of 1:1.

When used to produce a 50 Hz wave the pulse width is 0.01 sec, or 10^4 µsec. Thus, since the switched controls allow precise settings in 10 µsec steps, the nominal 50 Hz can be varied precisely in steps of 1 in 1,000, or 0.1%. Smaller variations can be effected, if necessary, by "pulling" the crystal frequency with added variable capacitance.

(Note that, as designed, it is not possible to obtain exactly 60 Hz for use in North America. For this a pulse width of 8333 1/3 µsec is required, and could be achieved by pulling or changing the crystal frequency, or by having one stage dividing by 3 or 6 somewhere.)

As shown, with output fed into a power stage having some filtering and tuning, the generator is very suitable for operating a synchronous motor in a clock or telescope drive. The switching can readily be set to give solar, lunar, siderial and other rates with precise repeatability. Half and double speeds are readily available by extra simple switching.

The generator is also suitable for driving stepped motors to give precise speed control, and as a precision time delay. A higher frequency crystal oscillator and extra dividing stages would allow even more precise setting of the pulse width. With the integrated circuits specified here, however, it is probably not possible to increase the precision by more than a factor of 10 because of the need for a reset pulse of about 1 µsec.

CIRCUIT DESCRIPTION

A train of pulses at 10 µsec intervals is produced from a flip-flop following a 200 kHz crystal oscillator (this crystal was readily available). The pulses are sent through a chain of three decade dividers (MC780) and then through a single flip-flop. Each decade divider, whose output is in binary 8421 form, is decoded to decimal by an MC770, the outputs of which are connected to a 10-position switch. The first decade is thus incrementing every 10 µsec, the second decade every 100 µsec and the third every 1,000 µsec. The flip-flop changes state every 10,000 µsec.

The switch-selected outputs from the decoders and flip-flop are applied to an INCLUSIVE AND gate consisting of inverters from the MC789 and the NOR gate of half the MC725 (the other half of the 725 is not used). When all four inputs to this AND gate go High, the Monostable formed by a µl 914 produces a 5 µsec pulse which both trips the output flip-flop and, at the same time, resets the counting stages to zero through a buffer amplifier formed by two inverters in the MC789.

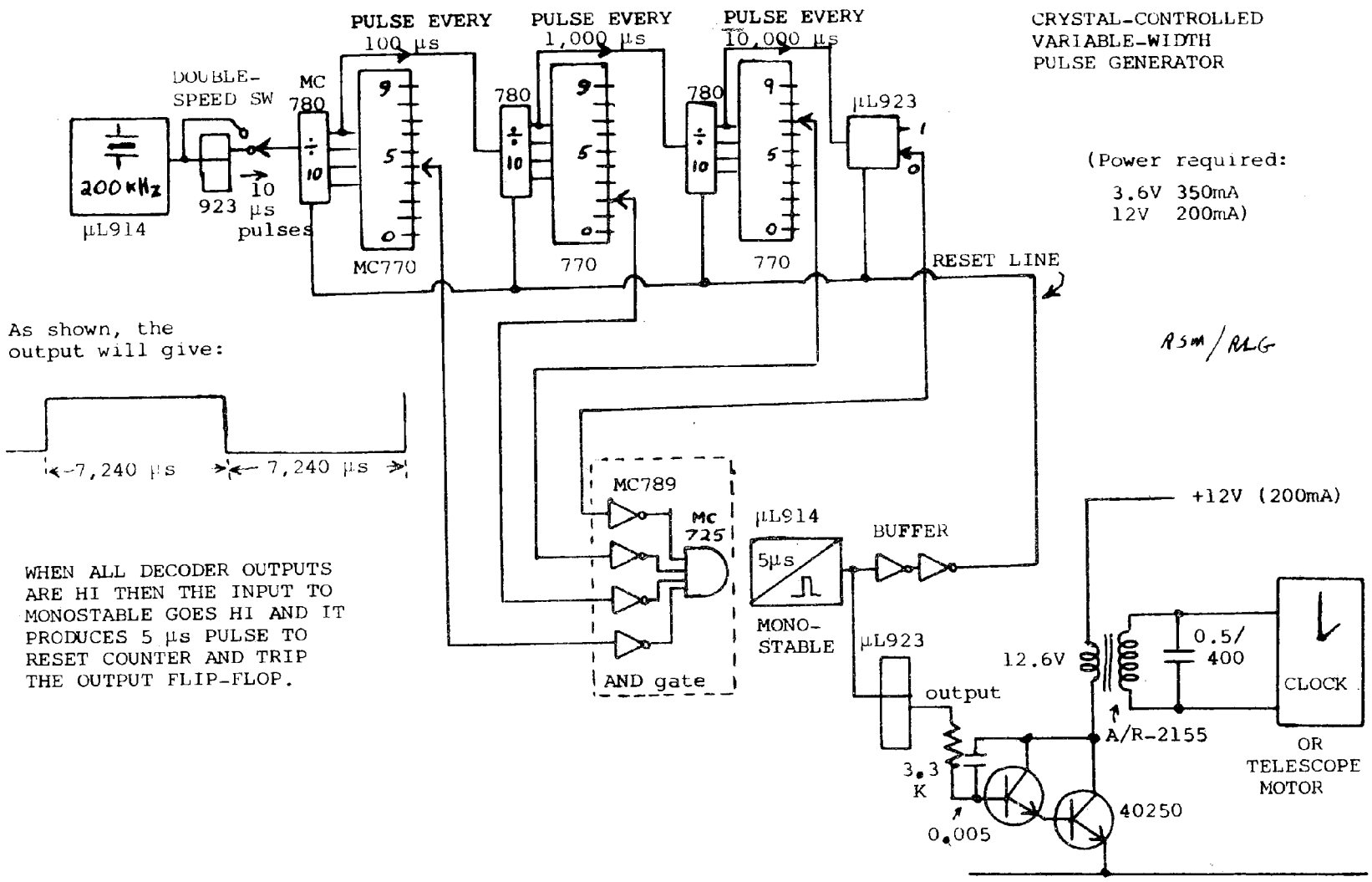
The output flip-flop thus changes state each time the "count" set on the switches is reached. It sends out a square wave, the "mark" and "space" lengths each being the count number x 10 µsec long.

For driving a 340 volt synchronous motor a simple darlington pair with a small mains transformer used "backwards" in the collector can follow the flip-flop and is very satisfactory. Output is approximately 300 volts peak-to-peak for a current drain at 12 volta of about 200 mA. Capacitors across the transformer secondary and between collector and base of the darlington pair improve the wave shape. Power can come either from a 12 volt supply, with suitable dropping to produce 3.6 V at 350 mA for the logic, or from a conventional mains supply.

Approximate cost: Oscillator $8, Dividing stages $27, Inverter etc $6, Output stage $8, Mains power supply $12, Switches (edge?) $10. Total about $75.

Accuracy: Essentially that of the crystal oscillator.

Schematic Diagram: Please turn to page 117.

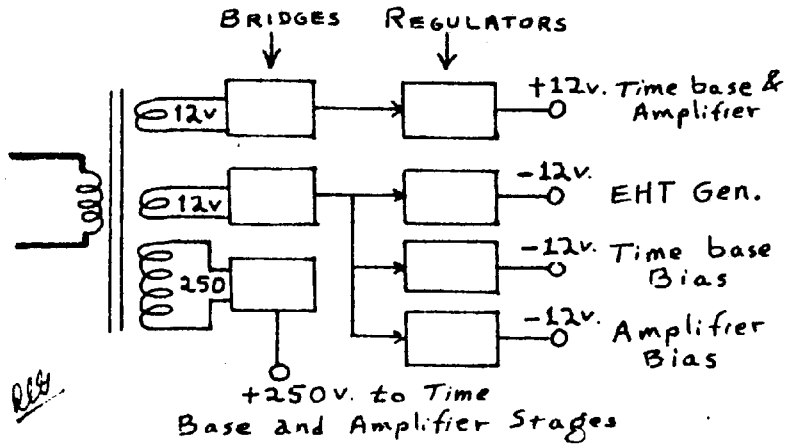


LETTER: Transistorised CRO Design Problems.

I've spent most of the last six months building a transistorised oscilloscope. It started life as a slow scan affair for tracing crystal filter passbands, but developed further.

I kept finding I could alter it, and now even though it is only 10" x 10" x 4", it has acquired the best part of 50 transistors and nearly as many diodes!

The biggest problem has been hum and interaction between the time base and Y-amp. To solve all this I have now four separate stabilised supplies, accounting for 12 transistors and four zeners. Thus:



On top of this is the +250v one stabilised at 220 (Two VR108's) for the output amplifier (each consisting of four BF178). The EHT is r.f. derived to give 3000V distributed as -1500v and +1500v. A 3FP7 CRO tube was chosen because it has both bong-persistence and short persistence screens. I filter out the right one by perspex scrreens. This proves very useful, as sweeps down to seconds can be used and still produce passbands well, whereas the short trace is good for general use.

The whole thing is d.c. coupled. If ever you want some fun, just try eleven transistors as a d.c. amplifier to produce push-pull output; every time you alter something you alter everything else!!

Finally, would anyone out there want to try a sked for me on 20m c.w. sometime; I need a VK or ZL for W.A.C. The location is not too good here, and input is only about 40 watts to a G5RV. When I do hear a station there are so many high power ones as QRM I don't get a look in.

-- Peter Lumb, G3IRM, 22 Hervey Road, Bury Saint Edmunds, Suffolk, England.

((Peter's problem of feed isolation in power supplies is not new. Back in the days of valves, this was a very big problem, since zero-impedance power supplies were very hard to find. These days, the problems are more easily solved. The situation is this:

((Due to improved technology, power supply currents have somewhat reduced with the use of transistors, whilst the voltages have gone down. What this means is that the capacitors can have higher values for the same physical size, but what is more important is the advant of the transistor regulator -- which Peter has put to good and typical use. This, with the aid of an operational amplifier, can be used to obtain a power supply with nearly zero Z_{out} within a limited current range. Hence inter-circuit coupling via the power supply can be eliminated, for all practical purposes.--RAJR))

MODULATED LIGHT COMMUNICATION -- Part IV -- Future Possibilities

BY: K. Burlinson, VK6ZEA

The equipment described in our Augtober 1972 EEB article (p. 87) might be considered rather impractical because of several deficiencies. It should, however, be emphasized that this does not represent our "ultimate" system, but merely the most recent stage of development. Nor should our interest in the system be interpreted as implying the practicality of the idea. Our interest stems mainly from the relative uniqueness of the project.

Further development was, alas, halted two years ago by the author moving interstate and being unable to continue expts.

Ideas for future improvement centre primarily around more sophisticated receiver design. By differentiating the signal from the photomultiplier it should be possible to reconstruct the original pulse-width modulated waveform in the receiver, rather than treat the signal as though it were intensity-modulated. The reconstructed pulse-width waveform could then be integrated to reproduce the modulation signal. Under these conditions the passband of the receiver could be restricted to the range between approx 5 kHz and 25 kHz. Note that it would not be necessary for the receiver passband to extend to low frequencies. This would enable us to roll off the receiver response to low frequencies such that 100 Hz interference from artificial lights would no longer be troublesome -- as long as the photomultiplier was not driven into saturation ((Maybe an argument in favour of a photo-FET of the low noise variety? -- Ed.))

Interference from moonlight and skylight should be minimised as light intensity variations, unless they are rapid and severe enough to interfere with the differential process, will all be suppressed when the constant amplitude pulse width modulated signal is reconstructed.

By the use of considerably improved optics, we may be able to operate in daylight. We make no apology for using low-quality optics, as our interest has been directed towards development of the electronics... There is also the problem of expense -- good optical equipment costs $.

Suggestions such as using volume compression and possibly AGC in our transmitter audio amplifier stages, and a better mixer, would result in a worthwhile improvement in the modulation percentage of our output.

Both RAJR and RLG have suggested the use of various Frequency Modulation (FM) ssytems. By using a carrier of approx. 10kHz, which would then be frequency modulated, it would be possible to achieve the same advantages as we could obtain by using PWM. The prime reason for using these more complex systems, it must be remembered, is to enable the use of a receiver with a passband which does not extend below, say 5kHz. This allows elimination of interference from artificial lights. It may also be possible to bypass this interference by the combined use of good optics and IR instead of UV, in which case ordinary intensity modulation could be used.

An important secondary reasonfor using PWM is the much improved modulation percentages achieved.

An important advantage of FM over PWM is that it would require a lower bandwidth. The bandwidth for PWM depends on the modulation % desired, and tends to infinity as the modulation % approaches 100%. The bandwidth of an FM system depends only upon the frequency response desired for the system.

We may, however, consider an important advantage of PWM to be the ability to use switching techniques to modulate the lamp. Hence it is relatively simple to achieve good modulation percentages, with no problem of overdriving the lamp nor the need for a high power modulator.

Some form of pulse-frequency modulation may indeed turn out to be a better proposition than either PWM or FM, where the advantages of switching mode drive circuits and the lower bandwidth requirements of FM would both be realised!

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POSTSCRIPT by RLG:

A major advantage of FM is the use of severe amplitude-limiting stages in the receiver. Since the vast majority of noise and pickup is AM, this slays numerout dragons at a blow -- if transducer saturation is avoided (viz, in the phototube or other light-receiver).

... I have a pile of literature which can be used as a Reference List, and which will appear another time, despite cries of protest by readers (for reasons described elsewhere in these pages). (Next month)

We have also received an immense circuit diagram of the whole mess from Mr. Burlinson. Since it occupies several feet -- I mean decimetres -- of space we shall try to summarise and condense it a bit. Another time.

If anyone else has any results from modulated-light work we should of course be very pleased to hear about it!

λλλλλλλλλλλλλλλλλλλλλ

LETTERS TO WELFARE DEPARTMENT (continued):
-- I am forwarding my marriage certificate and my three children one of which was a mistake as you will see...

"It would be impracticable and most confusing to adopt a different standard for domestic mail, said the Postmaster-General, Mr. Lionel Bowen, when announcing the new metric weight letter rates. Although 20 grams is less than the existing 1 oz. weight ((RLG observation: 1 oz. = 28.3 grams)), surveys indicate that almost 97% of all Australian letters of the one oz. step are no heavier than 20 grams and, therefore, they will automatically fall within the new weight step..." — APO News, June 1973. ((Jolly good, as long as we get charged 5c for 20 grams, consistent with the present 7c for 28.3 grams. Of course the Government will lead the country with an example of not making profit on the changeover))

How to Enviable

Talking about bull, you see there's this here bull up on a hill and his son trots over to him crying, "daddy, daddy, the fence has broken down; lets run down to the pasture and serve a cow!" "Son," replies the bull, "lets walk down and do the lot". I'm not sure but I think that that came from a politician, cleaned up here a bit.

Rather reminds me of one of the political adverts I saw, "You have two cows — under Socialism you give one to your neighbour, under Free Enterprise you sell one and buy a bull. Which system do you prefer?" I reckon he's got his stories mixed; under Socialism you give both to the Government and they will sell you the milk. Stephen's comment was: "I reckon your neighbour would give you a bull in exchange for the cow. You end up much the same but you're friends with the neighbour." All right, but then the Government will impose a Tax on the milk and on the number of calves. Never mind, mate; she'll be right!

Lifestyles

Awhile ago I decided that Inflation was here to stay (and stay), so I took out 10 year subscriptionsto several magazines, and Lifetime subscriptions ("membership") to Radio Communication and QST. This came as such a shock to the RSGB that they lost my address plate altogether and several months later it occured to me that I had been missing something (I lead a busy life). In due course they found it again and now I can depend on the technically valuable material in this British publication (Radio Communication) -- plus free adverts, help from the Society, useful contacts in the U.K. -- until the cows (ibid) come home.

About the same time I applied for the saem thing to ARRL, and the results were electric. Air mail letters started to arrive congratulating me on my great good fortune, and a golden special membership pin appeared, and a Certificate, I think, and whatall. The other day in the post came a gorgeous large ceramic placque in various colours, inlaid in richly stained wood, announcing proudly to the world that VK7RG was a lifetime member (how fortunate that it wasn't W6THN) of the American Radio Relay League.

I'm stunned by the magnitude of this signal honour, and I hereby express my gratitude to the Yanks for all that expensive jewelry. I'm not quite certain what to do with it, but it shore is pretty. Maybe I'll reproduce it on the cover of EEB sometime just to make the poms jealous. Anyhow, QST is a pretty good magazine too, although the "membership" is only "Associate".

Underneath the tumult lets remember that the various national amateur societies of the Western Democracies are the only ones who stand between us and a thoroughly commercialised and militarised aether. Have you joined the Wireless Institute of Australia or the New Zealand Association of Radio Transmitters (or both)?

Appliance Operators

A few weeks ago a friend wrote from America that he can now admit to having sunk to the level of "Appliance Operator," since he sent his commercial transmitter off to the manufacturer for overhaul. "Actually," he said, "I think only the factory, with its equipment, test specifications, and experienced personnel can do a really good job. On top of that, I detest working on any equipment I didn't build." Since the individual involved has done quite a lot of building, this seems reasonable, but I must say it is a new twist to the arguments in favour of Don't Do It Yourself. In fact I do sympathise; the ratsnest of compact construction in those commercial/amateur rigs is formidable...(PTO)

The Postal Threat to Magazines — etcetera.

"The British Periodical Publishers Association... shows the discrimination exercised against magazines which by 6 March 1972 had suffered a 100% increase in postal charges in 12 months, against a national average of under 40%. It is pointed out that magazines are an essential source of information for both professional and leisure activities..."*

--- Of course they are; why else do governments enjoy discriminating against them? Nothing irritates a bureaucrat more than the existence of a viable and independent Press. In a Democracy we seem to be able to maintain our independence, but the "viability" is the problem.

Since the quotation was typed at the top of p. 119 (overleaf) yesterday, I have managed to extract from our Post Office some advance information on the tentative scale of postal charges due to go into effect when they go Metric on October 1st, this year. I was assurred that "there will be no increase of charges, only the weights will change." Ho ho, big joke. You charge 7c for 20g instead of 28.3g and you've made a 41½% profit. Charge 12c for 50 g instead of 56.6g, and the profit is a mere 13%. Same thing with the cost of our bulk postings; but we can (probably) count our fortune there. The rate is due to go up 100% one of these days (see p. 106, last month), but it looks as though the "Optomistic Trend" on p. 106 is our luck.

Yes, I know about that "97% of all Australian letters" clause, and out of fairness that is why I quoted it obverse but it is still cheating, not to mention the fact that I do often pack my letters to the limit (and EEBs too sometimes). It is cheating, because like the situation in the conversion to decimal money, the Government is setting a shocking example of making a profit on the changeover. And the bloody hypocrites then have the nerve to chastise us for following their example. Watch for a really big boost to our already execrable Inflation during the changeover to metric... Take-home lesson: The Socialists are just as big ratbags as are the Nationalists (or whatever one should call the illiberal Liberals).

Have you looked at your "progressive" Income Tax recently? Remember it when you next strike for "higher" wages.

This & That

Listening to Yankee wireless I understand that young ladies will look better if they have good pastures. Wouldn't that be impassable? A sharking language.... G. Greer says that it is glad that its not a man; let us count our blessings... "Old Fashioned Giant Sale, commencing December 27th" (or April for Easter, etc); I wonder whether Father Christmas (well used) is one of the Giants.... Thought for the year: "It isn't easy to be rich and go on being human" (Helder Camara in "Revolution Through Peace", Harper/Row); its not easy when you're poor, either... Post-Christmas sign ((this Editorial was written 6 months ago!)): "All of these items must be sold!"; doubtless... Overheard between two youngies: "I can jump as high as a Post Office!" "No you can't; a Post Office can't jump." (but its prices can)... An excellent Science Fiction book read recently: "Stranger in a Strange Land" by Heinlen, paperback; comic (?) relief after ploughing through Toffler's fascinating but depressing "Future Shock" (or "Shark" as Toffler said on the wireless recently). Along a not-dissimilar theme was another beaut, "A Canticle for Leibowitz" by W. M. Miller (Corgi paperback), but it was written even better than "Stranger" and a real thought piece; its nice to see some really good SF for a change after the mass of rubbish appearing in recent years. The only trouble with all these social philosophers is that their elegant solutions require human beings. Any volunteers??

"Excuse me -- your streets are too filthy" (Miss Tan Siok Sun of Singapore, visiting Australia). She also said: "A cigarette butt will cost you 50 Singapore dollars. Singapore is a very clean city now."... There's a lot of objection these days to "inhuman bombing of women, children, and hospitals." Is it possible to do it humanely?? Finally, our nomination for Quote for 1972: "SAIGON: Another swing-wing F-111 fighter-bomber crashed west of Hanoi while on a..... Cause of the crash is not known."....

Love, Leo

---

* Quoted from "The Postal Threat to Magazines", Editorial in Radio Communication, April 1972.

Editorial Postscript:

As you doubtless realise from the first instalment of this edition last month, we are running a bit late this year. Indeed, I haven't looked at an electronics publication (or at least not many) during the first half of this year; maybe its a reaction to so many years of doing mostly electronics reading, but also work at Work has been crushing.

Therefore for a change, I am blissfully ignorant of all of the Newest Developments in electronics, and you must keep that firmly in mind if some incongruity arises in the texts of the next few issues — if it matters.

I have in fact given the whole lot over to Dick Ferris (about 75cm high!) for a while, and I hope that for this favour he will produce for us a succinct statement telling whether anything significant has happened in the Amateur experimenters literature this year. I reckon that he will produce anything from one sentence to a whole paragraph — depending on how cynical he is feeling that day...

I suppose Dick is going to have to be our new Assistant Editor one of these days, because Rod Reynolds is going to the Mainland maybe. Of course I could solve the problem by having no assistance (advice, namely), and thereby EEB would probably become more readable by being less exact...

As a reward to ye who have waded through this bumph I disclose H. L. Mencken's Law: "In the absence of provable social harm, when A undertakes by law to impose his moral values on B, A is a scoundrel."

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LETTERS LETTERS LETTERS LETTERS LETTERS LETTERS LETTERS LET

The Dangers of Ammonium Bifluoride

You state on page 103 of your recent EEB that you are a teacher of advanced chemistry and this prompts me to ask: Do you know of any reason why Ammonium Biflouride should be regarded as a highly dangerous substance?

I have used it from time to time for etching crystals & it seems harmless enough. Even handling the solid does not appear to have any adverse effect on the fingers; I still have all of mine.

The solution could perhaps be a hazard to a person with a glass eye, or with glass-fibre reinforced spare parts. I suspect that people observing the effect on a glass bottle have concluded that it must be highly corrosive. I suggest that it is no more dangerous than most ordinary chemicals and far less dangerous than, for instance, castic soda.

Re your query, "Are Radio Amateurs interested in Electronics?" I suggest, a lot are not, but those who are tend to be interested in electronics as a broad field rather than Electronics as specific to amateur radio.

— W. Roy Spotswood, VK4ZWR, Bingera Plantation, Qld.

((Being a chemist makes me neither an autority on electronics nor on pharmacology. But I rang up an authority on the latter subject and this is his opinion: Ammonium biflouride is substantially less toxic than the hydrogen flouride (hydroflouric acid) formerly used for glass etching, but it still contains the same dangerous ion: flouride. The difference appears to be that the acid destroys skin tissue so allowing easier attack by the flouride. The ammonium salt could do just as much damage if, say, it entered through a wound; it would pay to treat this compound with healthy respect, though not with the same extreme caution as for the acid.

I might add that there are horrific tales telling about the effect of the acid, usually about people who were wearing rubber gloves whilst working in it. A pinhole in the gloves produced dreadful results, often loss of fingers or whole hands. A friend working without gloves got one small drop on a hand, and the resulting sore festered for months. The biflouride salt is doubtless less toxic, but if you are not completely sure that your hands are free from breaks in the skin, it would be wise to treat this compound with the same caution reserved for caustic soda.... I can only admire Mr. Spotswood's devotion to the experimental method, but would caution that chemistry is full of nasty chemicals which do not necessarily produce obviously bad results, but which can produce cancer, liver or brain damage, or work as slow but insidious poisons in some manner, for example: toluene (often used as a solvent for various cements), mercury, carbon tetrachloride, dimethyl suphate, phenols, amines, and hydrogen sulphide (rotten-egg gas; 7% more poisonous than cyanide)

= =

Pollution and such

In answer to D. Brown's letter in the Augtober 1972 issue (p. 100), present methods of gneration make electric power supply ultimately the greatest pollution problem! But if instead of busily condemning technology wholesale, the ecologists were to persuade the politicians to finance- ↑ ┐

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((EDITOR'S NOTE: If you make anything publishable from DFI's ICs, please give us details! Earns free subscription))

WANTED: Techpress books 01CH1, 01CH2, TSSH3, TSSH3S and DSS. Radio Electronics Mag. Jan 69, May, July 72. Practical Electronics Jan 65, Jan 68. 73 Mag. Jan, Feb, June, Aug and Oct 70, and prior 1970. Vol. 2 Coryra. Any EEBs prior to 1968, ho ho. Please state condition and price, to: R. Martin, P.O. Box 151, Chester Hill, NSW 2162.

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all-out research in nuclear fusion power generation not only would the resulting process waste no resources but hydrogen (and we've more than enough for 10^9 years), but also no chemical pollution would result. Since fusion technology seems free from explosion as well as radiation and noise hazards, the plants could be built in or near towns. Instead of causing thermal pollution, the waste heat could be used to heat buildings and for manufacturing processes.

In reference to Mr. Borwn's comment on marihuana: Tobacco causes lung cancer and bronchitis, and to grow tobacco requires prime agricultural land with good soil, climate and irrigation. Marihuana may cause other nasties but, as far as is known, not the above; it is also a weed-type plant which grows anywhere it is let. If, therefore, we replaced tobacco with marihuana we would free much prime agricultural land for other crops, and reduce deaths and incapacity due to lung cancer and bronchitis.

— James M. Bryant, G8FNT, Wiltshire, England.

= =

Optimum Mixer Design

Recently I was fortunate enough to be given access to a great collection of old issues of QST, CQ, and Radio Communication... I was most interested to read the "classic" articles of the late 50's and early 60's in CQ & QST by the likes of Goodman, Crosby, Squires, etc, and the many enlightening bits & pieces in RC's "Technical Topics" ((but the latter have been anthologised nicely in "Amateur Radio Techniques" — RLG)).

Praised be! The articles by Peter Martin, "Plagiarise and Hybridise" were all there (as mentioned in your recent series of articles on receiver design), and what fascinating reading they made! Any partly formed plans I had for a receiver are now drastically modified. The 7360 valve is a hell of a price (if you can get it), but the articles praise it to the sky. It would appear that Martin's mixer circuitry uses the best ideas of all the others wrapped into a very neatly all-balanced arrangement.

— Ken A. Harding, Sydney, NSW

((Most unfortunately RSGB informed me that they were not planning to issue reprints of Martin's fine article, so interested readers will have to consult various libraries for it: Radio Communication, March-June 1971; see also our Reference List in the December 1971 EEB. — RLG))

= =

Semiconductors vs Valves

You seem to have taken a somersault in regard to the use of ICs, whereas my own tendency at present is away from ICs and back to discrete elements. The many failures I have had with IC, I thought, were due either to bad design, bad luck or poor workmanship. But the enclosed "Micronews" bit indicates that I would not be the only one so affected. ((He encloses Fairchild's "Micronews" entitled "Integrated Circuits Reliability; Plastic versus Ceramic DIP", June 1972. The reasons for IC failures are analysed carefully, and interesting reading it makes; Fairchild suggests that if you want more reliability the Ceramic are better than the Plastic DIP (at a price). All serious users of ICs should send to Fairchild for this sheet. — RLG))

After all the trouble I had in designing a transistorised millivoltmeter, I dug out my old valve voltmeter, made ten years ago... It has a 12AX7, with meter between the anodes and it is perfectly straightforward, without any feedback or other gimmick.

Its FSD on lowest scale, was 50 millivolts at 100uA. Linearity was as perfect as I could expect within the limitations of the meter movement itself, except right at the top end, where a protective diode reduced the reading.

Conclusion: The old steam engine (valve amplifier) has much to recommend it over transistors. It is little wonder that distortion is so rife with the latter. There is only a very small portion of the characteristic curve of a transistor which is really straight, and at that both loads and temperature have a marked effect on performance. It is a wonder that we get results as good as they are — and that mainly through the use of massive negative feedback.

— L. J. Yelland, Prahran, Vic.

((We have so many articles from Les Yelland and from Chris Pitcher that we are definitely going to have to devote a few issues entirely to their output! Whew. — RLG))

= =

Success Story

I haven't corresponded since I wrote you speculating on whether or not to go to Australia. You advised me to think twice, so I did. After finishing college I opened an electronic repair service which now thrives. So perhaps we'll visit you on vacation sometime. End of success sotry!...

Since my degree is in journalism, you are sort of a folk hero to me. I enjoy your style and publication immensely, and was much relieved when publication was ((cont. p.125))

resumed after the suspension.

— Nick Adams, Gainsville, Florida, U.S.A.

((I simply told him the streets weren't paved with rubies))

= =

Crystal Set Technology

I read with interest and some amusement RLG's Crystal Set Technology in the June 1972 issue. But it is virtually useless for readers like me. Where I live any germanium diode by itself and about 1 sq foot of metal for aerial (without ground) brings in the local radio station (3HA) loud and clear. Even 400PIV silicon diodes will bring it in faintly. I have tried numbers of tuned circuits to try to get some selectivity but the radio station swamps out nearly altogether any others.

— Robert A. Mc Intosh, Hamilton, Vic.

((Try shielding the whole crystal set thoroughly, as though you were trying to keep impulse noise from getting out. Then use tuned circuits in cascade using high Q coils suitably tapped for impedance match, and loosely coupled (with variable capacitative coupling). In crystal set technology there's more than meets the eye! I have rough notes on a continuation of that topic pointing out this and much more, but with the backlog of articles and with limitation of time who knows when that will see print... Recently I put Stephen's 120 metre aerial up some 40 ft in the air, and now the local equivalent of Mr. Mc Intosh's station drives a loudspeaker to good volume — alas. Incidentally, with such a powerhouse as 3HA it would be a fine opportunity to rectify the output and use it to drive transistorised circuits free!))

= =

The Cost of EEB, etc.

Back issues of Coryra are still available, and are well worth getting by electronics enthusiasts. For further details write Box 649 P.O., Canberra 2062.

I've received the No. 5a EEB and I must say I agree with Frank Merritt. EEB is too cheap. $2.50 or $3.00 per year for Australia would not be unreasonable and would probably go towards helping right EEB's publishing schedule, as a few of the tedious jobs could be farmed out.

Finally, if you think it would be of sufficient interest to readers I'd like to see an article on the problems involved in receiving colour TV. I know that the set would be expensive, but if all that became redundant (when colour TV arrived officially) was the circuit used to reconstitute the signals, then it might be a proposition.

— Ross Martin, Chester Hill, NSW.

((What say, Rod? — RLG))

= =

More about Automotive Ignition Dwell Meters

Re, my article on Dwell Meters in the December 1971 EEB and various comments which have been made subsequently:

I would state that my car, a Toyota Crown is fitted with

1. CDI
2. A permanently connected vacuum gauge*
3. RAJR's CDI "Tacho".

I at no time inferred a Dwell Meter to be superior to CDI, but would stress that a Dwell Meter can and will detect wear in a distributor.

If connected and used under ROAD TEST conditions it is often possible to find the cause of obscure ignition troubles. A popular slant "6" engine is prone to wear in the vacuum advance plate, causing large and erratic variations of dwell under road test conditions.

My contention is that an erratic or varying dwell affects the actual ignition point, irrespective of what type of ignition is fitted, therefore resulting in less than optimum performance.

I look forward to your article on an exhaust gas analyser. I would also appreciate any comments you care to make on HIFI AM, Tuners, circuit please?

— D. J. Beck, Seaton, South Australia

((Rod has scribbled his tuppence on Mr. Beck's letter, but I think we'll let the customer have this round. The very best AM HIFI tuner is a crystal set — fair dinkum! The main problem is selectivity, and that has been solved by the use of two (or three) cascaded parallel-resonant tuned circuits, capacitatively coupled with a small variable capacitor, with the tuning caps being ganged (and padded to track). Impedance matching is important for reasons discussed in June 1972; & it may be necessary to shield everything as mentioned at the upper left of this page. But all that will be worth it, as long as you have a good AF amplifier and a long antenna. The purist may also wish to bias his diodes forward a bit.— RLG))

= =

MURPHY's SECOND LAW?

I was very interested in your discussion with Winston

*I swear I copied Andy's list correctly (EEB p. 71)! But...
—RLG

(VK7WH) in the Augtober 1972 EEB. It showed very well how easy it is to be carried away by the wonders of new techniques.

Where you can gain from new techniques is in using selected modern hardware to make older configurations work better, e.g. highfrequency filters to allow single conversion, ICs for particular functions (see LM373, but be careful of layout and impedance matching) and so on and on. If one goes overboard on things like Direct Conversion then the complexity of making it work leads one back to square one. As Heisenberg might have stated the Second Law: "The more you look like getting something for nothing, the less likely you are to get it."

How does it feel to have someone agree with you? ((Incredible! -- RLG))

— John E. Andersen, VK2ZXU, Broken Hill, New South Wales.

= =

Transistorised Transmitters and Explosive Batteries, again.

I appreciate your series on receiver design and the much work involved. It is in the same useful tradition as the previous transistor transmitter series. Could we expect an extra instalment of the latter covering any developments since the series finished?

Here is an interesting comparison! "Explosive batteries", EEB p. 40 April 1972, vs p. 316 May 1972 Radio Control Models and Electronics. The latter quotes a Ni-Cd battery manufacturer to the effect that if stored for several weeks (or more) the betteriescould be discharged to below 1V/cell. I suppose it depends on what the Radio Bulletin means by "complete discharge", but RCM/E quotes further, that to condition batteries so as to get full capacity, they should be discharged "right down to zero volts"! Perhaps the moral is not to read so many magazines.

I wonder if HIFI from AMwould be a good topic for EEB; what is the best type of detector, etc? Perhaps one of your knowledgable contributors might be interested.

— S. Hinds, Cook, A.C.T.

((There is scant point in my continuing the series on the transistorised transmitter when that task has been taken on so competently and lucidly in other periodicals, e.g. The Milliwatt (EEB, Feb 1972 review etc), Ham Radio, and Pat Hawker in "Technical Topics" and Amateur Radio Techniques. The field has become vast... Concerning AM HIFI, see comments here, p. 125. Anyone else have ideas on this?

And as for the controversy on Ni-Cd batteries, well! I'll take the word for it by people who have definitive knowledge about the very real danger from the explosion of one of those beasts before I will that of a battery manufacturer. Nuff said. — RLG))

= =

An interesting Case Study

Here is an interesting case study. Two years ago or so a chap at work decided his speakers were not upto scratch. Unable to find anything commercially which was acceptable he built them himself; I understand he salvaged the magnets from somewhere, since casting was "a bit tedious". Of course, these needed decent enclosures, so he hollowed two cavities out under his house with large ducting (suitably loaded and damped) into his lounge room. The job is now complete, but can he relax? He finds now that it is tedious to cross the (admittedly large) room to adjust volume, tone,etc, so he has decided to make a remote control unit, to be placed next to his chair. Now you and I know what a remote control unit looks like, but he doesn't. So he has arranged a servo-drive system from his control unit to the pot-shafts on his amplifier. And now in his moments of idle speculation he wonders why we bother with electronic amplifiers when hydraulic systems, with positional feedback can be made much simpler (yes, simpler!). When the whole story came out, I had to stand up. If I had a hat I would have taken it off.

What can a man like that do in our plastic society — besides build stereo systems, I mean? Does it pay to take pride in one's ability as a craftsman? I hope someone knows where we are heading.

I find that the most annoying feature of being a student at Tech, is that one cannot pursue a topic to its logical conclusion, but must stop short at "what is in the exam". I understand that it gets worse as the years progress.

— Chris Pitcher, Northcote, Victoria

((Yes, Chris it does get worse, but it gets much better when you leave school; if its any consolation we are working on better methods of teaching and examining.... For "where we are heading, see RLG in CQ, August 1973 — RLG)).

LETTERSLETTERSLETTERSLETTERSLETTERSLETTERSLETTE

IC's vs Discretes

Arthur Adams' article in the June 1972 EEB on the Parts Availability Crisis certainly provoked great interest on my part. Having had similar problems as an amateur designer and general electronic "dabbler" I agree with his suggestions for helping to alleviate the situation.

Although I am not a communications or amateur radio bug, I find articles such as the Reciprocating Detector very interesting.

Without going into depth regarding the use of ICs vs discrete components, I have found in my hobby work and design/manufacture that each have their particular advantage for particular applications at hand.

I'm using ICs to great advantage in the latest design on a coin-operated unit, now on the drawing board. It is an "Electronic Darts" type game, with requirements for illuminated "players" dart flight trajectories, target score illumination, score update and readouts, coin counting, game timing, etc. As you can imagine, to do this with all discrete components would be too costly and physically prohibitive..

For hobbies, ICs offer many advantages, particularly in Audio/stereo/quadraphonic reproduction fields. Discrete transistor preamps and tone controls still are a lower cost method at the present stage, but ICs will soon be an advantage there too.

In general I believe in the policy of the best component for the job in hand.

-- Ron Corben, Anglers Paradise, Qld.

= =

Unrequited Virtue?

Many thanks for the October issue of EEB. Quite interested in your publication, but I do not wish to continue receiving it. Best wishes for Xmas and the New Year.

-- (Correspondent), Campbelltown, NSW

= =

Too Much Literature?

I would just like to make one comment; you recommend so many various magazines and various other assorted interplatedsniketts that it would leave me in an unusual state of total bankruptcy if I followed all your advice.

Your Crystal Set Technology was good, and I intend now to fiddle with vinegar 5c and 2c pieces instead of studying. Keep your standard where it is. I eagerly await your next issue.

-- Gordon Markwart, VK2ZGO, Robertson NSW

= =

We don't like "ham"-type radio either.

Regarding your magazine's content, although not particularly interested in ham radio, I generally find sufficient general electronics and hints etc in it tomake it worth the money.

-- Fred Temple, Morwell, Vic.

= =

Patience

You have a fine mag, and I patiently (I have to be) await my first copy.

-- G. Rand, VK7ZAQ, E. Devonport, Tas.

(continued from previous column:)

((You should see what its like having to produce it! -- RLG))

= =

Faint Hope

We wouldn't want EEB to expire. Please find cheque...

-- Roy Spotswood, Bingera, Qld.

((Can't say I share your sentiment... -- RLG))

= =

Part 2 next month (or next year)...

If I have any comment to make, one would be having to wait what one could loosely term an indefinite time for PART 2 of an article, when you've had your appetite whetted and are raring to go. One such article would be the R.D. detector.

Perhaps subscribers unconsciously adopt a similar "indefinite" or "put it off till next month" attitude when subscription time comes around. Possible?

Me? I like EEB, waiting and all!

-- L. J. Godfrey, Albert Park, Vic.

= =

Too Casual

No renewal, thanks. You are much too casual with publication dates for me.

-- (Correspondent), Wauchope, NSW.

= =

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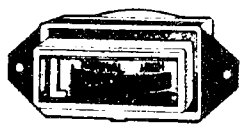

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((PLEASE PLEASE TELL THEM YOU SAW IT IN THE EEB!))

pitchers corner -- by chris pitcher (vk3)

—> Electronics in New Zealand

Those NZ magazines certainly make us look like country cousins don't they (hmmm, what's the life like in NZland?). Also the summary of parts availability in Electronics Weekly. Pity someone couldn't arrange a similar service here. The trouble is you'd be ridden out on a rail for daring to publish such 'private and confidential' information!

—> The Parts Availability Crisis

Crisis is right. But I'm a bit dubious about putting us at the mercy of the overseas suppliers. Since all the equipment we work on is Milspec and requires type-approved parts, all such parts have to be ordered overseas (local stocks nill, always). We wait, on average, 4 months for resistors and capacitors (yes!). For subassemblies and the like -- well, if we're lucky we get them, provided they are not "discontinued". We have a sweep generator, new cost = $5000, and the mots who built it have been taken over. So, no parts, no service, no new plug-ins. When it breaks down, throw it away. And our so-called "local" companies are not interested in type-approval, so it must get worse.

Here's an exercise. Try and buy a 28V d.c., 5A, DPDT switch. I don't care what it looks like, just so long as it is a switch. All the locals will supply is 3A; or 5A SPDT, and we would have to ask Quality Control to test it to a Milspec for us. Now, I'm not that much of a Nationalist that I demand everything have Australian labour in it; all I care about is the availability, and at the moment, it ain't!

Another thing, if things don't improve in (say) 3 years, I doubt whether there will be much opportunity for Engineers in this country. Mechanical Engineers are in that position at the moment; no manufacturing going on, so no jobs.... Things don't seem too bad in Electronics, but I fear for the future.

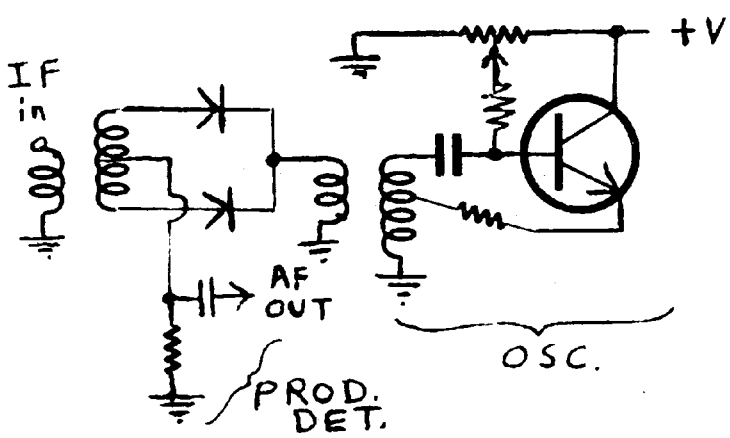
Back to the PAC. Have you tried to buy any precision resistors lately? They make 'em in the U.K. -- 12 weeks delivery from the time they decide to make them. This could be months from the time they get the order.

Finally, if you want to make a lot of money, find a way of importing and selling overseas Milspec components inside a fortnight, and you can name your price to the Services. Only takes good liaison with someone in the USA. And of course certain other advantages of local type... And further:

Most local suppliers now have $20 minimum orders, and they like retail sales like a hole in the head. If someone was prepared to become a retail outlet, buying in $20 lots, They would not only worship the ground one treads on, but likely also advertise for you as well. Me? Don't have the time, alas.

—> The Reciprocating Regenerator?

All you people are doing a lot of talking about Reciprocating Detectors, but I'm being rash and have built one. Its almost working. I'll let you know. But but but... I wonder. Have we rediscovered the Regenerative Detector? Have a think about this circuit for a moment (left). If we turn the pot up to the point where the oscillator is going, we have a normal BF /PD. But if we turn it down to the point where it is just not oscillating? Don't we end up with the equivalent of the R.D.? Time has not allowed complete development yet, but I feel there is a bit of sleight-of-hand in it somewhere! I'll let you know how it goes.



I saw a rather good attempt at defining Receiver performance in Ham Radio recently. So, people are listening... I recently worked up a method to use a transistor in place of a valve in an i.f. stage, using conventional i.f. transformers. Open secondary connection between capacitor and coil, run the C to emitter of a common base amp, run collector to output. Nice, eh?

AN AUTOMOTIVE EXHAUST GAS ANALYSER -- Part I

-- by Peter Ward (VK2) and Rod Reynolds (VK7ZAR)

Why?

A subject that most budding engineers and physicists have to study is the efficiency of heat engines, and in particular, internal combustion engines. These are horrible machines that are difficult to analyse inasmuch as there are lots of moving parts, all generating heat and wasting mechanical energy, and even the energy source is a somewhat irreversible explosion On top of this, mechanical considerations don't allow you to open valves suddenly, and it takes work to move gas -- and so on....

Real Systems

On the other hand, said engineers assume, at first anyway, that everything happens slowly, cylinder walls do not conduct heat, the bearings are all frictionless and everything is at STP etc -- and they do come up with some interesting results. Such as: It will work (probably). It might even have an efficiency of about 30%, which isn't too bad!

And so said engineers build the predicted engine and find that nothing goes right, and in particular the exhaust system burns up. Controlled fiddling does yield good results, however, and the whole analysis changes to the proverbial cut and try and trade-off.

Tradoffs

To an engineer, one of the minimums to be established is the amount of fuel used to obtain a given power output. Researchers as early as 1916 discovered that there was a relationship between the Power Output, the Fuel Economy, the Fuel to Oxygen (or more normally fuel/air) ratio, the Temperature of the exhaust gases (EGT), and in the particular case of the Internal Combustion engine, the ignition timing, for a given design of engine. See fig. 1 for a typical set of curves.

Easy Economy

So what does all this mean? It means that you can, with the aid of fig. 1 and a simple pyrometer (a thermocouple connected to a microammeter) set the maximum power or maximum fuel economy of any combustion engine, and in particular your motor car engine -- even if you have one of those new rotary engines.

Observe fig. 1 again; for a given throttle setting, peak EGT occurs at a fuel/air ratio of 0.067 -- a ratio at which 100% utilisation of available fuel and air is made, i.e. chemically correct or "stoichiometric" mixture. At this point, economy is at a maximum, but available power is down 3%. If we now richen the mixture until the EGT drops about 50°C. from the peak*, we come to the point of maximum power, but the fuel consumption has increased by about 20%!

The ramifications of this are enormous. On one hand the car manufacturers want to advertise maximum power and maximum mpg all at the same time, and with conventional testing methods the tradeoff is obtained by sticking an exhaust gas analyser up the tail pipe and setting the fuel to air mixture at 0.072 or thereabouts. This is rather messy.

---

* Traditionally this has been stated in degrees-Fahrenheit, but since the world is now going metric, it is time that we started stating and using temperature figures in sensible units: Centigrade. A degree-Fahrenheit is a bit over half of a Centigrade degree. 0°C. is freezing of water, 100°C is boiling of same, 20°C is a nice room temperature in Tasmania, 25° in USA; and 37° is blood heat. Simple? --Ed.

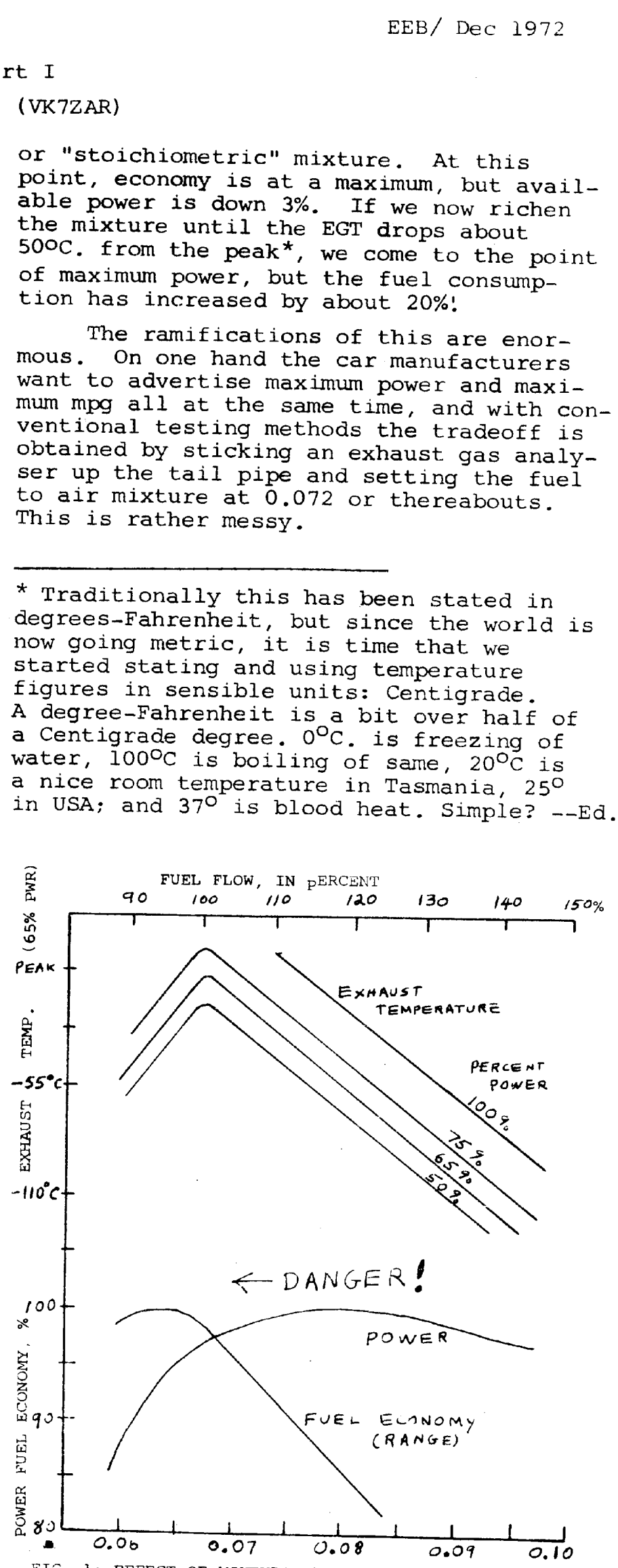


FIG. 1: EFFECT OF MIXTURE CHANGE FOR TYPICAL UNSUPERCHARGED ENGINE OF GOOD FUEL DISTRIBUTION.

But with the aid of an EGT indicator, simply finding the EGT peak, and then richening the mixture so that the EGT falls 30°C. or so is just as good.

With these figures in front of you, you will realise just how haphazard and inaccurate "tuning by ear" is, whether you are playing with your (?) aircraft mixture control, or the adjustable main jet in your car.

A Practical System

A thermocouple (to be described later) is mounted in the exhaust port of the leanest cylinder as close as possible to the exhaust valve. A microammeter on the dashboard is calibrated in °C. x 100. Chromel P - Alumel thermocouples are generally used because of their corrosion resistance.

The problem most apparent in adapting the EGT system to cars is that they do not normally operate with constant throttle setting. We can, however, use the system in the same way that we would a conventional Exhaust Gas Analyser. That is, set the carby mixture at any particular throttle setting. With multiple probes we can take the guess work out of tuning a multiple carby set up, e.g.

The production-line carby must be jetted to suit the worst possible fuel distribution characteristics in the production spread and must be richer than necessary for most engines.

WARNING WARNING WARNING WARNING!

It might look as though best economy might be obtained by running lean of EGT peak, but the fuel distribution in even the best engines is poor enough to cause lean hotspotting and eventual damage to valves, plugs and piston tops. Thus, it is advisable to run a little rich on theaverage so that the worst corner of the leanest cylinder is safe.

THESE PROCEDURES SHOULD NOT BE UNDERTAKEN BY READERS UNFAMILIAR WITH AUTOMOTIVE ENGINEERING PRACTICES

A good many cars have externally adjustable main jets or else may be fitted with them, e.g. Stromberg units as fitted to Holdens. If control can be extended to the dashboard by means of a flexible cable, the mixture may be set on the run (Memories of my old 1922 Essex 4! --RARJ) This is much better than the usual "runs sweetly" or "good grey exhaust" methods of tuning.

((Ed. Note: The matter of advisability or otherwise, of adjusting one's own jets, together with a number of esoteric and earthy matters will be taken up in Part II of this series, as well some various Improvements and modifications.))

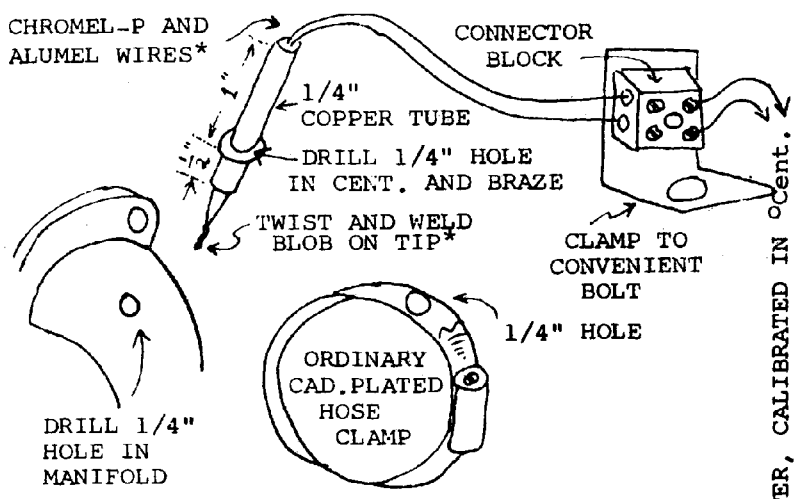
Building the System

The illustration (fig. 2) and notes should explain the job fully. With a homebuilt system, EGT peak is easy to find, though some difficulty arises if we want to set an exact number of degrees below peak. An approximate calibration system can be applied as follows:

Richen the mixture until the motor just starts to run roughly. This occurs about 100°C. below peak. Then consider the scale linear, and put marks (on the meter face) at 25°C. intervals.

Incidentally, the actual temperature is about the 900°C. level, and therefore it is not practical to calibrate the thermocouple with any equipment normally accessible to automotive enthusiasts. Indeed, it is neither practical nor desirable to consider the absolute temperature; only the ΔT matters, the desired reduction below peak temperature. The absolute temperature will depend on a wide variety of variables, and is not relevant.

The probe should be installed in the exhaust manifold of the leanest cylinder, identified by having the whitest or lightest grey plug electrode insulator. Under this condition a depression of 30° to 60°C. is probably safe. We must,



FILL COPPER TUBE WITH CLAY (MAKE SURE WIRES ARE CLEAR INSIDE, NOT SHORTING) AND FIRE IN KILN AT SUITABLE TEMPERATURE.

* ENSURE A NEAT SMALL EVEN WELD. No. 26 B/S CHROMEL-P/ALUMEL WIRE WAS AVAILABLE FROM H.B. SELBY AND Co., NOTTING HILL, VIC., AT 10c EA. PER FOOT, MATCHED PAIR.

FIG. 2: THE HOME-BUILT SYSTEM

however, emphasize that caution must be exercised to avoid the possibility of 'lean hot-spotting". Consequently, THESE PROCEDURES SHOULD NOT BE UNDERTAKEN BY READERS UNFAMILIAR WITH AUTOMOTIVE ENGINEERING PRACTICES.

The circuit of fig. 3 allows expansion of the top end of the scale in order to make the readings easier.

Adjustable main jets are available commercially for Stromberg and Solex carbys, whilst S.U. carbys are ready as they are.

Some Notes:

PAW: With a simple system such as ours, readings will vary slightly with cabin temperature, but this will not worry us. The aircraft models have to be fully compensated because they often have to be "redlined" at 1050°F for turbocharged engines.

RAJR: There are, of course, many ways to build such a unit as this. One way that I have attempted is to mount the thermocouple wires in the small twin bore ceramic from an old IRD two-watt resistor, the kind that was in general use some 30 years ago -- the type having solid lead ends. A search through the junkbox might yield a couple.

A hole can be drilled and tapped 1/8" BSP taper in the exhaust manifold at the appropriate point, and a brass rod threaded 1/8" BSP straight, drilled to just take the ceramic rod and slit, so as to act as a clamp when screwed into the taper in the manifold. Its easier if you have a lathe (though I didn't use one).

Due to the small d.c. voltages encountered, care must be taken to isolate the wires from the earth of the car at all points other than the meter unit.

Note: 1/8" BSP is about 3/8" O.D.

Esoteric Problems

There are numerous problems which may be associated with certain engine designs. E.g., pre-heated intake, water-cooled manifolds, or post-valve burning (in some high performance engines, e.g. motorbikes). And the Peak EGT can move, depending on pressure, humidity, oil in the petrol, % oxygen in the air, temperature at the other end of the thermocouple, and other factors according to Murphy. Finally, it could well be worth not going to any of this trouble for some so-called cars, such as the Volkswagen. Some of these matters will be discussed in Part II.

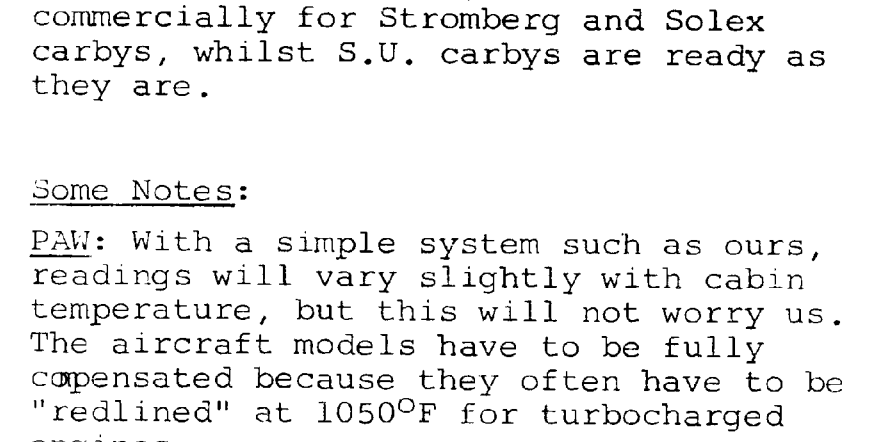


FIG. 3: CIRCUIT FOR EXPANDED METER SCALE. TRANSISTORS MAY BY AY1115 OR ANY SMALL SILICON TR. THIS CIRCUIT EXPANDS THE SCALE APPROX 4 TIMES USE "ZERO" CONTROL TO BRING POINTER ONTO SCALE AT THE DESIRED TEMP. INCREASING EMITTER RESISTOR TO 2.7K DECREASES MAGNIFICATION TO ZERO (i.e., SCALE READS NORMALLY, IN MY MODEL). DIFFERENT VALUES INBETWEEN GIVE DIFFERENT MAGNIFICATIONS. NOTE: IF COMPUTER GERMANIUM TRANSISTORS ARE USED, CAN USE GE. DIODE IN SERIES WITH EMITTER TO GET OFFSET.

LICENCE EXPIRATION (etc)

((ARNS Bulletin, Feb, 1972, note by KØNL))

Every so often, an item in the swap papers appears, telling how so-and-so is off the air because he let his licence lapse. This is a situation that could have been prevented by the expenditure of less than (25c).

Many years ago, the Foundatien for Amateur Radio of the Washington, DC area arranged a License Expiration Service. Joan Machinchick, K3KBI, volunteered to perform the service and she has been doing it all these many years. And it has been working wonderfully.

All you need to do is to send her a stamped postcard, with the date on it you want her to put it in the mail. You can say anything you wish to yourself. When the date arrives, which you have specified, she will mail your card to you, thus prompting you to get that renewal in the mail immediately.

Her address:

Joan Machinchick, K3KBI
1023 Lake Clair Drive, RFD 4
Annapolis, Maryland 21401, U.S.A.

EEB Ed's Note: This is intriguinging idea, and although the PMG takes care of licence reminders here, the service could well be useful for other matters as relevant. The only problem is that you have to pop U.S. Postage on the card, and you have to be prepared to wait some 6 to 8 weeks for delivery, assuming no postal strikes or dockers strikes on the East or West banks of the Pacific. But the normal time lag can be calculated in the date desired, and the Australian Postal Strike can be forcast with some accuracy by assuming that it will occur during the Christmas season of years just preceeding massive postage rate increases. For those brave souls interested in the scheme, send a Postcard as above, with about 15c u.s. postage on it, or 21c u.s. if by air mail (takes four to fourteen days by air, depending...).

A NEW LOOK AT FETs, by C. Pitcher (VK3)

Readers who feel that they want a review of various principles on FETs, may consult a variety of sources in this day and age, from a fairly sketchy coverage in all of the Amateur Radio Handbooks, to a wide variety of their applications in the Handbooks, Amateur Radio Techniques, etc. There are whole books on the subject, as in Ed Noll's "FET -- Principles, experiments, and projects" (Sams, U.S.A.), which was referenced several times in EEB during the past year. Or there are marvelous Application Notes on the subject put out by Siliconix, Motorola, and RCA. They are usually available from the right source by writing on suitable Company Letterhead (Siliconix: 1140 W. Evelyn Ave Sunnyvale, California. Motorola: H. M. Bamford and Sons P.L, 228 Murray St., Hobart, Tas. 7000; or Motorola Semiconductor Products Inc, Box 20912, Phoenix Arizona 85036. RCA: Write AWV, who are very cooperative, usually; Amalgamated Wireless Valve Co P.L., 348 Victoria Rd, Rydalmere, N.S.W. 2116). And finally there is ample material published constantly in all of the amateur magazines, e.g. "An Introduction to the Field Effect Transistor" by G. S. Byass, VK3ZWA, Amateur Radio, May 1968; "FET Primer" by J. Fisk, W1DTY, 73 Dec 1965; or a whole range of current material in the past years Ham Radio, particularly in the columns by Ed Noll (and come to think of it, see also his "Solid State QRP Projects" as reviewed in the Feb 72 EEB).

FETs: The Basics

As practically everyone knows by now FETs are far simpler in operation than the bipolar (i.e. conventional type) transistors. An FET exsentially combines the voltage-controlled conductance of a valve with the conduction mechanism of a bipolar transistor.

This simplicity shows in the data sheets. Only two parameters describe the forward characteristics. These are:

1) I_{DSS}: Zero gate-to-source-voltage drain current, and
2) V_P : Gate-to-source voltage for zero drain current (the "pinch off voltage").

Inbetween these points, the transfer characteristic curve is a parabola, pure and simple. Don't worry if the books give expressions like

((herewith follows an expression for I_D as a function of I_{DSS}, I_{GSS}, V_{GS}, V_P, with 16 terms in it, which I refuse to type! Hi. -- RLG)).

If it was that bad, I would have taken up fishing long ago. That is the correct theoretical relationship but the FETs don't much believe in theory, so they merely follow instead the curve,

$$I_D = (I_{DSS} + I_{GSS})\left(\frac{V_{GS}}{V_P} - 1\right)^2 - I_{GSS}$$

where I_{GSS} is the reverse saturation (viz leakage) current of the input diode. For $I_D > 100\mu A$ we can neglect this, and the expression becomes,

$$I_D = (I_{DSS})\left(\frac{V_{GS}}{V_P} - 1\right)^2$$

This may seem a bit far from George Ohm, but it isn't really.

Measuring an FET

The two constants (for a particular FET) needed to unscrew the FET are I_{DSS} and V_P, a voltage and a current, which we can easily measure.

Fig. 1 shows a suitable test set up. With the pot wound right down (zero voltage gate-to-source), the meter measures I_{DSS}. Wind the pot up until the current becomes some fraction of I_{DSS}, and then measure the voltage on the gate.

Then if we take,

$$K = \frac{I_D}{I_{DSS}} \text{ (at the measured } V_{GS})$$

the Pinch-off Voltage, V_P is

$$V_P = \frac{V_{GS} \text{ (as measured)}}{(1 - \sqrt{K})}$$

and that is all we need.

We could measure V_P simply by reducing I_D to zero, yes, but the only trouble is that everyone's idea of zero is different. It is safer to keep it up at a current we can measure.

The other thing I said you may need is I_{GSS}. This is simply the leakage of a reverse-biased silicon diode. If you can measure it, good luck to you; if you can't, then it won't worry you.... Grandma would have approved of this kind of approach; if the milk doesn't taste sour, it isn't.

Plotting an FET

Now, using the values of I_{DSS} and V_P actually obtained for a given FET (or do you believe that the published data apply to every unit??), we can plot our I_D vs V_{GS} curve*. Fig. 2 shows the idea.

*Strictly speaking, this is for constant V_{DS}, but who is strict in these permissive days?

But those who have met parameters before are going to worry about the forward characteristics that all the good books publish, i.e.,

I_D vs V_{DS}, with V_{GS} constant.

Well, I'll compromise with them and talk about the first bit for $V_{DS} < (V_P - V_{GS})$. See fig. 3.

What we want to know here are the coordinates of the knee voltage, which is where the triode region ends. This is useful if we are going to use our FET as a voltage-controlled resistor -- and that is rather nice, because garden-variety VDR's tend to work at highish voltages as far as semicons are concerned.

Thus above the knee is where the FET starts looking like a constant-current device (like a pentode) -- and that can be useful in voltage regulators, as RLG described in the 1970 power-supply series, and as he will revisit here in due course.

Finding the Knee in fig. 3

Start with the I_{DSS} curve ($V_{GS} = 0$). The knee is at

$$V_{DS} = V_P$$

Now the curve for $V_{GS} = 1$ volt has its knee voltage when

$$V_{DS} = (V_P - V_{GS}) = 6.4 - 1 = 5.4 \text{ volts}$$

in this instance. And the current at that point is given by

$$I_D = I_{DSS}\left(1 - \frac{V_G}{V_P}\right)^2 = 5.6 \text{ mA here.}$$

and so on, for each value of V_{GS}.

The average slope of the triode region (i.e., below the knee) is the resistance from drain to source for that particular V_{GS}. This is given by the complicated relationship, R = V/I, or in older books, R = E/I. In this case,

$$R_{DS} = V_{DS}/I_D$$

measured at the point where the triode region ends. And so,

$$\text{OUTPUT RESISTANCE} = \frac{V_P}{I_{DSS}\left(1 - \frac{V_G}{V_P}\right)}$$

Grandma's Results

On the other hand, showing their usual abhorrence for anything theoretical, the actual resistance will be between about 0.4 to 0.9 times this value. Also, it is not quite a straight line, but if you want to know how straight it is you have to measure it. The same if you want the output impedance in the pentode region (i.e., above the knee); you can take my word for it as being higher than 20 KΩ if you like.

The appropriate Murphy's Factor of 0.4 to 0.9 may therefore be represented as a suitable Arbitrary Constant in the above resistance formulae.

Discovering Transconductance (Gm)

Unlike the bipolar transistor, the FET is operated by voltage (rather than by current) at its input, and so like the good old valve, its amplification is related to mutual conductance, Gm, rather than current-gain.

In this case, without involving ourselves in maths, the transconductance, Gm, at any point is the slope of the I_D vs V_{GS} curve (analogous to I_b vs V_g for valves), and the initial slope is

$$Gm_o = \frac{2\ I_{DSS}}{V_P}\text{, measured at } I_D = I_{DSS}.$$

And this gets less as the current gets less, following the relationship

$$Gm = Gm_o\sqrt{\frac{I_D}{I_{DSS}}}$$

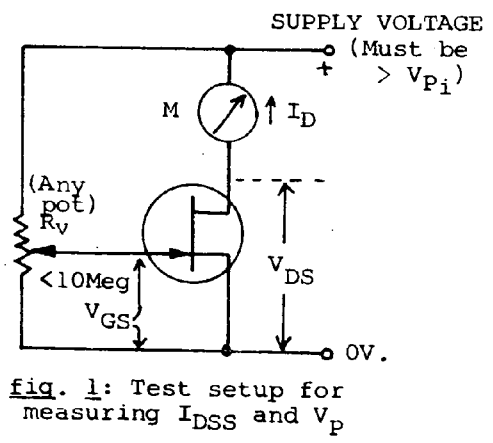


fig. 1: Test setup for measuring I_{DSS} and V_P

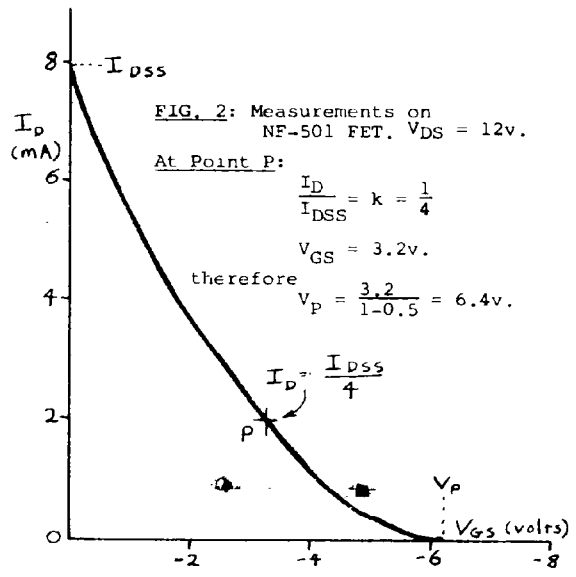


FIG. 2: Measurements on NF-501 FET. V_{DS} = 12v.

At Point P:

$$\frac{I_D}{I_{DSS}} = k = \frac{1}{4}$$

$$V_{GS} = 3.2\text{v.}$$

therefore

$$V_P = \frac{3.2}{1-0.5} = 6.4\text{v.}$$

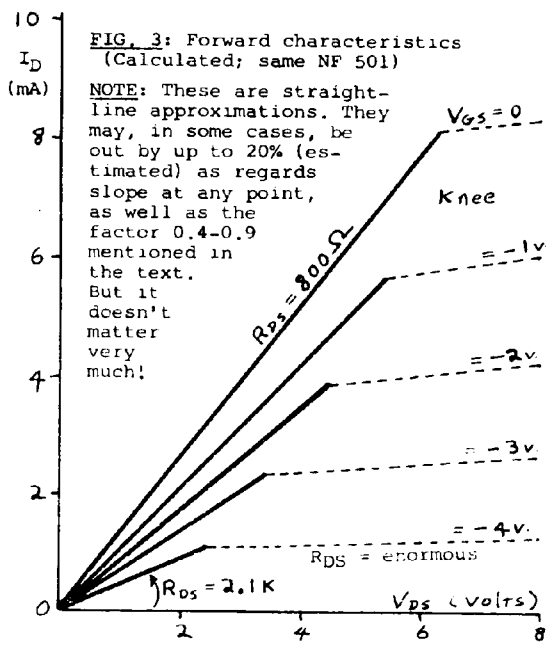


FIG. 3: Forward characteristics (Calculated; same NF 501)

NOTE: These are straight-line approximations. They may, in some cases, be out by up to 20% (estimated) as regards slope at any point, as well as the factor 0.4-0.9 mentioned in the text. But it doesn't matter very much!

Marvelous, isn't it, the amount of information we obtain from just two measurements! We can now describe and design around any FET we have, just by making two measurements. The implications are deep, and I leave you to ponder them alone.

More than this isn't particularly necessary, but where it is it is covered nicely in the Literature; incidentally, to the list at the beginning of this article, might well be added the RCA Transistor Manual, which like their Tube Manual contains in the beginning of the book a very nice condensation of the theory of operation of the relevants.

Here I will just make mention of two other topics, since they are an extension of what I have said.

FETs as Direct Current Amplifiers

The advantages of FETs here are the high input impedance, and the temperature performance. The former needs no mention -- most of us are old enough to remember valves; if not, museums will (probably) have some! But I would like to chat about temperature effects.

Consider fig. 4. The output voltage V_{DS}, can be set at one temperature (say, 25 deg. C. = 77° F.) by varying the bias voltage, V_{GS}. Now, that bias voltage is in series with a reverse-biased diode (viz, the gate-source), which has a leakage current which rises with temperature.

Obviously, current needs resistance in series with it to do anything (V = IR again), so the effect will be dependent on the size of our gate resistance.

A typical value for I_{GSS} is 10 nA (or 10^{-8}A) MAX, at 25°C. This will increase tenfold for a 50°C. rise in temperature, which should cover most places (except, perhaps, Melbourne). So, the range will be 10-100nA or 10-100mV equivalent input drift per Megohm of base resistance.

If thatis alarming, either select the FET for low I_{GSS}, or find another of the same, and long-tail-pair them? (i.e., use a balanced circuit).

The other source of drift is a little more complicated.

Still more Drift

What happens is that our transfer curve (I_D vs V_{GS}) shifts, as in fig. 5. Without getting tooo involved, there is a point (Q) where the temperature coefficient of drain current is zero; i.e., where temperature effect drops out. Very handy!

And naturally, the coordinates of that point depend on V_P and I_{DSS}. I will send the relationship to anyone who is really keen about it (along with two aspirns plus instructions for use), but it is simpler to find it by experiment (the point Q).

Fig. 6 is taken from Texas Instrument's "Communications Handbook", and can be taken as near enough. Read in along the bottom the value of Vp for the FET you have, and the vertical scale gives the percentage of I_{DSS} to run it at, for zero temperature coefficient!!

Then, of course, we use

$$I_D = I_{DSS} \left(1 - \frac{V_G}{V_P} \right)^2$$

to get it there.

Of course, you are going to be

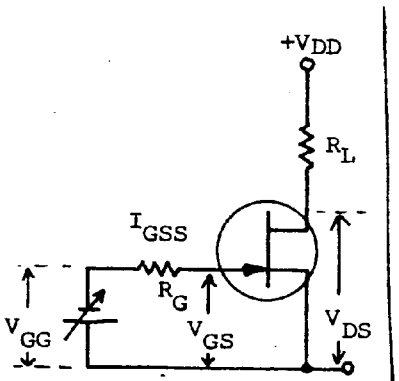


FIG. 4: Simple d.c. amplifier

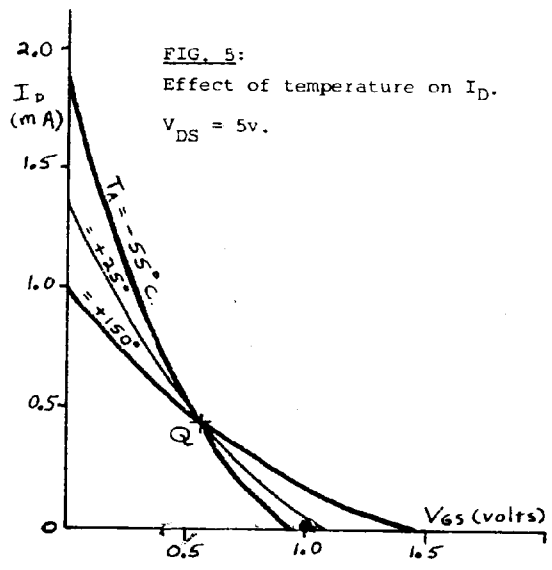


FIG. 5: Effect of temperature on I_D. V_{DS} = 5v.

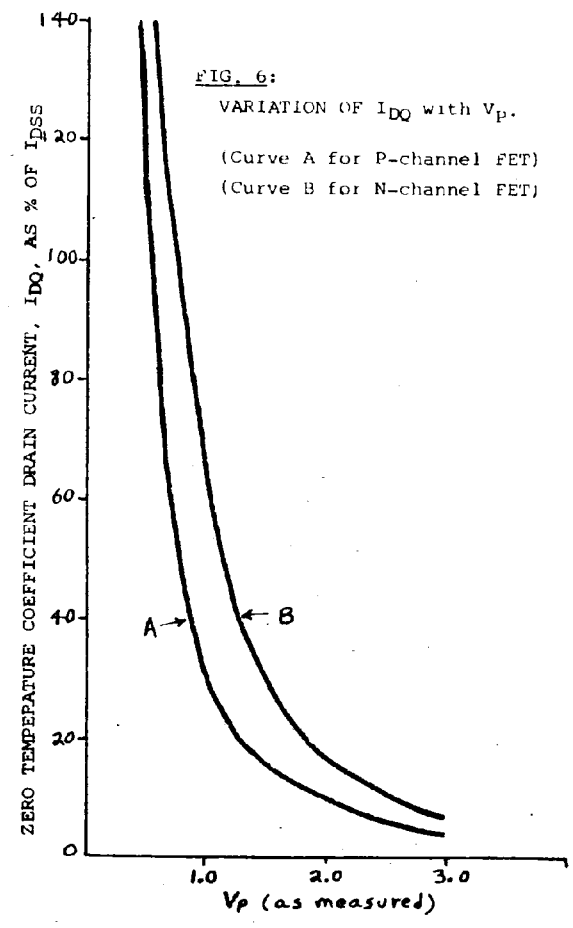


FIG. 6: VARIATION OF I_{DQ} with V_p.

(Curve A for P-channel FET)

(Curve B for N-channel FET)

awkward and ask what to do if your FET has a pinch-off voltage greater than 3 V or less than half a volt. Well, the first one will have a negative temperature coefficient, dependent on I_D, and the higher the value, the higher the temperature coefficient for a given current.

In the other case, it will be positive, and the same remarks apply. Very useful for temperature compensation, particularly when mixed with a few of the other beasts (- 2.5 mV/^oC, for example).

I hope you will agree that it is logical, then, to match two FETs for V_P and I_{DSS}, and claim that they will be matched as the temperature changes. The only remaining drift will be due to temperature differences between the two (never to be overlooked, I assure you!), and differences in gate leakages, which I talked around (rather neatly?) before. Temperature difference between the two transistors can be reduced by mounting them near each other (and MurphYs Law may produce feedback or something else as nasty as a result), or mounting them on the same piece of metal.

FETs when Frequency is higher than D.C.

There is plenty written on this aspect, so rather than take up any more space, I will refer to two articles for an excellent discussion of noise in FETs:

1) Robinson, F: Wireless World, 7/70,
2) Baxandall, P: " " , 12/68.

The only thing I would point out, is the article by Robinson, where he gives an expression for Noise Figure as

$$F = 1 + \frac{f}{f_T}$$

but the C he is referring to is the INPUT capacity, while f_T refers to OUTPUT capacity.

Additionally, I can recommend the "complimentary cascode" circuit for r.f. use from 100 kHz to somewhere-up-there! Fig. 7 shows the general layout.

In fig. 7, if $R_e >> h_{ib}$ of Q_2,

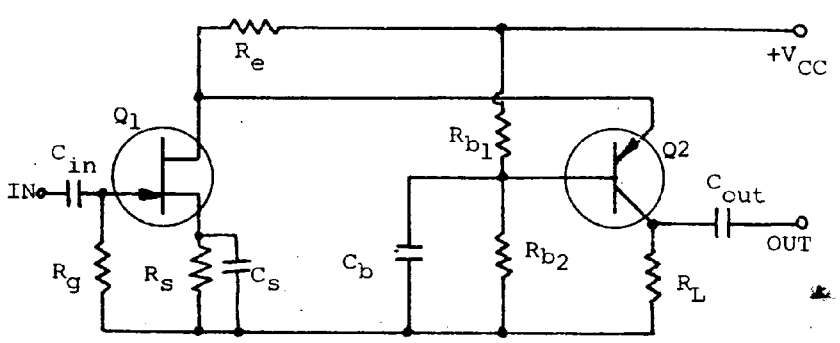


FIG. 7: COMPLEMENTARY CASCODE.

then the Gm ≡ Gm of Q_1

$Z_{out} \equiv Z_{out}$ of Q_2

$Z_{in} \equiv Z_{in}$ of Q_1

And the feedback impedance is negligible.

XXXXXXXXXXXXXXXXXXXX

SWOOP -- by Elise White (YF/KØCNV)

((Amateur Radio News Service Bulletin, December 1970))

Where can I find an old fashioned wash boiler? I had an influx of ten amateurs, causing a coffee crisis at our house last week. The gallon camp coffee pot was strictly supplementary to my 9-cup electric pot. Let's say it was more or less of a fluid situation until one of the follows wanted a solution to a problem. Apparently his wife didn't care for purple people on the color TV, and his particular brand of conversation did not jibe with what was going on on the screen.

The technical discussion got deeper and the coffee consumption got higher. A number of suggestions were made and the gentlemen seemed satisfied and then came another question. It seems he lives approximately three miles from his local telephone office. The problem: He has recently purchased a new linear. He puts it on the air one quiet Sunday afternoon. The local switchboard lit up like a fire station panel on a 5-alarm fire

Its a wonder he didn't have half the farmers in eastern Colorado sitting on his doorstep with pitchforks. The brain busters didn't have an answer to that one but the coffee consumption sure went up while the discussion was hot. Three gallons and 27 cups later one realised his wife had been waiting for him for 30 minutes so they could go back on the western slope and another had fifteen minutes to get to the optical company before it closed.

Purple people, high voltage, low amperage, transformers, proper grounding, restringing dial cords, leaky condensers, diodes, transistors, feedback, printed circuit boards, motor noise, emergency traffic, beams, antennas, wind, corrosion. Yes, it was a long informative afternoon. Each went his assorted way with new ideas and a satisfaction that he had helped solve a fellow's problem.

YYYYYYYYYYYYYYYYYY

LETTERS TO WELFARE DEPARTMENT (continued)

-- I am very much annoyed to find that you have branded my boy as illiterate, as this is a dirty lie. I was married to his father a week before he was born!