INTRODUCING: THE EQUIPMENT EXCHANGE BULLETIN, P. O. Box 177, Sandy Bay, Tasmania, Australia

A modest publication, devoted to Semiconductors and Pseudoconductors, published informally and sometimes haphazardly, on a ridiculous budget. Many of our readers seem to be wildly enthusiastic about the EEB. You are invited to join them. SUBSCRIPTIONS: $A 0.85 [to us], NZ 8/- [to Box 5183, Auckland], $US 1.25 [to 1440 S. Curson Ave., Los Angeles, California], or Stg 8/6 to G3UGT: Jim Coote, 56 Dinsdale Ave., Kings Estate, Wallsend, Northumberland, England.

VOLUME II [1966]: $A 1.50, Bound, Pretty cover, Post free*. CONTENT:

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* Sorry, no more Vol. I left. Copies of individual articles can be obtained at 9c per page.

THE AUSTRALIAN EEB, PO BOX 177, Sandy Bay, Tasmania 7005, Australia

WHAT? This is a Modest Publication, devoted to Semiconductors and Other Conductors, published informally, usually monthly, on a ridiculous budget. The EEB, edited by VK7RG, is an experimenters' magazine, but not necessarily a construction manual. There are constructional projects, but also commonsense observations on technique. Theory is not avoided, but it is practical, designed to inform rather than impress. Finally, however, the EEB is indefinable, there are no rules; it just staggers on from month to month. For some strange reason, many of our readers seem to be wildly enthusiastic about this magazine [journal? bulletin?]. You are invited to join them. And of course, personal advertisements are free.

SUBSCRIPTIONS:

Australia & Territories: $0.99 [ONO] sent to R. A. Walton, 115 Wilmot St., Huonville, Tas., 7109. If possible, please send [uncrossed] Postal Orders, or stamps, not cheques. Thanku.

New Zealand: $1.25 to Judy Smith, P.O. Box 5183, Auckland.

U.K.: 12/6 to Walton, or to G3UGT. U.S.A., etc: $US1.50 or equivalent.

EDITORIAL MATERIAL, requests for sample copies [accompanied by S.A.E., 4x9", please], etc, to the Editor, address as above [P.O. Box 177, Sandy Bay, Tasmania 7005].

BACK ISSUES: 1965: Not available, sorry. Maybe included someday in an Anthology. 1966: Vol II, Bound = $A1.65, $NZ1.75, $US2.00, Stg 17/6 1967: Separate Back Issues no longer available. Vol III[1967], Bound [available early 1968]= $A1.75, $NZ1.85, $US2.20, 18/6 sent to appropriate Representative, as above. 1968: 13c ea. Printed Covers: 35c ea.

We very much regret the higher prices for everything, but are forced by new Postal Rates. etc!

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VOLUME II [1966] by subjects [Numbers refer to month in which a given subject appears]

A] Constructional

Automatic door opener= 6 =
Dual voltage power supply =9=
Grandma, VI: Diode testing pwr spply =11=
Neon oscillator designs =7,10=
Organ, transistorised, Mandolin effect =4=
Plug for circuit boards =12=
Pseudounijunction Transistors [also known as "Compound Transistor" or "Regenerative Switch" - Substitutes for Tunnel Diodes, SCR] =5,6=
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SCR phase shift control =3=
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PADT50 [=AUY10]=6= [See also "AR" 9/66,10/66]
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IC: Voltage ratings in RF p.a.'s =5=
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III: More of same =9=
IV: Modulation =11,12, continued in 1968=
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Amateur Radio Mobile Society =12=
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Transistorised transmitters =7=
Youth Radio Club Services =5,10,12=
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= =

SUBJECTS PLANNED for monthly or in a separate collection: [Note: the article on detailed Computer Board transistors characteristics will appear in 'AR']
Best articles of 1965
Transistor construction
Transistor testing
Transformer construction
SCR Projects, care
Power supplies
Transistor frequency response
Transistorised transmitters, continued.
Electronic tick tock mechanism
Complementary symmetry amplifiers
Null-point amplifiers
Simple homemade coil winder
Coil winding nomograms
DC/DC conversion, a series of articles
FET's and application
Electrical safety precautions
Communication via light beam!
CW monitors, Base Dip Oscillators
Receiver noise silencing, squelch.
Simple SSB [heavens!]
Bias protection for final RF valves
Bias-shift modulation & modulators
Why Abuse Semiconductors?
What to do about magazines. ETC?

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BACK ISSUES are available at 5¢ each, beginning with the January 1966 issue. All issues for 1965 are available in a bound Volume I, for $1.25, post free. Separate copies of the individual monthly issues for 1965 are no longer available. The bound Volume I is furnished in an attractive 'pearl board' cover, with the appropriate information printed on the spine, just like a book. This Edition is limited.

The current issue and all others must be considered as back issues, because bulk mailing rates apply only when posting the entire month's printing.

BLANK PAGES can occur. If it happens to you, let us know.

AN IDENTIFICATION NUMBER follows your name on the address label. Please refer to it in any correspondence to us. Please notify us promptly of changes of address! And please send your renewal without our reminding you. Expiration date is on the Address label. This month "1/66" listings expire. Do it now!

CONTENT.

Editorial.

Does anyone read these editorials? We asked last month that replies to advertisments be sent to the advertisers, not to the EEB. The result? People are still sending us orders. Please, we don't have any valves, diodes, or jewellery-- at least that we wish to sell. All money is gratefully received, but it must be made out to the 'Equipment Exchange Bulletin.

We wish to apologise for the missing pages, light inking, etc., that may

Editorial (continued)
have been suffered in your copy of the December issue of the EEB. We asked a friend to help crank the machine, and he had to go through all the problems we did at one time. A duplicating machine has a soul and a personality, particularly if it is about 75 years old, and one has to speak nicely to it. It is a blow to one's pride, but new machines cost several hundred pounds, and that's what we get for doing this "on a shoestring."

Those troublesome folders. Well, you see, for some reason we didn't leave enough margin in the issues of Vol.1, so there is no way to bind the issues by putting something through the left hand margin, unless a loose-leaf arrangement is used. The binders for the latter, however, cost fantastically, and are altogether out of the question. We have, therefore compromised by squaring up the pages of all of the issues, applying bookbinding glue liberally, and sticking it all onto the inside of the cover. If paperback books can do it, why can't we? The argument has been advanced that "it won't last forever." Sure, who does? But the glue is better than some used in some paperback books we have tried to read. We have opened them, and with a loud crack, they fell to pieces in our hands. That's when we learned how to rebind books. It is, by the way, not at all difficult. You just open the front cover, and with a sharp, single-edged razor blade you separate the cover and edge from the body of the book. You then (if you have been careful) possess the front and back covers intact, joined by the edge. Then put the book in a clamp or vise after squaring off the edges of the pages which might have come loose, apply the glue (proper bookbinding glue, no other!) fairly thickly, and then apply a strip of ordinary linen cloth, pushing it down so that it gets wetted by the glue. Be sure not to let the glue dribble over the top or bottom edges of the pages; it is very adhesive. Allow to dry for a day or so, then apply some more glue to the cover edge, and apply the covers. If you want to be really elegant, you can glue a thin strip of cloth to the junction of each cover and book. The result will be a nice job which will last a long time.

But to return to the immediate problem of binding the EEB. We have received several requests for the covers only, so that the presently possessed back issues could have someplace nice to live. The covers are indeed available for 45¢ (that's only 4/6), post free, but that's all you get. Well maybe we could put a bit of the glue in a piece of sealed plastic, but the rest is up to you. Sorry. That 4/6 may sound like a lot, but have you tried recently to buy anything at a Stationary store? A shilling doesn't go far nowadays, alas, and it will go even less far after February 14th. Hmmm, isn't that Valentine's Day?

We have been receiving complimentary letters, but we wish right here to make one thing very clear: we are <u>not</u> competing with anyone. Heavens, with a circulation of 217, how could we, even if we wanted to? But we do not want to. This is strictly a hobby with us, and the moment it becomes serious or work, you can have it back. Of course it is not work to prepare and type and print and distribute ten pages or more each month, but you know what we mean! We have, in fact, stopped sending out publicity material. Our arms get awfully sore pushing that crank around some 2000 times, and the dream of raising that to, say some 5000 does not exalt us.

+ (Typist made a rude comment about this!)

<u>Letters to the Editor.</u>

1)... The G. E. SCR Hobby Manual is out of print, and G.E. says that they are wondering whether to print a new edition. The fact that all the circuits are

Letters to the Editor (continued)

110V doesn't worry stoic types like me. I only wish I'd got the thing before it went out of print.

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

((We are dismayed to hear this news. The G.E. SCR Hobby Manual is an excellent little publication, containing many practical and interesting circuits -- easily adapted to 250V systems. We suggest that every one of you who can find a pen and paper nearby write to G.E. right now, and beg that they consider reprinting that booklet. Our experience has been that it's pretty useless to write to the Australian outlet, and we suggest you write directly to the General Electric Company, Rectifier Components Department, Auburn, New York, USA. Regular mail will suffice, with an 8d stamp, but do it now. With a small population like ours, we need every person possible to contribute to this kind of vote. -- Ed.))

2)... I think E.E.B. is doing a much needed job, but think your subscription is much too low.

-- M.Baker.
City Beach, W.A.

((Ummm we love to receive letters like that! --Ed.))

3)... I agree that the discussion (about book prices) you presented in your November Editorial is quite justified, especially since I recently purchased some Motorola Handbooks from Cannon Electric for £1 each (U.S. price $2 !), while .... a large city bookstore in Sydney, was selling them at £1/16/9.

I have listed below some additional references which you may wish to include in your Bibliography:

Glow Lamp Manual, by General Electric, 1963.
Semiconductor Rectifier Components Guide, 2nd. Ed., G.E., 1962.
Tunnel Diode Manual, G.E., 1961.
Tunnel Diodes, A.W.V., 1964.
Transistors-- Theory and Applications, Philips, 1965.
Motorola Circuits Manual, Motorola, 1964 (many SCR circuits)
Motorola Switching Transistor Handbook.
Semiconductor Controlled Rectifiers --Principles and Applications of PNPN Devices, by F.E.Gentry, F.W.Gutzwiller,N.Holonyak, and E.E.von Zastrow, (Prentice - Hall, 1964)

The latter text book on SCR's may interest you. I have been told that it is very good, but have not yet seen it myself. It is unfortunately dear, at about £7-10-0. ((It maybe less from U.S.A. -- Ed.))

-- R.M.Brown
Sydney, N.S.W.

((We were not planning directly to have a Reference List in this issue, but here is a good opportunity to present this good news to you without delay. We might also mention Motorola's new Semiconductor Data Manual, recently published. It is an unfortunate fact that one must obtain data on semiconductors from several different manufacturers in order to cover the field. It amounts to the fact that when we want to look up a transistor, we have to consult a half dozen different Catalogues or Manuals, some of which are indexed by function rather than numerically. As far as we know, only the G.E. Transistor Manual makes an attempt to present a reasonably long list of transistors manufactured, not necessarily by G.E., and in numerical order -- though the technical details of that list often leave something to be desired. Anodeon also has put out a comprehensive list, having the advantage that it covers Australian types as well,

Letters to Editor (continued)

but it is rather dated. Diodes are covered quite comprehensively by the Diode Source Book (publ. by Cowan, N.Y.) or by the regular technical short form manuals published by Mullard and Philips.

((On the whole, as a definite minimum library for the serious experimenter we should recommend the various paperback Handbooks and Manuals published by Mullard, Philips, Anodeon, Motorola, General Electric, International Rectifier Corp., and R.C.A. These have been quite well listed in our various Reference Lists, along with reference to the distributors from which these items can most economically be obtained. These works form a basic library which leaves little to be desired in terms of simple theory and practice. As frosting on the cake, one might wish to possess the various Application Notes of marvellous interest and utility, published by the above firms, as well as Sarkes Tarzian, Transitron, Ferranti, and many others -- but this can be difficult to realise, at least for Australians ..... Ed.))

4)... I have modified a six transistor computer circuit board to act as a divider stage working on 6 volts. Am also working on printed circuits of my own, as well as the circuit boards to provide a tenfold division. Will let you have the circuits in due course.

Small modules of transistorised equipment may easily be made up for plugging into a B9A valve base, by using a McMurdo BLM9USP 9 pin plug, and say a few inches of 6-hole matrix board. The board can be held firmly to theplug, on its edge, with epoxy adhesive such as araldite.... There are also 12 pin plugs in the same range if more connections are wanted, but the sockets for them would not appear as readily available in spares boxes as the 9 pin units.

Does anyone know anything about obtaining Japanese Field Effect Transistors? Price? Availability?

-- R.Maddever.
Corio, Victoria.

((We have had several other enquiries about FETs. Can anyone tell us anything about the situation at present?... We are postponing, for reasons of space, a fascinating exchange between Mr.Maddever and some overwhelmed experimenters, concerning some pointed comments he made in these columns a few months ago. We must admit that we goaded him into this, so will have to see about helping to bail him out. Watch the next exciting installment of this epic! -- Ed.))

+ + + + + + + + + + + + + + + + + + +

VOLUME COMPRESSION. Part III: Compression for the Experimenter. - J.A.Hill.

This section is intended more as a guide than to provide concrete constructional circuitry. Since the last article (EEB. Vol.1. No11. p 7) was written, the author has tested dozens of diodes, suitable for the MAVCAT circuit and two things were discovered:

1).. Matching may be necessary -- some diodes were way out.
2).. Heat (eg; soldering) affects the characteristics severely, take heed and use long leads and a heat sink.

1. Longer "hold" time.

Serious music can be ruined by a compressor which has a short hold time. Short soft passages may rise in level giving an entirely unreal effect. To overcome this, a longer hold time or linear input level/output level region (see later) is desirable. C_1 and C_2 can be increased at the expense of attack time. (250 µF each is about the limit) However, under heavy compression

Volume Compression (continued)

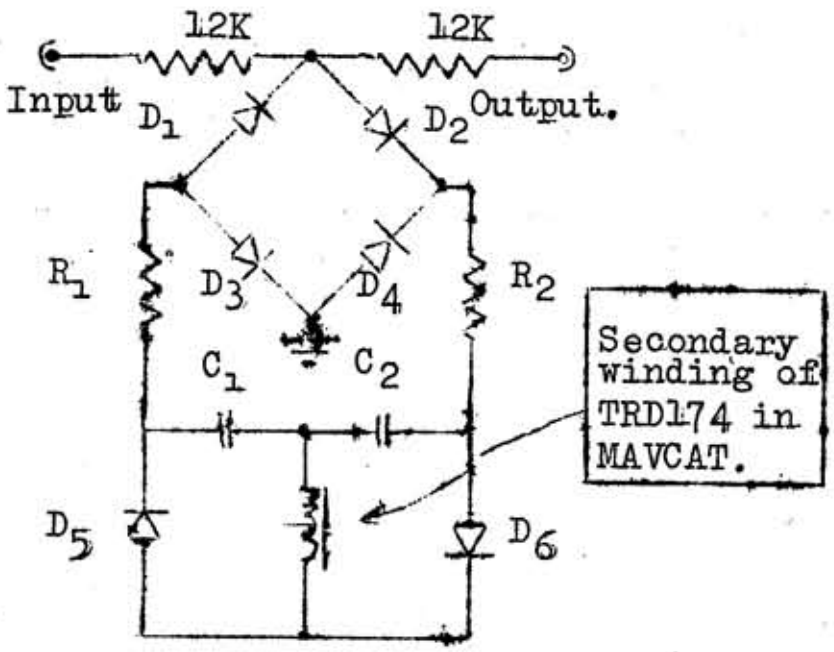


Fig.12.

instability (evident as strange plops, motorboating, or straight out oscillation - which maybe supersonic). A capacitor of 0.01µF should be wired from the collector of TR5 to chassis, to minimise this risk.

2. Better Compression Characteristics.

For serious recording or studio use, MAVCAT has a serious disadvantage. Once the input signal ceases (eg; at the end of a sentence on speech use) the gain may increase to such an extent that background noise becomes objectionable. To minimise this a linear portion of the Input level/Output level

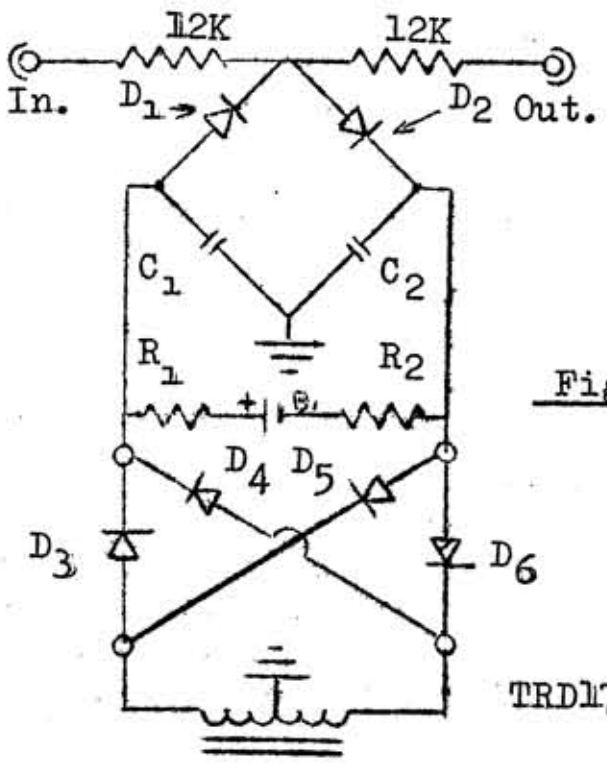


Fig.14.

conditions, the hold time may still be only in the order of a second or so. The circuit (fig.12) uses voltage doubling and resistance in series with the active diodes (D_1, D_2, D_3, D_4 ,) to make the time constant larger.

R_1 and R_2 should be equal, and may have values between 2.2K and 47K. Perhaps a 50K ganged pot could be used as a "hold time" control. C_1 and C_2 should be equal also, and may have values between 50µF and 250µF (suggest 100 µF). The same transformer (TRD174) may be used, with no connection to the centre tap on the secondary. Caution should be exercised with the wiring as stray capacitance and radiation may cause

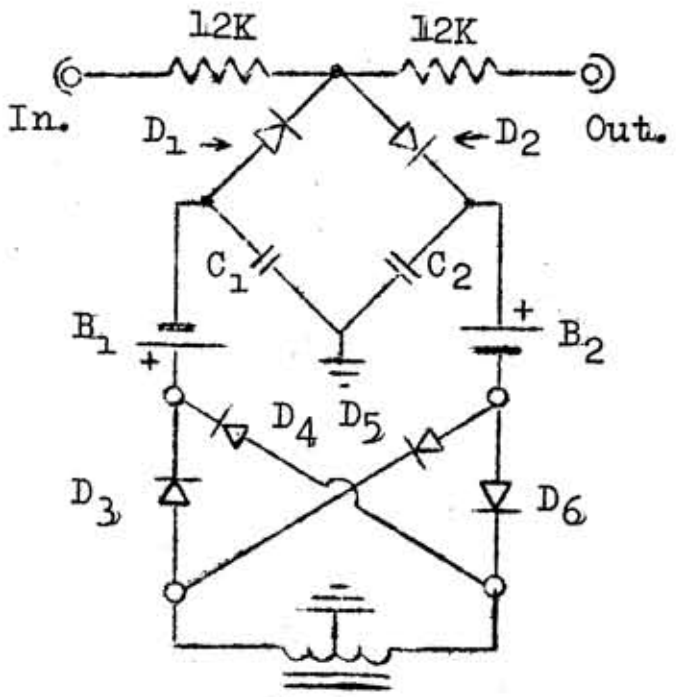


Fig.13

characteristic is required. This way it may be arranged to work only a few db. into compression for normal passages, so that background noises will only rise this amount when speech stops.

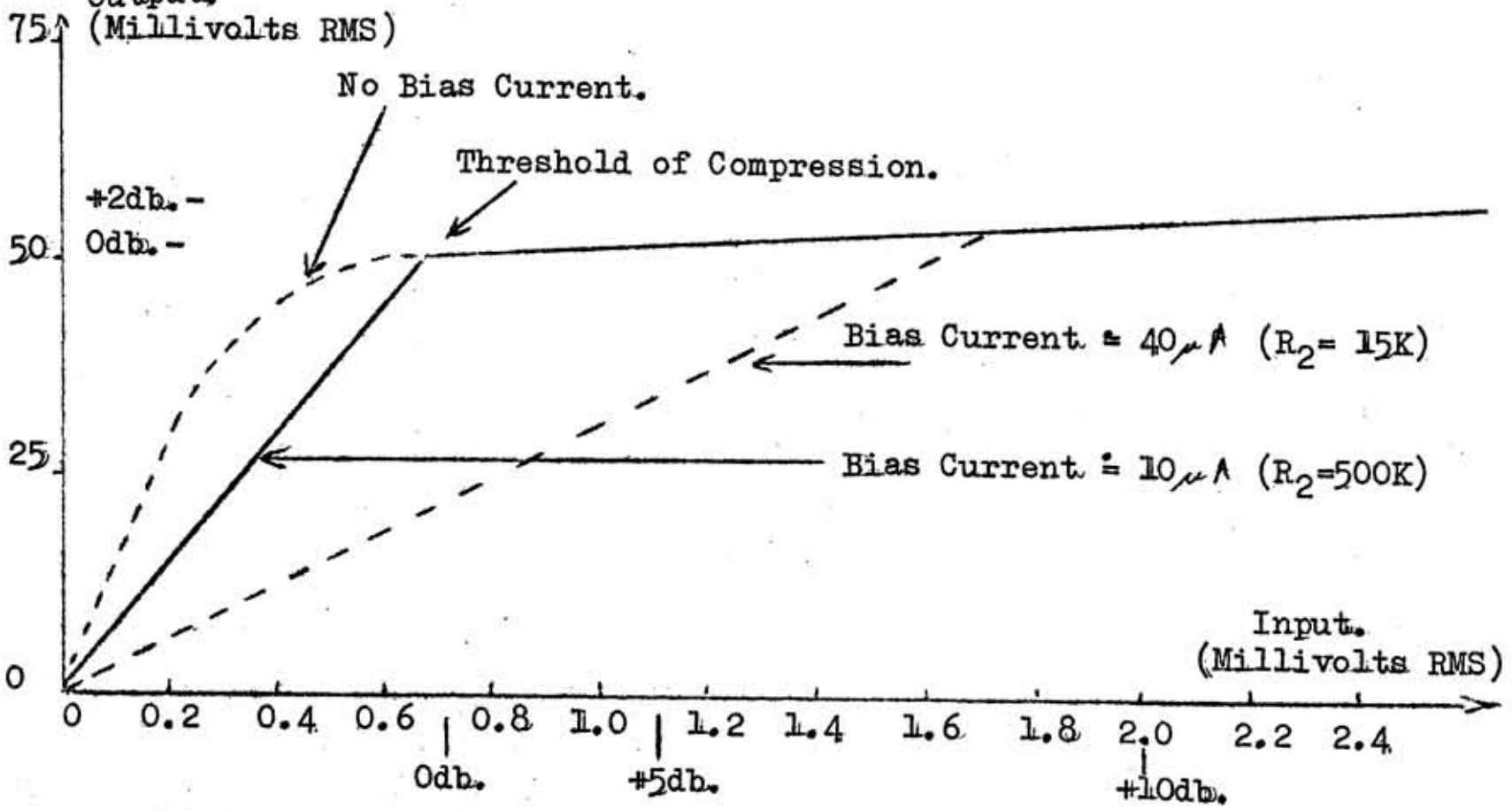
A linear region may be affected by back biasing the diodes so that no current will pass up to the threshold of compression. The obvious method is shown in Fig.13, however, instability is likely, due to slight mismatching of the batteries B_1 and B_2. This is substantially overcome by isolating the D.C. control current from earth (disconnect centre tap of TRD174), and using only one battery. However, stray capacit-

Volume Compression (continued)

-ance may still cause distortion, if not instability.

A more practical bias method is shown in Fig.14. Since the D.C. control circuit is still balanced with respect to earth, distortion worries are virtually eliminated. In fact this circuit has been used under adverse conditions for several months (in "Studio 2", the closed circuit radio station of the Royal Melbourne Institute of Technology. It was the necessity of a compressor for "Studio 2" which started all this.)

The battery B_1 is an ordinary "penlite" cell which should last 6 months continuously - no switch in series. R_1 and R_2 are not necessarily equal. In the "Studio 2" console R_1 = 15K and R_2 is a ½Meg. pot. C_1 and C_2 were increased to 250 each to increase hold time and reduce the frequency response peak at 50c/s, which occurs under conditions of heavy compression. This latter is due to the resistance of D_1 and D2 becoming so low that the reactances of C_1 and C_2 are no longer negligible. 14 volt supply was used, with all stages individually decoupled, and high frequency transistors resulted in critics being complimentary. Performance of this unit is indicated in Fig 15. Note the function of R_2 - it virtually changes the amount of linear region by shifting the threshold of compression with respect to input level.



Distortion of TR1 starts at Input level of 16Millivolts.

Performance : Above 0db. -(compressed) Input changes 10db. Output changes 2db.

Below 0db. -(linear) Input changes 10db. Output Changes 10db.

3. Perfect Compression.

The simple feedback principle used in MAVCAT can never produce perfect compression, since the control current will only increase when the output level actually increases. Putting two (or more) compressors in series is one

Volume Compression (continued)

answer, however the author is investigating other ideas, two of which are represented diagrammatically in Figs 16 and 17.

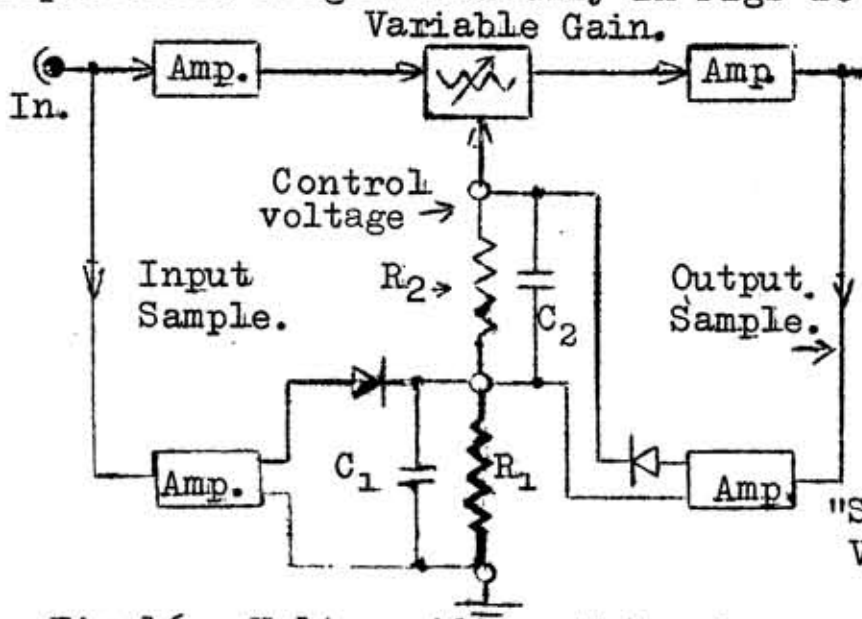


Fig.16. Voltage Adding Network.

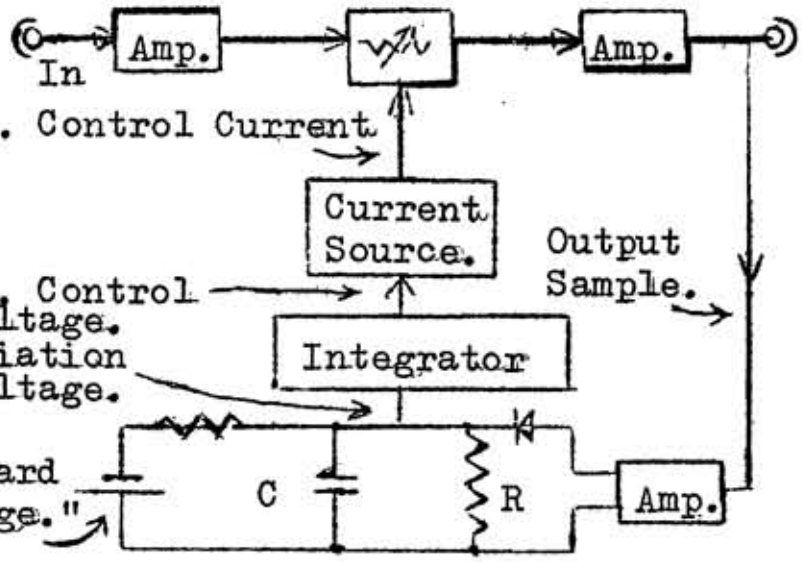


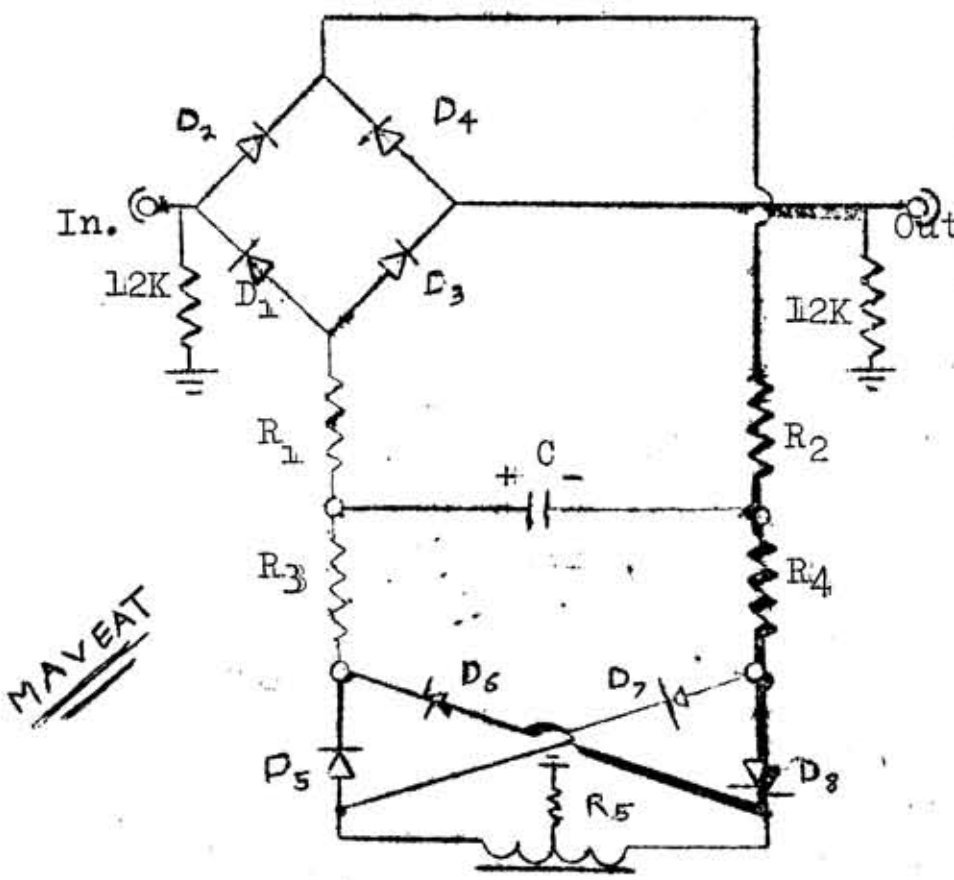
Fig. 17. Voltage Comparison Network.

4. Limiting.

This term is freq uently used in conjunction with different aspects of compression. Usually the principles referred to involve a "perfect" compressor with a very long hold time - eg, 5 to 15 seconds - which keeps the average level within 1db. or so. These are usually used in radio stations in conjunction with a Peak Limiter, which may be simply a couple of diodes biased to chop off any signal over a predetermined level. (eg, like a noise limiter) A conventional compressor can usually be called a peak limiter if the attack and hold times are very short. Reducing C_1 and C_2 to about 5 or 10 would do this, however some instability could result.

5. Volume Expansion.

There are two conflicting definitions of Expansion:-



(a) Increasing input level slightly, produces large increase in output level. This is sometimes used in Hi-Fi gear to compensate for compression on the recording. Fig 18 shows a possible method of converting MAVCAT to an expander. Note that the sample signal must be derived from the input side, not the output as for compression. Virtually the same results could probably be obtained by connecting an ordinary torch globe across the voice coil of the loudspeaker. ?

(b) Decreasing input level greatly, produces only a small decrease in output level. This is ordinary compression going backwards! If the operating point (zero db.) is regarded as being somewhere in the centre of the range,

Volume Compression (continued)

increasing the input will cause compression, decreasing the input will cause expansion.

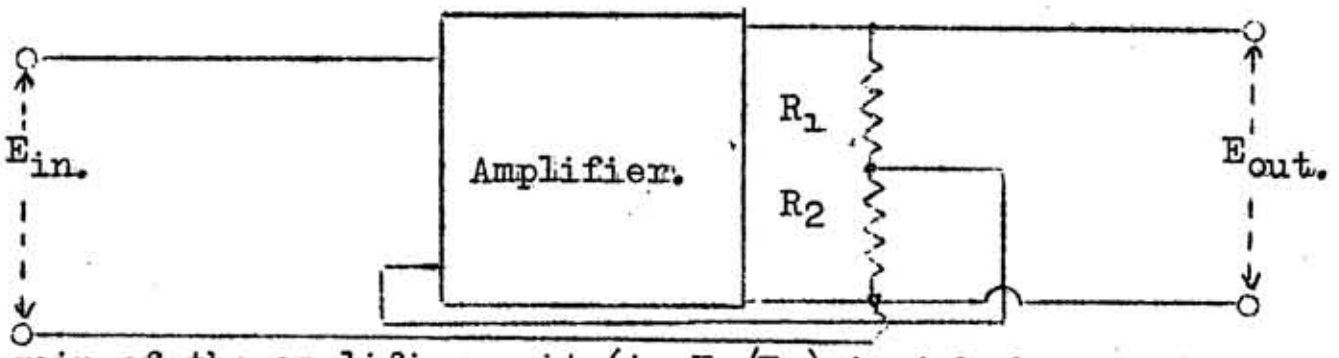
Circuit Details: R_1 and R_2 may have to give a long decay time
Say, $R_1 = R_2 = 10K$. C = 100μF
R_3 and R_4 may have to give a long attack time
Say, $R_3 = R_4 = 10K$

R_5 must provide an effective reference to earth for the control current, yet not shunt the signal via the rectifying diodes D_5, D_6, D_7, D_8. Say, R_5 =25K.

++++++++++++++++++++++++++

PUZZLE.

Given the general situation for negative feedback in an amplifier:



The gain of the amplifier unit (ie E_o/E_1) is A before applying the feedback, and A' after applying the feedback.

If $\beta = R_2/(R_1 + R_2)$, it can be shown that $A/A' = 1 + \beta A$. Now, then, I built an amplifier using R_2 =1K, and R_1 =9K, and measured gain, A'=10. What was the gain A, before feedback? Or could I have made a mistake somewhere?

No reward for this one, except glory. Too easy.

==========

TETRODE TRANSISTORS, Etc. Part III. -- R. L. Gunther

We continue discussion of applications of this ubiquitous device, by presenting a scheme suggested by David Brown (in VK2), using the tetrode as mixer in a Voice Operated Relay (VOX) unit.

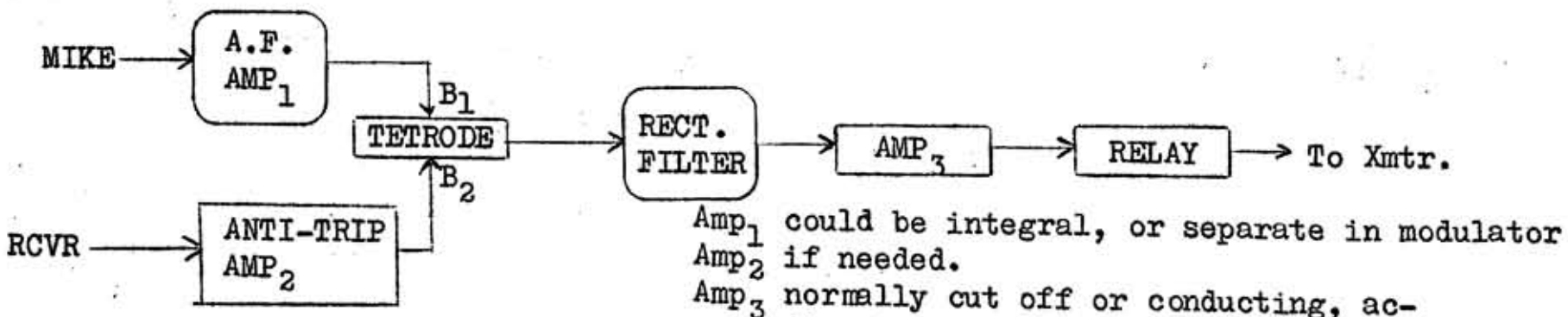


Fig. 12

Gain Control

I am going to approach this subject cautiously, for fear of those wiser than I, particularly in matters of speech-operated automatic gain control, with diode

Tetrodes, Etc. (continued)

compression (MADCAT). It is likely that lower distortion can be obtained from diode operated automatic gain control systems, but the tetrode transistor could have advantage over the triode. In the usual AGC system, the automatic control of gain in a triode is effected by reducing the emitter current, thereby reducing gain and increasing input impedance (thereby reducing gain through mismatch). Typically a tenfold change of AGC control voltage can cause about a fivefold change of transistor circuit gain. The trouble with this system can be seen by examining Fig. 4 of the first part of this article. At low collector currents the characteristic is most non-linear, and distortion can be severe.

The tetrode transistor avoids this problem by the ability of the base$_2$ to reduce gain even with appreciable collector current flowing. See Figs. 5 and 6 of same article (EEB, November 1965). The reduction of β (viz., d.c. current gain) is ordinarily as good or better than that obtained by emitter current control of a triode; this depends on the type of tetrode, and varies from one transistor to another. The distortion can be appreciably less for control of strong signals. The d.c. control current for this operation can be obtained by running the base$_2$ line to a negative potential derived from the network of rectification and filtering of the r.f. signal. Circuits for this have been presented in the technical literature. (see below).

Etc.

The double base configuration of the tetrode suggests its use as a Unijunction Transistor. W. Mc Mahon (VK3) has tried this idea with a 3N35 tetrode, but was not able to duplicate UJT action, presumably owing to insufficient base-base resistance (R_{bb}). However, T. Ohsberg and D. Horgan are developing practical versions of the interesting configuration in which an NPN-PNP direct coupled combination simulates UJT action closely. This will be published in a forthcoming issue of the EEB. It has the not-inconsiderable advantage of low cost. (The UJT-imitation, that is).

In addition, the tetrode transistor can be used to good purpose as modulator, full wave detector, synchronous (product) detector, signal translator, logical 'OR' gate for binary computers and for control and sequencing operations, various gating circuits, or ring counters.

Point-contact tetrodes are also possible, and in fact antedated the junction type. Their circuitry is discussed in the reference by Bewitt, below. Bevitt also describes the contruction of a typical germanium crystal tetrode which I'm sure could be contructed by an ordinary home experimenter armed with an old fashioned piece of 'galena' and an extra couple of catswhiskers. It is necessary only to find three active areas about 0.002 inches or so apart, equally distant, ie in a triangle. Two of the contacts would be emitters, and one would be collector, with the bulk material being the ('N' type) base. This is essentially a PNP transistor with an extra emitter, rather than our previously discussed NPN transistor with an extra base connection. Applications are similar, however, albeit with some modification of circuitry as described by Bevitt. The crystal tetrode transistor was in operation at several hundred megacycles at a time when everyone was greatly impressed that junction transistors had extended their operation to 5mc/s. If I can find my old catswhisker setup, I'll try reconstructing the experiment, and would be interested to hear from anyone else doing the same.

Pentode transistors are possible, but of course a triode transistor already behaves like a pentode valve (ie high collector resistance). So, the only advantage toadding more elements is that of providing more control points. The most simple pentode transistor is a point contact type with four catswhiskers, three for emitters and one for collector. The pentode has been used for switching and as mixer or modulator.

(Bibliography presented in next EEB issue).

ADVERTISING

WANTED Back issues of A.W.V. Radiotronics (before 1963 and some1963), Mullard Outlook (before 1962 and some 1963), Miniwatt Digest (1961 and some 1962), R.T.V.&H. (some 1956-1961).Write R.Brown, 29 Pangee St., Kingsgrove,Sydney, giving details and prices.

* *

GROUT MULTIPLE wave winding machine for power, audio transformers etc; bed 3ft 6in., 18 fingers, winds from about 16 B&S to 40 B&S, head can swing coils up to 6 inches across. Width of coil approximately 4 inches maximum, but could be easily extended. With all electrics, 1 h.p. 3-phase motor, starter, etc., steel bench, clutch foot control, and 18 spindle reel carriers in steel frame with tensioners etc. £200 -- no offers. The current price of this equipment is £1700, and an energetic man with a flair for transformer design could earn himself a comfortable livlihood with it. Reason for sale: lack of space, no no wish to hoard. Reference 'GM', c/o EEB,P.O. Box 177, Sandy Bay, Tasmania.

* *

FOR SALE. AT5 Transmitter and Aerial Tuning Unit. Unmodified. £10 ... Geloso VFO with 6J5, 6AU6, and 6L6, £10.... 240V.a.c. relay, 6 rpm electric motor with gearbox, 2 micro switches, all board mounted, £1/10/-.... SCR 522 Receiver, (some bits missing, but with all tubes), £1/10/- .... Autotransformer, heavy duty (probably 2 amps), £1/10/- .... Box of assorted i.f. transformers (455kc/s in varying states of repair, 1 BFO coil 530kc/s, 7 SCR522 i.f.'s), 10/-.... Box of assorted Audio transformers (mainly older types in iron pots),15/-.... Coaxial Aerial c/o switch (Navy type, I think), £1.... Case from some species of Navy Tx. Slideout chassis with mating contacts on case. Measures 9in W x 13in H x 14in Deep, £2.... Pair 400pF Tx condensers (variable) approx 60 thou. spacing, mounted with thermocouple, £1/10/- .... Command Rx genemotor and mounting, 15/-.... Pair used 805 transmitting bottles, £3.... I am open to negotiation on all items. Please include enough to cover shipment by rail. John Lilley, O.T.C. Radio Station, Bringelly, N.S.W.

* *

ELECTRONIC SPEED CONTROLS. for portable (ac/dc) drills, saws, sanders, etc., up to 3 amp nameplate rating. Controls speed from 0-50% of full speed, and closely maintains preset speed under varying load conditions. Suitable for countersinking wood screws into timber without pilot holes. Ideal for sanding off paint, and will not clog discs. Allows reduced speeds for portable drills, for longer life of large bits. Attractively housed in hard plastic case with carrying handle. Guaranteed for 12 months. £7/17/6. Post free in Australia. ELECTRONIC SWITCHES, P.O. Box 138, Balgowlah, NSW.

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TRANSISTOR IGNITION KITS complete with coil and special ballast resistor with starting tap, and diode. Full instructions. 12V negative earth £15/0/0. post free. Literature free on request. Other models available. Unsurpassed for performance at this low price. There is much more to the engineering of a Transistorised Ignition than merely hooking up a transistor to a coil; our kits provide maximum reliability at minimum cost.

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Advertising (continued)

Each 1¾" square, clear plastic face. 48/- each, post free. MEECO. P.O. Box 407 Naracoorte, S.A.

* *

WANTED : Manual for B28/Cr100 Receiver (Admiralty Publication No.BR1430), 10/- (Aust), plus postage costs. G.R.Petherick, 4 Marlowe St. Blockhouse Bay, Auckland, S.W.3., New Zealand.

((Ed. Note: Reply to New Zealand Advertisers by air; 8d per half ounce))

* *

FROM AUSTRALIAN ELECTRONICS, 76 View St., Hobart, Tasmania, formerly "Electronics Associates". Several people plunged deeply into our stock of 300V/4.7Amp SCR's at 8 for 88/-, and Circuit Boards and HT diodes continue to be most popular. We still have some more of the 300V SCRs, at the same price while they last, and we finally figured out a simple way of putting them in series without using dual pots. One of us will publish it eventually, but by then the stock will certainly have been long gone. Current stock: (if you don't see it here, we don't have it now).

DIODES: 0.75Amps.

200PIV	10 for	20/-
300	8	20/-
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500	6	26/-
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600PIV	10/6	
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Other zeners available from 25-205V at prices competitive with other sources.

EXPOSURE METERS, easily convertible to 100μA miniature meters, complete with scale and detailed instructions, 28/6. No thermocouple meters...yet. Be patient.

TRANSISTOR SOCKETS. Three pin type =1/6 ea, four pin type =1/9each. Please do not order more of these than you need. We keep them in stock as a non-profit service, and intend to keep them in stock, so no need to hoard. On the other hand, we definitely recommend that you hoard diodes, or perhaps you haven't noticed that our stock has become smaller and smaller, with no replacements indicated?

COMPUTER BOARDS. A new shipment has arrived, and truthfully it looks even nicer than the first. There are more diodes on the boards, and some of the boards have 2N1038 (2W/3Amp, mostly 40V: PNP Germanium) transistors -- distinguished by being about twice as high as the usual transistors. The latter are mostly NPN germanium, though PNP and silicon are found. Most of the clear diodes are the miniature silicon small signal type (like OA200), about 30V/200mA; and the germanium point contact VHF type usually have a blue band at the cathode end, and a much finer anode contact wire. Their circuits probably differ from the one given in November EEB, you will have to ascertain them yourself. We won't take up valuable advertising space, but will discuss these privately elsewhere in the EEB sometime.... For some of these boards we ought to charge for the diodes, and give the transistors away! But the boards will remain at 2/- per transistor (£1 overall minimum, as usual) while they last. Boards have 4,5,6, 8, or 20 transistors each at this date, so order to make it come out to a practical number.

FROM:- The Equipment Exchange Bulletin
P.O. Box 177
Sandy Bay, Tasmania
Australia

//Registered at the G.P.O. Hobart, for transmission by post as a periodical//

TO=

Rodney Reynolds//42
St. Georges Rectory
Battery Point,
Hobart, TAS

Advertising (continued).

ZZZZZ WANTED URGENTLY !! -- University Student requires draughting machine, preferably Band-type, with or without scales, to suit 40in. x 30in. board. R. Reynolds (VK7ZAR), St. Georges Rectory, Battery Point, Hobart, Tasmania. ZZZZZZZZZZZZZZZZZ

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CONTENT.

Editorial.

Oh joy, the Great Decimal Change is upon us. But why such consternation? We hearsaid of people attending classes to learn all about Decimal Currency. Why? 100cents = one dollar. And subtract one from 3d to 9d, and two from 10d to 12d. That's all. But if someone gives you 17/4for change from £1 for six items costing four for 17cents, don't worry, they probably cost 3d each before C-Day, and it doesn't matter now, we keep telling ourselves.

Well, we might as well be patriotic too, and raise the subscription to 60c per year, post free anywhere in the world (including Australia). The real adverts really don't pay for costs, and our friends are strangely reluctant to help without pay. Deficits have been made up by our principal Advertiser, but we make them pay for this privilege by writing articles for us. So-- next month the new rate will apply. That is not a lot considering what you get; we are proud of this publication. But please don't all write in with 5-year renewals between now and march, huh? The idea is for us to meet our expenses, and that would defeat it -- and us. If, however, you are a poor student or something, do renew now. We have a fondness for poor students, being a fair proportion of our staff..... Thank you.

We were amused to see the statement " my regrets for the late publication of this issue" in the Elitorial of an informal publication, similar to the EEB in some respects. Time can be a problem, because the kind of people who are

Editorial.

impossibly busy are often the kind of people who get things done. But there must be a limit, and that kind of person often strains it. That's us too. The moral is that you'll probably get your EEB sooner or later, even if the February issue arrives in March. Never mind.

We have received a comment that the EEB is interesting, but that the Editorials are really the best. Amazing. So why work ourselves to death on articles. We could gab here all day, saying not much; once we belonged to the Rag-chewers Club, but don't tell the XYL.

By the way (chain of thought: long editorials, New Hampshire, Connecticut), have you joined the Wireless Institute of Australia yet? You don't have to be a radio amateur, but it helps. Membership involves meeting a wonderful lot of chaps having similar interests, subscription to "Amateur Radio", a worthwhile technical publication, and support of the organisation which is the voice of the Australian radio amateur to the world. In these difficult times, every bit helps. If we lose our bands, at least we can say we tried.

Incidentally, has anyone given thought to what amateurs might do if the bands are lost? There are a number of interesting possibilities.....

We have had a few requests for anonymity from prospective authors of articles for the EEB. Fascinated, we asked one of them why, and here was the gist of the reply:" It is the practice... to submit articles prepared for technical journals to a committee for approval before sending them for publication.. I do agree that the circumstances existing when writing for EEB differ from those which exist when writing for more sophisticated publications such as Proc. IREE, but I wish to play safe, and not to have to submit my articles for approval....."

This fascinates us utterly. It is true that a certain amount of editing does take place when an article comes before us, but other than to clear up major faults, we let it pass as it is. We do this not only in the amateur spirit with which this journal is obviously imbued, but also from the assumption that if there does arise some profound and interesting error, a reader will write us to that effect. (We might also mention that our own technical knowledge is less than infinite.) In any event, we shall be pleased to publish the technical correspondence on the subject, and we should all be the wiser. This does, then, constitute a Committee of a diverse sort, but with a difference.

This difference is the heart and soul of the philosophy with which we publish the EEB. We ourselves are well acquainted with the formal procedures for publishing serious scientific contributions to the Literature, and realise that for that exacting procedure one has to tread most carefully, making experiments in advance to attempt to meet every likely objection. And then the great work is submitted to a group of Referees who judge the contribution on its merits and on their prejudices -- or does anyone still believe that scientists are altogether impartial? We appreciate the reasons for that procedure, and wish only that it were even more exacting than it is, since the volume of the published Literature is growing as a power function of an exponential. But must we drag these reservations into the EEB?

It is just to get away from such serious considerations that we enjoy the EEB, If we had to weigh seriously every technical statement we made here, we should -- like the tortoise-- never know which foot to move first. We read and we experiment, and we try to be right, and we urge our contributors to do the

Editorial (continued!)

same, but it isn't all. If we print a diode backwards in a circuit, we'll depend on you to ascertain that fact by logic, at least until the apology the following month. Most of the people who read the EEB are experimenters, either in fact or in interest. We hope that if they discover something interesting or useful or intriguing, they'll let us know about it so that we can all share it. It doesn't have to be earth-shaking. Let's not get tied down in formalities or fears of public disapproval...

One of these days we'll print a two page issue of the EEB, just to show that we don't have to follow any rules anytime! Actually, we were going to do that this time, but we couldn't resist the sound of our own lovely voice in print -- as it were.

-- RLG.

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Letters to the Editor.

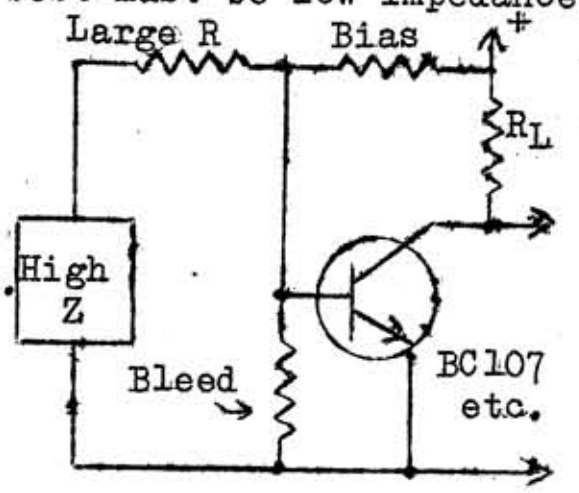
1. It appears that characteristics of transistors can vary quite a bit within a given type designation, and this can pose a problem for the experimenter. I have been a ham for a couple of years, although not very active on the air, preferring to build things, try them out, and pull them apart again. When one has been "brought up" on valves, it is hard to adjust oneself to saying, "now I want so many volts of audio to drive this, and so much audio to drive that," after having thought for years "oh yes, a 6AU6 into an 807 should be okay for that." In a way, the latter method is easier, because one does not have to consider so many parameters. The fact is that until surplus semiconductors became readily available on the Australian market, many people, including myself did not feel like spending the retail prices asked by the manufacturers and wholesalers. Consequently valve circuits were king. Now things appear to be different. This, then, is the time for amateurs and experimenters to carry out what Mullard advocated in "Outlook" a couple of years ago:"stop being afraid of semiconductors." I'm not afraid of them, but I still don't know them well enough to have full confidence, but I'm willing to learn. One problem is the difficulty of testing transistors, and knowing how to apply that information to circuits.

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

((It is not difficult to test transistors casually. One needs only a power supply and a meter or two. Maybe we can run an article on this one day. Transistorised circuits can be designed to be relatively independant of transistor characteristics, and many circuits are inherently uncritical of them too, so that this may not be as much of a problem as it might seem. We are, however, also preparing an article on simple transistor circuit design. In the meantime we recommend that you consult the various simple manuals and handbooks now available. We might mention, in passing, that valves are not really obsolete. They are valuable in many applications where the impedance, power, or temperature sensitivity of transistors makes semiconductor circuitry less desirable, and indeed, hybrid circuits, and the appearence of HT transistor ratings can make them directly applicable to valve power systems, where impedance relationships are suitable.... Finally, we might mention that the price of commercial semiconductors in Australia is becoming quite reasonable, and where high frequency voltage or power requirements are important, the commercial item can prove more useful, reliable, and economical than the surplus one.

Letters (continued)

((Where transistors are 'replacing' valves, careful attention must be given to the impedance relationships, since transistors at best must be low impedance devices. For example, if a transistor must load a high impedance output, the emitter follower configuration might be indicated, but real ising that the output impedance of same cannot be greater than the output impedance multiplied by transistor current gain -- and will in fact be less, owing to loading by base biasing resistances. On the other hand, it might prove more practical to use the transistor in a common emitter configuration as a current amplifier, as shown in the figure to the right. This is particularly valuable when loading photocells, geiger tubes, and the like. The BC107 is ideal for this application, because it has low noise and enormous current gain. For example, β is about 150 when I_c is only 20uA! This means that useful amplification is obtained with I_b =0.14uA, which is well within the useful range of current variation in most high impedance circuits. -- Ed.))



2. I think that transistorised tachometers ought to be an improvement over the "straight" type. Namely:

a) A 1mA or 10mA FSD meter could be used with subsequent saving in cost, with greater ruggedness.

b) The input impedance would be higher, resulting in more accurate readings, and less interference with the ignition.

c) It could be more easily adjusted -- the meter could be calibrated beforehand, and the base bias resistor varied until the calibrations are correct.

I'll be ready soon with the article on the transistorised Proximity Relay. I am now madly rewinding a speaker transformer (for miniature geometry). It is turning out longer than I thought it would, with a lot of theoretical background (guesswork?).

-- D.Brown.
Gosford, N.S.W.

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(Next month : the great Maddever Debate)

TETRODE TRANSISTORS Part IV.

References:

G.E. Transistor Manual , Sixth Edition, p.55,57,63: Third edition, p.99.

Junction Transistor Electronics, by R.B. Hurley (Wiley, 1958) ,p.299.

Modern Transistor Circuits, by J.M. Carroll (McGraw Hill, 1959), p.18.

Selected Semiconductor Circuits Handbook, Ed by S. Schwartz (Wiley, N.Y., 1960), p.4-33. (Also available in soft cover Services edition).

Transistor Circuit Analysis, by M.V. Joyce and K.K. Clarke (Addison-Wesley, London, 1961). p.230,303.

Transistor Circuits and Applications, Ed by J.M.Carroll (McGraw Hill, 1957)p.15.

Transistors Handbook, by W.D.Bevitt (Prentice-Hall, 1959),pp 133-147,283.

I wish to thank Dr. John Brodie of the Dept. of Electrical Engineering at the University of Tasmania, for some very interesting and useful conver-

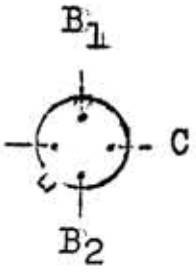
Tetrode Transistors (continued)

sations on this subject, but I take full responsibility for the confused text. I also wish to thank L. Osborn, J. Hill, and T.Ohsberg for looking intently at the manuscript.

Characteristics of the 3N35 tetrode transistor:-

Type = NPN, Silicon, Low Power, VHF.
P_c = 125mW (Max)
I_c = 20mA (Max)
$f_{\alpha b}$ = 150mc/s (typ)
h_{fe} = 20-100
BV_{cbo} = 25 -100V.

Typical application:
V_{ce} = 10V.
I_c = 1.3mA.
β_1 = 30 at I_{b2} = 50uA.
β_2 = 25.
I_{b2} = -100uA for VHF operation.



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Answer to Puzzle.

The only reward for a correct answer was going to be glory. It seems that that wasn't enough. No one even wrote in about it. Tsk, tsk, how banal.

If you apply the figures given to the equations given, you will find the amplification before feedback is infinity. I build amplifiers, but not that well. What happened? Well, I was taking the resistance values off the colour coded bands on the resistors. The resistors had a 10% tolerance. R_2 was actually 990 ohms, and R1 was 9.9K. That brings β down to 0.091, whence the gain before feedback was 111, which is appreciably less than infinity.

As usual, there is a moral to this tale.

1) Don't trust colour coding where it matters. Indeed, don't trust values printed on the resistor itself. A gross inaccuracy in the scale of one of those cheap little PT-34 meters was traced to a resistor being one-tenth of the resistance it had printed on it! Some error.

2) It is sometimes considerably easier to measure the gain of an amplifier after negative feedback has been applied, than before, if the initial gain is so high that instabilities are prohibitive. If the circuit constants are known, the equations allow calculation of the gain parameters.

3) It is sometimes (nay often) inconvenient to measure the input impedance or resistance of a transistorised amplifier. You can, however, determine it quite easily by applying a bit of negative voltage feedback, measuring the gain before and afterwards, and calculate β whence comes R_b or equivalent.

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JOYSTUCK? Readers are invited to send us intelligent technical comments on the following item we received from the Joystick people :

PARTRIDGE SPILLS THE BEANS!

How can a 7'6" long device outperform a conventional antenna many times its size? A fair question - HERE IS THE ANSWER!
Whereas the conventional antenna is fundamentally resonant to a given frequency, and resists efforts to make it radiate on another a channel, the JOYSTICK is INHERANTLY (sic) NON-RESONANT, HAS A SUBSTANTIALLY FLAT RESPONSE CURVE OVER THE ENTIRE H.F. SPECTRUM, AND PRODUCES A HIGH " Q" RESONANCE ON ANY GIVEN FREQUENCY!
This means a perfect match at the Pi tank, resulting in ALL the "soup" going "up the spout" on the fundamental frequency and NO WASTAGE VIA T.V.I. CREATING HARMONICS.
Unquote.

ADVERTISING, etc.

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HALLARD ELECTRONICS, Box 58 P.O., Campsie, N.S.W.

* *

ELECTRONIC SPEED CONTROLS. For portable (ac/dc) drills, saws, sanders etc., up to 3 amps. Controls from 0-50% of full speed; closely maintains preset speed under varying load conditions. Ideal for countersinking wood screws, sanding off paint, and preserving the life of large bits, when used in portable drills. 12 months guarantee: £7/17/6: Post Free in Aust. ELECTRONIC SWITCHES, P.O. Box 138, Balgowlah, NSW.

* *

TRANSISTOR IGNITION KITS complete with coil, special Ballast resistor with starting tap, and diode. Full instructions. 12V Neg. earth:£15/0/0. Post free. Literature free on request. Other models available.

Also available: 0-15V meter with coloured dial for Automotive use; 0-15Amp meter with coloured dial for Transistor Ignition: 30-0-30 Amp meter (centre-zero); $1\frac{3}{4}$" square, clear plastic face. 48/- each, post free.
MEECO. P.O. Box407 Naracoorte, S.A.

* *

WANTED: Technical Manual, including alignment data for B28/CR100 Navy receiver. R.Reynolds, St.George's Rectory, Battery Point, Hobart, Tasmania.

WANTED: RSGB Radio Handbook, 1st. Edition; old Radio Handbooks (Editors & Engineers, Ltd). R.L.Gunther, P.O. Box 177, Sandy Bay. Tasmania.

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Type and Wattage:	A1/10W	A2/15W	A3/50W
Primary:	240V/50cps	230-240V	230-240V
Secondaries:	12.6V and 6.3V (separate)	6.3V (tap) or 12.6V	22 or 44V (centre tapped)
Sec. Current:	0.5A and 1.0A	1.0A	1.5A or 0.75A
Mounting:	Clamp	Clamp	Frame
Size:	$(1-3/4)^2$ x 2-1/4		
Price:	$2.55 each	$2.85 each	$5.00 each

And here are two surprises typical of Australian Electronics: 1)These prices include Sales Tax and Freight. 2) For about 25 percent higher price, you can order any reasonable combination of windings, custom wound to your specifications. Let us know what you want, and we'll see what we can do. These custom windings are secondaries only. All primaries are 240V/50cps, in sizes of 10, 15, or 50 Watts. Please note that the matter of Sales Tax included is important. The prices for ordinary commercial items are specified less tax and freight. That makes our transformers a real bargain. Try dividing the dollar price by two in your mind to make it sound reasonable; it is amazing how much worse prices sound in $ than in £. All transformers ordered in March will be posted toward the end of the month..... AUSTRALIAN ELECTRONICS, 76 View Street, Hobart, Tasmania.

Advertising (continued).

MORE from Australian Electronics, 76 View St., Hobart, Tasmania, formerly "Electronics Associates." ..... What causes demand for a given item? For months we have had SCR's, but now everyone wants them, and this is in addition to the bargain 300V line mentioned previously (and now exhausted). So of course stocks are now depleted a bit. It is impossible to keep large stocks of items which usually move slowly. We'll get around to ordering more SCR's one of these days, because we like them, but not diodes. We have had diodes, up to Here..... We are frankly annoyed by the Decimal Changeover. Pounds could have been decimalised, with ten shillings to a pound, ten pennies to a shilling, and some half pennies for the fastidious; what can a penny buy nowadays? Oh well, in any event we don't have to follow the trend in prices. Out of spite, and too many of those ugly silicon diodes in the drawer, we are LOWERING prices. Yes!

PIV	Amps	Quantity	for $	PIV	Amps	Quantity	for $
200	0.75	12	2.00	1000	0.75	4	3.00
300		9	2.00	1200		2	1.70
400		6	2.00	1600		2	3.00
500		5	2.00	1800		2	3.30
800		3	2.00	2000		2	3.80

And Zener Diodes, Autumn sacrifice special sale: $2.50 for ten of the following one watt ratings (can be assorted). 75V, 95V, 100V.

Please specify alternative in event of depleted stock. By the way, although we forgot to include in the Catalogue this month, we still have some tetrode transistors at 7/6. Or 75c if you wish..... Computer Circuit Boards: We have seen some 500mA silicon diodes on them, ratings over 600PIV. No, you can't request them. What happened last month? We mentioned 2N1038's on the Circuit Boards, and everyone wrote in asking for them. You can imagine how long that line lasted. Well, we do have some 2N1038 new-surplus transistors we were saving for ourselves, which you can have for 9/- each if you don't want too many, and if too many people don't request them. If ordering same, kindly specify an alternative item. Too often we have sold our last semiconductor of a given rating, because someone begged and pleaded that his little son would be heartbroken... or the like. Bah..... We have received letters of dismay at the news that we are reducing operations. We are sorry, but business has been far too active for us to relegate this to a hobby, and that situation is intolerable. Furthermore we have had considerably more experience with the various things that can happen in business enterprise, and that can be ugly. On the other hand, we note that the price of commercially new semiconductors has plunged drastically, and many of them are now priced well within the budget of the average experimenter. Do not overlook this. For example, the BC107 or SE1002 are far superior to anything on our Circuit Boards, and the BA102 voltage variable capacitor is available new at the same price as the surplus equivalent in America. Good surplus bargains can be found in the Classified portions of Electronics Australia or Amateur Radio, though you will want to order cautiously from any given vendor at first, to establish a measure of reliability. If you order from abroad, bear in mind that it is fraught with difficulties. Surplus merchants in America have been known to pocket the money and forget to send the merchandise to overseas customers; a 'Letter of Credit' arranged with a Bank can solve that problem. Yield can be indeterminate, and a largish order will yield a more useful range of ratings. In addition, suppliers prefer to sell in reasonable quantities. This can be met by pooling orders, eg through a Radio Club. In general it is not feasible to order small ratings, and for example it is more practical to obtain your 100V diodes from the degraded part of the yield from 600V ones. Furthermore, by eliminating the Middleman, your components will be so much cheaper that you will be able to use HT ratings for most applications, thereby reducing design problems and simplifying parts stock. Before you order, it is wise to consult your local Postal Customs office to find out the ground rules, and remember that duties from UK are lower... We recommend that light items be sent by insured First Class Post, not

(continued): Parcel Post. FC is more reliable, and not much dearer. If you pay cash in advance (make a moderate trial order first, to ascertain supplier reliability?), do not send too much money to cover postage; it may very well be absorbed entire, in "handling charges." A moderate amount (based on estimated weight) is better, with request to bill for the remainder of postage. But by all means pay that bill promptly, or others will suffer! If the order is placed through a Club, the supplier will also be more likely amenable to extend this small credit. But do not attempt to get credit for the main body of the order. You won't get it. At best, overseas orders tended to be treated with reserve.

Good luck.

P.S. (circuit boards 1/- per transistor)

Rodney Reynolds//42
St. Georges Rectory
Battery Point,
Hobart, TAS

FROM:- The Equipment Exchange Bulletin
P.O. Box 177
Sandy Bay, Tasmania
Australia

TO:

//Registered at the G.P.O. Hobart, for transmission by post as a periodical//

EQUIPMENT EXCHANGE BULLETIN

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P.O. Box 177
Sandy Bay
Tasmania, Australia.

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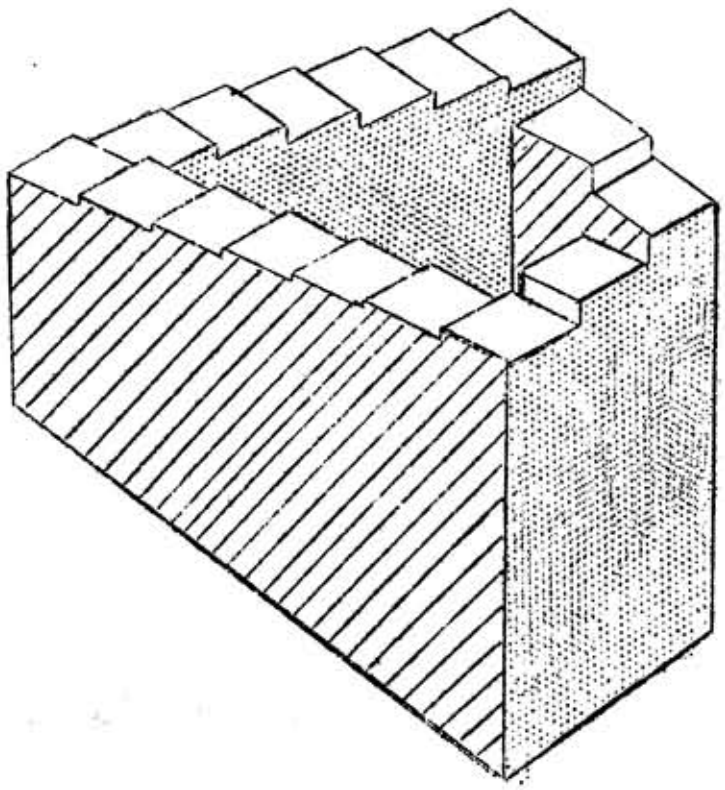
CONTENT:

Editorial. Has your order for Back Issues been delayed? You have our heartfelt sympathy !



* *

Letters to the Editor.

1) Does anyone have any idea why the BV_{cbo} of some Power Transistors is very much higher than BV_{ces} ? E.J .Watts suggests "possibly an uneven mixture of impurities at the two junctions?" Any other suggestions?

Letters to the Editor (continued)

2)...Regarding your suggestion that at some time in the future you will print an issue of EEB with only two pages, it would seem more appropriate when publication is now a month behind if you could print the next issue with not two pages, not one page but no pages. This would save the need to write an editorial for that issue and allow more time to be devoted to the preparation of the following issues. Of course all the subscribers would expect an adjustment on their subscription.

-- H.Pfiefer.
E.Malvern. Victoria.

3)...I have found a simple low cost substitute for silicon grease. In fact, it has a better heat conductive property than the grease. It consists simply of a mixture of flat blackboard paint, about 4 to 5 parts, to one part "Japan cold Size" (made by Berger Paints). I learned of the mixture from a friend who has used it in industrial electronics. I use it both to blacken heat sinks, and as a substitute for the expensive siliconb grease. $1.00 will buy about 3/4 pint worth of the two substances . The method of application is simply by using a brush (not too thick). The diode or transistor (etc) should be placed in position before the paint dries. If necessary the component can be removed easily by a gentle pull. I always mix the two substance as I need them, though the mixture should keep well if sealed. I have used the mixture and tested it on 50Amp diodes, and have found it most effective.

-- T.Laidler
Hamilton, N.S.W.

((We might note that it is not necessarily wise to use this interesting compound to blacken heat sinks, because of the extra heat capacity of the thickish layer it would form. Far better for blackening (only) is the use of some simple dying agent, like "Texta Colour" , in the black colour of course -- Ed.))

--- The following note arrived too late for inclusion in the Computer Board article :

4)... Regarding your circuit boards. I did not like your method of removing the transistors from the boards, namely, cutting the board into pieces with the transistors still on it. The way I do it is to take a sharp knife or other suitable tool, and pare away the solder on each side of the bent transistor lead. Then I push the knife under the end of the lead and bend it up vertically. When all three leads have been straightened I gently pull on the transistor and out it comes. It is then just a matter of scraping away any remaining solder on the leads and the transistor is ready to be plugged into a socket. And I think a socket is more convenient to solder and mount, than a piece of printed circuit board.

-- T.W.Vieritz.
Brisbane, Qld.

The Great Maddever Debate next month, because The Great Maddever replied with an Epic ! Watch for it, in the April EEB. Grandma's Recipe for Simple Transistors.
In the meantime the following Communication has passed our Desk :

5)... I agree that you should solicit articles as possible. Authors will, in any event gain confidence by seeing that others have expressed themselves informally. Surely what EEB could do is to be a platform for people to write about their ideas. If someone then contributes an improvement or correction, the first person (and others) should then be pleased he is learning. Who should be afraid to acknowledge that his word on a thing is not the ultimate, and that he can learn? -- R.S. Maddever.

COMPUTER CIRCUIT BOARDS. -- by R.L.Gunther.

I have received a number of comments on these interesting assemblies, and thought you might be interested in an outline of them. Ref : EEB, Nov. 1965.

EK says "It is possible to remove transistors using a wire buff (the wire brush wheels that are used on grinders in place of emery wheels) to rub off the solder. I tried one to see, and it works OK. There is no mechanical damage if done carefully. I was worried about any electrostatic effects through friction, but the transistor may be alright if tested with an ohmmeter..." No, static electricity should be no problem, because of the very low impedance presented by most transistors, though this would not apply to the newer high Z devices. But for heaven's sake, please don't ANYONE ever test a transistor with an ohmmeter, unless you are 100% certain of what you are doing. Some ohmmeters use HT batteries, and the lower voltage transistors might be damaged. Far more likely is the fact that on the lower ranges, many ohmmeters deliver a considerable current, eg. several hundred milliamperes. If this is passed in the foward direction through a delicate base emitter junction, it can be ruined. I have seen this happen, and invariably the comment is "bad transistor." The statement was true, but misleading! P.S. EK says that one must be careful to buff off solder from leads in the same direction as the leads are bent, or trouble will ensue.

HP suggests stripping off the printed circuit wires, and using the holes to mount components as desired, connecting them with ordinary wire. This sounds very good, but first of course one would want to remove the ordinary components by the usual desoldering methods. I should think it would be desirable to leave as many of the transistors on the boards as called for by the design of the proposed circuit. I suggest this: with a razor blade cut the wiring leading to the transistor terminals. Then when the rest of the wiring is removed, the transistors are left with their contacts intact, without necessity for desoldering. They can then be tested for characteristics, and excess or unsuitable ones can be removed. The extra strip connected to the transistor leads also provides a convenient method for connecting leads to them, causing minimum heating of leads.

RAR has looked into the question of why the boards are available on the surplus market in the first instance. He believes that some of them may be superseded by more modern types, but in others he has found various defects, from hairline cracks in the wiring, to defective resistors, diodes, or transistors. It would seem that when something goes wrong with a board, they just replace it, and write off the board without bothering to repair it. This certainly indicates that it would be wise to test all components on a board before depending on them.

RM has done an interestingbit of work in the darkroom, taking shadow pictures of the boards. From the sample he sent, however, I doubt that this could be much real use in tracing out the circuits. One could spend as much time trying to interpret the photograph as to trace out the original board. The method I have found useful is to mark each connection with a marking pen as I trace it, and then the amount left to be done is unambiguous. It is possible to determine the order of the leads from each transistor, by observing that they form the apices of a triangle whose base is broader than the other two sides. With the long leg of the triangle at the bottom, the apices are emitter, base and collector - going from left to right. (ie clockwise)

RLG has omitted previously to make mention of the plastic coating

Computer Circuit Boards (continued)

which covers the circuit side of the boards, because it seemed obvious. It is, however, apparently proving to be a problem for those working on elegant methods for removing solder, because the coating seriously hampers heat transfer from a soldering iron. There are three methods for handling this coating. One is to scrape it off with emery paper; this is tedious, and the abrasive clogs. Another method is to buff it off, using the method of EK, but taking off only the coating and leaving the solder intact; this is suitable because it is quick and effective, and does not face the various problems of buffing off the solder itself. And then there is the method RLG prefers: soak the board in acetone by placing the board, wiring down, in a shallow dish of acetone so that the liquid covers only up to the top of the board (but not the components). The acetone is highly flammable, and even its fumes can conduct flame from a spark; it is also toxic. Therefore the abovementioned operation must be conducted out of doors, well away from any flames or sparks (or sparking electrical contacts). Acetone is not as explosive as petrol, but it is to be treated with respect. The acetone will soften the coating, which will then dissolve after a time, or can be wiped off after a shorter time.

GT and TO have made an ingenious suggestion which merits attention: when the plastic coating has been removed, solder can be removed with remarkable efficiency simply by placing lightly tinned wire braid (as used for shielding wires) on the connection, and then pressing down on it with a hot soldering instrument. The solder underneath melts and is promptly sucked up into the braid as to a sponge, leaving the terminals underneath quite clean of solder. A given spot on the braid can only be used once for this operation, whence a new spot adjacent to it must be used. Braid is not inexpensive, but since this operation would be most relevant only for transistors, it would not have to be done for all of the connections on the board. Other components can be removed by the usual expedient of heating one end (from beneath) and pulling that end of the component clear from above, but apply the heat intensely and briefly. As far as RLG is concerned, however, it is not even necessary to unsolder the transistors, inasmuch as they can be obtained intact with a piece of circuit board simply by using a fine saw to separate them from each other and from the rest of the board after other components have been removed by ordinary methods. This alternative avoids difficulties of desoldering transistors, and the rather short leads which result. On the other hand, if transistors are desoldered, they can be installed without difficulty into three conductor transistor sockets of the round type of design. (Not the linear type)

I want to say a few more words about the components on the board themselves. I have tested the very small transistors since the original text was submitted, and they all appear to be PNP Germanium, but having very low power ratings, and rather low voltage breakdown characteristics as well; if you are testing BV_{cbo}, be sure not to apply more than -50uA to the reversed collector-base junction, or the transistor may be destroyed. Although I have not tested them for high frequency characteristics yet, we have received some reports of excellent performance from them, above 10mc/s, thereby indicating that they are in the same class as the NPN Germanium units, which fill most of the boards.

We have also seen some very tiny potentiometers on the boards, in various resistance values; also fuses, printed condensers, and OC-26 type transistors. The ordinary small condensers appear to be of ordinary high quality construction, and attain their small size mainly by low voltage ratings, but the electrolytics, according to TO are most likely Tantalum types, and are built for

Computer Circuit Boards (continued)

reliability. I might add that if this is so, those electrolytics will be highly resistant to temperature effects, but one still must not take liberties with them whilst desoldering.

There are several components of questionable identity. Although most of them are clearly marked, there are some little boxes which could be resistors or transformers, or something; I didn't bother to dissect those boards. One must be careful not to confuse condensers with large resistors; the former have more colour bands, and of course test "infinity" on an ohmmeter. The extra large size of resistor is two watts, and the extra small size is $\frac{1}{4}$ watt or 1/3 watt, Some of the boards are rich in diodes, and most seem to be of the small signal, LT silicon type (eg OA200), though some are point contact VHF germanium. I believe that the germanium ones usually are distinguished by a blue band at the cathode end, but in any event, the anode wire of the germanium types is much finer than that of the silicon ones. Also, the foward voltage drop to, say 50mA, ought to be about 0.5V for germanium, and 1.0V for silicon, but sometimes this can be uncertain. The uncertainty arises from the existance of special diodes used (for?), some of which appear to have unusually high forward resistance. From a reasonable power dissipation of about 150mW per diode, some of these would be rated at only about 30mA. HP suggests that they might not be germanium or silicon at all, but copper oxide or selenium. I have run some characteristic curves on them, and this hypothesis does not seem unreasonable, because the characteristic is very sloppy. These tests were, however, run on some specially encapsulated diodes, appearing on the boards as rows of black strips topped with epoxy resin. Most of the ordinarily packaged diodes (eg in small glass seal) have a low foward voltage drop, with the sharp slope characteristic of germanium or silicon.

Most of the transistors do seem to be the 150mW NPN or PNP (mostly NPN) silicon as described by A.E., but some are obviously power types, similar to OC26, and some are extra small ones obviously used for tiny power levels. I have not tested them, but it seems reasonable to assume that they would not be rated to dissipate much power (perhaps 20mW), but probably have unusually good frequency or stability characteristics. Does anyone know? There are some small transistors, about twice as high as the 150mW variety, (but the same diameter) and these are obviously of the "2N1038" variety. I have tested the 150mW variety, and most are in the vicinity of 40V, though some go up to 90V, PNP, germanium, $f_{\alpha b}$ about 200kc/s, 2W collector dissipation if ventilation is perfect, or 20W with a good heat sink, 3 -3.5Amps absolute maximum collector current.

RAR says 10mc/s

In general, I should say that if you wish to know the characteristics of transistors or other components, it is far more rewarding to test them on the workbench than to spend a lot of trouble to dig up the characteristic numbers. Most of the transistors on the boards are of the 2N1300 series, but that won't tell you much. For one thing, you don't know to which of the series a given transistor belongs, and for another, the variation in characteristics of transistors within a given type rating can be greater than the variation between types! Those type numbers (2N...,OC...) are guides to approximate characteristics only, and unless your circuit is very uncritical, it is always wise to test each transistor thoroughly. Indeed, you must test it for NPN/PNP, or dire consequences will arise. I must warn you only that you keep that ohmmeter away from transistors. Use a separate battery, some resistors, and the sensitive current scales of the meter..... Keep I_b under 500μA.

SILICON CONTROLLED RECTIFIERS PartVIII --D.L.Aspinall (VK7)

Herin is described an improved phase-shift control method for the handling of power by Silicon Controlled Rectifiers. Although it is not more simple than a previous system*, it could be more versatile for control of power delivered at low voltages. It can definitely control power over a wider range than in a simple constant-phase circuit**, and has the advantages that not only is the output of the"full wave" type, but it can be used directly with a condenser input filter, and does not depend on feedback interaction with the resistive component of a load.*

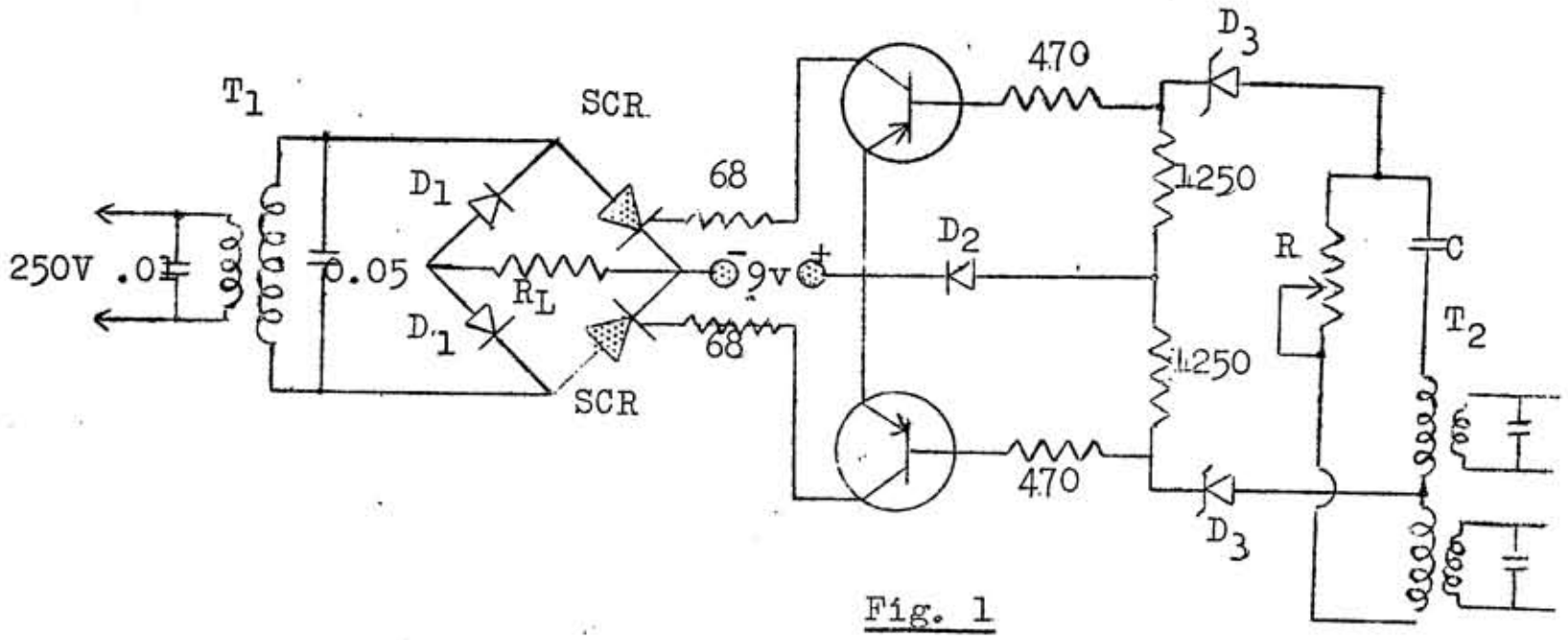


Fig. 1

Notes for Fig.1:

T_1 = 250V to 45V RMS in this instance.
T_2 = one 24V c.t. or two 12V transformers, though two 6V ones would probably work with the correct values of R and C.
TR = OC72 or any small general purpose transistor. NPN could also be used, with suitable adjustment of polarity and configuration. Silicon transistors would also be less affected by temperature than germanium.
D_1 = 250PIV/10A in this instance.
SCR= 200PIV/10A in this instance.
D_2 = any low voltage general purpose silicon diode.
D_3 = 6.8V Zener diodes.
R = 2500 ohms, variable, phase-shift (output) control.
C = 4uF paper or pyranol (not electrolytic!)
R_L = Load. Since the voltages of the circuit are obtained from transformers, one side of the load may be earthed if desired.

The circuit of Fig.1 was developed to obtain a steep fronted phase shifted gate voltage to minimise temperature effects on the control of the SCR's. I believe that it is also an improvement over the phase shift methods described in the G.E. SCR Hobby Manual, in which impractical requirements are evident. Thus, for their cirucit, one could require 255uF for C and 125 ohms for R, leading to a requirement of 46VA for C. It seemed more reasonable to use small C, and large R, and to make up the gate power requirement by using transistor amplifiers.

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*
**Refer to "SCR.PartVI, A variable-phase voltage control system" EEB,May1965.
**Refer to " SCR.PartII,EEB Jan. 1965, and Part V,EEB March 1965.

SCR/VIII (continued)

The circuit of Fig. 1 works well, giving control over essentially the entire cycle, viz, zero to full output. The supply and load components can be varied to suit your own individual req uirements, but of course remember to adjust voltage and current ratings of the semiconductors, in proportion. In my own circuit, the transient suppression components across the primary and secondary of T_1 actually consisted of seriesed R and C, calculated from the article in the Philips Miniwatt Digest for July 1962. I have not indicated these values, however, because they depend closely on the magnetising current of the transformer, and this will vary from one transformer to another. If you do not measure this parameter, the values of simple condenser bypass shown will suffice, remembering that the capacity at the secondary will vary in inverse proportion to the secondary voltage used. Further experiment yielded Fig.2:

Notes Fig. 2

D_1 should have PIV at least twice the nominal voltage rating of motor load.
D_2 =50PIV if transient suppression condensers used across T_2. Otherwise 200PIV or higher.

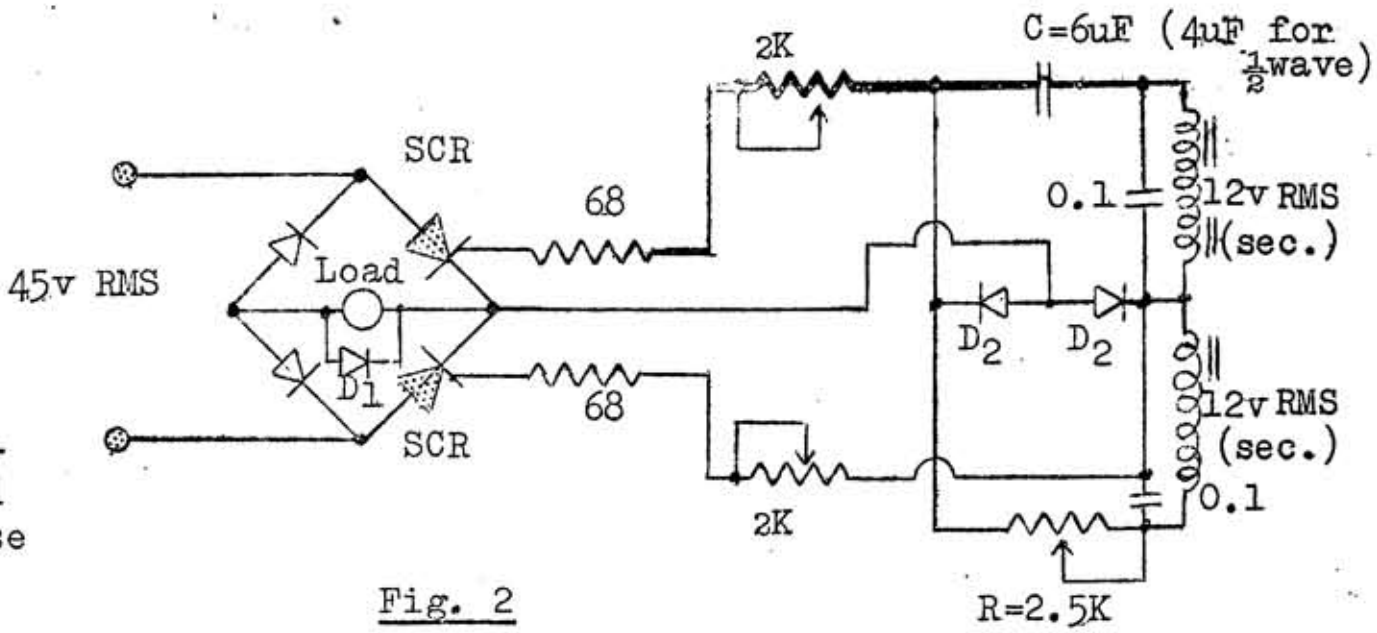

Fig. 2

This is simpler, and works well, limited only by the fact that full control is not obtained over the whole cycle. There is, however, little power lost in the "trailing edge" of the sine curve of anode voltage. The circuit is in use at present driving a separately excited shunt motor having a speed variable from zero to about 6000 RPM, and delivering about 3/4HP. Notice the diode across the load, which is quite necessary in this instance, because it suppresses the back voltage from the switching action of the inductive load, which would otherwise develop nasty output transients across the semiconductors of the circuit.

In Fig. 2, owing to the barely sufficient output of the phase shift bridge (R and C with T_2), the 2000 ohm pots are included to allow adjustment for differences in gate characteristics, so that the SCRs share the load properly. They are also found necessary to provide smooth control over the full range of R. Once set, the may be locked, or replaced by power resistors. Evidently, in this instance, at least 24V c.t. must be used for the secondary of T_2, and perhaps more, if available. This is a useful circuit, and you ought not be afraid to use it, and to experiment a bit for best results as necessary.

At present I am working on a current limiting device, to protect the rectifiers, but it seems to be a bit difficult without including valve circuitry. ((- But very high impedance input can be obtained by using suitably cascaded emitter follower transistors.--Ed.)) ((See also-- EEB Vol. 2, P. 16))

FROM AUSTRALIAN ELECTRONICS, 76 View St., Hobart Tasmania. All items Tax Paid and Post Free, highest quality.

*** Transformers. A1/10W-12.6V/0.5A and 6.3V/1.0A, $2.55; A2/15W-12.6Vct/1A. $2.85; A3/50W-44Vct/0.75A (1.5A if only half used), $5.00. Conservative ratings. For about 25% more we can wind transformers to your specifications; let us know what you want and we'll see what we can do. All primaries at this time, are 240/50cps; A2 and A3 have taps for 230V primary. These transformers are real bargins, but we can continue this offer only if you are reasonably enthusiastic about it, so if you have been thinking of getting a transformer, do it now, or write us with your ideas. No, we didn't buy the Grout Multiple, but we know someone... Transformers ordered in March will be posted late in the month or early in April; after all, you can't get a real bargin, and instant delivery.

*** Diodes. We have obviously saturated the diode market, or do you want us to give them away? See last month's (ha ha) EEB for stock. Zener diodes, however, are going well, and we are gratified. Why use VR valves for low current voltage regulation? But we repeat, if you want LT zeners, get the OAZ series. They are good and cheap.

*** Transistors. We are pleased that no one took us up on the 9/- 2N1038 offer, but we are planning to get some nice "T14" transistors which will be rated for 20W or 3A, with BV_{cbo} probably about 80V or 100V. These will help to fill the gap caused by the collapse of our negotiations for 2N250 transistors; we apologise for the long delay in finding out whether we could get 2N250's, but it's not our fault. If a 20W rating is not sufficient for your needs, you can get a 2N250/2N301/OC26 type from Custom Electronics in Adelaide. They cahrge a bit more than we would, but their quality seems to be good, and the price is still a lot less than retail. My my, who ever heard of a business boosting its competitor? Watch next month's EEB for announcement about the "T14" power transistor.

*** Circuit boards. These look like a good thing indeed, and everyone raves about them, but supply will probably not be inexhaustible. We did not see any more of the miniature potentiometers on the latest lot, but there were a few thermistors, some printed circuits (printed circuit modules mounted on the circuit boards!), and the usual abundance of resistors, miniature condensers, OA200-type diodes, and of course the high quality switching-type transistors, most of which are NPN-Germanium; the miniature ones are low power PNP-Germanium. We got some lovely boards with a great abundance of diodes on them, or several OC26-type power transistors, and we have been including some with orders of 50 or more transistors, counting each large power transistor as worth two small ones. Some 2W resistors are also seen. If you have preferences, state them, and we'll try to satisfy them if practical. Boards are now 3,4,5, or 6 transistors per board; please order to make it come out right. Still 2/- per transistor.

*** Letters. Some of these we just can't resist: "You must be the printers friend. No sooner do you get all that nice "Electronics Associates" station-ary printed, than you go and change your name!.... And best of luck for that 2N174. I've almost forgotten why I wanted it! Ah well, you can't have everything (but I've got nothing). Enclosed is a Christmas present." And he sent an aspirin tablet, much needed indeed. He and a number of others got their 2N174's finally, and in fact we have no more, but we do still have some 2N1100C and 2N1100D really HT power transistors for Hot Transistor Ignitions, for outrageous prices. We have zeners for them too.... "Without setting up the CRO or adjusting any components...., I held an 8uF electrolytic across the

NOW AVAILABLE IN VERY LIMITED QUANTITY : Mechanical Filters, 105Kc/s, ...ndpass 1000cps. ...

Adverts (continued).

motor. The valiant little SCR took its 760PIV for 30 seconds, passed out and delivered the N.S.W. Electricity Grid to the condenser in my hand. When the smoke cleared, I was in the dark, and 4.20 dollars short (oh well). I will in future protect SCR's and my person with diodes regardless." Ah, such honesty, it returns our faith in people. But the SCR took a voltage overload for 30 seconds? Incredible. It only shows what exceptional SCRs we produce, considering that our ratings are Absolute Maximum... By the way, talking about exploding condensers, we had a 0.01µF 600V high quality condenser on the primary of a power transformer, transient protecting a power supply. There was amotor nearby switching on and off. Suddenly, there was a great flash of light and much smoke, and we repeated the abovementioned performance with the Tasmanian Electricity Grid too. The equipment wasn't much good afterwards, because there was a fine layer of carbon over everything, and the components operating at high impedance were hopelessly contaminated with it. Moral: use transient suppressing condensers of high quality, and sufficient voltage rating to withstand the transients they are trying to suppress. This would seem to mean a 800-1200V rating for condensers across the 240V mains; seriesed condensers require equalising resistances, of course. You may find a 600V rating satisfactory-- or not. It doesn't seem to be worth the risk; this is the second time this has happened to us.

FROM: The Equipment Exchange Bulletin
P.O. Box 177
Sandy Bay, Tasmania
Australia

//Registered at the G.P.O. Hobart, for transmission by post as a periodical//

TO: =

Rodney Reynolds//42
St. Georges Hectory
Battery Point,
Hobart, TAS

Sorry for the faint spots in the duplicating. It looks like a flat pressure roller, and since we just had the machine renovated for £18, we are pretty annoyed too!

NOW AVAILABLE IN VERY LIMITED QUANTITY .. Mechanical Filters, 105Kc/s, Bandpass 1000cps. £6 each.

FROM AUSTRALIAN ELECTRONICS, 76 View St., Hobart Tasmania. All items Tax Paid and Post Free, highest quality.

*** Transformers. A1/10W-12.6V/0.5A and 6.3V/1.0A, $2.55; A2/15W-12.6Vct/1A. $2.85; A3/50W-44Vct/0.75A (1.5A if only half used), $5.00. Conservative ratings. For about 25% more we can wind transformers to your specifications; let us know what you want and we'll see what we can do. All primaries at this time, are 240/50cps; A2 and A3 have taps for 230V primary. These transformers are real bargins, but we can continue this offer only if you are reasonably enthusiastic about it, so if you have been thinking of getting a transformer, do it now, or write us with your ideas. No, we didn't buy the Grout Multiple, but we know someone... Transformers ordered in March will be posted late in the month or early in April; after all, you can't get a real bargin, and instant delivery.

*** Diodes. We have obviously saturated the diode market, or do you want us to give them away? See last month's (ha ha) EEB for stock. Zener diodes, however, are going well, and we are gratified. Why use VR valves for low current voltage regulation? But we repeat, if you want LT zeners, get the OAZ series. They are good and cheap.

*** Transistors. We are pleased that no one took us up on the 9/- 2N1038 offer, but we are planning to get some nice "T14" transistors which will be rated for 20W or 3A, with BV_{cbo} probably about 80V or 100V. These will help to fill the gap caused by the collapse of our negotiations for 2N250 transistors; we apologise for the long delay in finding out whether we could get 2N250's, but it's not our fault. If a 20W rating is not sufficient for your needs, you can get a 2N250/2N301/OC26 type from Custom Electronics in Adelaide. They cahrge a bit more than we would, but their quality seems to be good, and the price is still a lot less than retail. My my, who ever heard of a business boosting its competitor? Watch next month's EEB for announcement about the "T14" power transistor.

*** Circuit boards. These look like a good thing indeed, and everyone raves about them, but supply will probably not be inexhaustible. We did not see any more of the miniature potentiometers on the latest lot, but there were a few thermistors, some printed circuits (printed circuit modules mounted on the circuit boards;), and the usual abundance of resistors, miniature condensers, OA200-type diodes, and of course the high quality switching-type transistors, most of which are NPN-Germanium; the miniature ones are low power PNP-Germanium. We got some lovely boards with a great abundance of diodes on them, or several OC26-type power transistors, and we have been including some with orders of 50 or more transistors, counting each large power transistor as worth two small ones. Some 2W resistors are also seen. If you have preferences, state them, and we'll try to satisfy them if practical. Boards are now 3,4,5, or 6 transistors per board; please order to make it come out right. Still 2/- per transistor.

*** Letters. Some of these we just can't resist: "You must be the printers friend. No sooner do you get all that nice "Electronics Associates" station-ary printed, than you go and change your name!.... And best of luck for that 2N174. I've almost forgotten why I wanted it! Ah well, you can't have everything (but I've got nothing). Enclosed is a Christmas present." And he sent an aspirn tablet, much needed indeed. He and a mumber of others got their 2N174's finally, and in fact we have no more, but we do still have some 2N1100C and 2N1100D really HT power transistors for Hot Transistor Ignitions, for outrageous prices. We have zeners for them too.... "Without setting up the CRO or adjusting any components...., I held an 8uF electrolytic across the

ADVERTISING

KIT-SET SPECIALS FROM HALLARD ELECTRONICS.

TRANSISTOR MK4 BROADCAST RECEIVER KIT-SET. This is a new release from Hallard Electronics, and as such we are giving a special introductory offer. The kit when built up has an amazingly high sensitivity for only four transistors. As a point of interest we were able to receive inter-state stations when testing the capabilities of the set. This high order of sensitivity is produced by an efficient reflexing circuit, employing voltage doubling diode detection. The output of this stage is coupled to two driver stages of amplification, which in turn, are coupled to the output stage which drives a 5 X 3 oval speaker. The transistor compliment is: OC169, 2 X OC71, OC74. The set is housed in an attractive plastic cabinet, which is covered with white leather making the set look very professional indeed. The kit is complete to the last screw, and includes instruction booklet and batteries. This kit makes ideal gift when built up. Ideal for the home or the car. SPECIAL INTRODUCTORY PRICE £6-19-6 or $13.95. Prompt attention. HALLARD ELECTRONICS, BOX 58, P.O. CAMPSIE, N.S.W.

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

TRANSISTOR MK2 BROADCAST RECEIVER KIT-SET. Over the years this kit has proved very popular to beginners and enthusiasts requiring a good quality personal receiver, at a reasonable price. By employing regeneration, this set has a range of 30 miles, without the use of an aerial or earth. Of course the sensitivity is greatly increased when a short aerial and earth are used. The kit is complete to the last screw including a special technical explanation to aid beginners. The 9v battery is supplied. FULL PRICE 65/- or $6.50. HALLARD ELECTRONICS, BOX 58, P.O. CAMPSIE, N.S.W.

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

ELECTRONIC SPEED CONTROLS. For portable (ac/dc) drills, saws, sanders etc., up to 3 amps. Controls from 0-50% of full speed; closely maintains preset speed under varying load conditions. Ideal for countersinking wood screws, sanding off paint, and preserving the life of large bits, when used in portable drills. 12 months guarentee: £7/17/6: Post Free in Aust. ELECTRONIC SWITCHES, P.O. Box 138, Balgowlah, NSW.

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

TRANSISTOR IGNITION KITS complete with coil, special Ballast resistor with starting tap, and diode. Full instructions. 12V Neg, earth: £15/0/0. Post free. Literature free on request. Other models available.

Also available: 0=15V meter with coloured dial for Automotive use: 0-15Amp meter with coloured dial for Transistor ignition: 30-0-30 Ammeter (centre-zero); $1\frac{3}{4}$" square, clear plastic face. 48/- each, post free.
MEECO. P.O. Box 407 Naracoorte, S.A.

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

WANTED :- Copy or loan of 22 set circuit diagram. Please contact R.S.Maddever, 35 Biddlecombe Ave. Corio. Victoria.

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PUBLISHED USUALLY EACH MONTH

EQUIPMENT EXCHANGE BULLETIN

P.O. Box 177, Sandy Bay, Tasmania, Australia.....

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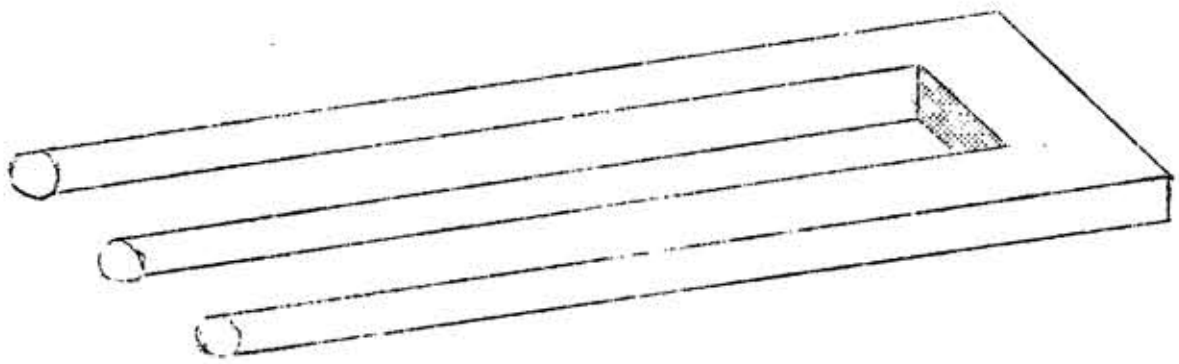


P.S. We published early this month. Fat lot of good it did us.

Letters to Editor.

1)... I enjoy your publication very much, and consider it the most interesting of all publications that I subscribe to. I class myself as belonging to a similar group as Lilley - "Letters to Editor, Feb.'66." I look foward to your promised articles on simple transistor circuit design, and also an article on simple testing of transistors.

For your reference list. I recently acquired a book, which I consider excellent for Amateurs, who wish to catch up on transistors:
"Transistor Pocketbook" by R.G.Hibberd. (George Newnes Publication)

-- N.W.Deague, Malvern. Vic.

2)... I would like to appeal to R.Maddever (Letters to Editor, Vol.1//No.11) to help those who "hesitate to modify a circuit... to take another transistor." We plead with him to help us,(and not just refer us to technical books,)in a series of articles, written for the non-university type. Perhaps a team effort is called for, but please, don't let the experimenter down.

-- E.Kershaw. Footscray, Victoria.

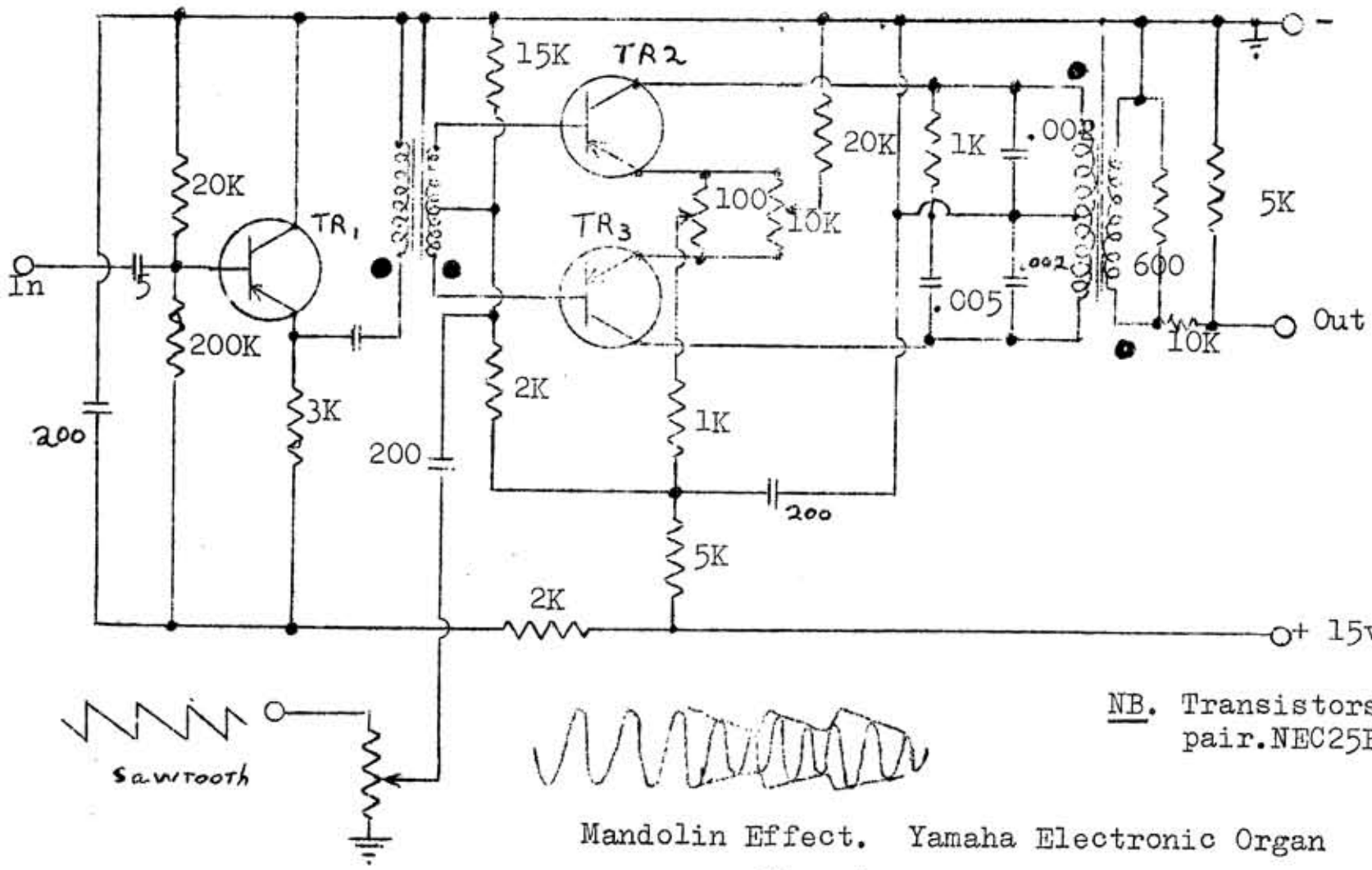
3)... I think that the criticism made of the Australian experimenter, in the EEB, Vol.1//No.11., is unfair. While some of the statements remain true,

Letters to the Editor (continued)

I feel that the experimenter has been blamed for something which is not entirely his fault. He is at the mercy of the publishers of several Australian Electronic publications, who seem to publish articles explaining how various circuits and components work, print constructional articles using the publishers designs, yet they do not print articles covering the design of circuits to meet the particular experimenter's needs. Many experimenters do not know what a loadline is, or how to draw one, simply because they have never been told anything about them. Often the little they have learned is mixed up with advanced mathematical calculations that they cannot understand.

-- H.Pfiefer.
East Malvern. Victoria.

4)... After reading your articles on Volume Compression, I realised that the Mandolin effect circuit in the Yamaha Electronic Organ could possibly be modified to do the same job. In Fig.1, a modulating sawtooth wave is fed in to the amplifier. When the Mandolin effect is required, the control is adjusted until the required depth is obtained. At this point, a DC signal could possibly be coupled, to control the gain.



NB. Transistors matched pair.NEC25B111

Mandolin Effect. Yamaha Electronic Organ

Fig. 1

Since I have been fiddling around with electronic organs, I find the ear is a funny thing. A louder high pitched sound can tend to over-ride a lower pitched note. Actually it seems to make it go softer, even though the CRO still shows it at the same amplitude. Tone generators are an expensive part. My brother and I have been experimenting with an SCS, which could have possibilities. Fig.2 shows one possibility, which operates quite well, from practically nothing up to about 50K, by changing the value of C. It can be synchronised by very small pulses from a previous oscillator. Has anyone

Letters to the Editor (continued)

come across any circuitry which would do to following job? I wish to fill up the top octave of an organ, (1Kc to 2Kc) with a sawtooth waveform, having a voltage output of 1½v. and operating on 12Volts, DC. A Unijunction transistor could operate similar to the SCS, but they are expensive.

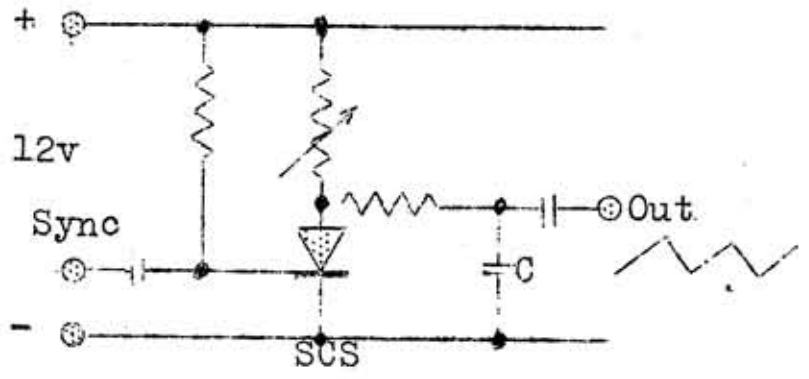


Fig. 2

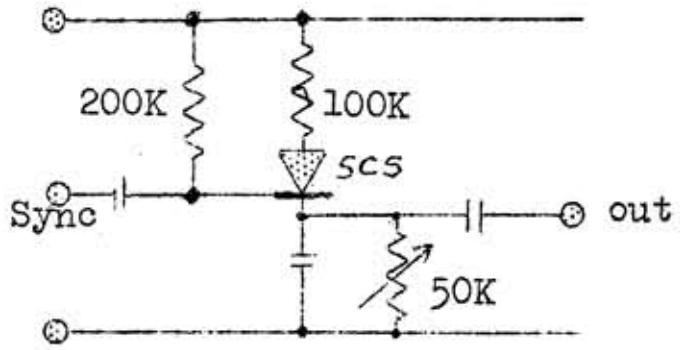


Fig. 3

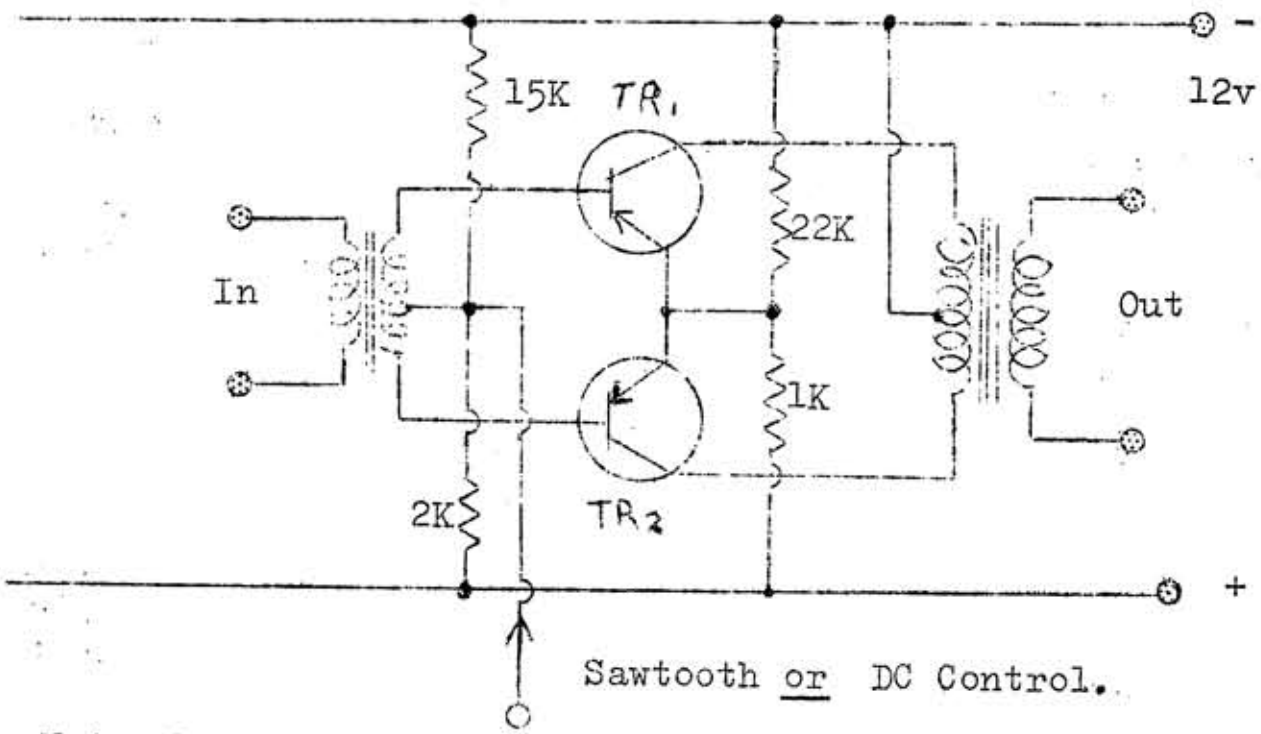
Fig.3 is a theoretical circuit (untried as yet) that should give a more desirable waveform, with a sharper front.

-- K. Veritz.
Brisbane, Qld.

((The problem of expensive UJT's might be overcome by using a UJT substitute. T.Ohsberg will publish an article on UJT Substitute, in a near future issue of the EEB.- Ed.)) Hopefully MAY

((The following letter from J.A.Hill, author of the articles on Volume Compression, is a comment on the above letter and circuit. Ed.))

5)...The Organ circuit shows good observance on the part of Mr. Veritz, namely that the principle involved is somewhat similar to that required for a compressor. The active part can be simplified to this:-



Note that the emitter voltage balance network has been omitted for simplicity. Also the three capacitors and one resistor across the output transformer are only to avoid ringing at H.F. (Hence omitted for simplicity.)

Now, what do we have? Just a simple "Push-Pull" amplifier stage, plus a means to apply DC (or varying DC- eg. sawtooth) to the bases of TR_1 and TR_2.

Letters to the Editor (continued)

This DC changes the bias on these transistors, thus altering their gain. As a result the gain of the stage is dependant on the DC control voltage.

Referring to the August/September edition of EEB - "Volume Compression Part I", note that this (organ) circuit would form part of the "Elaborate distortion cancellation circuitry" to produce a practical form of the idea in Fig 2 on page 8. In fact there were several reasons why I avoided this idea:-

(1) Requires 2 expensive transformers.
(2) Maximum compression limited to about 20 - 30db.
(3) The diode method proved much simpler.

The diode method, however, does have several disadvantages of its own:-

(1) Maximum hold time is in the order of 2 -5 seconds. (Limited by C_1 and C_2 ; increasing these capacitors beyond 250uF each causes deterioration of attack time.)
(2) Does not lend easily to use of compression meter.

To overcome these disadvantages, I am toying with the idea of putting diodes in as emitter loads in a small signal balanced (DC coupled) amplifier. Also thinking of using an advanced system of threshold control, it could then be classed as a "limiter", to supercede those valve types currently used in radio and T.V. stations.

Of course this unit has now developed out of the realms of being simple, so it is not a practical proposition for home applications. However, MAVCAT if properly adjusted has frequency response and distortion figures which would make a Hi Fi enthusiast happy - its capacity is certainly not limited to speech.

-- J.A.Hill.
Mildura. Victoria.

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

GRANDMA'S TEST FOR SEMICONDUCTORS.

Part I: Simple substitution and circuits. -- by R.S.Maddever (VK3)

Many constructional articles in Australian journals certainly do help in understanding how circuits work, but the more basic information supplied, the better. Perhaps I can tackle this subject here, and give some insight on how you can vary circuits to suit your own ends. The most complicated maths used will consist of permutations of these two simple relationships:

1) OHM'S LAW. $E=IR$

2) Current gain in a transistor. $\beta = \dfrac{I_{c_2} - I_{c_1}}{I_{b_2} - I_{b_1}}$

where E = Voltage, I = Current, R = Resistance. I_{c_2} is the collector current flowing when a base current of I_{b_2} is applied, and I_{c_1} is some smaller collector current, corresponding to a base current I_{b_1}. On these two relationships one can build a palace.

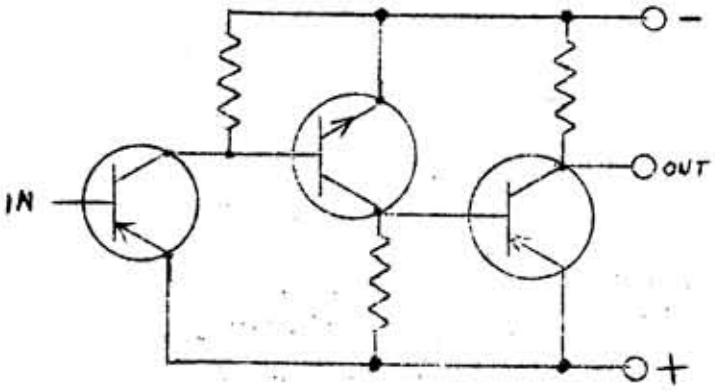
I might mention that some overseas periodicals can be valuable in obtaining basic information too. British ones can be obtained profitably at the Newsstands, and many American ones can be obtained at a considerable saving in cost by buying a subscription directly from the publishers. The Radio Constructor costs about 30c per month, and has a longstanding series of articles on "Understanding Radio," as well as many more circuits of experimental interest.

Simple substitutions and circuits (continued)

Practical Electronics, a relative newcomer, at 25c per month is also strongly recommended. It is available from the publishers, and some copies from Electronic Developments, Melbourne. Among other good things this one recently had a series on "Semiconductors" which included (in May 1965) "Simple Circuit Design." Back issues are probably available from the publishers. Radio-Electronics, Electronic World, and the various Amateur publications from America can often be most interesting. Specific non-periodical publications have been mentioned in the Reference Lists in the EEB, and several of these have simple and direct treatments.

To be practical, however, I might discuss here five main factors to be taken into consideration when substituting transistors, and in the discussion we can cover the elements of basic transistor amplifier design as well.

1) NPN or PNP. If changing over all the transistors from one type to another, the battery polarity must be reversed. But do not forget to change the polarity of electrolytics too. If only one transistor is changed, it may be necessary to redesign the stage, particularly if the stage involves control elements (eg. AGC) from other stages; in that event it is necessary to use common sense, and consider several relationships too involved to treat here. If, however, a circuit is being designed from the start, the combination of NPN with PNP can lend a marvelous versitality for directly-coupled circuits and others. For example, Fig. 1.:



2) Frequency. If a circuit needs transistors of a given frequency response, substituting another with less than this response either means it will not operate at all (eg. oscillators) or that the waveshape will be seriously affected (eg. amplifier or square wave generators). No actual harm should come to the transistor, other things being suitable. Using a transistor with a higher response should seldom cause trouble and may even improve things. Occasionally it may allow spurious oscillations to take place; these would have to be eliminated by a suitable bypass condenser.

3) Power. The power actually dissipated by the stipulated transistor can ordinarily be found or estimated from circuit values. A substitute should be able to carry this power with perhaps a safety factor of 2 (or more! Have you ever tried to put 15W on an AD140 using nominal heat sinks?). Operating power may usually be roughly estimated in an RC coupled amplifier stage by supposing on the average, that the transistor has across it half the supply voltage; then the current can be deduced from the voltage across the collector load, (ref. Fig. 2.). Where this would not apply, such as with a transformer winding in the collector circuit, the base bias may be estimated from the potential divider producing it, and the emitter potential assumed to be a certain constant voltage below this; this base-emitter voltage is characteristic of the junction, and is (for small transistors) about 0.2V for germanium, 0.5V for silicon. When the emitter potential is known, the emitter current is deduced from the emitter resistor by ohm's law. These steps will be considered in detail below.

4) Peak values. It seems evident that the peak values of current and voltage for a substitute transistor should not be exceeded. For voltage, it is simplest

Simple substitutions and circuits (continued)

to ensure that the supply voltage is kept below BVces (the breakdown voltage between collector and emitter, with the base shorted to emitter *), provided the collector load is resistive. Where there is a relay or other inductive load in the collector circuit, higher back voltages are likely to be enccuntered, and these should always be suppressed in some manner, eg, by condenser of suitable value or a diode across the coil. The latter method is better, but in audio or r.f. circuits may be impractical, and capacitative peak suppression is indicated. Where this is not possible, the transistor must be rated for maximum possible peak values under any possible conditions.

Peak current may be estimated by assuming that when it flows, all the supply voltage is dropped across the collector and emitter resistances.

5) Bias. This will be of interest if a change from Ge to Si is contemplated (or vice versa) or if transistors with different gain are used in a stage where there is very little or no resistance in the emitter to ground line. In a stage such as Fig.2, changes are not usually necessary since the circuit is a sophisticated one, and is largely independant of transistor characteristics. The bleeder network of R_1 and R_2 reduces dependance on bias variations due to temperature changes, and the emitter resistor R_4 provides degenerative D.C. feedback to assist the process. If R_4 is not bypassed, it also gives A.C. negative feedback, and although amplifier gain is reduced, linearity and input impedance are increased, and dependance on transistor gain characteristics is minimised.

Now let us consider several examples of circuits involving these parameters. EXAMPLE A). Refer to Fig. 2. Assume that the values indicated are found in a circuit in which a substitution is desired. (The substitution may not be to replace a bad transistor, but may be a matter of trying to decide whether a transistor from your junkbox will be suitable for use in a published circuit which specifies some nice but expensive transistor).

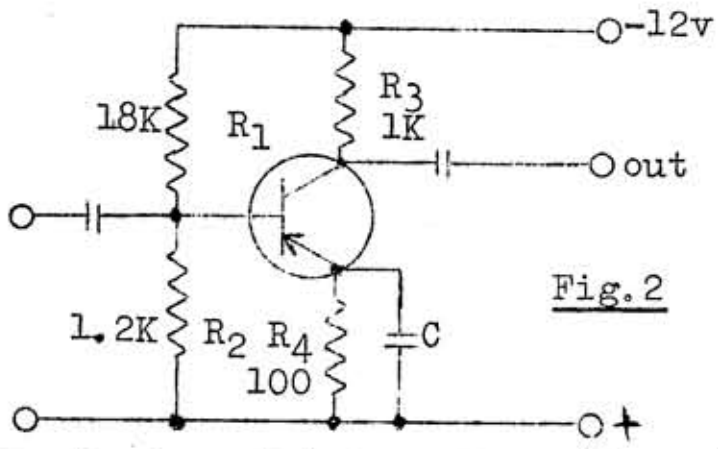


Fig.2

Assume half the supply voltage is supposed to appear across the collector load resistor, R_3. Then from Ohm's law, collector current, Ic = 6V/1K =6mA. And E_4= 6mA x 0.1K = 0.6V. Then the voltage across the transistor is 12 - (6 +0.6) =5.4V, and thus the average power dissipated by the transistor (in class A operation) is P =EI =5.4V x6mA =33mW. A transistor rated at 100mW would be suitable if not located next to a hot component; OC71, 2N1306 etc, or as determined from characteristics found by experiment (to be discussed in Part II).

To Be Continued.

* *

LASER DANGERS.** -- by Kayla Bloom WØHJL

I was attracted recently by an article in one of the magazines which described a "Laser pistol", which has been developed by IBM. It seems likely that such devices may hit the market at some time in the future. It is also possible that being a ham, you may be toying with the idea of lasers as an

* BVces is usually a bit less than BVcbo, the usual characteristic published.
** Reprinted from CQ, September 1965, p, 38, by permission.

Laser Dangers (continued.)

experiment. If so, take heed to the warnings in recent research on the subject.

I would like to quote from a report by the Army Surgeon General's office on a piece of research done by Dr. Edmund Klein and Dr. Samuel Fine and supported by the Army. This report said in part:

"Although the laser irradiation caused only superficial external damage when focussed on the foreheads of mice, damage inside the skull was extensive and frequently fatal.

" In other animal studies, laser radiation of the gastrointestinal tract— either directly or through the intact body wall-- was followed by perforation, peritonitis, and death.

" In test tube studies, the action of fibrinolysin, a substance which aids normal blood clotting, was reduced by laser irradiation.

" In animal tissue, laser radiation resulted in the formation of "free radicals" -- extremely short-lived molecular fragments which some researchers believe may be associated with the cancer process."

Laser beams have already shown themselves to be valuable in the fields of medicine and communications. Apparently it would behoove us to treat them with great respect. It would be a tragedy if one of us, in experimenting with this new tool, were to cause the death or permanent injury to one of our children by careless direction of the laser beam, without being aware of the potential dangers.

((It should be added that the coherent radiation in a laser beam is very little attenuated by distance, compared to ordinary light. If you were using a laser beam for communications to a point, say a mile away, severe damage to the eye of an observer at the receiving end might be possible if he happened to intercept the small effective area of the beam -- as for example in lining up the receiving apparatus with the beam. Also unfortunate would be the injury which could be caused to an innocent person who happened to intercept the beam between transmitting and receiving locations. The laser may very well be the "death ray" of future International pleasantries, and is in no sense a toy or casual method of communication. -- Editor.)) (EEB)

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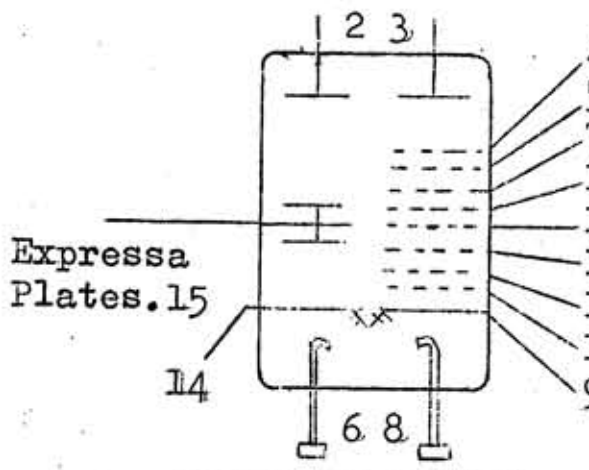
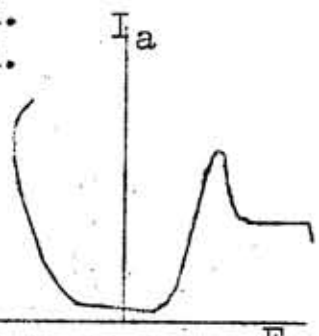
PRESSURE INJECTED ARGON SATURATED CATHODE DIODE DECTODE. -HP



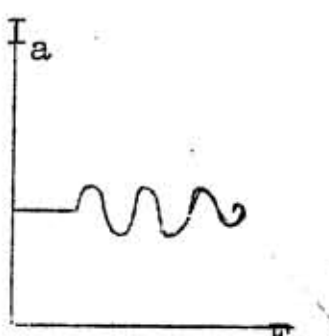
4. Radioscopic Contortion Preventer.
5. Bounce Absorber grid.
7. Xcyclotronic Suppressor grid.
12. Anti-inertia grid.
10. De-emphasis grid.
13. Compressor grid.
1. Suppressor grid.
11. Screen grid.
9. Control grid.

93BZA4X10GTM

(Services equivalent = 93CVA4X10GTM)



Dectode Section



Diode Section.

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TRANSISTOR MK2 BROADCAST RECEIVER KIT-SET. This kit has proved very popular to beginners and enthusiasts requiring a good quality personal receiver, at a reasonable price. Employing regeneration, set has a range of 30 miles without Aerial (can be extended by addition of aerial and earth). The kit is complete to the last screw including a special technial explanation to aid beginners. 9v battery supplied. FULL PRICE 65/- or $6.50. HALLARD ELECTRONICS BOX 58 P.O. CAMPSIE, N.S.W.

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ELECTRONIC SPEED CONTROLS. For portable (ac/dc) drills, saws, sanders etc., up to 3 amps. Controls from 0-50% of full speed; closely maintains preset speed under varying load conditions. Ideal for countersinking wood screws, sanding off paint, and preserving the life of large bits, when used in portable drills. 12 months guarantee: £7/17/6: Post Free in Australia. ELECTRONIC SWITCHES P.O. BOX 138, BALGOWLAH, N.S.W.

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

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Also available: 0-15V meter with coloured dial for Automotive use: 0-15A meter with coloured dial for Transistor ignition: 30-0-30A meter (centre-zero): $1\frac{3}{4}$" square, clear plastic face. 48/- each, post free.

MEECO. P.O. BOX 407 NARACOORTE, S.A.

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NEWS FROM CLIVE WITCHELL INDUSTRIES.

Just released - a new Australian magazine designed especially for newcomers to electronics. It is called "Transistor Kits" and as the name implies each project is backed by us with kits of parts or separate items. Three issues have been published and are available as No. 1, 2 and 3. They cost 25c each or the three for 70c. A subscription for 6 issues is a very good investment at only $1.45 (14/6) which includes postage to your home immediately they become available.

(Continued on P. 39)

SELL two U.S. Army Walkie Talkies BC-116B. Complete with valves, $30 (£15) the pair, or offer. S. Rasmussen, 36 Amarroo St., Chadstone, Victoria. Phone 27-4112.

==========

Advertising (continued)

From Clive Witchell

One of the projects described in the magazine is an electromechanical project. The electronic sensing circuit detects a predetermined intensity of illumination to operate a relay. The relay is connected to a small battery motor which in turn drives through a gearbox to activate any display you wish such as railroad models, animated displays, science projects etc.

The parts for this project are divided into 3 units:

* Electronic circuitry kit $5.50
* Electromechanical kit $3.00
* Gearbox kit $2.10

The complete kit is only $10.50 and comes with full instructions.

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

Another popular kit is our six Transistor Superhet Radio. This kit is built in progressive stages to enable each section of the set to be checked easily.

* Superhet - 2 $13.00
* Superhet - 4 $21.00
* Superhet - 6 $27.00

Each unit is complete in itself. The superhet - 2 gives personal earpiece listening. The superhet -4 gives medium loudspeaker output while the superhet-6 gives full loudspeaker output. The dimensions of the set are only $4\frac{1}{2}$"x$2\frac{3}{4}$"x$1\frac{1}{2}$". Each kit comes complete with comprehensive instruction manual. (manual separately, 90c)

- -

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FROM: Name: -

Address: -

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FROM Australian Electronics, 76 View Street, Hobart, Tasmania: Gee, thanks, BJ, for leaving us so much room. Never mind, it's only money.

== Semiconductor Testing Service. Do you KNOW that the 'bargain' semiconductors you buy are worthwhile, stable, reliable, specified as advertised? Maybe not. We are willing to relieve this uncertainty for you. If you send us your diodes, transistors, etc, we shall test them competently for you. Charge: 2c per diode, 5c per transistor for all ordinary tests (specify if you want unusual ones), and an extra 5c for frequency limit test (it is difficult!) for lmc/s and above, 5c per SCR, etc. You name it, we'll test it. Prices include post, and guarantee as long as items are used within their Absolute

(continued): Maximum ratings, as specified. We hardly expect to get rich from this, but the experimenter in distress may find this service useful. Please specify whether or not you are in urgent need of the items (viz, more urgent than usual). Ah but of course these tests are already performed on merchandise purchased from us. Heh heh. == Well, nearly all merchandise. Computer circuit boards have been selling at a dazzling rate (at 20c per transistor, with a great lot of resistors, condensers, diodes free). Although the circuit boards are the one exception to our usual guarantee, we have received repeated statements of considerable satisfaction by customers. You are, however, cautioned to test everything on the boards. If components are left on the boards for complete circuits, the circuit should be tested for function. Technical details on the circuit boards can be found in the EEB of November 1965 and March 1966. == No more 2N1100 or 2N1100B. Only 2N1100C, etc. No more SCS (Silicon Controlled Switches) either, sorry. Still plenty of diodes, darn it. NO we refuse to give them away, but oh well, say if you order about £3 worth of diodes, you can have 10pc discount.... 500V/10Amp SCR's will be £2 even, when they arrive. Negligible profit, but lots of good experimentation for you. Mention EEB advert... No 'T14' yet. Soon, maybe.

Still have a couple of the electromechanical filters at £6 ea. Amazing!

Rodney Reynolds//42
St. Georges Rectory
Battery Point,
Hobart, TAS

FROM. EQUIPMENT EXCHANGE BULLETIN
P.O. Box 177
Sandy Bay, Tasmania
Australia

TO

// Registered at the G.P.O., Hobart, for transmission by post as a periodical //

EQUIPMENT EXCHANGE BULLETIN

PUBLISHED SOMEHOW EACH MONTH. P.O. Box 177, Sandy Bay, Tasmania, Australia.

STAFF. Worries= RLG, Arrangements= CKP, Stencils= BJS, Printing= DFD, Advisory= RAJR, DSM, JAH, TO, etc. ARTICLES earn a free one year subscription. Copyright is the author's. ADVERTISING, prepaid. 2c per word (no minimum required), 1c each after 20 words, half page $1.00, etc, call sign or name free. Please write legibly! BACK ISSUES for 1966 are 30c per quarter (ie, 3 months). Volume I (1965), bound, $1.25, post free. AN IDENTIFICATION NUMBER follows your name on the address label. Please refer to it in any correspondence to us. Please renew without our reminding you. Thank you!

CONTENT:

EDITORIAL: Finally got all the 1965/6 back issues printed. Whew, what a job! You ought all now to have back issues if you have requested them. If not --- let us know. The Vol.I copies we have will definitely be a "limited edition" and when they are gone they will be gone; the amount of work to print them is prodigious and expensive, and the stencils are in shreds. This Back Issue thing has become a major timewaster, so as you can see from the addition to the Heading, current Back Issues, (eg.1966) are available only in Quarterly fractions (eg. Jan, Feb, Mar.) at a time, at a cost of 30c per quarter.

Does anyone have access to a typewriter with particularly small type, eg. like that in last month's Heading? We can nolonger get satisfactory results from the firm handling it for us previously, and we do have need for such work now and then.

Our comment in the April Editorial, about publishing early was, of course, typed before duplicating commenced. When we started to turn out copies on our Antique Machine, the stencils started to shred. The solution was simple: a few major parts were needed, (this,after an £18 "overhaul" job) and we needed only to send to Melbourne, and waited and waited. You know what? There was a postal strike. No parts. So we tried some more patching and turning. Result: more shredded stencils, and gnashing of teeth. Oh well, our hearts are in the right place. May 6th: You know what? The material from Melbourne still hasn't arrived. We have worked out an ingenious method to keep stencils from tearing: Celotape in choice spots. This kind of Rugged Individualism comes from long hours of trying to make transistors do the proper jobs of valves!

We notice that Elsewhere there is a significant trend to eliminate the old trusty "cycles per second" and substitute for them "Hertz." With all due respect to the inventor of radio communication (yes!) and other matters, we don't like it. The argument that you can't tell whether or not "Mc" means megacycles or millicycles is silly, and the sound "Kilo Hertz" grates on the ear... Oh well, progress will never be denied, and no doubt we shall learn to live with Hertz as we have learned to live with Henry, Ohm, and Farad. But why didn't they decide this matter long ago? Just think; if we continue to use cps, kc/s, etc we'll be the only ones easily understood. //--RLG

Letters to the Editor.

1)... In response to your enquiry about the Joystick (see P.17, Feb. 1966 EEB), I did some tests on one borrowed from a friend, so it could not be torn apart. Tests indicated a Q of 110 when tuned by a 100pf capacitor at a frequency of 2.4mc/s. Z at the input was 27 ohms. Inductance 50uh. X-Ray indicated a close wound coil. The coil is approximately 180 turns of No. 14B&S enamel wire on a $\frac{3}{4}$" dowel (calculated L= 45uh). For those wishing to construct one (goodness knows why) at a considerable saving in cost, take 21$\frac{1}{2}$" of $\frac{3}{4}$" dowel and drill a 5/32" hole 3" from each end; start winding $\frac{3}{4}$" from the hole and you should end up about $\frac{3}{4}$" from the other hole. At the top (feed) end use 44" of $\frac{3}{4}$" aluminium tube, feed at the end remote from the coil, use 32" of the same tubing (copper if you want the delux version). Drill a 5/32" holle $\frac{1}{2}$" from the coil end of each tube, and use a 5/32" screw to attach to dowel, and to connect wire. Remember the tighter you make the screws the more you squeeze the tube end and the more she wobbles.

The transmitter loading unit consists of a 385pf variable with the tx (50 Ohms) fed to the rotor,and the fixed plates going to the coil of 1$\frac{1}{4}$" in diameter, and approximately 21 R&S tapped at (from capacitor end) 4, 7, 11, 21, 31, 46, 58, 82, 86, 98, 117, 140 turns with a total of 177 turns. Tap the aerial feeder onto the coil, shorting out the unused section ((Ed. Note: that must do wonders for Q!)). Feeder must be at least 7 feet long and preferably 70 feet, so why use Joystick?

I have used a similar system of loaded whip on top of a 60 foot mast, and it does help shift the current node up in the air a bit on low frequencies (eg 2-3mc/s), but I cannot see what is to be gained on the higher frequencies.

Most of the advertisments for the Joystick are based on testimonials, and indeed some people may be getting good results, better, say than a short unloaded piece of wire ((or a poorly matched resonant aerial---Ed.)), but I know of some who are not. The testimonials on mobile operation are certainly no recommendation, as amateurs are allowed much higher power than fire brigade people, and as we get as good if not better results with centre loaded whips as far as range is concerned. As for construction, I always look at this from the point of view of how it would stand up on fire brigade use, and the Joystick certainly would not, with the present construction which may be alright in a sheltered attic but which is appalling for mobile applications.

The one qualification by the manufacturer seems to be that poor results can likely be attributed to power being drained from the Joystick by nearby resonant aerials. Their solution is to remove the other aerials. From a practical stand point, this seems a rather unlikely proceedure.

-- Kallam
Victoria.

2)... The magazine (EEB) looks good; it seemed a bit heavy on exotic devices and short on ham stuff, but of course, it's not designed for hams... I wish Australia weren't so far away. I'd really like to visit, but the fares are a bit too high for a casual visitor. Too bad they couldn't have arranged for it to be between North America and Asia!

-- P. Franson
Peterborough, New Hampshire.

3)... I have just received the MARCH EEB, and it is now still MARCH (albeit

Letters to the Editor (continued)

the 29th). Please convey my heartiest congratulations to the publishers! Seriously though, (more or less) its a good rag and worth every cent of the 60c p.a. it's going to cost. I'm glad to pay it now (but I won't be when renewal time comes along)... I noticed the comment about 600V condensers on P.29 of the March Issue. I had built a T.V. set using surplus radar CRT's etc, and silicon diodes (from your favourite advertiser!) in the power supply. So, as apprcved by your Rectifier Rules I wired a 0.033uF 600WV paper condenser across the mains. Sometime between the time of building, and a routine check it must have quietly and gently exploded. I found the pigtails still on their terminals each with the end-seal of the tube. The middle cardboard tube, foil, and paper roll were just floating about loose. No fireworks, no nothing. I would never have noticed if I had not decided to make a few adjustments. Exactly how it happened I'm at a loss to explain. Manufacturer's literature suggests that the 600V type of condenser may be used on 240V 50cps, but it seems that there is little safety margin. As you say, 800-1200WV would seem preferable....

-- P. Kominatos.
Vaucluse, N.S.W.

((--Maybe someone turned on the T.V. set when you were out of the room?--Ed.)

4)... I read the comment in the February Editorial about the editorials being "really the best," and I must say that I agree wholeheartedly with this statement. Also I find the rest of the Bulletin very interesting, but wonder why you never publish articles on valves?

-- S.Rasmussen
Chadstone, Victoria.

((-- You write us an article on valves, and we'll publish an article on valves. We are intrigued by semiconductors, though we still prefer valves where high power, high frequency high power, high impedance, or good linearity are involved, not to mention the beautiful insensitivity of valves to the effect of temperature: perhaps it is not generally realised that not only does temperature affect I_{co} of transistors, but also gain. This can be a first class headache when a solid state device is supposed to work outdoors or at high altitude ... One sees plenty of circuits for high fidelity power amplifiers in the national and international literature, but do you know what? We are building a nice hifi amplifier for our radio and record player, and it is going to use the beautiful little circuit found on p.146 of the 16th edition of the Radio Handbook (Edited by Editors and Engineers, Summerland, California, and available from them for considerably less money than usually charged locally), a publication of great value in many fields, we might add. The circuit uses three valves equivalent to the 6AS7G in a transformerless single-ended push-pull configuration, with a 16 ohm output to loudspeaker. Harmonic distortion at 10 Watts is 0.2% and only 0.4% at 20 Watts. On the other hand, if you are not charmed by the handsome look of bulky glowing valves and stout real construction, our favourite solid state circuit for same is the one on P. 64 of the May 1963 issue of Radio -Electronics, boasting 0.1% distortion at 10W, though of course with a considerably reduced transient frequency capability .... Ed.))

((Ummm, why write Editorials, when we can reply to Letters....Ed.))

((Simpler circuit in Mullard Outlook, July-Aug. 1965, though not as good))

5)... What wild names you people choose for Semiconductor setups! Texts call "pseudo-tunnel diodes". "Back diodes". How about simulating a transistor by two unijunctions and calling it a pseudo transistor? Or use 4 transistors (in pairs as unijunctions) to get simple transistor action, and call it a pseudo-pseudo-Transistor?

-- D.R. Horgan. Brisbane, Qld.

Grandma's test for Semiconductors. Part II -- R.Maddever.

Peak Current and Voltage. If no collector current flows, the peak voltage will be 12V between collector and emitter. Peak current will be obtained when the 12V supply is dropped across the 1K + 100 ohms, ie, I_{pk} =12V/1.1K = 11mA. The transistor must be rated so that the peak voltage and current ratings never exceed the absolute Maximum ratings.

Bias. If the transistor is Germanium, the base will be about 0.2V above the emitter. Since in Fig.2, E_4 =0.6V, the base will be about 0.8V above the positive line. So R_1 and R_2 must divide the 12V to give this value, thus the values of resistance shown. Indeed, if the bias voltage divider resistances are known, the collector current (and therefore the collector dissipation) can be estimated by reversing the abovementioned procedure. In general the bleed current is 5 to 10 times the transistor base current, and the latter can consequently be ignored in the calculations.

If you are designing your own amplifier, you would follow a similar reasoning: Choose Ic, choose R_3 to drop half the voltage at this current, choose R_4 to drop 0.5V or 1.0V (depends on the amount of stabilisation desired, and whether R_4 is bypassed or not), and choose R_1 and R_2 to give the appropriate base voltage, assuming a bleed current through R_2 of say, ten times I_b, unless battery life is a major consideration; in that event the factor might be as small as four, though this would increase effect of temperature on amplification, distortion,etc.

Substitution. Given the values shown in Fig. 2, could we safely substitute a silicon transistor for the germanium one? The base-emitter potential of the low power silicon transistor will be about 0.5V. This means that if the same collector current were to flow, the base ought now to be 0.6V + 0.5V =1.1V. above the positive line. This could be accomplished by reducing R_1 to 13K. If it is not reduced, what happens? Then the voltage across R_4 will be 0.8-0.5V = 0.3V. And emitter current will be 0.3V/0.1K =3ma. The transistor would still be operating on the linear portion of its collector characteristic (as it would be for any I_c above about 0.5mA), but the signal handling capabilities of the amplifier would be reduced, since the collector can now swing only 3mA before reaching cutoff, compared to 6mA previously. Whether or not this is allowable depends on requirements of the circuit. These can be estimated by inspection of general input and output levels. Thus, if the stage is being used to drive a power amplifier stage, it is likely that the full 6mA of collector current would be desirable, particularly if linearity is important (eg high fidelity). If, however, the stage is being used only as a simple voltage amplifier, the reduction in current might be tolerable if the reduced voltage swing were acceptable: note that the original voltage swing could be obtained by raising R_3 from 1K to 2K (or 2.2K for actual values of resistors available), if $R_1$and R_2 remain the same. One of the simplest and best ways to determine whether a given substitution gives adequate output, is to try it! But you must not do this indiscriminately; you must first make certain that ratings will not be exceeded. For example, if the circuit had first been designed for a silicon transistor, substitution of a germanium one could cause a substantial increase in collector current, as well as power dissipated. One would then have to make certain that current rating was not exceeded, power dissipation was reasonable, and that operation was still on a linear portion of the characteristic curve. The other factors can be determined at least approximately by inspection, as discussed here, but minimisation

Tests for Semiconductors (continued)

of distortion is best done by listening (or looking at CRO), and varying bias for best results, all other things being equal.

A collector current of 1mA is reasonable for small voltage amplifier stages, perhaps 5-50mA for driver stages, and 100-800mA for Class A power amplifiers. On the other hand, a transistor in an ignition system may pass as much as ten amperes!

EXAMPLE B. Reference Fig. 3. Power. From the values of R_1 and R_2 given, the base potential will be about 12 x 680/1500 =5.4V, if base current is ignored. Now, for large power transistors, base-emitter junction voltage will be about 0.5V for germanium, or 0.8V for silicon. If we assume germanium in Fig. 3, emitter current is seen to be $I_e = E_3/R_3 = (5.4 - 0.5)/82 = 60mA$. Then the power dissipated by the transistor is approximately (12 -4.9)x0.06 = 0.4Watts. From this we should be able to estimate that a general purpose medium power transistor of the OC30, 2N1038 type ought to suffice if ventilation is reasonably good. Or an OC26, 2N1042, 2N301, or 2N250 could be used without a heat sink.

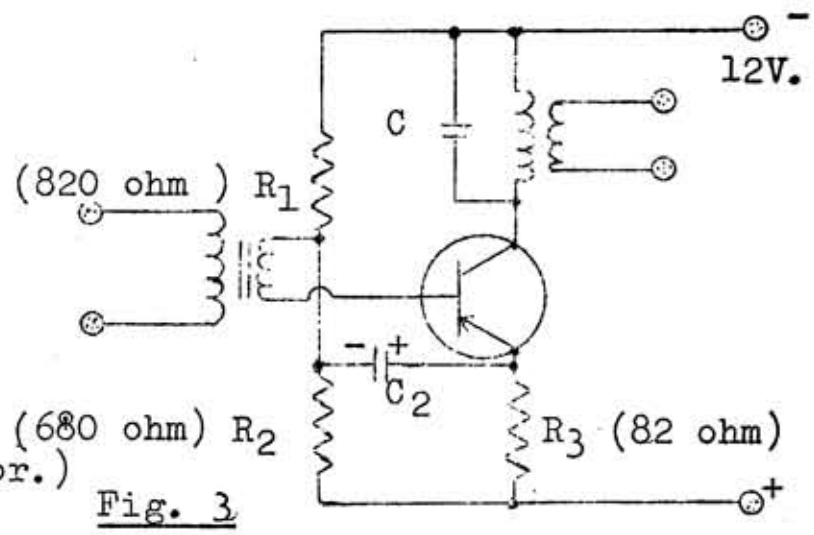

Fig. 3

Peaks. As discussed above, the peak voltage for an inductive load can be considerable, and in this example, C reduces it at high frequencies; C might be0.005uF for Z_a = 2000 ohms, or 0.1uF for Z_c = 100 ohms. (a = anode, c =Collector.) Even so, the transistor ought to have a voltage rating of 30- 40V with a 12V supply. Maximum current will occur when the entire 12V is dropped across R_3, (neglecting ohmic resistance of the transformer in this instance.), ie, 12/82 =146mA. The actual peak current will, however, depend on the rise time of the input signal, since the reactance presented by the transformer primary will be proportional to frequency. ($X_L = 2\pi fL$)

Bias. Above, we calculated base potential at 5.4V if base current is ignored. The base of the transistor will, in fact draw some current through R_1, and if we assume the d.c. current gain ($h_{FE} = I_c/I_b$) about 40, I_b = 60mA/40 =1.5mA. The bleed current through R_2 only is about 12V/ (820+680) =8mA. The actual drop through R_1 is then not only the 8mA through R_2, but also the 1.5mA through the base, and the drop across R_1, E_1 =(8+1.5)(820 ohms) =7.8V, whence the actual base voltage is now 12.0 -7.8 =4.2V instead of 5.4V. Then E_3 = 4.2 -0.5, and $I_3 = I_e$ =3.7/82 =45mA, bringing the actual dissipation down to 0.37W. Thus the approximate estimate was pessimistic, as it ought to be; in this instance with a transistor rated for 2W or 4W it ought not matter, but it might if a 1W transistor were contemplated. Amplifier stages using OC26 type transistors, giving power outputs of several watts can be more complicated, owing to dangers from "thermal runaway" (because of smaller safety factors), and I shall not discuss them here. They involve the use of a thermistor to replace part of the value for R_2, and negative voltage feedback in the collector circuit; typical circuits can be found in the Handbooks and Technical manuals.

In power circuits it will be obvious from the size of the previous transistor (or the one presented for preference in a design in the literature)

Tests for Semiconductors (continued)

what general power rating would be necessary for a replacement transistor. A simple procedure for best results could be to install a replacement (keeping voltage and current ratings in mind), and to adjust R1 (beginning with a large value) until minimum distortion is heard (or seen) in the output, but in any event adjusted for a collector current such that the collector heat dissipation is reasonable. For an OC30 type, this might be 0.8W, and for an OC26 type this would be 7W, assuming adequate heat sink. The design of a suitable thermistor network can be found Elsewhere, if necessary.

Note in Fig. 3 that the emitter bypass condenser goes from emitter directly to the base circuit. This keeps the base bias constant and independant of signal, as it is supposed to do, but has the considerable advantage over a condenser across R_3, in that no additional condenser across R_2 is also needed, and the voltage rating of C_2 can be low indeed. C_2 need be rated for the base-emitter junction voltage, and can be a 1000uF/2.5V unit, allowing reduction in space and cost. This trick is not usually possible, of course, with resistance coupling to the base - only with transformer coupling.

These suggestions are only rough and ready guides. At most they involve only Ohm's Law, and the basic amplifier formula, plus voltage dividers and common sense. In the end the same test has to be applied as grandmother used to test for bad eggs! In a circuit such as Fig. 3, if a replacement transistor consists of a unit of indeterminate power rating, the abovementioned adjustment of R_1 could be made (viz for lowest distortion), but in testing the transistor for dissipation every so often, by touching it. If it feels uncomfortably hot, the current should be reduced appropriately. If you don't start with small currents first, however, you may have to finish up by retesting the transistor to make certain it is still good. If an operating current is found which gives half the voltage across R_3 for Fig. 2, or which gives moderately warm operation of the transistor in Fig. 3 with adequate output quality, all is well.

To find out just what a particular transistor is capable of, which one finds in the junkbox, is another story, to be explored in the next thrilling article in this series.

* *

PSEUDO UNIJUNCTION TRANSISTORS! --by T. Ohsberg (VK7)

Unijunctions are expensive things, even on the surplus market, but ordinary transistors are now reasonable. In the October 1965 issue of Radio Electronics was described an ingenious method for simulating UJT action by the use of two complementary transistors connected for reinforcing feedback. The basic circuit is shown in Fig. 1. I have built this circuit, and have found it interesting and useful. It is capable of handling appreciably higher power levels than the Pseudo-tunnel Diodes described previously (EEB, Vol. 1, Nos 7, 10, 11). It is a device, essentially for generating negative resistances; general technical details about negative resistance devices (TD & UJT) can be found ably presented in the G.E. Transistor Manual, Tunnel Diode Manual and elsewhere.

Refer to Fig. 1. As TR_1 starts to draw bias through R, its collector current becomes the base current of TR_2. This increases the base current of TR_1, and so forth, until both transistors saturate. The leakage through TR_2 produces a voltage across R, and the above conditions only occur when this voltage is sufficient to start conduction of TR_1. Therefore the circuit is heat-

Pseudo Unijunction Transistors (continued)

sensitive, but at any one temperature its characteristic is stable and reproducible. The firing point at 34-36°C (using germanium transistors) is reached for R =68ohms, and this must be increased to 120 ohms at 59-62°C. By the way, it is not difficult to think in terms of Centigrade degrees. 0° is the freezing point of water, 20° is comfortable room temperature in British counrties, 25° in American ones, 30° is a hot day in Tasmania, 37° is human body temperature or a hot day in Sydney, 35° is neutral temperature to the touch, 45°is quite warm to the touch, 60° is definitely hot to the touch, 80° hurts, and 100° is unbearable. 100° is also the boiling point of water, so no wonder! Ordinary refrigerator temperature is about 10° and this is also the temperature at which water begins to condense on surfaces. .... This 'temperature by feel' can be very useful in evaluating performance of electronic components, from power resistors to transistors. Thus, germanium transistors or diodes should not get more than fairly warm to the touch, and silicon ones should not get more than very hot to the touch, and never hotter than the point at which a drop of water sizzles.

To resume, the PUJT can function as a tunnel diode if R is used as indicated. This means that if it is placed in an oscillating circuit, (RC or LC) its negative resistance will cancel. losses, and the circuit will oscillate.

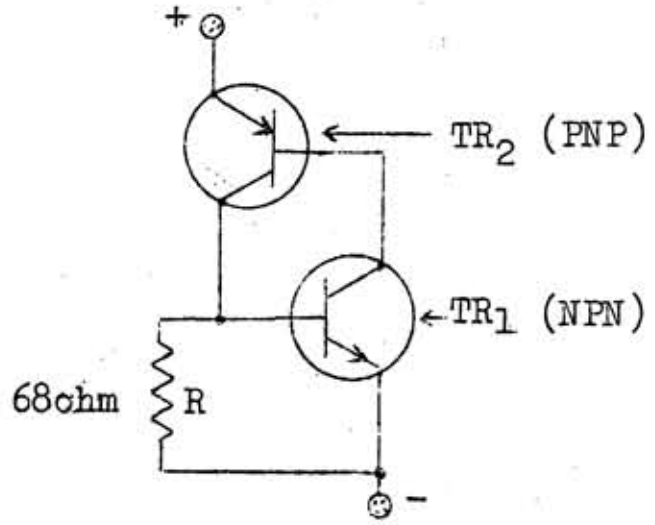

Fig. 1

PUJT Basic Circuit.

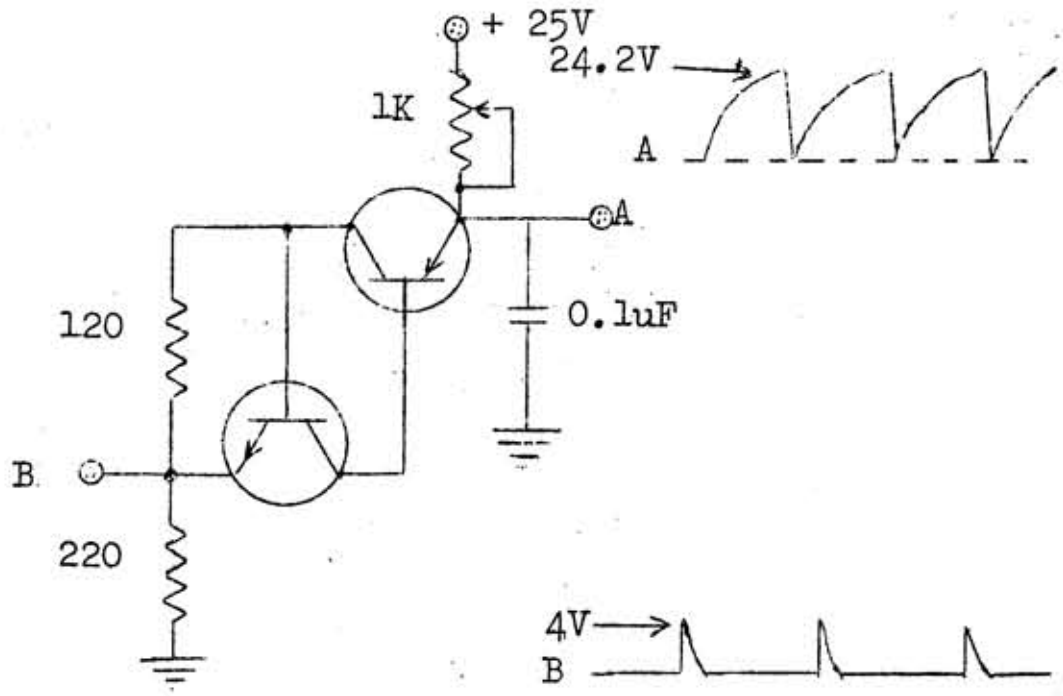

Fig. 2 PUJT RCRO

Fig. 2 shows a practical relaxation oscillator, which can be used to control SCR's, as code practice, etc. (with suitable choice of values). A choice of waveform is available, depending whether output is taken from points A or B. Frequency is 10Kc, approximately, for the constants given, and depends on gain of TR_1, type of transistor (eg silicon, germanium), time constant of the RC, and feedback resistance.

(to be continued next month)

* *

NOW WE KNOW! We have just seen a largish Computer Circuit Board which may be able to explain the mystery of why the Boards have appeared on the surplus market. Attached to this board was a yellow tag bearing the following inscrutable inscription: " Item No. 17 should be 663 diode. Item No. 16 should have 6.8K, 2.5W±3pc. Item No. 15 R4, R13, R17, R22 should be 822 resister. R1, 2, 3, 6, 11, 12, 15, 21 should be 473 resistor." It must be that resister! Can anyone tell us what it is? We have seen it referred to from time to time by readers (and authors), along with 'computor boards', 'condensors', and 'transisters.' A new semiconductor technology?

ADVERTISEMENTS, ETC.

SPECIALS FROM HALLARD ELECTRONICS.

BROADCAST RECEIVER BOOSTER KIT-SET. This transistorized R.F. Amplifier will increase the sensitivity, selectivity and signal/noise ratio of any transistor or valve receiver without alterations to the receiver circuit. The output of the R.F. Amplifier connects to the receiver aerial socket. Power gain: 25db. Ideal for use in areas of low signal strength or car radios. Picks up distant stations without fade. Full price 35/-.
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Advertisements (continued)-

FROM AUSTRALIAN ELECTRONICS, 76 View Street, Hobart, Tasmania. All items Tax Paid, and Post Free. Highest quality. Minimum order $3.00 please. Catalogue free on request.
== Computer Circuit Boards. We have had some reports of bad power transistors (of the OC26 type) from these boards, so maybe this wasn't such a gift after all to those who ordered 50 or more transistors worth of boards. Well, though these boards are the one exception to our Guarantee of all merchandise (because of the impossibility of testing components on the boards), we are willing to stick our necks out and consider any legitimate objection, though at 2/- per transistor the Boards are still a fair bargain. We had occasion recently to test the transistors from a large number of 6-transistor Circuit Boards, and found to our amazement that about half were NPN and half were PNP; these are the 'TO-5' case type, 150mW, etc. Since the 6-transistor boards appear to be commonly blocked double NOR gates without complementary symmetry, perhaps some boards are all NPN and some are all PNP? This makes it particularly difficult to fill requests for 'all PNP' or 'all NPN', since the transistors look alike and the markings on them are cryptic. The only ones we know to be PNP are the extra-small LT types, appearing mainly on the 11-transistor boards, and a few on 4- or 6-transistor boards... Of the transistors tested, all were germanium, and voltage rating (BVcbo) varied from about 30V to 130V. β varied from about 30 to 240, with most values lying between 40 and 100. Testing methods have been discussed in the November and March issues of the EEB, and a general testing article will appear in the Grandma's series, by RLG.... Circuit Board Sale until June 30th to clear stock for June Inventory, EEB readers only. 1/6 per transistor, or for readers in Australia, 15c. 100 transistors maximum per customer, please; regular (now) minimum order of $3.00 still applies, but of course may include other items (diodes, SCRs, meters).
== 350mA Thermocouple Meters. We are excessively annoyed about these. We waited several months until a friend decided he was truly ready to invest in them, and then finally sent away for them ourselves. In the interim, the supplier sold out of them, even though we had asked him to put some aside for us. We have not even been able to get a few to satisfy those who placed orders for the meters. Those were lovely meters, and cheap. What a life.
== T13 transistors are here, a small shipment now, more later. They are indeed 75-100V, and a few higher than that (for a price!). 20W, 3Amps, β from 15-50. $1.20 each, for T13. This is considerably less expensive than we had estimated, and we are pleased to bring them to you at the lower price. These are nice medium power transistors, but please note that they are not the equivalent of OC26/2N301/etc, which are rated some 50pc higher for power. The T13 will, however, when bolted to a suitable heat sink, do a good job for moderate powers, but be careful of the threads which are aluminium and must be tightened cautiously. F_α is 220kc/s, which is appreciably better than OC26 calibre, though not VHF. Good for audio and LF, though... We do have a few 2N1038 around for 9/-, which could be provided if needed; they are the same as T13, but not in a heat sink fitting. So: 2W rating.
== 500V/10A SCR's are here again. They are popular, because 10 Amp diodes which would protect lower PIV SCR's from the mains cost the earth. 500V/10A SCR sells for $4.00 each, which reduces our profit to nearly nothing, but we are anxious to get these into the hands of experimenters. A more crass motive might also be that we pay a lot for these items, and don't like to tie it up in the drawer.
==500V/0.75A and 600V/0.75A miniature SCR's have been ordered and ought to arrive soon. This is a new thing for us, and may prove to be popular, because of the possibility of using them on the mains at relatively low cost, without necessity for protective diodes. It should be remembered that the only way to get full wave output from SCRs having a common line with the input, is to use two of them back-to-back (details on this and much more in the article 'A Tale of Two Diodes' by RLG, to appear eventually in EEB). Full wave output by use of bridged protective diodes causes a floating output.
== Transformers. All right you like to pay retail prices for your transformers. Be happy.

EQUIPMENT EXCHANGE BULLETIN

Ten Cents Per Copy // 60 cents yearly. Box 177, Sandy Bay, Tasmania. Australia.

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CONTENT.

Editorial. Recently we have received some articles which were accompanied by modest protests of having only written a simpleminded approach. So, who complains? That's what we have repeatedly asserted as the basic EEB aim. It is not exactly a "lowering of standards" as one chap delicately put it, except in sofar as any direct and simple exposition is lower than a lofty and obscure one. We are rather of the opinion that if something has to be said in a practical way, it can be said simply, notwithstanding the wordy style of this writer. Complimentary letters we have received tend to support the idea that this is what readers like too -- at least the choice cross section of Australiana represented by our quarter-of-a-thousand (doesn't that sound impressive!) subscribers. We hope only that this popularity does not become too widespread, because in spite of our having stopped EEB advertising, subscriptions continue to pour in alarmingly. This effort already keeps four or five of us in decided turmoil, and we shudder to think what Real Success might mean to this sparetime activity.

In a proper article, in say, the Journal of Scientific Instruments, one ought to publish evidence supporting a given claim for performance, and what a headache that is too. But for the EEB, you have built a Thing. It works for you; it will probably work for someone else, unless he has not included something vital which you had taken for granted. If so, he will find it out for himself if he is conscientious. If you wrote a book, you could probably cover all possible theoretical eventualities, but why bother? That has been done well already in a number of references; the one concession that might be made to thoroughness might be for an author to add a list of references for further interest -- if he can.

Now this attitude is subject to a criticism that was made by another contributor: if this idea is taken to its logical conclusion, one need only publish a few sketchy notes about an idea, leaving the rest to the presumed ingenuity of the experimenter. Indeed, why publish? Wouldn't the time be spent better by all parties in the workshop rather than at the typewriter and reading desk? We must admit that this idea is not without its obvious attractions, but then why bother doing anything about anything? Obviously common sense must step in. Human civilisation would never have progressed without some individuals having passed on their experiences to others; for

Editorial (continued)

purposes of the argument we shall here ignore the question whether human civilisation has progressed. After all, it would have been most tedious to try to build a MAVKITTY without a John Hill to tell us about it. ((Ref: EEB Vol. 1 No 11)), but for all its details, the article was fairly sketchy. A simple presentation is neither a jotted-down note, nor a technical treatise; it is just a page or two telling others about something that interested you, with a few details. If you happen to be grossly wrong about something, we'll likely catch it, and write you a letter; recently RAJR wrote such a letter which could form the basis of an article itself. So don't worry, at least for the first draft. Now this doosn't mean that a given presentation in the EEB is the end of a given design. You are encouraged to write to us about what you think about it. If it is publishable, we can put it into Letters or into a proper article, depending on the length. If it is a query to the author, we can pass it on to him. The EEB is for you.

Apologies to John!

-RLG

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Letters to the Editor.

(1).. One of my serious doubts in tackling circuitry, particularly with unknown transistors is to be able to calculate the required resistors in the various emitter, base, and collector circuits. Even with known transistors one needs graphs to read off the necessary details, but one does not always succeed in obtaining this information. How far can one go in instrumentation to obtain this information? If... one does not have theoretical training, it is difficult to recognise or use the information one finds in the electronic literature ... Would a transistor tester be necessary? How much would it tell me? Would be the most useful instruments?...

E.J. Watts
North Geelong, Victoria.

Reply by Editor:

((The current series of articles by Mssrs Maddever, Gunther, and Reynolds are designed in fact to answer some of these basic enquiries, which are shared by many enthusiastic experimenters. But at most these can only be a hint at the truth, which is that the basic facts of radio theory are NOT difficult, though the permutations into which they can lead are complex indeed. Now it helps not at all to look at the complex literature, as do so many experimenters, and to decide that it is all too complex to bear, and what can a solitary individual do about it. The answer is to look at the simpler literature. This can be misleading, in that most of the frequently seen literature tends to be the various digests and handbooks published by the big valve and transistor firms. It is material that is simple only in appearence, since it is grossly condensed, and is intended principally as a reference and working manual for those already familiar with basics. But there does exist a body of elementary theory, on simple circuit design in all directions, whether it be for elementary theory, or for elementary circuits and applications. What more does one need? These simple treatments tell you how to test transistors (no it does not require expensive equipment), and what to do about it. Other than this, it can help greatly to keep up with the periodical literature as possible with regard to time and finance: Electronics Australia, Amateur Radio, Equipment Exchange Bulletin, the American radio amateur publications. Some basic references have been mentioned previously in EEB references (eg Maddevers article, April), and others are added here:

Letters to Editor (continued)

P.S. Has anyone else not received their April (or any other) issue?

Electronics Builder's Handbook (Allied)
Basic Electronics. (Allied)
Any of a wide variety of booklets in the "Basic Electronic Series" published by Howard W. Sams Co. In addition, they have "Beginners and Hobby Books" such as "Electronics Experiments and Projects." "Electronics for the Beginner". Similarly, the John F. Rider Co. publishes a wide variety of items at all levels, eg. "Principles of Transistor Circuits," "Basic Transistors", "Fundamentals of Transistors," etc, etc, etc. The last mentioned item is described as "written in a pleasant easy-to-understand style..."

Another publishing giant is the Gernsback Library, boasting books with similar titles and coverages. And there is the Rinehart Books series, McGraw-Hill Publications, A.R.R.L.*, Amateur Publications, a most worthwhile set of booklets published by Cowan ("CQ Magazine") dealing with many practical aspects of electronics; Coyne Shop Manuals, and the magnificantly conceived publications of "Editors and Engineers (Radio Handbook, Transistor Radio Handbook, etc.)*

The above list was taken from a quick look at the book lists in the Allied Radio Corp Catalogue, similar lists can be found in the Lafayette. Radio Corp Catalogue. An enquiry at Mullard and Philips will yield a wide list of technical references at all levels. A suprising number of these books can be purchased off the shelf in larger bookshops, (city), or borrowed from the larger libraries (particularly University or Technical Colleges), or from friends who happen to have them. (But if you borrow anything, be sure to return it!!!!!!) Overseas sources are much cheaper, and well worth the extra trouble. In London H.K. Lewis Co can obtain any technical title published in Britain. American mail order sources are slightly more trouble, and you are advised to add an extra amount (10%) to cover postage, as "Post paid" does not apply outside the country. We shall welcome letters from readers on this general subject; if you wish any statement not to be published, please say so explicitly.))

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PSEUDO UNIJUNCTION TRANSISTORS! Part II by T. Ohsberg (VK7)

It is possible to improve these circuits if the transistors are germanium, by adding a silicon diode in each of the emitter leads. Consider Figs 3 &4. In these instances, the entire PUJT is treated as a unit, with an equivalent collector (Ec), equivalent emitter (EE) and equivalent base (EB)

Fig. 3

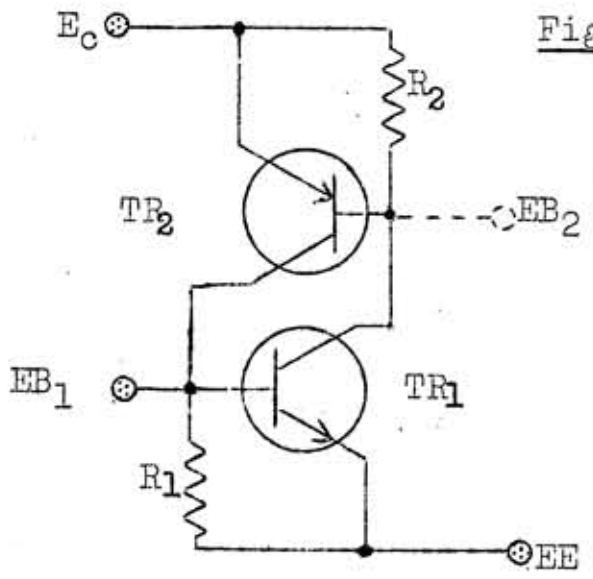
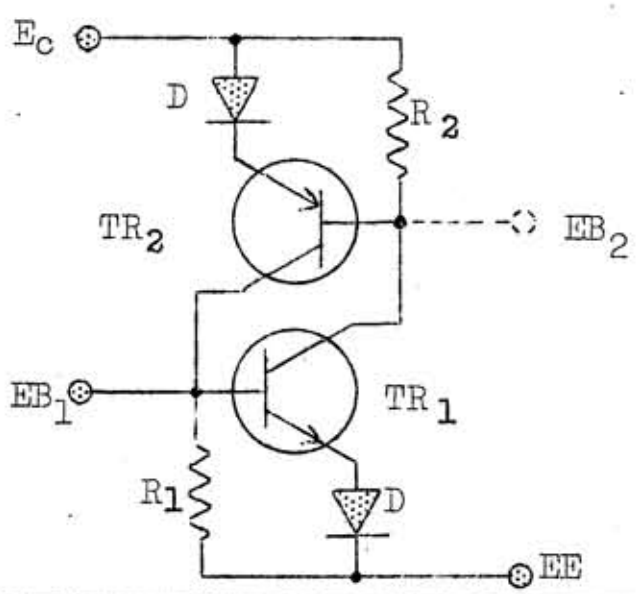


Fig. 4



* These handbooks, and that of RSGB have useful chapters on instrumentation and workshop design.

PUJT (continued,)

The diodes, D reduce the firing current, and increase input impedance , (EB_1 to EE). The following charts are self-explanatory:

TR_2 / TR_1	Si PNP / Si NPN	Ge PNP / Ge NPN	Ge PNP +Diode / Ge NPN	Ge PNP / Ge NPN + diode.
R_2	4.7K	300 ohm	3.3K	1K
R_1	4.7K	300 ohm	1K	3.3K

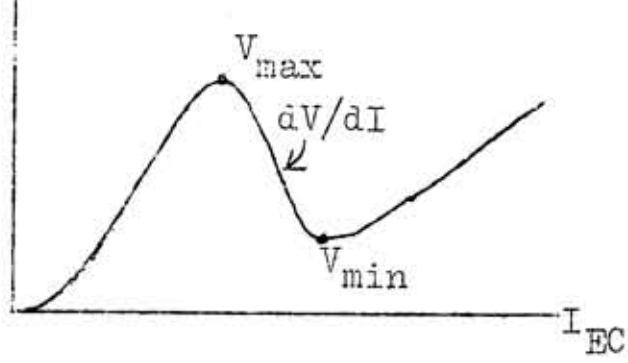
TR_2	β_2	TR_1	β_1	Position of Diode.	I_{EB_1}	$\triangle V$	dV/dI	I_{EC}
Si	300	Si	100	--	1.5uA	3.4V	1.2K	5mA
Si	20	Si	100	--	200uA	3.4V	500 Ohm	7.5mA
Ge	40	Si	100	TR2	250uA			
Ge	40	Ge	40	TR2	800uA	2.5 - 3.0V	250 ohm	20mA
Ge	40	Ge	40	--	2000uA	2.0-2.5V	200 ohm	15mA

It can be seen that V_{max} is higher with silicon, so sensitivity and input impedance are highest. Higher transistor gain obviously results in better firing sensitivity.

The curve of Fig. 5 is similar to that of a Tunnel Diode, and illustrates clearly the negative resistance characteristic of the PUJT: this is the region where voltage across the PUJT goes down as current is increased. dV/dI is the slope of this region, therefore the dynamic negative resistance. In the above charts, I_{EB_1} is the current to 'fire' the PUJT when I_{EB_2} is zero. $\triangle V = V_{max} - V_{min}$, and I_{EC} is the Equivalent Collector current after firing. Where a range of values is shown for $\triangle V$, it is strongly dependent on temperature.

V_{EC} (EC= Equivalent Collector)

Fig. 5



Dual EB Control.

If signals are introduced to both Equivalent Bases at the same time, the circuit as shown in Fig. 6 exhibits interesting triggering properties. These are summarised in the following Chart :

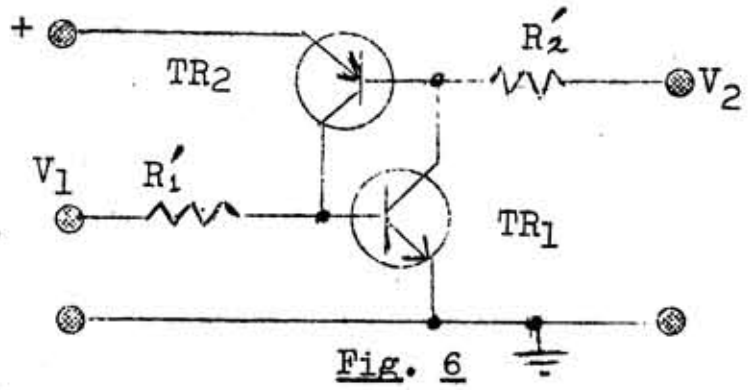
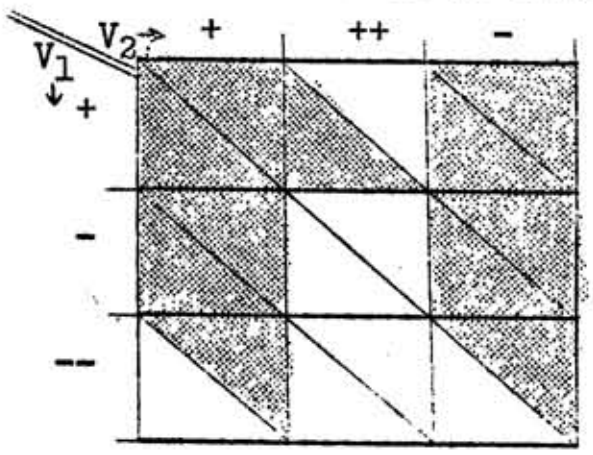


Fig. 6



Dual EB-Control Chart

Code:

= Only TR1 on, PUJT off.

= Only TR2 on, PUJT off.

= TR1 and Tr2 on, PUJT on.

= Neither transistor on, PUJT off.

PUJT (continued).

The following conditions are also relevant to the above chart :
V_1 - = TR1 is cut off only when TR2 is cut off, but is on when TR2 is on.
V_2 + = TR2 is cut off only when TR1 is cut off, but is on when TR1 is on.
V_1-- = TR1 is always cut off, no matter what the state of conduction of TR2.
V_2++ = TR2 is always cut off, no matter what the state of conduction of TR1.

Behind these relationships lies the fact that the base of a PNP transistor must go (sufficiently) negative with respect to its base for the collector to pass current, and conversely for the NPN transistor. 'sufficiently' means that the junction potential has to be exceeded; about 0.2V for germanium, 0.5V for silicon. Thus, the exact state of conduction (i.e., on or off) of the PUJT will depend on the relationship between voltage dropped across R1 or R2, the supply voltages V1 or V2, and the transistor characteristics.

If, however, the supply to the Equivalent Bases is a constant current (viz., R and V both high), the unit will work essentially as a doubly gated Silicon Controlled Rectifier. Although it then resembles a Silicon Controlled Switch (i.e., a high sensitivity low power doubly gated SCR), it has the unusual property that it can be turned off <u>while</u> conducting, merely by suitable polarisation of the Equivalent Base currents. An SCR or SCS can only regain control after its anode voltage drops to nearly zero. Typically, currents of 4-10μA are needed to turn it on, 25-50μA to turn it off, using ordinary small (TO-5) transistors. This increased control ability makes the PUJT uniquely useful in switching control circuits. By suitable variation of the phase relationships of the V1 and V2 signals, enormous flexibility of operation could be achieved.

One curious property of the circuit is the fact that the internal base currents are enormous, eg 50pc of the external current if transistor gains are equal. This is possible without damage to the transistors, because when the bases are conducting heavily, the transistors are saturated, and collector dissipation of each is limited by the base resistance of the other. High base currents are injurious only in two circumstances: 1) When collector circuit resistance is low, and collector current becomes excessive, and 2) When base current exceeds the space charge threshold value. Both of these parameters can be estimated by knowing (or measuring) the characteristics of the individual transistors. The collector current will usually be within safe limits for ordinary supply voltages, but the base currents must not exceed the maximum rated value for a given transistor. If the latter is not known, it can be estimated by dividing the maximum rated collector current by the high-current current gain of the transistor.

From a practical point of view, use what transistors you have available, but start with low supply current (i.e., limit by large resistance in series with supply), and measure base currents (inside the loop) when conducting, to ensure that they do not exceed the maximum rating. An alternative method could be to apply low supply current, throw the PUJT into conduction, and calculate the resulting total current to be distributed between the two bases in inverse proportion to the current gains of the transistors. Then it can be seen that

$$I_{b1} = I_{EC}\left(\frac{\beta_2}{\beta_1+\beta_2}\right), \quad \text{and} \quad I_{b2} = I_{EC} - I_{b1}$$

where I_b is base current at the transistor, I_{EC} is total current (to the Equivalent Collector), and β is transistor current gain at the I_c for each transistor. It should be noted that when calculating maximum tolerable base current from rated collector current and current gain, the current gain decreases appreciably as collector current goes up, and a pessimistic estimate should be used. --(Continued on P. 63)→

GRANDMA'S TEST FOR SEMICONDUCTORS Part III Commonsense Testing. —RLG

The various handbooks are full of elegant methods for testing semiconductors, and indeed I have written a detailed article on the subject which will probably be published here eventually. There is, however, a need for a basic simpleminded approach to be described, of the sort I have used for some years. Non simpleminded readers may turn to the Advertisment section now, others follow along with me!

Amplifier Bias. Now what is a transistor? A considerably degraded version of a valve, but it still manages to do the same thing in most instances: amplify. One does often see the statement that a transistor is basically a "current amplifier", and one can look at it that way, but one can do the same for a valve too. The fact is that circuits can be arranged so that either amplified current or voltage or both appear at the output of a given stage. Let us, however, for purposes of testing, remain with the current-amplification concept. How to test how much amplification one will obtain from a transistor? Bias it a bit out of cutoff, as you would with a valve, and watch the output while varying the input, as in Fig. 1. If E_1 and R are large enough, the input resistance of the transistor (usually 1K or less) will be relatively small, and input current will be dependent mostly on R, thereby making it a "current generator". Amplification, β is the measure of the increase in output for a certain increase in input current, or the a.c. current gain;

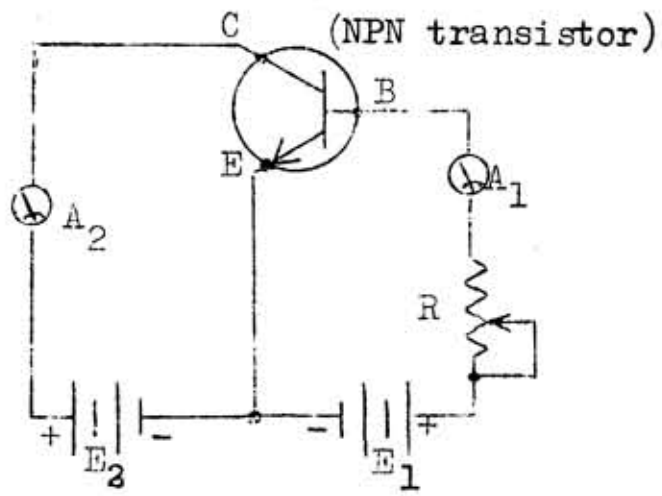


Fig. 1.

$$h_{fe} = \beta = \frac{Ic - Ic'}{Ib - Ib'} \qquad \text{eg: } 50 = \frac{1.5 - 0.5\text{mA}}{40 - 20\ \text{uA}}$$

where of course, Ib and Ic refer to base and collector currents respectively. This measurement will give about the same figure for β for collector currents greater than about 100uA, and the usual collector operating current is about 1mA for small transistors, 10mA for medium ones, and 100-500mA for big ones (eg OC26). (But in a transistorised ignition, a 2N174 operates at Ic =10Amps!)... Now, as you can see, E_1 and E_2 can be combined into one battery of say, 9V, and if you are short of meters, A_1 and A_2 could be the same meter switched around. Thus you have measured current amplification. Simple? For large power transistors, it is more common to measure d.c. current gain, $H_{FE} = \frac{Ic}{Ib}$ which will be similar to, but not identical to β.

Amplification. Now if you want to do something useful, like amplify voltage, you put in some resistors, and turn the current into voltage via Ohm' Law.

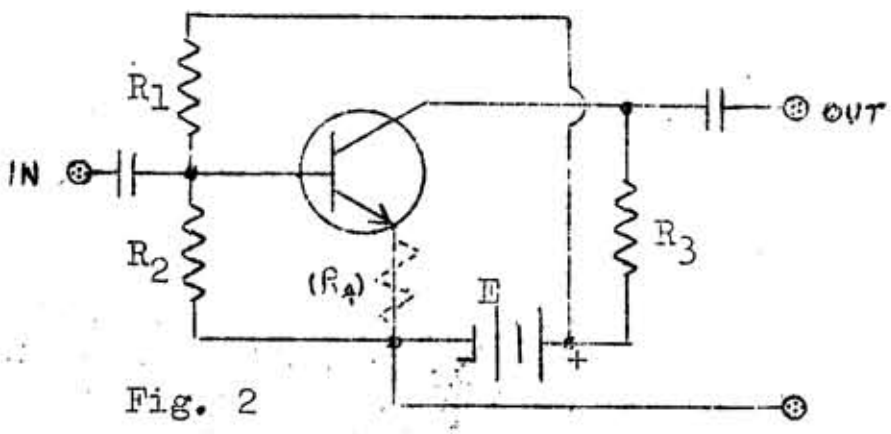


Fig. 2

See Fig. 2. R_1 biases the base to a reasonable value (eg for collector current of 1mA), analagous to R in Fig. 1. R_2 bleeds some current through R_1 so that the bias won't be affected (so much) by temperature sensitivity of the transistor, and of course R_3 is the collector load resistance. It's value should be chosen to give about half the battery voltage across the transistor.

Test for Semiconductors (continued)

For practical purposes R_2 can be chosen 1K, and R_1 adjusted for desired collector current (eg 1mA). The voltage amplification obtainable from this circuit is roughly, $Av = \beta \times R_3 / R_2$

A more exact relationship would take account of the fact that the input resistance consists of the resistance of the base-emitter junction, R2, R1 and the signal source resistance -- all in parallel. And the output resistance consists of R3 and the load resistance in parallel. This latter situation can be important in cascaded common emitter amplifier stages, where the input resistance of the next stage may be of the order of 1K. Indeed, you can see that if the total load resistance is equal to the total input resistance, the voltage amplification available will be limited to about the value of β. Now, I mention the amplifier configuration, because that is part of testing too. A transistor must do more that amplify. It ought to do it with reasonable linearity and stability, and this can be ascertained from the amplifier configuration. The fact is that the transistor is a wretched device for amplifying, compared to a valve, and you will find that the circuit of Fig 2 will be improved considerably by adding a resistor in series with the emitter, or by running R1 to the collector instead of battery. These modifications introduce inverse feedback which increases input impedance, has the advantage of reducing the effect of temperature of amplifier behaviour, and of giving similar results with different transistors. But the refinements increase the circuit complexity somewhat, and make it more difficult to calculate results. Let's assume that R1 stays where it is, and we have added a resistor in series with the emitter (you can write it in at the appropriate place in Fig. 2, and call it R4); here is a summary of the calculations for resistances needed:

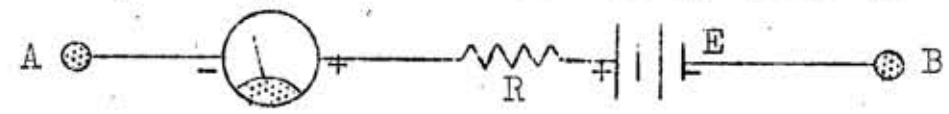
Calculations of bias parameters (with R4 in series with emitter)

(1) Decide on an operating collector current (1mA for small transistors, OC71, or 2N1300 type: 10mA for OC74N types, 10-100mA for OC30 or 2N1038 types etc)
(2) Choose R3 to drop half the supply (E) voltage, at this current.
(3) Choose R4 to drop about $\frac{1}{2}$ V at this current.
(4) Choose R2 = 1/Ic ((or accurately, R2 = $(V_{be} + V4)/ 20I_b$))
(5) Choose R1 = R_2 (E/V) ((in general, R1 =(R2) ($\frac{E}{V} - 1$), where V= $(V_{be} + V4)$))

In all of this, nothing more complicated is involved than Ohm's Law and the transistor formula for β. By applying these plus the usual relationships for bleeders, you can work out any other combination. Typical examples were discussed in Parts I and II.

NPN Vs PNP In Figs 1 and 2 I have shown the transistors as the "NPN" type. PNP would certainly involve opposite battery and condenser polarities. If you have a transistor of uncertain parentage, you can ascertain easily enough which polarity it is by using the test circuit in Fig. 3:

Fig. 3



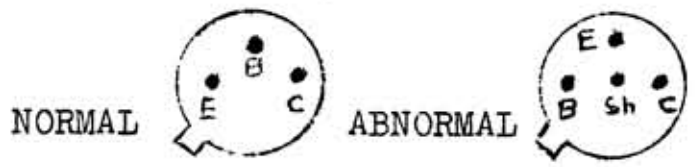
If E is 9V, R can be about 47K and the meter can be, say 0.5mA FSD. Attach terminal A to the collector, and B to the base. If appreciable current flows the transistor is PNP type, and if it doesn't, it is NPN type, but reverse A and B connections in each instance just to make sure. If more than 50uA of current flows through an ordinary small transistor in both directions, throw it away, or at least put it in a box labelled "for power supply use only."

Tests for semiconductors (continued.)

When not to use an Ohmmeter. Notice that Fig. 3 is simply an ohmmeter. I do not recommend, however, that you use an ordinary ohmmeter to test transistors. Some of them on certain scales can pass enough current to damage the transistor. → See P.55 Rod Reynolds, however, insists that he has been using an AVO for years to test transistors, on the appropriate scale. This may be so, but you had better be certain that if you do this you (a) know the actual polarity of current at the meter terminals, and (b) that the meter has 10K/V sensitivity or better, and (c) that you don't use it on the lowest range for testing transistors. For the latter, the centre scale resistance ought to be greater than or equal to 100 ohms. Personally I still disagree, but you can make your own decision about it.

Silicon Vs. Germanium. Silicon transistors are often better than germanium transistors for many applications, since they are much less sensitive to temperature effects, though the power dissipated for a given collector current will be less for germanium than silicon, because of the larger voltage drop of the latter. Sometimes this can be important. To tell one from the other, hook up Fig. 3 in the direction that allows appreciable current to flow, decreasing R so that it goes up to say 1mA, and measure the voltage across the junction with another meter. If it is about 0.2V the transistor is germanium. If it is about 0.4V it is silicon. Simple? Remember however, from Part I of this series that at 10-15mA the junction voltage will go to about 0.4V for germanium and 0.7V for silicon. Good idea to compare with known transistor.

Emitter Vs Collector. If there is no indication which leads are which, (eg the red dot has rubbed off), use the circuit of Fig. 3 to determine which is the base. If A is connected to base, the behaviour of the system (ie conducting or non-conducting) will be the same for the other two leads. Then connect Fig. 3 so that one terminal goes to base with the correct polarity to give conduction to the others. Then the emitter will be the lead that gives the highest current of the two. Unfortunately, according to Rod, this is not always so. "Very often (eg 2N410) the readings are the same, and the emitter and collector are actually interchangeable in some circumstances. If this occurs, look more closely for where the red dot might have been, but if no luck, don't worry about it." On the other hand, in the higher power units, there is a definitely better heat sink connection to the collector than to the emitter, and this is obviously important for handling power. Beware of AF117 and similar high frequency transistors which have base and emitter connections in positions opposite to those in the conventional triangle.



Voltage Rating.

Most transistor applications use low voltage, well within the rating of most modern transistors, but if for some reason it is important for you to find out the voltage rating of a transistor, simply apply a variable voltage between collector and base (eg from a potentiometer), in the non-conducting direction, and with a series resistor to limit the maximum possible current to 20uA. Then the BV_{cbo} is approximately that voltage across transistor at which collector current starts to rise suddenly. If you have limited it by said resistor, no damage will be done to the transistor. Of course the current meter must have sufficient sensitivity. If the emitter is shorted to base for this test, you will be measuring the BV_{ces} whilst if the base is left open and voltage is applied between collector and emitter, you will measure BV_{ceo}. Sometimes BV_{ces} is obtained when the voltage starts to drop as the reverse collector current is raised to some (high) value, but it is safer to assume simply a more rapid increase in current as indicative of the danger point.

(correct for V_R by Ohm's Law)

Commonsense testing (continued)

It can be worthwhile to perform these tests on a few cheap transistors, and move the potentiometer freely without fear of destroying the unit under test so that you get a feel for it.

Although rating is usually done in terms of BV_{cbo}, the other measurements may be more significant if relevant to the specific requirements of your intended application. Thus for transistorised ignitions, the BV_{ces} is most important, because external base-emitter resistance is usually only a few ohms, and BV_{ces} can be 10-20V less than BV_{cbo}. It is the BV_{ces} value for which you would choose the protective zener diode (allowing 10-20V for safety factor). Breakdown voltage for the usual small transistor can be measured at perhaps 20uA. For 2W transistors it may be perhaps 0.5mA, while for 150 W transistors (ignition transistors) it could be 6mA.

(To be Continued.)

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

S.C.R Polarity Inverter. -- by Dane Horgan (VK4)

In certain cases when a particular piece of commercial equipment needs modification the entire job can often be made simpler if the right polarity power supply can be included easily in an assembly where it was not originally planned. Recently, as an example, a negative bias source was needed in a unit where only HT and heaters were available. What was needed was a simple, cheap, low current "polarity inverter" to operate directly on the HT line. The "Polarity Inverter" below, is a three terminal device featuring +200V input, and -200V output, both with respect to earth. The output impedance is about 50K and there is, therefore , not a stiff supply as regards load.

Operation. The unit is basically a high voltage DC/DC converter which does not therefore need a step up transformer. It features the usual oscillator and rectifier, filter setup.

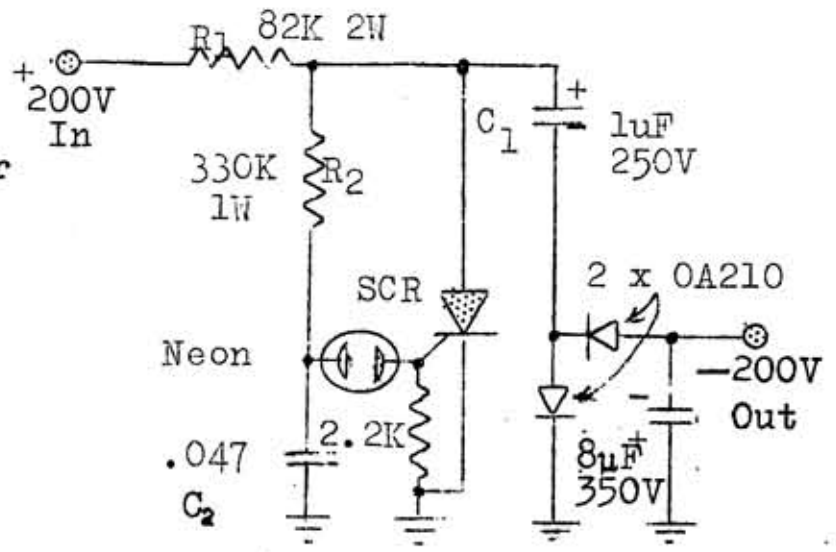


Fig. 1

An SCR discharges a condenser (C_1) on command of a neon relaxation Osc. C_1 is charged via R_1 from the HT line, R_1 being sufficiently large to not sustain the avalanche in the SCR after C_1 has fully run down. The negative-going edge is suitably rectified providing a negative voltage DC source.

or could use UJT or PUJT osc.

The time constant R_1C_1 is shorter than the neon oscillator period, which is proportional (but not equal) to R_2C_2. This latter period is 40 70 Hertz.* Power is limited (or output impedance is some 10's of Kohms), because R_1 is high (avalanche) and C_1 is not large (or filtering would be difficult).

The SCR spikes are not of excessively short risetime and R.F. hash is unnoticed though shielding would be simple. A 250V/3A SCR was used, somewhat excessively. No limit appears necessary on the discharge current of C_1 through the SCR. The output voltage at any fixed load is as stable as the HT source, and virtually all parts are non-critical for the end result.

could use 0.15A SCR

The circuit offered is only one arrangement of the broad principle indicated in the above discussion.

* oh no! This is BJ's doing. I disclaim all responsibility. Progress, BAH! - ALG

ADVERTISING, ETC.

SPECIALS FROM HALLARD ELECTRONICS.

BROADCAST RECEIVER BOOSTER KIT-SET. This transistorized R.F. Amplifier will increase the sensitivity, selectivity and signal/noise ratio of any transistor or valve receiver without alterations to the receiver circuit. The output of the R.F. Amplifier connects to the receiver aerial socket. Power gain: 25db. Ideal for use in areas of low signal strength or car radios. 35/- HALLARD ELECTRONICS, BOX 58. P.O. CAMPSIE N.S.W.

COMPONENT SALE Resistors, condensers (electrolytic, paper, mica and variable tuning), coils, transistors, speakers, etc. etc. All half price. Write for lists and prices. HALLARD ELECTRONICS, BOX 58 P.O. CAMPSIE N.S.W.

TRANSISTOR MK4 RECEIVER KIT-SET. This is a new release and as such we are offering this kit at a special introductory price to EEB readers. The set uses an efficient reflexing circuit employing voltage doubling diode detection. An OC169 type transistor is used for this stage because of its superior characterisitcs. Following is two stages of amplification to drive the output transistor, an OC74, which in turn drives a 5"x3" speaker. The set is housed in an attractive plastic cabinet. Complete to the last screw, the kit, when built up, makes an ideal companion in the home or car. Naturally the set has a high sensitivity with the reflex front end. Transistor complement: Oc169, 2 xOC71, OC74. Full price $13.95. or £6/19/6 HALLARD ELECTRONICS, BOX 58 P.O. CAMPSIE N.S.W.

TRANSISTOR 2 RECEIVER KIT-SET. By using a special regeneration circuit, the range of this set is 30 miles. The sensitivity is greatly increased when a short aerial is used, we received stations 500 miles away with 6ft of aerial. A very practical receiver with an OC169 and OC71 type transistors. Full price: 65/-($6.50)HALLARD ELECTRONICS, BOX 58 CAMPSIE NSW

ELECTRONIC SPEED CONTROLS. For portable (ac/dc) drills, saws, sanders, etc, up to 3 Amps. Controls from 0 -50% of full speed· excellent speed regulation under varying loads. Once you have used it you will wonder how you ever got along without it! 12 months guarantee -- £7/17/6, post free in Australia. ELECTRONIC SWITCHES, P.O. Box 138, Balgowlah N.S.W.

TRANSISTOR IGNITION KITS complete with coil, special Ballast Resistor with starting tap, and diode. Full instructions. 12V Neg. earth. £15/0/0. Post free. Literature free on request. Other models available too. MEECO. P.O. Box 407, NARACOORTE S.A.

ΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣ

News from CLIVE WITCHELL INDUSTRIES
2-6 Ethel St, Moorabbin, Victoria.

From replies to last month's advertisement it seems there is a need for individual parts rather than complete kits. We are now offering a wide range of individual components (many exclusive to us) such as printed circuit boards. These boards have been designed by us for our kits, and to aid constructors in building the projects described in our magazine. One circuit board accepts parts for a miniature push-pull audio amplifier strip, and is available for 55c with the circuit diagram. Anyone with some familiarity with simple electronic layouts would be able to work out the position for each part (for those who can't, a manual is available for $1.60). We must remind you that the strip is only 1-1/2 x 3 inches, and only the latest miniature parts are used. If you don't have all the parts in your parts box, they are

Advertisements (continued).

available at quite reasonable prices, such as:

Output transformer $1.50	Four electrolytics at 32c each
Driver transformer $1.35	Speaker $1.80
Four transistors $1.10 ea.	Complete amplifier strip $9.45
8 resistors at 9c ea.	(Send for price list).

These miniature components are used in numerous other projects, such as the Voice Actuated Relay, which is built on a 'universal' P.C. board (size 1-1/2 x 4 inches) available for 45c, or a Blocking Oscillator (P.C. board 15c) or an impedance matching unit (P.C. board 15c). These are only a few of the circuit boards available.

DON'T FORGET OUR MAGAZINE (see EEB, April P. 38, May P. 48)! A subscription to it will amplify all details mentioned here, since each issue carries with it a set of pages giving the price for each component and the final price for each kit.

In the near future we intend to give free items with issues. The forthcoming variety include -- free printed circuit boards, free manuals, free circuit cards and artwork aids for making your own boards. Obviously these gifts will only be available to subscribers. All in all, it looks like a bright and interesting set of issues coming up. A six issue subscription is a worthwhile investment for only $1.45 (14/6). Four issues have already been released, and are available for 95c.

Postage on 1, 2, or 3 boards = 5c. 4 boards Post Free. Cover charge on any lists, etc = 10c (to cover printing and postage). The tear-out order form found on P. 39 of the April EEB may be used to itemize the required parts.

((Editor's Note-- We have seen some copies of this magazine, and it is really very interesting; we recomend it enthusiastically to you!))

ΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣΣ

From Australian Electronics, 76 View Street, Hobart, Tasmania.

++ ENOUGH! We wish formally to announce that we intend to terminate or greatly truncate our operations toward the end of 1966. The Manager of this Enterprise carries most of the responsibility, and spends too much time on it. Although he enjoys money as much as the next chap, he has had to ask himself the interesting question-- what am I doing here? The inescapable answer on a practical level appears to be -- to act as a creative individual. It is now simply impossible for him to find sufficient time to do this in fields not connected with AE. Money can buy gadgets, things, comfort, but it cannot supply spare time to work in the shop and home. The alternative of having someone else to do the business work has already been carried as far as possible, with a Secretary, Assistant, and Technician. To carry it further would be impractical when considering the nett profit of an activity of this type.

One reason for this quandry has been the fact that it has been impossible to limit AE activities in the manner envisioned initially, as a hobby activity providing an interesting method for getting some spare cash. The first problem was to get sufficient capital to meet the unexpectedly great demand for our reliably tested surplus components. All profits went back into stock and overhead for a long time. The other main problem was the unpredictability of supply. Aside from the ghastly headaches which we have previously described briefly in these pages, there was the real difficulty of ascertaining ratings. We should have preferred selling, say only 400V diodes. But when we ordered '400V' ones we received everything from 30V to 800V. The latter tended to pay for the former, but complicated the situation (and pity the poor customer who ordered the originals and used them without testing). Now the testing methods of surplus merchants have improved, and this problem is less, but others have taken its place. The net result has been a

Advertisements (continued!).

proliferation of types of stock, and an ever-expanding catalogue.

Then there was our perfectionist desire to supply customers with comprehensive technical literature. This also got somewhat out of hand, particularly when people started writing long letters about it, or dropping by. The EEB was born out of such thoughts, but now the tail is wagging the dog..... We enjoy helping you and discussing things, but there are so many of you!

What now? There is certainly a market for surplus components for casual experimenters in this part of the world, and it does not greatly harm the regular new-commercial market either. The latter does not get rich off of experimenters, but rather off of industrial and institutional turnover. But the greater activity by experimenters who buy inexpensive components certainly stimulates the electronics field in general. One has only to regard the interesting situation which has arisen from the appearance of excellent and cheap components from Fairchild (Aust) Pty Ltd, for which by the way, we extend to them the heartfelt appreciation of experimenters everywhere.

There is however, another method to keep the cauldron boiling. You can form Cooperatives. A Cooperative is a group of people who cooperate for their mutual benefit, to obtain better or cheaper things of all kinds. The groups should be close together geographically, for preference, and can vary in number from a half dozen upwards, depending on what is needed and how much money (and time) can be contributed by each person. A 'Co-op' can be organised by an enthusiastic and idealistic individual (NO we are not available for such an activity!), or can be organised simply as part of an already-existing radio (or other) Club. Communal testing facilities would be arranged, and turns at duty could be taken for the secretarial and technical tasks..... To those of you who suspect that this kind of thing has dire political implications, let us point out that any society must involve both individualistic and cooperative activities, and that society remains healthy when these are kept in balance. There is ample room for cooperatives in Australia, and we can all benefit from them.

The actual machinery of ordering surplus from abroad or domestically is not difficult, as we have discussed in these pages. And do not overlook the fact that appreciable discounts can often be obtained even for new items purchased in quantity from local manufacturers, particularly if your group qualifies for Trade Prices. Suitable information about suppliers can be obtained from advertisements in the experimenter and trade journals, and from various contacts. Within reasonable limits we are willing to advise bona fide groups of private (not business) character, concerning methods and pitfalls, reliable suppliers, and so forth. We do, however, caution prospective Co-op groups to think carefully before embarking on the idea of reselling components as a regular business. It is possible, but it multiplies problems and overhead costs alarmingly.

One obvious saving in expense and trouble with a Coop is the fact that it is unnecessary to stock a large body of merchandise in the (sometimes forlorn) expectation that someone might want it sometime. You just order what you want, paying in advance of course, when you want it. If, on the other hand, the Coop chooses to charge its members an extra percentage, some stockpiling can be done, for greater flexibility; but there would still be no advertising or employment costs.

New members might very well be recruited by advertising in the EEB and in other magazines, if a few friends can be interested sufficiently to pool initial resources for this advertising. But this idea will not happen automatically. It depends on you. We shall not take up more valuable advertising space to nag you about it, so give it a go, eh?

We are, however, still in business, and an Addressed Envelope will inform you of the latest. In addition to our usual widish (but ever diminishing) range of diodes from 0.16A to 100A (our 0.16A and 20A ones are now most competitive!), we have a goodish stock of 10A SCRs, and the new low cost 0.75A SCRs. And Ckt Boards.....

Advertisements (concluded).

More from Australian Electronics, 76 View St., Hobart Tasmania.

As you may know, we have been trying to clear out diode stocks, so as to be done with the wretched things. We are even reduced to the expedient of placing an advertisement in the national magazines this month. But we do have something extra interesting for you now, which we should definitely like to finish before the end of the year: more of those nice little silicon signal diodes we were selling about a year ago. Most of them are in the 30-100V range, some are 100-200V, some 200-300V. The LT ones are roughly analagous to OA200, HT to OA202, etc. The 30-100V ones cost you 4c each, by the hundred; somewhat dearer for the HT ones. If you insist on buying less than a hundred, add a bit extra to the remittance. You can find the exact PIV more accurately than our broad ranges, by the various diode testing methods which have been and will be described in the EEB. These little diodes can be used as rectifiers with a forward current rating of about 160mA, or to rectify signals up to 25mc/s, or to protect meters. Technical details on these applications will appear in next month's EEB. -- FOR SALE: Hand-operated Duplicating Machine, cheap.

PUJT (continued from P.55).

From a practical point of view it appears, however, from the tables above, that germanium transistors of the 2N1300 series (as on Computer Boards) can pass base currents of several mA without harm. This is not surprising, as the collectors are rated from 100-300mA maximum, but less robust types such as OC71 may prove fragile.

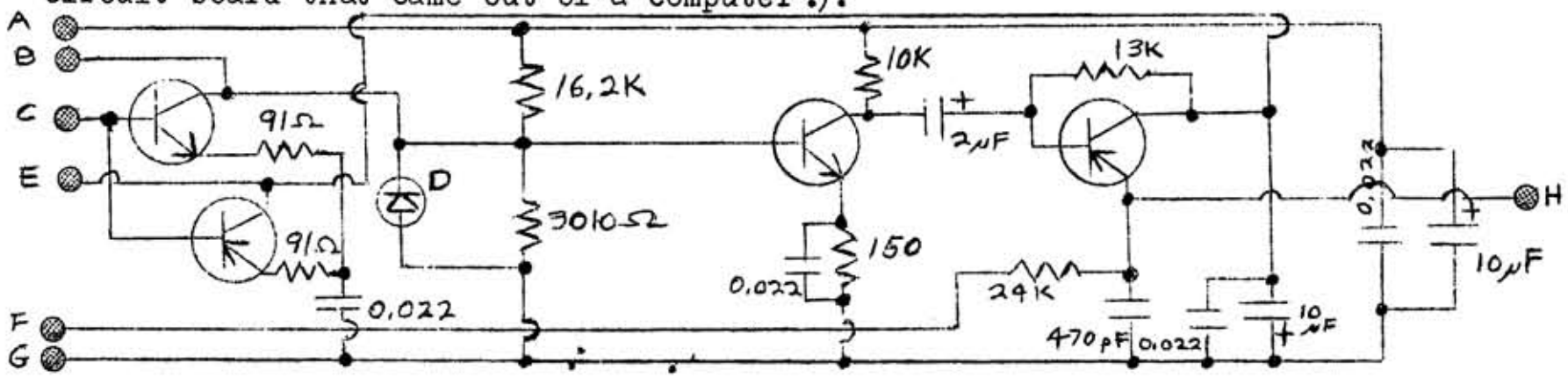
The PUJT can, thus, be used as Tunnel Diode, Unijunction Transistor, or Silicon Controlled Switch with full cycle control. With the UJT it shares a reasonably stable firing voltage, low firing current, high pulse current capability, a negative resistance characteristic, and low cost. Its temperature sensitivity can be minimised by using silicon transistors, and by stabilisation. Its range of possible applications is enormous, and I should be pleased to receive publishable comments about it. I should also like to find references to the use of this configuration in various practical circuits already published.

In Part I of this article I described a practical relaxation oscillator. The PUJT has also been used as a UJT to trigger an SCR, but with the small transistors and currents used, this was practical only for SCRs having reasonably high gate firign sensitivities (eg. less than 5mA). The circuit involved is standard for UJT trigger applications.

I wish to thank R. L. Gunther and R. A. J. Reynolds for valuable assistance in preparing this article.

PUZZLE!

What is it, and why? One year sub for correct answer. (Hint: it is on a circuit board that came out of a computer!).



EQUIPMENT EXCHANGE BULLETIN

P.O. Box 177, Sandy Bay, Tasmania, Australia.

PUBLISHED IN DUE COURSE EACH MONTH. TEN CENTS PER COPY. 60c yearly, worldwide.

STAFF: Worries = R. L. Gunther, Help = R. S. Maddever, Arrangements = C. K. Pallaghy, Stencils = BJ, Printing = D. F. Dainton, Advisors = Larry, Rod, John, Tony, etc.
ARTICLES earn a free one year subscription. Copyright is author's. All opinions expressed belong to the authors. We guarantee nothing. BACK ISSUES for 1966 are 30c per quarter. No more* back issues or Vol. I for 1965! SUBSCRIPTIONS are now accepted for only one year at a time; otherwise too much paperwork. All subscriptions must begin with the current issue for postal reasons; Back Issues are extra. If you don't write your name and address legibly, someone else will probably receive your EEB. YOUR RENEWAL DATE preceeds your name on the address label if it falls in 1967 or +. 1966 expirations remain as before. If you don't renew, you won't get any more EEBs. Very simple. So do it right now. Thank you.

CONTENT

Editorial. It occurs to us that there are a lot of you out there, and we'd better mind what we're saying, or we might say something stupid. Now this is very bad. It means that we are beginning to take ourselves seriously. Down with it. The first thing that will go will be that silly editorial 'we.' 'I' am not a 'we,' even though I may be the mainspring in this impractical operation.

Now while I'm being an individual, would all the people in Hobart who have borrowed books from me please now return them? Some of them are not replaceable, and technical books tend to cost a lot of money too. Everyone who borrows protests he will return the stuff right away. I'm still waiting. I don't keep lists of borrowers because I think people are basically worthy. Way deep down.

RSM and I have been thinking about 'glossing up' the EEB, by printing it by Litho process. This would make reproduction easier, particularly for drawings, and would give the publication a more polished appearance. But it would cost a lot more, necessitating an increase in subscription rate. It might be done by taking advantage of an interesting opportunity about which more will be said next month. But, I have reservations about all of this. If the EEB becomes glossier, I should have to become serious and professional and all that. Is it worth it? The regular national magazines accomplish this excellently well-- I'll have more to say about that controversial subject later, too. If the EEB becomes Glossy, it will lose some of its amateur flavour. Is it worth it? The one concession we might make could be to increase the number of articles-- particularly constructional ones, but the thicker EEB would take longer to read (do you have the time?), and the sub would probably have to be raised to a dollar. What do you think? I'd like to have your opinions on this. Glossier? More articles? No change?

* well nearly no more.

Editorial (continued)

I have reorganised the address stencils which begin in 1967, six pages of them. Ugh. It had to be done, because the renewal system became unweildy. One reason was the fact that correspondents didn't always furnish their Identification Number. Now, when your subscription falls due, you need only send money and your name. This is more reliable, and also more humane. Who likes to have a Number, or to be told that he is due to Expire at such-and-such a date? The renewal situation has also provided some interesting insights. People either tend to be passionately enthusiastic (why?) about the EEB, or wildly uninterested. Thus, it has proven useless to send reminder EEB issues to expired subscriptions, and we shall not do it again after this month. Just as well; the new subs will probably come to equilibrium with expired ones, and we won't be doing much publicising for extra subs until we get a motor-driven duplicator. That may be (?) fairly soon. We received a response to the cryptic notice inserted in the last issue, about selling the present duplicator.

I honestly don't know how much of the abovementioned 'Content' will be appearing in this issue. BJ is having exams, and I have to type the whole flaming thing myself. If I don't get much beyond 'Letters,' you'll know what happened. But I'd better get in as much as possible, because next month's issue is going to be a lovely. By the way, is anyone else interested in typing stencils, in case this sort of thing happens again? It's hard work, but to compensate for that, the pay is miserable, and you'd have me on your back to do the job perfectly. Your main reward would be in having a vital part in uncomplicating my life, and in building a Busier Australia. Only busy people need apply. Applicants will be considered in order of application. Closing date is July 4, 1976. Lasciate ogni speranza, voi ch'entrate.

-- RLG

??????????????????????????????????????

Letters to the Iditor.

1) ... I have had a card from G.E. thanking me for my queries about the SCR Hobby Manual, and advising that the Second Edition is now in print. Good news indeed.

-- J. Lilley, Madang, T.P.N.G.

2) ... About valves, etc, personally I wouldn't care if you never mentioned them again. But surely the time is ripe for the publication of some transistorised ham gear. Goodness knows we have been waiting long enough for these much promised receivers, transmitters, etc in the national magazines.

-- P. Nesbit, VK3APN, E. Malvern, Vic.

3) I have been experimenting with transistorised transmitters using circuit board parts. I found that the power transistors are warm to the lips (about 40-50°C) when drawing 1.8-2.0 watts. I intend to make a 3 stage TX using those transistors. I have had a few problems in the oscillator, but I think they are over. Provided the whole thing is stable enough it should be adequate for round Perth (17 miles distant). If and when I get it going, I'll write and give you the details.

In the meantime, I have been looking over the indices of 'Amateur Radio', and have found plenty of transistorised ham equipment. Who says there is a lack of it? Thus-- Modulator design, 5/61, 6/61, 9/62, 3/65. Transistorised crystal checking, 9/65, 7/62, 11/65. Oscillators, radios, 10/62, 8/61, 4/62. D.c. Power Converters, 10/61, 12/65. Power supplies, 4/62, 11/62, 2/62, 2/65, 8/65, 11/65. Receivers, 4/62, 6/62, 7/62, 9/63, 8/65, 10/65, 11/65. Mech. filters, 5/63. Transmitters, 10/62, 7/65, 11/65. VFO's, 10/62. And more subsequently. Not a lot of this kind of thing has appeared in RTVH, but there has been some. The overseas literature, of course is full of it, and any hams seriously interested in construction ought to subscribe (or at least read) to QST, CQ, or 73. The New Zealand publication, 'Break-

Letters (continued).

In' is really excellent, frequently publishing transistorised stuff, and ought to be subscribed to by all Australian radio amateurs. 'Break-In' is the official publication of the NZART, Box 1733, Christchurch, N.Z., costs 35/- (stg) and worth it!

-- L. Smith, Carmel, W.A.

((Ed. Note: Many thanks, Leslie, for that information. But watch out about touching hot things with lips. Always touch first with the finger (with power off), or you might acquire some sore lips!)).

4) April's copy hasn't come to hand yet, though I suppose that it will turn up eventually. Usually I don't worry much if they don't turn up for a month, but after that all sorts of weird thoughts run through my mind-- that the duplicating machine has blown up, been stolen, or merely ceased to function. Or perhaps the staff is all out on strike. Or then again, seeing that a lot of the staff are students brings dark thoughts to mind -- perhaps they've gone and drunk all the profits....

Finally, I must add that I think you put out a very good little magazine, even to the finding of articles on how to import from overseas, disguised in adverts.....

-- D. Nolan, N. Albany, N.S.W.

((What profits?? -- Ed.))

5) I have been having a half-hearted play with SCR motor speed control, but every system seems to have its inadequacies. I feel that effective phase control of SCRs is not as simple as it looks. The circuits in the SCR Manual have, so far as I've investigated, functioned as constant phase, and in a sense more like speed controlled choppers. I see by the EEB that others are finding the need for sophisticated design. For good results amplified feedback seems indicated....

-- G. Noble, Lismore, N.S.W.

((Why not try Tony's phase control circuit of the EEB, May 1965, adapted to HT? I have been doing some experimenting with series-type phase control, and should be able to publish it in the EEB in due course. I wish, at this time, however, to warn prospective SCR experimenters against two pitfalls: 1) Don't put a condenser larger than 0.01μF from anode to cathode of an SCR in a 240V circuit. The only circuit which eliminates radio interference from SCR circuits is the one shown in the SCR Hobby manual: put an inductance in series with the anode, and bypass it and SCR by a 0.005μF. 2) Avoid placing 240V across gate to cathode of an SCR. It shortens life.))

--RLG

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SEMIANNUAL INDEX, 1966. Volume II EEB, Box 177, Sandy Bay, Tas. 60c per year.

SILICON CONTROLLED RECTIFIERS. Part X -- by D. R. Horgan (VK4)

-- A simple Full Wave Lamp Dimmer

If you put a single diode in series with an ordinary incandescent lamp, its light output is reduced to about 33pc of normal, because of the reduced power available from alternate half cycles (and lower lamp efficiency at reduced power). If the diode is inserted in series with a very large lamp, eg above 500W (for theatrical functions, etc), the operation of the filament becomes so inefficient that negligible light is obtained from it. The circuit shown in Fig. 1 was developed to take advantage of this phenomenon. Alternate half cycles are admitted freely via diode, D1, and the other half cycle is controlled by the SCR. When the SCR is not conducting, the light from the large-lamp load is very dim. When the SCR conducts completely, both half waves are obtained at the output. This allows maximum output (about 97pc nominal light intensity) without requirement for more elaborate systems for controlling both halves of the a.c. cycle. When small lamps are used as load, minimum light intensity will be higher, and some flicker will be obtained (ripple freq. = 25cps), but this smooths out quickly as some SCR power is introduced. No flicker is obtained at full output-- where it is most important. For very large lamp loads, however, smooth control of light is obtained without noticable flicker at any position of the control. With a 10 Amp diode and 10 Amp SCR, up to 5kw of lamp load may be controlled.

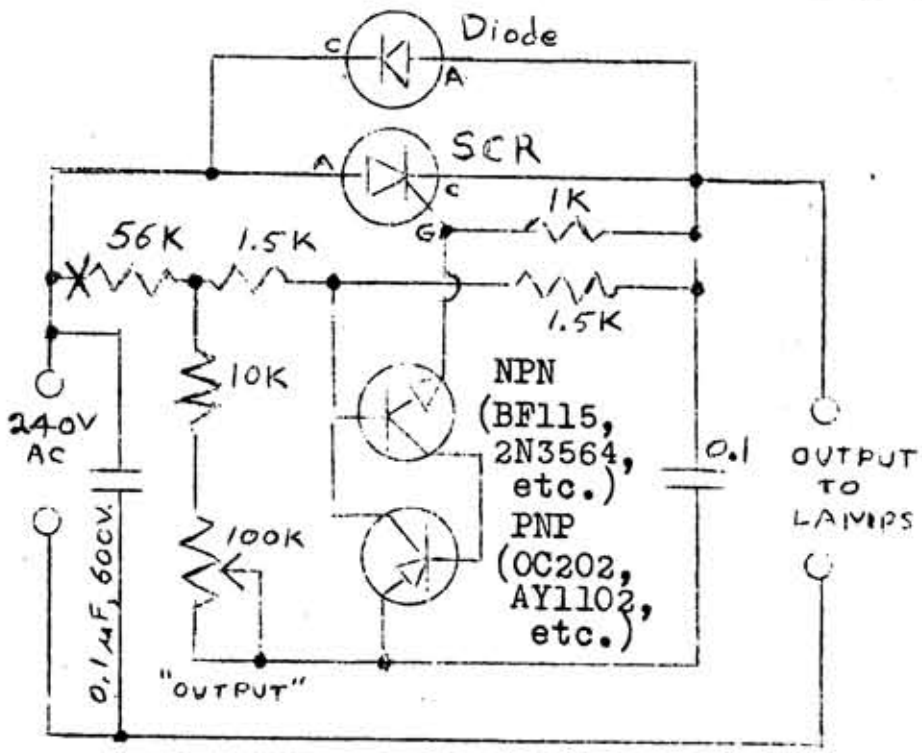

Fig. 1

Not only does the diode provide the missing half cycle, but it makes the PIV of the SCR virtually irrelevant[x], and it serves to bring the lamp from its dead cold (very low R) state. The resulting surge current can be handled by a diode rating substantially cheaper than that of an SCR of similar peak current rating[xx].

The gate control system is an amplified phase shift type, similar to the conventional Unijunction Transistor circuit, but in this instance uses the two-transistor configuration described as 'PUJT' by T. Ohsberg in the May and June 1966 issues of the EEB. This circuit could be used with SCRs in a variety of arrangements. Although this two-transistor system is likely to be relatively inexpensive, it should

[x] Note that however low the SCR PIV rating may be, its V_{BO} in this circuit must still be at least 380V, to maintain control over the peak of the cycle. If the diode is omitted, the PIV of the SCR must be either at least 500V, or protected by a series diode of about 600V rating, as discussed in the EEB, Vol. I, Nos 3 and 4. In Fig. I here, the diode itself must be rated for a PIV at least 500V, preferably 600V, and with current rating appropriate to load. Since the load is only resistive, up to 1.4 x 250 = 350V can appear across the diode when the SCR is off. A 500V rating gives a safety factor of 1.4, which is not excessive. 1.7 would be even better. -- Editor.

[xx] This would be most important when maximum load is used for a given diode/SCR current rating. In any event, conservative practice would indicate that lamps should be turned on at minimum output. This can be ensured by using a 100K pot with a switch, and inserting the switch at 'X'. When the pot is turned to max. resistance, switch goes off.

SCR, Part X, continued.

not be overlooked that some types of Unijunction Transistors have recently dropped sharply in price, and should soon be readily available to Australian Experimenters. A UJT-type control circuit is not strictly necessary, but gives better control over a larger part of the cycle, with smaller R-C values than a simple R-C network.

Other series-type SCR lamp-dimming circuits will be discussed next month, ~~or~~ The NEXT including neon lamp mediated phase control for half or full wave output. This will be followed by an article describing parallel gate control circuits, and the best ways of avoiding Grief with SCR systems.

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MULTISTABLE NEON OSCILLATOR DESIGNS -- by L. Smith (VK7/VK6)

The basic circuit for most neon relaxation oscillators is shown in Fig. 1. By connecting 'X' to HT, a sawtooth wave is obtained between 'D' and earth. This is a permutation of the usual configuration in which the condenser is placed in parallel with the neon. In this instance, the load impedance becomes part of the discharge path, and although this imposes certain limitations, it leads to the interesting circuit in Fig. 2.

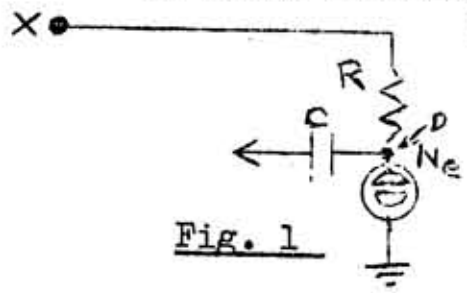


Fig. 1

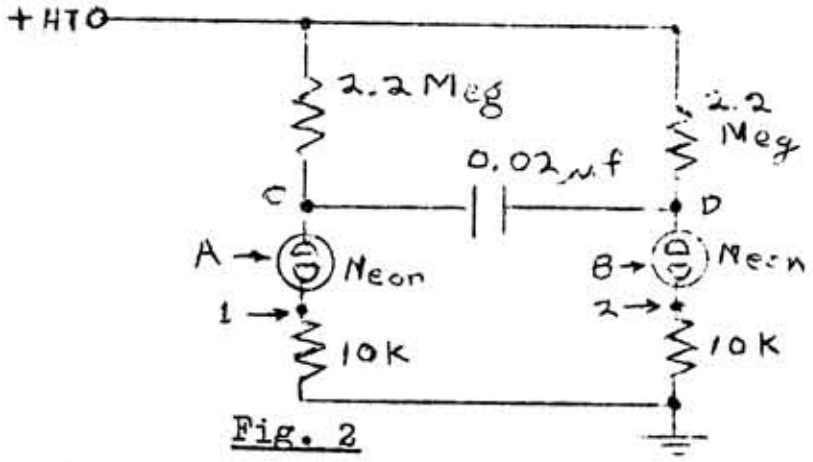


Fig. 2

By extending the principle to two lamps, a free running multivibrator is formed. Like the triode multivibrator, the neon oscillator shown in Fig. 2 has two stable states. The first state is obtained when lamp B is on, acting as a short circuit between point 'D' and earth. The circuit is then effectively as shown in Fig. 1. When the voltage across neon B falls below extinguishing voltage (about 60V), the voltage across neon A rises above firing point, A fires, and the circuit is once again similar to Fig. 1, but now with the other neon in operation. Useful square waves may be obtained by taking output from Points '1' or '2.' Well, nearly square, as shown in Fig. 3. The sloped

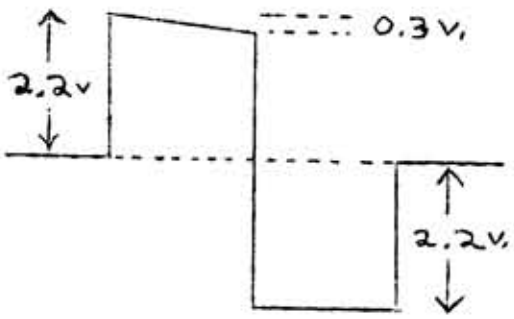


Fig. 3

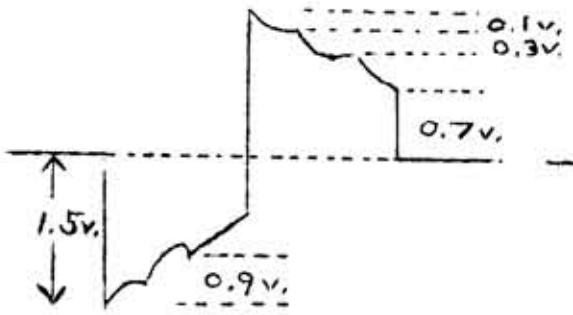


Fig. 4

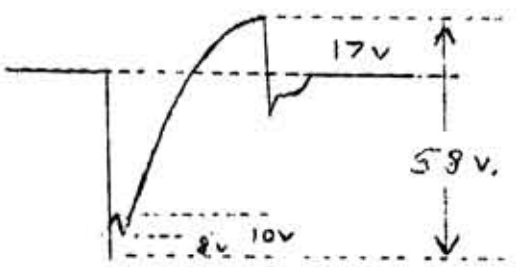


Fig. 5

positive peak is caused by the condenser differentiating the waveform. The operating frequency with the constants shown is about 70cps. By increasing the condenser to 0.86µF, frequency is reduced so that convenient visual observation may be made. If a condenser is inserted in series with the output from Points '1' or '2' the bottom part of the wave will, of course, become differentiated, and a symmetrically degraded square wave will be obtained. Putting the CRO between Points '1' and '2' yielded the incredible waveform shown in Fig. 4. Between Points '1' and 'C', the wave shown in Fig. 5 was obtained.'

Neon Oscillators (continued).

Now in Fig. 2, the current through each 10K resistor is about 220μA when the supply is about 320V d.c. This current is greater than the 150μA one might expect from ohm's law, because extra current is obtained from the charge on the condenser. Since the 2.2Meg resistor is so large, this output current remains fairly constant over a wide range of load resistors, and output voltage will depend on resistance. Thus, for a 10K resistor, the output from points '1' or '2' will be 2.2V; for 20K it will be 4.4V, and so on. 50K is about maximum practical for 320V supply, giving output of 11V; 100K is possible, but oscillation stops when supply exceeds 210V. Thus, the choice of output resistance will depend on the voltage and impedance requirements of the load. For practical purposes, the load impedance ought to be at least twice the resistance used, to maintain output. If a lower output impedance is required, the 2.2Meg and load resistors can be lowered as necessary.

The frequency of oscillation of Fig. 2 will depend on the R-C values, and on supply voltage. If 0.02μF gives 70cps, 0.01μF will give 140cps, etc. The dependence on voltage is indicated by the following chart, measured for C = 0.01μF: This relationship can be useful to vary frequency over a wide range, without changing R-C values. Since the osc draws so little power, it can be fed from power taken from a potentiometer. If, however, a very stable frequency of output is required, it will be desirable to stabilise the voltage of the HT supply. This can be done with HT zeners or by still more 1/25th watt neons! Fig. 6 shows a suitable arrangement. Neons fire at about 75V (varies from one to another), and regulate at about 60V (ditto). Therefore in Fig. 6 it is not possible to use five neons to give 300V output, because they would require 375V to fire. To get the highest output voltage, HT zeners would have to be used. The frequency-varying potentiometer could still be hooked up to the output of this regulator, if the bleed current taken by it were calculated.

HT	f_o
320	140cps
190	70
135	35
92	17

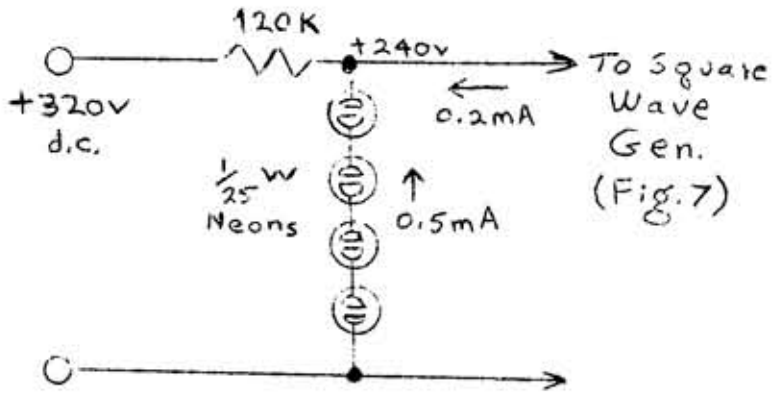


Fig. 6

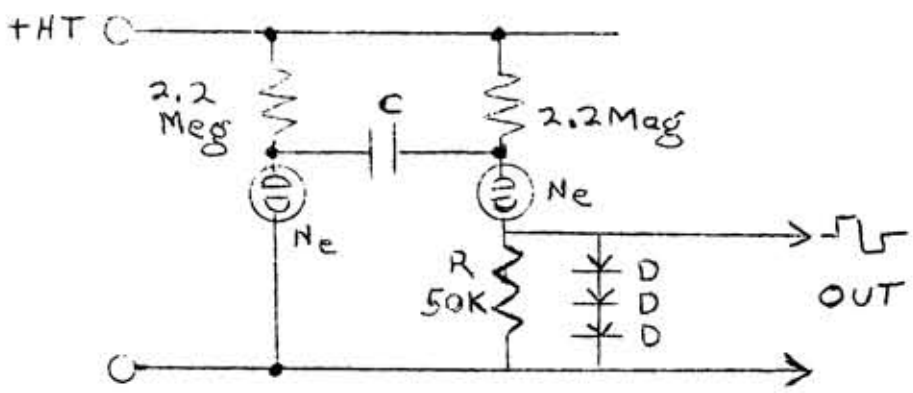


Fig. 7

It is possible to square up the wave of Fig. 3, and to obtain constant output over a range of HT supply voltages, by inserting regulating diodes as shown in Fig. 7. This makes a nice simple square wave generator, whose performance is exceeded only by more elaborate systems using oscillators to drive Schmidt Triggers. The diodes square off the top of the wave because of their constant voltage characteristic. The bottom of the wave is square, because the neon is off, and absolute output voltage drops to zero. When ordinary diodes are used with the polarity shown, they are acting as 'Forward Zeners' and their forward voltage is quite constant with varying forward current. Small glass (OA200 or equivalent) diodes have a drop of about 0.55V each at +220μA, while 750mA metal silicon diodes have a drop of about 0.45V each at this current. It is not very practical to use germanium diodes, because of their low voltage drop (about half as much). The output voltage will de-

Neon Oscillators (continued).

pend on the number of diodes used, but for voltages above about 4.5V it becomes impractical to use Forward Zeners, and instead conventional zeners are used, up to a practical maximum of about 9V; of course then the polarity of the diode is then opposite to that shown in Fig. 7. The output impedance will be equivalent to the resistance which would have been used to give the same diode voltage from Fig. 2. Thus, if 5 glass diodes are used in series in Fig. 7 to give 2.7V output, that voltage could have been obtained if the diodes were omitted, and R were 2.7V/0.2mA =12K approximately. Then the load should be 25K or more, to maintain this output. To drive a common emitter stage having an imput impedance of 2K, the large resistances could be lowered to 1Meg each, and a single 750mA diode used across R. Lowering the resistance to 1Meg increases the current to 0.4mA, and equivalent output impedance is then 0.5V/0.4mA = 1.25K. C would have to be doubled to maintain same f_o.

To drive an emitter follower, on the other hand, an ordinary zener of 9V would produce an output from the EF of about 9V at considerable power. Since HT is in fact required to operate the neon oscillator, it would also be practical to drive a valve. Appropriate neon circuit voltage output would then be chosen suitable for the grid bias used.

Note that quite a good zener can be obtained from the forward-biased emitter-base junction of any silicon (not germanium) transistor. Surplus transistors may give upwards of 10V, but good quality transistors (eg from Fairchild) will be in the range of 6.5-6.8V, with an equivalent power rating of about 300mW.

By making a further extension of the two lamp circuit, an unusual flasher sequence can be obtained, using the circuit of Fig. 8. The sequence may be left to

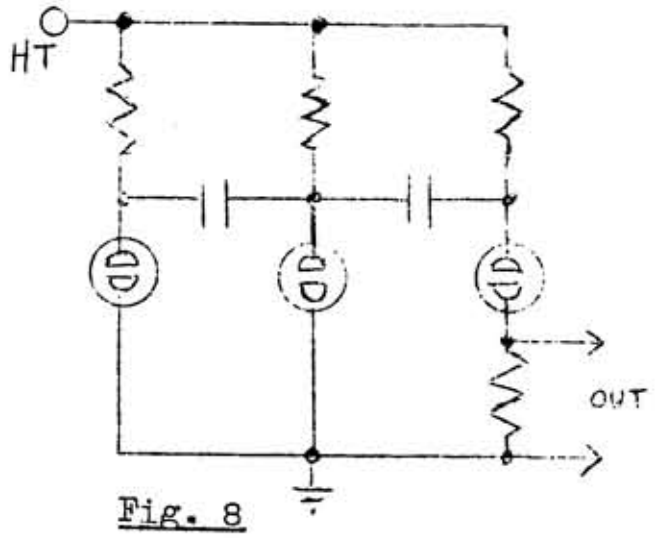


Fig. 8

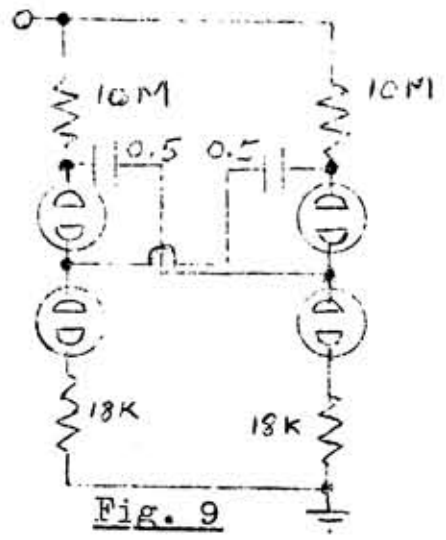


Fig. 9

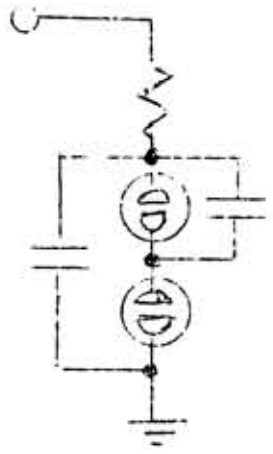
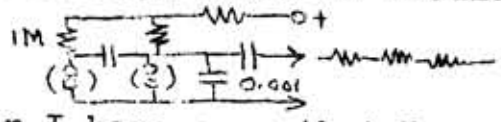


Fig. 10

right or conversely, but although it cannot be predicted, it is stable once it is extablished. Adding yet another neon in the same direction resulted in strange sequences depending on supply voltage the the individual firing potentials of the neons. Neons used in all cases, were the miniature 1/25th watt type. These permutations by no means exhaust the total number of circuits possible, and an evening spent with the circuits of Figs 9 and 10 should yield interesting results. But don't get across the HT!



Addendum.

Since the above was written I have seen that Practical Electronics is running a whole series of articles on various uses of neon lamps. The sixth of the series presents a 'Neon Warbler,' of a form similar to Fig. 2 without 10K resistors, but with a 0.001 condenser across neon B, and output taken from point 'D' to earth. C is 0.5-1.0μF, the big resistances are 1Meg, and 220K or 770K is inserted in series with the HT. This gives an output looking like this: and 'warbles.' See Practical Electronics, Feb. 1966, p. 103, by R. Bebbington.

BUILD YOUR OWN COMPUTER?? -- RLG

In the course of various correspondences I have been asked whether I knew a source of information on computer circuitry. Since the computers I have seen have generally occupied three or four rooms of equipment, I had never given much thought to the subject. But come to think of it, there are two firms in America who sell do-it-yourself computer kits, so it must be possible. It appears that the most current sources of information on computer circuits of a practical nature are these:

A considerable number of small articles in the Mullard 'Outlook' scattered over the past few years. Too numerous to mention here. Find a collection of them, and dig out the information by browsing. It is worthwhile subscribing to 'Outlook.'

What appears to be an excellent series of articles on computer theory and fundamentals has started with the June 1966 issue of 'Electronics Australia.' I recommend it to you.

A number of books:

Transistors in Logical Circuits, by J. K. Altes (Philips). 'Starting from already known analogue relay circuits, this book describes in a special way the logical electronic circuits using semiconductors...'

Selected Semiconductor Circuits Handbook, Ed by S. Schwartz (inexpensive Services Edition. See EEB Reference List, Vol.1), Part 7. This is also an excellent reference book on practically everything else involving semiconductors.

The Radio Handbook, 15th Edition, Chapter on 'Electronic Computers' (publ. by Editors and Engineers, Ltd., Summerland, California). Also good, better than ARRL.

G.E. Transistor Manual, Chapters 11 and 12.

ABC's of Computers, by A. Lytel, (. H.W. Sams) '... explaining digital and analog computers and their circuits, numbering systems, logic of computers, how information is put in... etc.'

Basics of Digital Computers, by J.S. Murphy (J.F. Rider), 'A 3-volume picture-book training course in electronic digital computers.... fully illustrated. Covers basic theory, circuits, memory, distribution of timing impulses, etc.'

Design of Transistorized Circuits for Digital Computers, by A. L. Pressman (J.F. Rider), 'Basic Building Blocks in digital computers, transistor transient response, diode gating, resistance logic with transistor inverting amplifiers, design of flip-flops and delay multivibrators, transistor fundamentals, etc.'

Digital Counters and Computers, by E. Bukstein (Rinehart), 'Complete description of theory, design, and application of digital counters and computers and output...'

The Design of Switching Circuits, by W. Keister, A. E. Ritchie, and S. H. Washburn. (Van Nostrand Books). 'Covers telephone switching circuits, digital computers, control systems, etc. Illustrated....'

Digital Computer Fundamentals, by T. C. Bartee. (Published by McGraw-Hill). 'Explains computer operations, programming, logical circuits and design, memory, and other important topics, with applications....'

Electronic Designer's Handbook , by R. L. Landee, D. C. Davis, and A.P. Albrecht, (Mc Graw-Hill), Ch. 19.

Electronic Analog Computers, by G. A. Korn (Mc-Graw Hill). Reviewed in 'Electronics

Computers (continued).

Australia' June 1966, p. 171.

Practical Robot Circuits, by A. H. Bruinsma, Philips Technical Library (1959). My favourite. A fascinating little booklet describing in clear detail all you need to know to build a practical Robot Dog! Canis ex machina. In Ch. 5 is also described the principle and practice of methodfor using diodes as switching elements instead of relays. This idea has also been used for other systems, eg T-R switches for amateur installations (eg. '73' January 1965, 'Break-In' June 1965). In Ch 5 is also described the philosophy and practice of introducing errors purposely into a Noughts and Crosses Robot, so that he will be able to play a reasonably human game. What won't they think of next.

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GRANDMA'S TEST FOR SEMICONDUCTORS. Part IV -- RLG
-- Testing Diodes, Zeners, and SCRs.

It is considerably easier to test diodes than transistors. For this, however, it does help to know how diodes work. This is found in the Mullard Reference Manual, in the Selected Semiconductor Circuits Handbook, and elsewhere. The main things about diodes are the PIV and forward current ratings. You test the PIV by increasing reverse current gradually, and watching the voltage across the diode. When the current starts to increase faster than the voltage (you have to watch both meters at the same time), that's it. For silicon diodes above 100V this will usually occur at about -20µA, but for LT diodes it can occur at considerably higher currents, because the curve gets more sloppy-- eg at -300µA. I shall discuss this in greater detail next month.

You can test forward current by putting some through the diode, and watching the voltage. The maximum current will be that for which V x I = the power rating of the diode. For small glass types, this will be about 300mW. For 'Top Hat' types it will be about 1 watt. For Stud types it will depend on junction size and on heat sink. A 'Grandma's Method' would be to increase current through the diode (forward direction) until it gets hot. It should not get hotter than you can touch with finger, under maximum ambient temperature conditions. All of the above applies to silicon diodes. Germanium ones have a much sloppier reverse V-I curve, and should not get more than quite warm to the touch. It is wise to examine small glass diodes to see whether they are junction or point contact types. The latter will have a very fine wire asanode, while the junction types will have a heavy ribbon or bar as anode connection. If point contact, it is germanium, for VHF, and generally ought not to take more than about 50mA.

I'm tired of typing, now, so this can be continued next month.

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ANSWER TO PUZZLE

Several geniuses wrote in to say that they thought that the circuit in question ought to be a 'Novel Gated Multiple Flat Pulse Analyser.' Just to show you that it is sometimes worthwhile to reply to the EEB, we'll give them the free sub anyhow. But don't depend on that happening again. The circuit presented is indeed one of that genre, with inverse floating paraphase integration of sync locked stabilisers. It has a differentially stabilised input, and diode D and the RC Networks shape the wave for specific pulse analysis applications in computer systems networks. It is designed to feed a pulse sensitive discriminator, which activates an SCR-controlled trip inducer, in order to remove mains power from an ALGOL coded FORTRAN memory bank.

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See June EEB, p. 60 for details, or write Hallard Electronics, Box 58, Campsie, N.S.W.

CLIVE WITCHELL INDUSTRIES NEWS: Would you like to make your own printed circuit board by the new photographic process? All you do is draw the circuit either full size, twice size, or three times and send it along to us for processing. The finished price for even 1-off is about half the price you would pay at an electronics retailer. A kit of circles, tape, and clear film is available for you to make this enlarged layout of the board, and is available with full instructions for 85c (items can be reused).

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RECTIFIER DIODES.

Type	PIV	Amps	Price
Miniature glass*	100	0.16	0.05
	200		0.07
	300		0.08
(Cathode= banded end or twisted lead)			
Metal silicon	800	0.75	0.65
	1000		0.75
	1200		0.85
	1400		1.10
	1800		1.65
	2000		1.90

Type	PIV	Amps	Price
Stud silicon	1000	2.0	1.00
	2000		1.85
	800	3.0	0.90
	800	5.0	1.20

Type	PIV	Amps	Price
Stud** silicon	300	20	2.00
	550		2.95
	700		3.90
	800		4.50
	100	35	2.75
	30	100	6.50
Germanium power	P100	1	0.50
	P200		0.65

* Miniature glass encapsulated silicon junction 'signal' diodes, similar to OA202,etc. These are excellent for general-purpose rectification within their ratings. As an added bonus, some of them will rectify up to 25mc/s, and some will work for protecting meters (when used in the forward direction). Experiment to determine best results.

** No 'Heat Sink Adapters' are necessary for Stud Diodes, just heat sinks. We do recommend that silicone grease be used between the metal surfaces if load will be heavy.

ZENER DIODES. These are now nearly all gone, but we have a few about every 5 or 10V between 70V and 190V, 1 watt maximum power rating. $0.50 each. Also a few 5 watt ones suitable for transistorised ignitions: enquire, stating BV_{ces} of transistor used. No LT zeners left. Note that good zeners can be obtained at about 6.5V by using a back-biased base-emitter junction of a good silicon (not germanium) diode (eg. 2N3638,SE1002, etc.), with maximum power rating of about 300mw.

SILICON CONTROLLED RECTIFIERS. Like thyratrons, but solid state. Literature on SCRs is published by G.E., I.R.C., Motorola, Mullard, Philips, and the Equipment Exchange Bull Characteristics: $+I_{gate}$= 1-10mA (for 4.7A), 5-30mA (for 10A). $+V_{gate}$ = 1.6 max. $+V_{ca}$max = 1.5V at $+I_{ca}$max. Each SCR comes with a tag attached, showing PIV, V_{BO}, and $+I_g$. X= Forward Breakover Voltage (V_{BO}) $\geq$ 380V, therefore can be used with Mains 240V RMS (if transient suppressed) supply if protected by series diode of at least 600V if resistive load, or at least 1200V if capacitative load. For direct operation on 240V mains with resistive or motor load, we do not recommend PIV rating less than 600V. Stock of some SCRs may be limited. Please specify alternatives.

PIV	Amps	Price
600	0.75	3.25
700		3.60
400	4.7	2.50
500		3.50

PIV	Amps	Price
600	4.7	4.10
50	10	0.90
100		1.50
200		2.10

PIV	Amps	Price
500	10	4.10
600		4.75
X		2.50

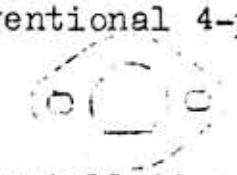
PIV	Amps	Price

(LT 1A. type may be coming)

TRANSISTORS. Voltage ratings are Absolute Maximum for these too, including peak and transient voltages in a.f., r.f., or power systems. Power and current ratings are typical values given for 25°C case temperature, except for 2N2988 and 2N2990 which is at 100°C/case temperature (200°C max.). Derate conventionally for higher temperatures.

Type	Connections (cw)	NPN	PNP	Ge	Si	Pc	Ic	fT	V-β	BVcbo	Price
2N1038	Tab, E, B, C+		x	x		2w	3A	225kc/s	8	80V	0.90
T-13			x	x		20w	3A	225kc	5,11	100	1.50
									4,10	80	1.15
2N498		x			x	4w++	240mA	50mc	6	150	1.00
									6	200	1.20
2N2988	Due in August	x			x	1w	1A	40mc	12	200	1.45
2N2990	Due in August	x			x	15w++	1A	40mc	12	200	1.65
										250	1.85

Notes:
No more tetrode transistors or Silicon Controlled Switches, sorry.
+ Collector connected to case. Conventional convention.
++ With good external heat sink. 2w for 2N498 when used with spring clip heat sink.
For 2N498 and 2N2988, BV_{cbo} is the same as BV_{ces}, but BV_{ceo} is about 30pc less. Just think, now transistors can be used in HT regulator supplies! The HT ratings are also useful in keeping collector current down for a given power, in r.f. power amplifiers. But remember that you must take the peak a.c. voltage plus safety factor. Needless to say, it is essential to avoid parasitic oscillations before power is applied to the amp. f_T is frequency at which common-emitter amplifier gain falls to unity, or at which the common-base amplifier gain falls by 3db from the low frequency value.
T-13 threads made out of Dural; tighten cautiously but firmly, to heat sink.

TRANSISTOR SOCKETS. We have now found a reliable supplier of the most lovely transistor sockets we have yet seen. They are the conventional 4-pin universal type, and come with a mounting plate which we shall here trace:  and which can be fitted to the main socket body, or not, as desired. This item is mechanically rugged, as these things go, and most useful for a wide variety of experimenter applications. Makes a neater more reliable installation, ideal for experimentation, and for low capacity at r.f. It seems only logical to install transistors into a circuit after all other wiring is completed. 18c each//Try some, and you'll be delighted!

METERS. Microammeter/exposure meters. 100μA type, easily convertible, complete with nicely printed scale in μA, and complete instructions. See Catalogue Notes for rough reproduction. Excellent for small instruments (or as exposure meters), null indicators, GDO's, etc. Please specify whether use will be primarily electrical or photographic. $3.00 each.

UNIJUNCTION TRANSISTORS, SILICON CONTROLLED SWITCHES. Not stocked. For a good and inexpensive substitute, see the Pseudo-UJT article in the Eqpt. Exch. Bulletin, May/June 1966.

SILICONE GREASE improves heat contact greatly between metal or mica surfaces. It can be obtained from chemical suppliers as 'Silicone Stopcock Grease' or from Shell Service stations. A little goes a long way, so share a tube of it with your friends. We thought that we would stock some, but the supply did not materialise, sorry.

COMPUTER CIRCUIT BOARDS. As available. 20c per transistor. Post free. Includes any resistors, condensers, diodes, thermistors, potentiometers, torroid coils, etc which may be on the boards, though most of the components are only resistors, condensers, and diodes. About half of the transistors are NPN, half are PNP on the average, virtually all are germanium. Ico usually less than 1.5μA at 5V. 150mW, 100mA, 25-130V (base-collector), except very small ones which are low power LT. Freq response varies. Some are 2mc/s, some are 50-100mc/s. FULL DETAILS about these boards, reprinted from the EEB, including stripping instructions, etc etc etc are supplied with each order. No choice of boards, but you can state your preferences and we'll do what we can. 4,5,6, or 11 transist. each.

Advertisements, etc (continued)

RMS and DC voltage measurements with negligible circuit loading. Resistance measurements up to 1000 Meghoms. 4-1/2in meter, protected. $50.50, wired.

All prices + 12-1/2pc Sales Tax, FOB Hobart, from
ELECTRONIC SUPPLIES PTY. LTD., 22 Karoola Road, Lindisfarne, Tasmania.

NEW BATTERY-operated 4-speed Philips Record Players. Type NG1012, 6V operation, improved crystal head. A real bargain at £4.10.0 for one or £9 for two. Or if you have something useful in test gear, eg a simple L Bridge, a swap might be arranged. Write Dept. A, c/- EEB, P.O. Box 177, Sandy Bay, Tasmania.

FROM the Manager of Australian Electronics! : Since I am saving some work by including the Catalogue here (because a number of readers have requested it), I shall take this opportunity to make some extra comments here. We may have some 100V/3A and 5A diodes next month, after some are left over from a special order for same. See EEB. 500V/10A and 600V/10A SCR's are in short supply right now, but will arrive soon. Customers write to say that it is too bad that the Australian experimenter will now have no source of inexpensive components when we go. First of all, that's nonesense. Look at the Classified pages of the national magazines, and even the new-merchandise prices of some of the semiconductor vendors. It is already impractical to import vhf transistors, varicap diodes, thermistors, Nicad and Alkaline batteries, and most valves, simply because the new or readily-available surplus prices have dropped so much. This, by the way, is something to keep in mind when deciding whether to import. Secondly, how about our suggestion about forming a cooperative? I find it hard to believe that you can't find another half dozen like-minded people with whom to cooperate to obtain merchandise in reasonable quantity. One possible exception may lie with our ZL friends, and since there aren't too many of them, we'll continue to do what we can for them. Their import situation has become execerable. ZL becomes poorer and poorer, just like their British cousins. What a pity!

==Co-ops. That brings me to the matter of cooperative groups. We have had some replies to this, but it is evident that we are going to have a problem in advising them. We do not want to turn out a duplicated sheet on this subject, because it is not altogether a simple matter of supplying addresses of suppliers. We want to treat each case individually if possible. For this, then, will co-op groups please advise us of the number of members, how far they have organised, and the approximate fields of interest or of operation, and some idea of quantities at least initially. In addition will all such groups please first read the various notes we have made in these pages, on business philosophy and importing.

==In Deo Speramus. There are a few more general points, however, that we might mention here for the benefit of all prospective coopters. One is the matter of trust. If you ever do sell some surpluses to people outside of the Co-op, insist on cash. Do not take promises for payment, even from friends. Especially from friends... This is not only our experience, but that of many other informal groups we know about. Even well-meaning people can have a lapse of memory when it comes to money. Note.

We have had several exceedingly expensive experiences with credit, one of them with a friend. Why? As with politics, it seems that when people get involved with money, something can happen to their sense of proportion. But this is caused by confusing an idea for a thing. Money is only an abstraction of power; it is not in itself a lever for manipulating the environment very profoundly. It may seem so to the young, but one learns that, given sufficient money for food and shelter, there can be other things that can be more important: friendship, love, emotional security, creative individuality, freedom. It is true that some people learn this more slowly, and that they tend to find themselves leading emotionally poverty-stricken lives, however much money they may extract from their business or personal environment by various means. But sanity directs otherwise, and who really enjoys bludging?
.... All of which leads to this: 1) There is ample philosophical justification for our reducing operations, for the sake of time to use parts rather than sell them. 2) Those of you who are forming cooperatives, elect an honest treasurer, and insist that he keep accurate records right from the beginning. This is not so much to check his honesty, as for your own security. If there are a dozen of you, one of you may

(continued).

be somewhat less conscientious. Maybe this sounds cynical, but it isn't. Human virtue is so frequently equivocal that it must be guarded from its own excesses, since there no longer seems to exist (did there ever?) an explicit frame of reference to judge it.....

= The Non-Reply. The cult of the Non-reply is a marvelous creature of modern technological progress. This is what happens: you write to a firm asking for information or the availability of something, or its price. Then you wait. And wait. And wait. No answer. You write again. And again. Nothing. Either 1) The letters got lost in the post (relatively unlikely), or 2)The firm decided on a negative answer, taking the form of a Non-reply. You see, this is very efficient-- it eliminates need for a filing system (modern business is strangling in a sea of papers), and saves money both in secretarial time and in postage. The only one who suffers is the customer, but there are plenty like him, so who worries? We went round this circuit for 18 months one time trying to get some American publications. When we did finally get an answer, of course it was favourable. British firms tend to be less susceptible to this kind of temptation, and not all American ones are that way. But we have noticed that some Australian firms are not immune to the utility of the Non-reply. I have before me a page I typed full of examples, but let it pass. I have also a letter from a customer who also had similar difficulties. "Of all the letters overseas I have written, I have received replies from about 20pc..." He also tried to obtain a back-issue of a magazine from a large American publishing house, without success. Finally when he complained that they were ignoring him, "they simply stopped sending me the magazine, although I had recently taken out a three year subscription..." Isn't that lovely? The only answer we have found for this, is to have personal contacts in the country involved. But don't let this discourage prospective co-op groups. Where real difficulty is encountered, perhaps we can try to help out. A co-op activity may not always be easy, but it can work.....

RODNEY REYNOLDS
St.Georges Rectory
Battery Pt., TAS.

FROM== The Equipment Exchange Bulletin
P.O. Box 177
Sandy Bay, Tasmania
Australia

// Registered at the G.P.O. Hobart, for transmission by post as a periodical //

Owing to numerous requests for technical information on these boards, we here summarise a body of information derived from the November 1965 and March 1966 articles in the Equipment Exchange Bulletin+, from our own researches, and from numerous suggestions and data kindly furnished by customers.

===Why? These boards may have appeared on the surplus market, because they have been superseded by more modern types in new computers, but also because entire boards are replaced when a defect appears anywhere within them. Those may be hairline cracks in the wiring, defective components, or even wrong components placed on the boards initially! In any event, it is evident that it would be wise to test all components or circuits on a board before depending on it. Obviously it is impractical for us to guarantee circuit board components, but the yield of good material is high, and customers have been most satisfied with the boards.

===Components. Most components are 1pc or 5pc, are usually clearly marked, and are of the miniature, LT type. Some are colour coded, some have printed ratings.

Resistors-- Frequent. Largest are 2W carbon, or 3-10W wirewound. Smallest, 1/10W.? The half-watt ones are the usual size. Sometimes miniature potentiometers, screw adjust.

Condensers-- The ordinary type appear to be of high quality construction, but attain their small size mainly by low voltage ratings. It is important not to confuse them with large resistors. The condensers have more colour bands (standard coding), and of course test 'infinity' on an ohmmeter. Electrolytic condensers are of the tantalum type, and are built for reliability and relative freedom from temperature effect. Label= µF, WV.

Coils-- ±5pc. A few µH to several hundred µH. Green body of colour coded, µH.

Transformers-- Rare, except for the pink box on some of the four-transistor boards. This is a pulse transformer (at high frequency) having two centre-tapped windings, by which a symmetrical amplifier drives some kind of phase sensitive or rectifier system. Construction is torroidal. Some torroid types are labelled with turns ratio.

Fuses, Outboard printed circuits, Thermistors, etc-- Various, rare.

Diodes-- Relatively frequent, though not on every board. Most of them are of the miniature, glass-encapsulated type, capable of continuous power dissipation of abt 300mW. Most seem to be of the silicon junction type, analagous to OA200, with voltage rating about 30PIV, current 160mA or more, poor zener characteristics but excellent rectifiers. When used for detection, some work better than others (no apparent relationship to low frequency rectification efficiency or PIV), to about 25mc/s. When used for meter protection, some work better than others, depending on the sharpness of the forward conduction curve. Although some protection will be obtained simply by placing the diode across a meter (in the forward direction), optimum protection will occur when a resistor is also placed in series with the meter itself, of sufficient resistance to cause diode conduction when meter current slightly exceeds FSD.... The germanium diodes will detect up to 100mc/s or better, but are not suitable for meter protection. Silicon diodes have a broad conductor at the internal anode (and a forward voltage drop of 0.5V or more, at +10mA), while the germanium diodes have a very fine internal anode wire (and a forward drop of only a few tenths of a volt).... Large plastic case diodes are rare, but are silicon, 300mA, 400-800PIV rating. The PIV of these should be tested carefully if HT.

Some of the diodes are encapsulated in long black strips, sealed with epoxy resin. These are used in logic switching processes, but would be good for only about 30mA forward current, because of their high voltage drop. Germanium, copper oxide, selenium??

Transistors. Most of the transistors are in 'TO-5' cases, of the 2N1300 series, with power rating about 150mW (25°C case), current 100-300mA (at saturation), BV_{cbo} 35-130V, β from 20 to 250, I_{co} ordinarily less than 2µA. On the top of many is a type number, usually beginning with '0'. The other numbers appear to be irrelevant. In the Chart

NOTE: BV_{ceo} generally 25-65pc of BV_{cbo}.

+ Equipment Exchange Bulletin, P.O. Box 177, Sandy Bay, Tasmania. Subscription 60c/year.

shown below, we summarise some of the other characteristics of the most frequently found transistors on the boards. We hope later to fill in the blank spaces, and to add more types. The great majority are germanium. We have found an occasional silicon transistor on the boards(but most rare.). If the collector lead is welded to the case, it is likely to be silicon, but if the base lead is welded to case, it is still germanium (but be caseful of unintentional contact between case and other components). Before coupling a transistor to chassis for heat sink (to multiply power rating severalfold), be sure to check whether the case is electrically isolated from the leads... 'Sym' means that BV_{cbo} (maximum reverse voltage between collector and base, with emitter open) is about the same as BV_{ebo}. 'Asym' means that whatever BV_{cbo} is obtained, the BV_{ebo} is low, having a zener type characteristic, at about 10V, but with rather poor dynamic resistance, eg. 100-400 ω. This corresponds to a zener power rating of only about 25mW. This subject will be discussed in more detail in a forthcoming issue of the EEB. For now it is sufficient to note this relationship, in order to know the limit of reverse voltage which can be placed on the base-emitter junction. 'f_{osc}' is the practical limit of oscillation freq., as determined by operation in a conventional tapped-coil oscillator. With 25pc tap. In a random sampling of the boards, about half of the transistors were PNP, half NPN, and a given type of circuit will not always use transistors of the same polarity. On some boards, too, NPN will be alternated with PNP, in an obviously complementary symmetry arrangement. This is particularly obvious where large (TO-5) transistors alternate with the miniature (TO-18) ones. The small transistors are definitelyLT 150mW types, with BV_{cbo} of the order of 20V (reverse current for testing must not exceed -10μA), and linear BV_{ceo} of about 6V (zener BV_{ceo} 10V to 12V), with BV_{ebo} = 2.5-3.5V. They are not, therefore, very suitable as ordinary amplifiers, but are good for low power very fast switching, which in this instance is hardly surprising. The 11-transistor boards, which contain a number of these small transistors, consist of a number of common-emitter stages in various arrangements, and can be converted to decade or multiple binary counting operation, by adding condensers and diodes. Miniature transistors are likely 2N705 or 2N711 (Ic 50mA) ↗ "028"

Number	NPN	PNP	Sym	Asym	f_{osc}
015✳		x		x	30-50mc
016		x		x	30-50
025		x	x		6-12
026		x	x		6-12
029	x			x	
033✳		x	x		6-12
034✳		x	x		6-12
035		x	x		10-20
N593		x	x		10-20
063	x		x		6-12
065✳	x			x	30-50
066	x			x	30-50
075	x				6-12
083✳	x		x		6-12
(TO-18 case)	x			x	45-65
013		x	x		6-12
030		x	x		6-12
082	x			x	30-50

There are a few transistors twice as tall as the TO-5 case type, and these are 2N1038, 2W, 3A (sat), 30-90V, 20-50β. Some transistors are of the OC26 type, with analagous characteristics. A few curious transistors are those which appear to be of the 'TO-5' size, but which are imbedded in large flat heat sinks with numerous fins. 5W perhaps? ↘ "036, 042"

✳These are the most frequently used types. ↘ "091, 092"

=== Circuits. The number of circuits involved is bewildering, but most are relatively standard logic types, of the 'NOR' or 'AND' configuration. Since many of them are various permutations of common emitter amplifiers, either cascaded or with leads brought out to the ends of the boards, they are readily modified for use as amplifiers or oscillators right on the boards, although substitution or addition of components will be likely. The circuit for the frequently seen 5 and 6 transistor boards consists of two sets of three (or less, for fewer transistors per board) commonly blocked NOR-gates. The bases come out to the edges of the board, through resistors or directly. Each collector goes to the midpoint of two resistors forming a voltage divider, with all the dividers connected in parallel. Collectors themselves are also brought to the edge.

It is altogether impractical for us to describe other types of circuits here, and you are invited to trace them out for yourselves. This can be done with minimal difficulty, marking each board connection as you draw it (preferably on a blackboard for easy modificationn) There is room for small components to be added to the boards, or with tag strips, etc.

===Stripping techniques. If you wish to strip the boards for components, it can be done by using conventional unsoldering techniques, but some suggestions here might make it easier. In any event, apply heat from a hot iron, quickly, with minimum heating of parts.

1) It is desirable first to remove the plastic coating. This can be done by soaking the bottom of the board in a flat dish with acetone (caution, very inflammable !), but the acetone should not cover the components themselves. After a time, the coating will dissolve, or can be wiped off. Or, the coating can be buffed off by wire brush or wheel.

2) The major problem will be to remove the transistors. For this it can be convenient to make a three-prong desoldering tool. Pull on the transistor while heating from the bottom.

3) A motor driven wire brush wheel can be used to buff the solder by abraison, but be sure to buff off the solder from leads in the same direction as the leads are bent, or trouble will ensue. There is no mechanical damage if done carefully. Static electricity should give no trouble, because of the low impedance of the transistors.

4) When the plastic coating has been removed, solder can be removed efficiently simply by placing lightly tinned wire braid (as used for shielding wires) on the connection, then pressing down on it with a hot soldering iron. The solder melts and is promptly sucked up into the braid as to a sponge, leaving the terminal underneath clean of solder. A given spot on the braid can only be used once for this operation, whence a new spot adjacent to it can be used. Braid is not inexpensive, but since this operation would be most useful for transistors, it would not have to be done for all of the connections on the board. Other components can be removed by the usual expedient of heating one end (from the bottom), and pulling that end of the component clear from above.

5) A sharp knife or other suitable tool can be used simply to pare away the solder on each side of a bent transistor lead. Then push the knife under the end of the lead and bend it up. When all three leads have been straightened, gently pull the transistor out. This is obviously a simple method, and has the disadvantage merely of tedium.

6) The transistors can be obtained intact with a piece of circuit board attached, simply by using a fine saw to separate them from each other and from the rest of the board after other components have been removed. This avoids difficulties of desoldering transistors, and the rather short leads that would result. It also provides a piece of board forming convenient connections to which one can solder without difficulty. If the piece of board attached to the transistor is large enough, it can also be drilled for mounting by a screw and lug. If, on the other hand, transistors are desoldered, they can be installed without difficulty into three-conductor transistor sockets of the round type.

7) The printed circuit wires may be stripped off, and the holes used to mount components as desired, connecting them with ordinary wire. It would be desirable to leave as many transistors on the boards, as appropriate to the design of the proposed circuit. For this, a razor blade should be used to cut the wiring leading to the transistor terminals. Then, when the rest of the wiring is removed, the transistors are left with their contacts intact, and without necessity for desoldering. They can then be tested for characteristics, and excess or unsuitable ones can be removed.

8) Simplest method: Heat tr leads simultaneously with large bit, pull transistor firmly. strip

=== Testing Components. Resistors, condensers, etc, can be tested by ordinary methods. The testing of diodes and transistors can be complicated, though the use of simple techniques and some Common Sense can furnish useful data. The main instruments are a variable power supply, some resistors, potentiometers, and meters. This subject is discussed at length in the series of articles "Grandma's Test for Semiconductors" which began in the April 1966 issue of the EEB. We must mention one important caution here: Do not use an ohmmeter for testing semiconductors, unless you are absolutely certain that the current or voltage imposed by the ohmmeter will not exceed the ratings of the items being tested !

In general, the breakdown voltage of diodes and transistors may be tested by measuring the voltage developed across the component when a small amount of current (eg.100μA for

TO5 germanium transis.) is passed through it in the back-biased direction./ (But exactly depends on shape of curve ↓ PARTICULARLY FOR DIODES.) The usual rating of a transistor is taken between collector and base, with the emitter open, but other arrangements of the leads will result in lower ratings, and depend very much on the specific use to which the transistor is to be put. Forward current rating of a semiconductor will depend on the voltage developed across it for a given current, and will be limited by the amount of power the device can dissipate. Current gain of small transistors is often measured for a collector current of 1 mA, and is defined by $\beta = \delta I_c/\delta I_b$, where δI_c is the change in collector current produced by a change of base current, δI_b. It is approximately equal to $h_{FE} = Ic/I_b$, assuming a nominal voltage applied between collector and base. If you don't have a microammeter of sufficient sensitivity to measure small changes in I_b, I_b can be calculated from Ohm's Law, and the values of supply voltage and series base resistor. If supply voltage is low, you will have to take into account the fact that about 0.2-0.4V (for germanium) or 0.4-0.7V (for silicon) is developed across the base-emitter junction in any event.

Determination of frequency response of an amplifier is not simple, but can be approximated by determining the maximum frequency at which a transistor will oscillate. The oscillation can be followed with a GDO or diode+meter connected so as to load the system minimally. The common-base configuration gives the best high frequency response, and will generally be three to ten times higher than the frequency obtained from a common emitter amplifier. f_T for the latter is approximately 3 times the max freq. of an oscillator with a 25pc tap... The situation is further complicated by the fact that the frequency limit of a transistor also depends on its collector current and voltage. Frequency goes up as collector voltage goes up, but passes through a minimum as collector current is raised from zero....

=== <u>In General</u>, if you wish to know the characteristics of transistors or other components, it is far more useful to test them on the workbench, than to spend a lot of trouble to ascertain the characteristic numbers. Most of the transistors on the boards are in the 2N1300 series, but that won't tell you much. For one thing, you don't know to which of the series a given transistor belongs, and for another the variation in characteristics of transistors within a given type rating can be greater than the variation between types! Those type numbers (2N..., OC...) are guides to approximate characteristics only, and unless your circuit is quite uncritical, it is always wise to test each transistor as relevant. Indeed, if you do not know its polarity beforehand, you <u>must</u> test it for NPN/PNP, or dire consequences may result; very simple: Apply voltage through a large resistor, (eg. for 100µA) between collector and base. If it is NPN, more current will flow when collector is negative with respect to base, vice versa for PNP. Even characteristics curves may be obtained by the use of potentiometer and meters, and these will enable you to compute load lines, linearity, optimum operating points, etc. For serious experimenters we recommend to you the 'Grandma' articles in the EEB, and follow the basic articles published in <u>Radio Constructor</u>, and elsewhere.

We have received requests for information about Computer Design and circuitry. This is altogether outside of our field of competence. Information on this subject can be found in technical libraries, and in leading bookshops. A surprisingly large number of technical reference works contain chapters on computer principles and design. In addition, the magazine, <u>Electronics Australia</u> has initiated a series on the subject, beginning with the June 1966 issue. A general Reference List for computers appeared in the <u>Equipment Exchange Bulletin</u> for July 1966.

We wish to extend grateful acknowledgement for assistance and information furnished by the following parties, and others.

E. Foster
R. Gunther
E. Kershaw
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T. Ohsberg
H. Pfeifer
R. Reynolds
T. Vieritz
G. Petherick

PLEASE NOTE: A new and amplified article on characteristics of Circuit Board components is in preparation, for the <u>EEB</u>. Soon.

EQUIPMENT EXCHANGE BULLETIN

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CONTENT.

Editorial. July's issue was No. 7, of course. Please change that as appropriate at the top of p. 65 of last month's issue. Just be glad that we didn't make it No. 8, and forget No. 7 entirely. Since, for obvious reasons, I am starting to type this on the day that the July issues were posted off, we'll have to wait another month to comment on the matter of replies to 'slicking up' the EEB, though we have done some further discussion of the matter in the Review published this month.

It is frustrating to receive letters from experimenters who boast that they are constructing the most beautiful possible transmitters or receivers out of transistors, but who become very cautious when asked to send us details of the finished product. We have a good backlog of articles now, so no problem there, but we do certainly need variety, and this subject needs particular attention in the pages of the EEB. I happen to be interested in power supplies and SCRs, but surely you get tired of those subjects? Those of you who are playing about with transistorised ham gear, have pity on the poor readers who have to plough through wordy pages of RLG, and give us some diversity?

Along these lines, I note that the state of the art has progressed so rapidly now, that we are nearly at the point with transistors that we have been with valves: to use a given transistor because it has the right power rating or linearity, rather than frequency response. In the lab where I work, they are already using a general purpose transistor for everything, because it has high gain, high voltage rating, and works up to unbelievable frequencies-- and is cheap. Consider

Editorial (continued).

the Fairchild SE3030. It is rated at 15W/150V/10Amps, with F_T of 100 megacycles! And for a price less than 7 dollars including tax. This means that this one transistor could be used without prejudice in HT d.c. power supplies, automotive transistorised ignitions, or a.f. or r.f. power amplifiers out to several megacycles! Even with a 100mc/s rating, however, this is the frequency at which common-emitter current gain falls to unity, and its nominally usable frequency is lower (as will be discussed in detail in a forthcoming EEB article). We hear from the grapevine that another large Australian manufacturer is going to offer a line of silicon planar transistors at most reasonable prices, and we rejoice. And here by 'we,' I do mean we. Competition is good for everyone, and I hope only that the practice of advertising prices will also become widespread. I don't know about you, but when I see a glowing advertisement giving everything except prices, my impression is that if one has to ask the price, one probably can't afford it.

Transistors seem to get better and better, and cheaper and cheaper, hooray. But, to return to the SE3030, if it is contemplated to obtain appreciable power gain above 10mc/s or so, it would seem advisable to use the common-base rather than common-emitter configuration, since the gain with CB is down only a few db at the frequency at which the CE gain is unity. How about someone verifying this hypothesis? And giving us a little description of results?

--RLG

Anyone want to buy a duplicating machine-- cheap??

++++++++++++++++++++++++++++

Letters to the Editor.

1) In the May 1966 issue of "Equipment Exchange Bulletin" you published a letter to the Editor on page 42 from Kallam, Victoria, relating to a commercially produced antenna which is sold under the trade mark "JOYSTICK". In view of the contents of this letter to the Editor and as the principal Patent Attorney acting for the inventor of the antenna, the subject matter of the above-mentioned letter to the Editor, I would like to notify you and your readers that this antenna is the subject of a Patent Application in Australia and the subject of granted Patents and Patent Applications in other countries throughout the world. Also, "JOYSTICK" (and incidentally "JOY-MATCH") is a registered Australian Trade Mark and as such I would ask you kindly to appreciate that it is used in the said letter to the Editor in an incorrect manner; in the letter the trade mark is used incorrectly as a noun and alone as the name or description of the goods in question.

I fully appreciate that you were most likely unaware of the above facts when publishing this letter to the Editor. Nevertheless, it would be greatly appreciated if, in the next possible issue of "Equipment Exchange Bulletin", you would be so kind as to publish the following:

" In connection with the letter to the Editor from Kallam, Victoria, appearing on page 42 of our issue of May 1966, the Editor would like to draw to the attention of readers that the antenna described in Kallam's letter is the subject matter of a Patent Application in Australia and of granted Patents or Patent Applications in other countries throughout the world. Furthermore, "JOYSTICK" is a registered Australian Trade Mark and as such should not be used as a noun nor alone as the name or description of this antenna, which such use in our May 1966 issue is regretted."

Kindly acknowledge safe receipt of this letter and send me a copy of "Equipment Exchange Bulletin" in which the above notice shall appear.

-- P.F. Jennison
Chartered Patent Agent
Lausanne, Switzerland

((In view of the above letter, we herewith reprint both the item from p. 17 of the February 1966 issue, and the letter from p. 42 of the May issue of the EEB. We have reproduced the p. 17 item exactly as it was received, including the spelling error, and including the work "JOYSTICK" used as noun and alone. -- Editor))

Letters (continued).

1a) PARTRIDGE SPILLS THE BEANS!

How can a 7'6" long device outperform a conventional antenna many times its size? A fair question - HERE IS THE ANSWER!
Whereas the conventional antenna is fundamentally resonant to a given frequency, and resists efforts to make it radiate on another channel, the JOYSTICK is INHERANTLY NON-RESONANT, HAS A SUBSTANTIALLY FLAT RESPONSE CURVE OVER THE ENTIRE H.F. SPECTRUM, AND PRODUCES A HIGH " Q " RESONANCE ON ANY GIVEN FREQUENCY! This means a perfect match at the Pi tank, resulting in ALL the "soup" going "up the spout" on the fundamental frequency and NO WASTAGE VIA T.V.I. CREATING HARMONICS.

1b)

In response to your enquiry about the Joystick (see P. 17, Feb. 1966 EEB), I did some tests on one borrowed from a friend, so it could not be torn apart. Tests indicated a Q of 110 when tuned by a 100pf capacitor at a frequency of 2.4mc/s. Z at the input was 27 ohms. Inductance 50µh. X-Ray indicated a close wound coil. The coil is approximately 180 turns of No. 14 B and S enamel wire on a 3/4" dowel calculated L= 45µh). For those wishing to construct one (goodness knows why) at a considerable saving in cost, take 21-1/2" of 3/4" dowel and drill a 5/32" hole 3" from each end; start winding 3/4" from the hole and you should end up about 3/4" from the other hole. At the top (feed) end use 44" of 3/4" aluminium tube, feed at the end remote from the coil, use 32" of the same tubing (copper if you want the delux version). Drill a 5/32" hole 1/2" from the coil end of each tube, and use a 5/32" screw to attach to dowel, and to connect wire. Remember the tighter you make the screws the more you squeeze the tube end and the more she wobbles.

The transmitter loading unit consists of a 385pf variable with the tx (50 ohms) fed to the rotor, and the fixed plates going to the coil of 1-1/4" diameter, and approximately 21 B and S tapped at (from capacitor end) 4, 7, 11, 21, 31, 46, 58, 82, 86, 98, 117, 140 turns with a total of 177 turns. Tap the aerial feeder onto the coil, shorting out the unused section ((Ed. Note: that must do wonders for Q!)). Feeder must be at least 7 feet long and preferably 70 feet, so why use Joystick?

I have used a similar system of loaded whip on top of a 60 foot mast, and it does help shift the current node up in the air a bit on low frequencies (eg 2-3 mc/s), but I cannot see what is to be gained on the higher frequencies.

Most of the advertisements for the Joystick are based on testimonials, and indeed some people may be getting good results, better, day than a short unloaded piece of wire ((or a poorly matched resonant aerial-- Ed.)), but I know of some who are not. The testimonials on mobile operation are certainly no recommendation, as amateurs are allowed much higher power than fire brigade people, and as we get as good if not better results with centre loaded whips as far as range is concerned. As for construction, I always look at this from the point of view of how it would stand up on fire brigade use, and the Joystick certainly would not, with the present construction which may be alright in a sheltered attic but which is appalling for mobile applications.

The one qualification by the manufacturer seems to be that poor results can likely be attributed to power being drained from the Joystick by nearby resonant aerials. Their solution is to remove the other aerials. From a practical stand point, this seems a rather unlikely procedure.

-- Kallam, Victoria

((In view of the above, we recommend that you do not use the word 'Joystick' as a noun nor alone as the name or description of this antenna, and that you do not manufacture that item for resale at any price.-- Editor))

2) Regarding your 'Joystuck' piece, I say nothing except to point out that 150w from an 813 to a Joystick on a 40-ft pole reached from Invercargill to Great Britain on 80M. My own Joystick has pulled them in from Broken Hill to the west, Campbell Island to the south, and Panotonga to the north. Whether or not one believes the... material in the advertisements... the thing <u>does</u> work.

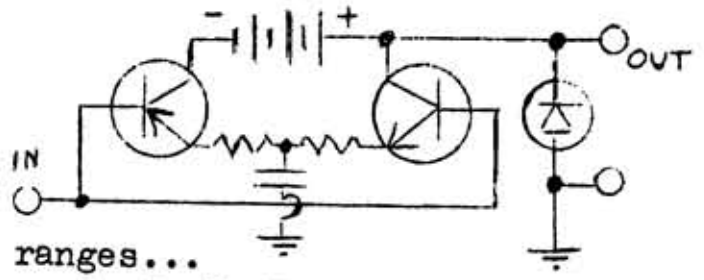
Personally, on transmitting I don't pretend to believe that it can match even a long wire end fed, but it certainly pulls them in on receive. Heard a couple of DA4's and a PY the other night, and had I been on SSB I reckon I could have got 'em.

-- G. Petherick, Auckland, N.Z.

((I once worked W1 from W6 on 75M using two lusty 6L6G's running warm on AM, and a piece of wire dangling about the garage. Sigs improved somewhat with dipole--RLG))

Litters (continued).

3) SCR Proximity Relay has now been built-- it only remains to get it working. An article should follow, followed by a 'Variable Rate Flasher,' a thrilling article on individualising your car... Why do you try to make puzzles so difficult? Draw it like this (Refer to EEB, p. 63, June 1966), and everyone can see at a glance what it is and why it is like that, expecially radio control fans, who will find it a relatively common circuit.... Tested some Circuit Board transistors, found β (not h_{FE}) from 20-140, mostly 50-100, except for one somewhere between 500 and 1000. Yes! I measured it four times using different current ranges...



-- D. Brown, Gosford, N.S.W.

((Maybe I have glanced at it too long, but it seems like an excessively complicated way of providing common-emitter function. But of course that is due to the differentially symmetrical flat pulses it has to regulate... As for that transistor with a gain between 500 and 1000, we'll store that one with the C.B. transistor one chap insisted was oscillating happily at 450mc/s. Pardon me for skepticism, but it sounds like you people are suffering from a low decimal point diet. -- RLG))

4) A Contributor to your magazine has mentioned that he had blown a 0.033µf/600V capacitor across the mains. I have been using a 0.1µf/400V polyester across the mains for some 6 months in our radiogram, and it has not yet shown any signs of distress.

-- J. Greig, Brisbane, Qld.

((Yes a condenser across the mains may work indefinitely, or it may not. Several people have experienced failures. There is no magic; if the dielectric will stand a surge, it will stand it, but if there are weak spots, it won't, and this doesn't necessarily seem to be related always closely with 'working' voltage rating. The only question is whether you are prepared to take the risk. The small additional cost of nominal condenser voltage rating would seem worth the reliability, vs the risk of blowing up diodes or whatever might be pulse sensitive in the overloaded circuit.--RLG))

5) In regard to the problem of voltage rating of transient suppression capacitors, rather than fiddle around on the secondary winding, it is now my practice to use a 'Simplex' (Ducon) disc ceramic 0.01µf/3kv capacitor across the primary. This is cheap (about 1/-) and seems very effective.... I note that one of your advertisers is in the trani-winding business. Transformers must cost a lot more in Aussie, if those prices are 'bargains.' We have a very efficient and obliging trani-winding industry over here, with very reasonable charges.

-- G. Petherick, Auckland, N.Z.

((Ah, to be in N. Zeeland when the Bird is on the Wing,
Where the Trani-winding business makes the Customers sing,
Where the price of labour gives Industrialists Glee,
And where the good old Trade Balance is a Sight to See!))

6) On p. 29 of March EEB, reference is made to the destruction of capacitors by transients. At one time I operated some transistorised equipment from a 26v d.c. power supply having an extremely low internal impedance and shunted by approx 6000µf of filter capacitors. The equipment required 12v d.c. which was obtained from the 26v supply by a zener diode dropping about 8v in series, and an electronic regulator across which the remainder of the excess voltage was dropped. The regulator output was also shunted with about 6000µf. Whilst connecting a C.R.O. probe to one part of the equipment I accidentally shorted the 12v supply line to earth, causing a rapid discharge of the filter capacitors and a slightly mutilated probe. However, there were no signs of serious damage, and the equipment was left operating. About a minute later there was a loud noise, and further investigation revealed that one electrolytic capacitor across the 12v supply had exploded. When there were a large number of capacitors shunted across the supply, it seems hard to explain why one should fail in a position remote from the place of the short circuit... In checking the pwr supply I found that the 10w series zener diode had also been destroyed and that the OC26 in the regulator had withstood the overload. The explanation for the exploding capacitor seems to lie in the fact that modern capacitors, although small physically, have a certain internal resistance, and any sudden change in the voltage applied would produce a current surge, resulting in considerable heating. If this produced an internal short circuit, even more heat would result, resulting in change in the chemical composition of the electrolytic, leading to vapourisation, etc... Thus, in your case, perhaps destruction was caused by a current surge, and not by destruction of the insulation by an excessive voltage... When the nearby motor turned off, its inductive transient would not reach the capacitor, as the motor switch would be open...

-- H. Pfeifer, E. Malvern, Vic.

AUTOMATIC DOOR OPENER

by Clive Witchell

A project which combines electronics with a small amount of mechanical construction should, according to statistics, have the greatest appeal amongst electronics enthusiasts. This article should, therefore, obtain this great appeal since it combines these two aspects.

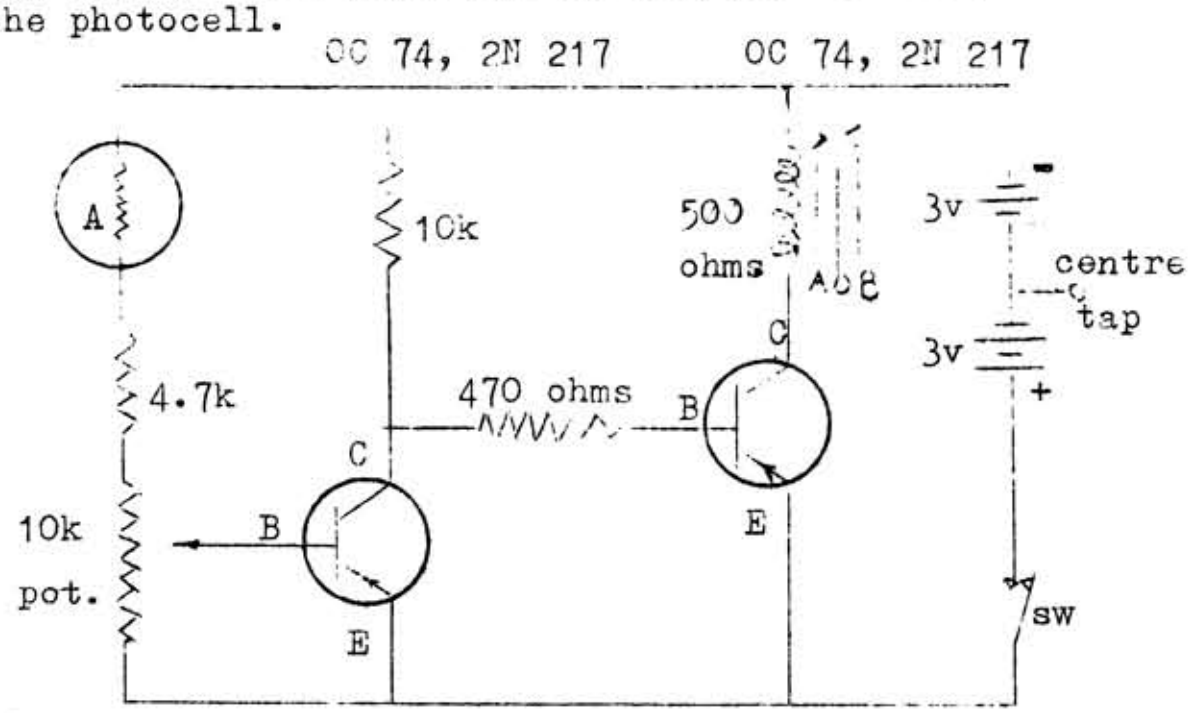
The model presented in this article is described as a demonstration model suitable for science displays etc. however it can easily be adapted to operate more practical units such as door locks, advertising displays, opening venetian blinds and for model control use as lap counters.

OPERATION

A small pre-focused lamp shines on a photocell so that when the beam is broken the photocell and two transistor amplifier will operate to energise a relay. The relay then switches on the warning device whether it be a buzzer, bell, high pitched siren or electric motor. In our model the light beam passes through the door, which is made of plastic (clear PVC), so that any person or object approaching the door from either side will interupt the beam and operate the relay. The relay is connected to a small motor which in turn operates the door via a simple mechanical linkage. The beam is kept broken while the person passes through the doorway and is remade when the person is quite clear. An alternative method of keeping the door open is to provide a time delay - this will be discussed in another article.

CIRCUIT OPERATION

During normal conditions the sliding arm of the potentiometer is near the photocell.



With the light shining on the photocell its resistance is low (about 300 ohm) so the base of the first transistor is effectively connected to the negative which causes the transistor to conduct fully. In this condition the transistor is said to be "saturated". When the light is broken the photocell sees darker surroundings and its resistance increases to 100k or so; which is almost the same as an open circuit.

The base is now effectively connected to the positive side of the battery (via the 10k potentiometer) and this causes the transistor to "cut-off" or cease conduction. Thus we see that as the resistane of the cell varies the base is being taken from the negative terminal of the battery to the positive terminal. Now the action of the transistor is such that the current flowing through the collector to emitter circuit depends upon the position of the base. When the base is connected to the negative maximum current will flow through the collector-emitter circuit. As the base is brought down to the positive side of the battery the collector current diminishes until finally no current flows when the base is connected to the positive. Then the transistor is cutoff.

If we now look at the second transistor we see that its base is made to shift from negative to positive but, now the varying resistance causing this shift is the internal resistance between the collector and emitter leads of the first transistor. When the base of the second transistor is taken to the negative it is bottomed and thus the relay in the collector circuit is energised. To bottom the second transistor the first transistor must be held in cutoff, and vice versa.

The 470 ohm resistors function is to keep the base of the second transistor slightly distant from the positive terminal of the battery. The10k resistor is a current limiting unit so that the maximum current flowing through the first transistor is 1ma. If the second transistor is of the type AC 128, AS128, AT1128, the max. current through the collector-emitter leads is 1 amp. To enable the transistor to conduct this current the 10k resistor will have to be lowered to between 1.2k- 2.2k. with this modification it will be possible to leave out the relay, however the heavy current required to energise the motor as a rotary solenoid (i.e. rotate the armature 90° and keep it there) will be over 1 amp so that a dropper resistor of 10-47ohm will be necessary under these near maximum conditions. Even then the transistor will get quite hot in a relatively short space of time so that the unit will have to be switched off periodically to allow the transistor to cool. Obviously an efficient heat sink wil be necessary to prevent outright destruction of the transistor.

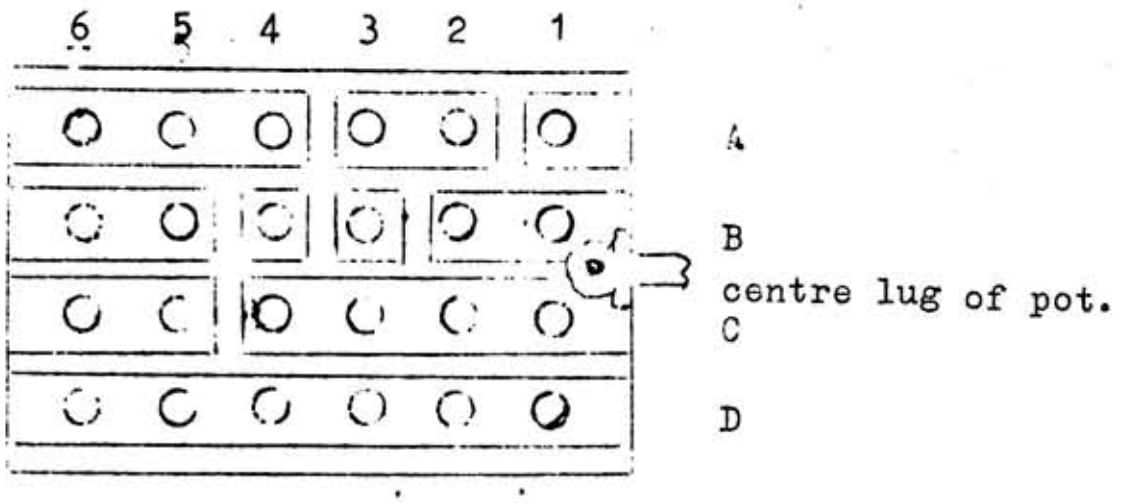
ELIMINATING THE RELAY

Elimination of the relay is not recommended for any long term display since operation becomes somewhat unreliable when the output transistor becomes hot. With the relay in place the whole unit is most reliable and ideal for installation around the home. When omitting the relay it is not possible to directly couple a bell or buzzer in place of the motor due to the high induced voltages generated by the magnetic coil. This means that if the circuit is required to operate a bell the relay must be included.

PRINTED CIRCUIT BOARD

The use of a small printed circuit board in this project makes assembly work very easy. For those who are unfamiliar with printed circuit board we can describe it as being a sheet of insulation (such as bakelite, plastic or paxolin) about $\frac{1}{8}$" thick with thin copper strips on the underside. A number of holes are drilled in the sheet so that the leads of the components can be inserted through and soldered to the copper. Our printed board is a Universal Board meaning that it is designed for a number of different circuits. For this particular project it is necessary to make six cuts in the copper strips.

These cuts or breaks are made with a razor blade. Two parallel cuts are made at each required position and the small piece between the cuts is carefully removed by laying a razor blade flat on the board and with a sawing-cutting motion, the piece of copper is lifted. The other five pieces are removed in the same way.



CHOICE OF TRANSISTORS

Almost any small audio transistors can be used. The following list of types are suitable: OC 71, OC 72, OC 74, OC 77, 2N 301, 2N 185, 2N217, 2N 217(s). It is advisable to use a fairly high current handling transistor for Tr2 when direct coupling the motor to the circuit. These are: AC 128, AS 128, and AT 128; other-wise a pair of medium power transistors is quite sufficient.

IDENTIFYING THE COMPONENTS

The leads of the two transistors are identified with coloured sleeves so that they can be correctly positioned on the board.

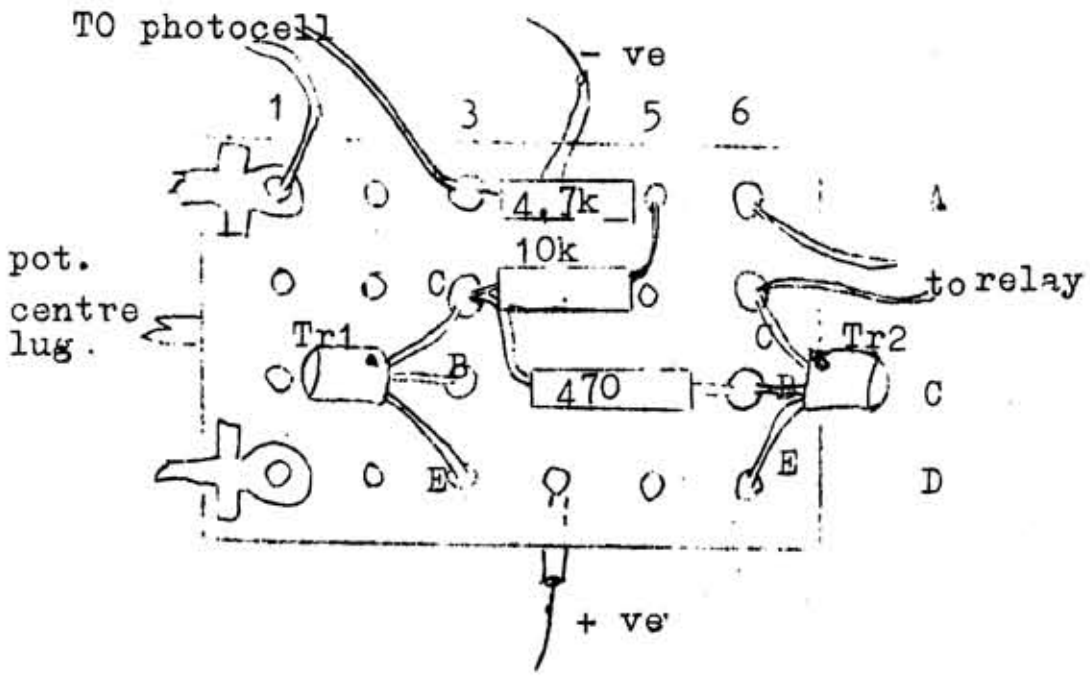
The preferred colour coding is as follows:

Collector lead - yellow
Base lead - green
Emitter lead - red

All sleeves are $\frac{3}{4}$" long.

CONSTRUCTION

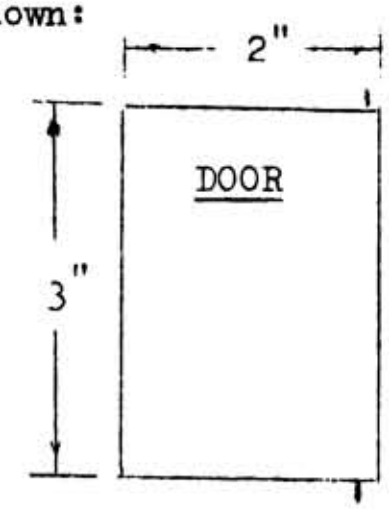
Refer to the diagram for the position of each component.

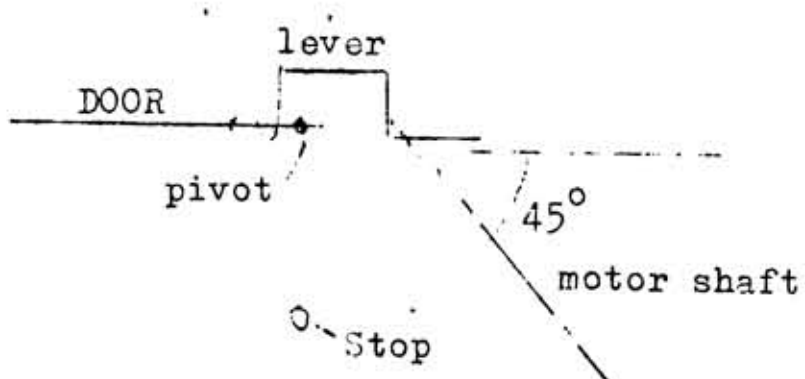


Carefully mount each component, soldering the parts in an orderly manner along with the leads of any ajoining compcnants. Position the potentiometer and solder its three leads as shown. Connect hookup wire to the board for the relay or motor (as the case may be), and photocell. Remember that a 1.2-2.2k resistor takes the place of the 10k resistor when connecting the motor directly to the circuit- it may also be necessary to add a resistor (10-47 ohm) in one motor lead to reduce the motor current. This resistor should be added when the model is finished. If the door opens quickly the motor is receiving ample current however the output transistor may not be able to withstand this current as shown by it heating up excessively. To reduce this add a resistor (between 10-47ohm) and compromise between lack of motor torque and over-heating.

DOOR FRAME

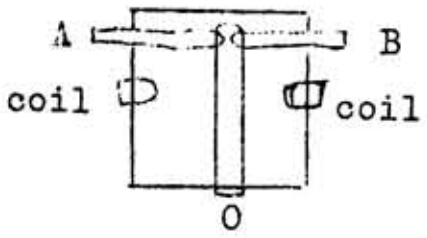
The door is made from a piece of rigid PVC (clear) and is made to swing in a post-and-lintel frame by gluing or melting a nail at the top and bottom as shown:

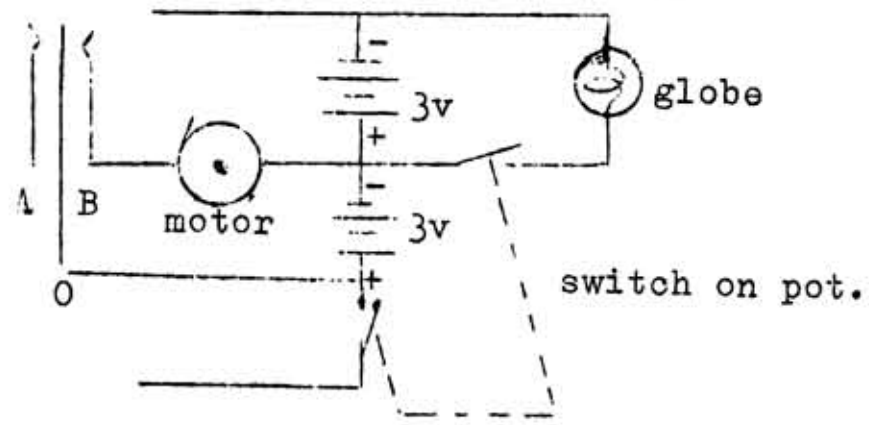




These nails then pivot in the balsa wood frame. A small piece of stiff wire is now fixed to the door and bent to form a lever.
The lever connecting the motor shaft to the lever on the door is a short piece of balsa wood pushed on the motor shaft so that when the motor is mounted it moves the door lever through 90° to operate the door. A small spring (a rubber band will do) is positioned so that it closes the door when the motor is switched off. A stop is required in the position shown to limit angular movement of the armature.

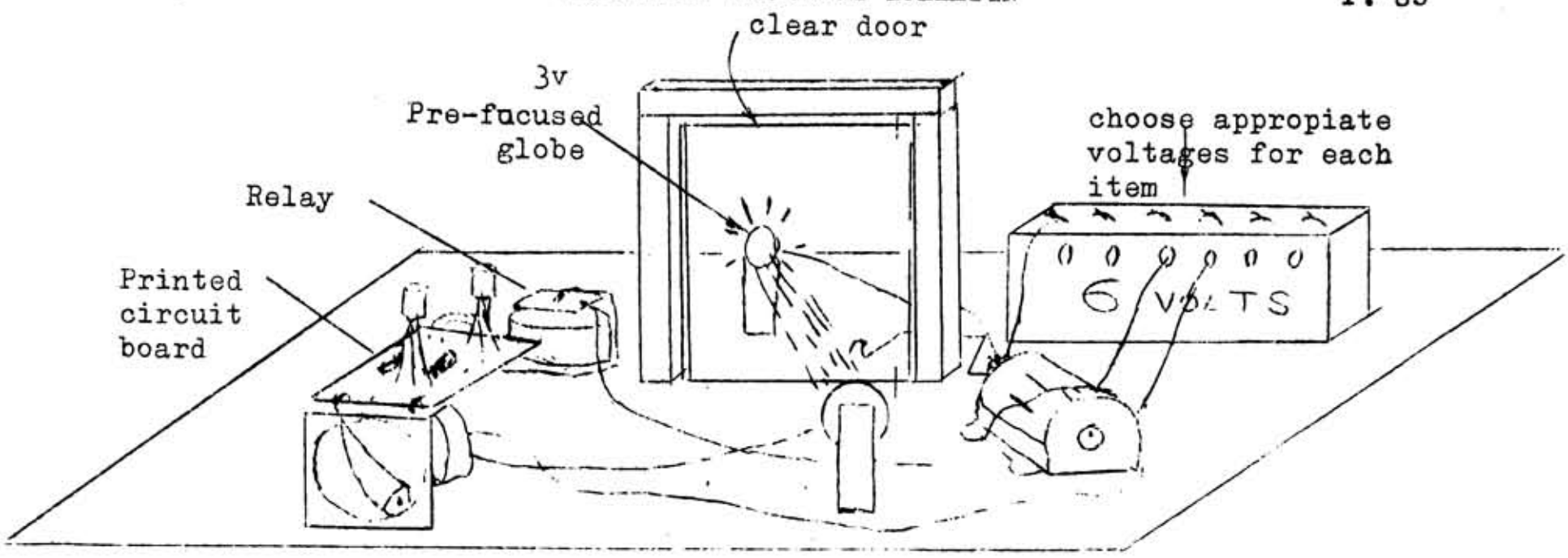
All that is left to do is carry out the battery wiring to the pot. switch and to the globe, relay and motor. The diagram on the next page will help clerify the position for the major components.





Once the demonstration model is accepted as working correctly the electronic circuitry can be repositioned in a model railway set for operating street lighting etc. or positioned in the home as a secret door door lock where a mirror might be required to beam light down a hole to the photocell - any amount of ideas are possible and so we wil leave it here for you to design your own novel application.

We hope you have found this project worthwhile and instructive.



COMPLETED LAYOUT

PARTS LIST: PRICE LIST

( )	1 transistor med. power	1.10
( )	1 transistor med power	1.10
	OR	
( )	power transistor	1.25
( )	power transistor	1.25
( )	10k pot. and switch	1.20
( )	knob	0.30
( )	470ohm resistor	0.09
( )	4.7k resistor	0.09
( )	10k resistor	0.09
( )	printed circuit board	0.35
( )	tubing	0.05
( )	photocell " "	1.10
( )	balsa wood ¼" sq. 12" long	0.10
( )	plastic for door	0.15
( )	relay (500 ohm coil)	2.10
( )	motor	0.60
( )	hook-up wire	0.10
( )	plastic mount for board	0.15

All these parts are available from:

CLIVE WITCHELL INDUSTRIES

2-6 ETHEL ST.,

MOORABBIN

VICTORIA

Additional items such as nails, globe, wire, glue and solder will be found in your own oddment box.

" TRANSISTOR KITS" -- A Review -- by R. S. Maddever and R. L. Gunther

Readers of the EEB Advertisements will be familiar with the magazine 'Transistor Kits' and the merchandise available from Clive Witchell Industries. Recently some of these magazines were submitted to the EEB, and we here present an evaluation of them, because we believe that they represent something more important than a strictly commercial endeavour.

'Transistor Kits' is a neat lithographed magazine, of 10-20 pages per issue, which has been published since November 1965, and which appears approximately monthly. It appears to be a formalisation of the experimental activities conducted by the Witchell group previously.

The idea of 'Transistor Kits' is to introduce various tested circuits which are backed up by the supply of all parts necessary at reasonable prices. Since parts are standard, though miniature, they need not be obtained from the magazine people. Indeed, the authors go to some trouble to list alternative transistors, etc, and suggest that the spare parts box may contain many, if not all of the parts for at least the simpler projects. Standard lined, or special printed circuit boards are available, and a specimen supplied was of good quality.

The publishers put it well by stating that ''this magazine is issued to help you to learn electronics and have fun at the same time, and the parts are there to save you the time and trouble of collecting them for yourself.' Certainly the cost of the parts is no greater than obtainable from sources available to the average experimenter, and in some instances is lower for the total cost of parts in a kit than if bought separately.

The thing, however, which sets this interesting enterprise apart from a simple kit-supply activity, is the considerable care with which information is presented. The magazine is well printed, and contains carefully drawn wiring layouts as well as theoretical circuits. The step by step instructions are clear. In the earlier articles at least, they went into such detail as 'cut 3/4 inch of yellow sleeving' and gave the colour coding of each resistance used. Diagnostic suggestions are often included, such as the steps to take if the amplifier makes certain noises. A reasonable attempt is made to explain how the circuits work, and how to alter components in order to modify performance. Further help can be obtained through a 'Readers Query'page.

It should not be inferred that all of the projects are of a very elementary nature, even though the magazine is aimed primarily at the beginner; some of the projects are sophisticated, and interesting. Each of them is, however, so carefully treated that experimenters at all levels ought to have no difficulty building the circuits, from kits or spare parts. It would, indeed, be rather nice to build something which worked the first time on turn-on! Projects so far covered have been:

Variable Flashing Beacon (flip flop)
Ohm's Law Nomograph
Light Activated Flashing Beacon
Personal Superhet-6
Light Activated Automatic Venetian Blinds
Simple Crystal Set and Amplifier
Personal Superhet-6 (continued)
Light Activated AVB Opener (continued).

The Editors state that other subjects to be covered will include fish lures, pulse counters, photographic timers, proximity relays, various radio projects (including eventually, transmitters), various audio projects, tape recorder accessories, hi-fi amplifiers, etc. The Door Opener article in this month's EEB is an illustration of the kind of material that comes from C. Witchell's fertile workshops, but of course his proper kit treatment is even better. In this month's EEB article, by the way, the text is not an excuse for the price list at the end; we included the latter for the sake of continuity, but you can assume that it is included in the Advertising

'Transistor Kits'-- Review (continued)

section.

A relatively unusual feature of the magazine is the inclusion of projects of an electromechanical nature, such as the automatic venetian blind system, etc. So often a person with a mechanical point of view does not try electrical projects, and vice versa. There is value in combining the two. In this case, the parts available from the 'Transistor Kits' group include even the motor and gears for projects. This could be a real help for the country enthusiast who could have difficulty obtaining them locally, then having to write to one or more city suppliers and meet interminable delays. This is no joke; we have experienced it (particularly in isolated Tasmania-- which is still part of Australia, other evidence to the contrary notwithstanding !)

If we could make a suggestion, it might be valuable for them to provide at the end of each booklet, or perhaps as a separate leaflet, brief soldering hints, and a colour code for resistances, capacitances, and a few hints on other things. Rather in the same way that Heathkit do it, on the inside of the back cover of most of their Circuit Manuals.

In sum, this seems to be an interesting attempt to combine careful and imaginative experimental procedure with practical and economically feasible construction practice. The combination of magazine and kit availability should do much to encourage those who wish to build things of real use, despite only a moderate knowledge of electronics, or who might give up the idea of building some things because of difficulty in obtaining specified parts.

xxxxxxxxxxxxxxxxxxxxxxxxxxxxx

The appearance of 'Transistor Kits' prompts us to some thinking on the matter of small publications in general. In spite of the criticisms one hears of the national magazines, we think that Electronics Australia, Amateur Radio, and Break-In are doing a commendable job of covering the electronics field in this part of the world. In addition we believe that the apparent attempt of Electronics Aust. to become kind-of a 'Scientific Australian' magazine cum electronics is not at all unworthy. It makes fascinating reading on a broad variety of subjects, which should be read by those of us who tend to become overspecialised in electronics. For those who maintain that Electronics Aust. lacks variety and experimental interest, just look through, for example, the June 1966 issue (which happens to be at hand as this is being written), and count up the wide variety of subjects of interest to experimenters, from computers to test instruments and book reviews.

Therefore, when small publications like EEB and Transistor Kits arise, they are not filling a need 'vacated' by the large magazines, but are supplementing it. There is plenty of room for experimenter publications, and the only limitation on the part of readers might be time to read, and money to afford so many subscriptions. The matter of time and money must be solved by each individual, but generally in a manner consistent with his best interests... The one thing he must realise is that there is an enormous amount of work and expense involved in publishing even the most modest of magazines, and that the 60c per year for EEB or $2.90 per year for Transistor Kits is not set at a level to enrich the publishers.

Since it would undoubtedly be interesting to read both the EEB and TK, we would recommend that you consider seriously subscribing to both ! Each of these publications brings something different to experimenters. The EEB provides a forum where people can bring ideas forward, to describe even small and casual things they have found interesting. TK on the other hand, is an eminently practical publication,

'TK' -- Review (continued)

and in this respect fills a gap in the EEB format. Indeed, it would be difficult to imagine one casual magazine would could readily combine both points of view without having considerable resources and a full-time staff.

It would be worthwhile to encourage our readers to subscribe to both magazines, by offering a reduced rate for joint subscriptions, but how can we do that? The subscription for each is at rock bottom minimum, and one can only offer concessions where there is margin to conceed. The alternative would appear to be simply an informal association of the two publications, with each making routine efforts to inform the readers of the other. There is the possibility of combining mailing procedures of the two publications, but unfortunately postal and distributing costs are the smallest part of the cost of the enterprises, and this would not save enough to make a significant offer of subscription reduction. 'TK' has had the interesting idea of offering a sub to EEB together with a special calculating facility, at a price ($1.00) less than the combined separate costs of items, but that does not solve the basic problem (though as it stands it sounds like a good idea)(details later).

Therefore, we shall probably continue to publish the EEB in its present format (see Editorial in the July issue), but we shall include each month or two a small feature describing the contents of the current issue of Transistor Kits. Your opinions about this would be welcomed.

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ERROR: In the Semiannual Index, 1966, appearing on p. 67 of the July issue, please add the following item which was inadvertently omitted: p. 36 Laser Dangers.

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A FEW MORE SEMICONDUCTOR REFERENCES

1) See Computer Reference List on p. 72, last month.

2) Information on Tetrode Transistors has appeared in old editions of the G.E. Transistor Manual, but not in new ones. This is a good illustration for the desirability of keeping old editions of anything. New ones usually become slicker and terser, with deletion of old but useful material.

3) Information on Electronic Ignition Systems has appeared in the Motorola Power Transistor Handbook, Ch. V. Treatment of this subject is rather terse, though the general coverage of Power Transistors is quite good. RTVH carried a whole series of articles on this subject last year, and both Radio-Electronics and Electronics-World have featured various designs in numerous articles for several years-- not to mention our own Transistorised Ignition in EEB, Vol. I. For those interested in this subject, a few hours spent going through back issues of these publications (in a public or personal library) could be rewarding.

Please let us know of anything interesting which could be of use to readers.

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GRANDMA'S TEST FOR SEMICONDUCTORS. Part IV (continued?)

Don't you think that this issue is already quite long enough? So, let's postpone this subject for yet one more month, and give it to you in one big piece rather than fragmenting it in snippets. Watch for our gigantic (?) Grandma's Diodes Issue.

ADVERTISING, ETC. =

2c per word up to 20 words, 1c each thereafter. Call sign or name free. Write clearly.

FOR SALE. All parts to build, Mullard Type 'C' Tape Pre Amplifier $40. RTVH Feb.64 W.P. Grid Dip Oscillator with Modulator, $30. O.S. 5AR Transistor Radio Control Relay Receiver, $16. Write to R. P. Singe, 29 East Crescent, Hurstville, N.S.W.

NEW BATTERY-OPERATED 4-speed Philips Record Players. Type NG1012, 6V operation, improved crystal head. A real bargain at £4.10.0 for one or £9 for two. Or if you have something useful in test gear, eg a simple L Bridge, a swap might be arranged. Write Dept. A, c/- EEB, P.O. Box 177, Sandy Bay, Tasmania.

CALIBRATED Power Chokes for sale. 5-7 Hys, 220mA, New, potted. 4-3/4" tall x 3" X 3". Very nice. Each choke is calibrated within 0.5pc at 1kc/s, 0mA. Use them as inductance standards, or as nice husky filter chokes. Are you discouraged by having to use gigantic condensers? Add a choke. Just the thing for low hum HIFI installations, transmitters, etc. $2.50 each, POST FREE. Write-- R. L. Gunther, 76 View St., Hobart, Tasmania.

R.F. CHOKES, Pi-wound, 1-1/4mh, 125mA, new. $0.15 each, post free. RLG, as above.

FROM Australian Electronics:

A reader/customer writes that he finds that 1pc precision 2.2K resistors from the Circuit Boards are very useful when pulverised and dissolved in absolute alcohol, as a treatment for athlete's foot. But he also suggests that it would, indeed, be better if we did give our diodes away, so obviously his opinion isn't worth much. Have you thought of building a computer with those little silicon diodes? Or one of those clever devices which charge condensers in parallel and discharge in series? Or protect all of your meters? The latter is very simple. Simply put a diode across the meter so that the diode is forward-biased (ie, current will cause it to conduct). For better protection, add a resistor in series with the meter, and parallel both with the diode. Choose resistor large enough, but not so large it affects meter linearity at the high end..... Oh-- um, by the way, we have run out of Circuit Boards for a little while. Shipments seem unaccountably to be delayed. Could it just possibly have something to do with the recent Shipping Strike??? Bah.

== Last month someone received one of our 'A2' transformers, and it had a slight buzz when power was applied. So he sent it to us for repair. We put it into a vise, tightened the frame slightly, and returned the transformer. Total cost to us = 80c postage, because of course we refunded his postal cost. It served us right, no doubt, but would it not be reasonable to use Common Sense in a matter of this sort?

== Telegrams have, with one exception, been a unequivocal catastrophe. Aside from the fact that telegraphed enquiries often take more time (eg by leaving a phone number) than a simple postal transaction, there seems to be something strange about the mentality of some people who telegraph for urgent orders (with payment promised subsequently). They appear to be in much more of a rush to get the merchandise than to pay for it.. So now we ignore telegraphed orders unless they include cash-- and then they get urgent attention only if including the usual 10pc urgent surcharge!

Note: only 200V & 300V glass diodes left. No 300V.

Etc (continued).

Honi soit qui mal y soit. We also discourage orders except by post, because of some nasty experiences, the most lovely of which was the chap who talked his way in, and helped himself to the diode box when the OM was out. We note that an Adelaide firm advertising in El. Aust. goes even farther with 'No S.A. sales.' Similar problems?
== The other day we got back one of our Questionaires which were sent out in Nov. 1964. 'Rather belated' indeed. Oh well, one of the items he checked was interest in silicon transistors at vhf. There are and will be plenty of those available cheaply now, new. See this month's EEB Editorial. We note from this months 'Classified' in El. Aust. that 'M and R' Electronics are selling out all stock. Heh heh. Yup, us too.

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Urgent note to people who have ordered Vol. I's of EEB during the past few months: Don't despair. It's such a ghastly job to collate and glue them that we do it only a dozen at a time, and generally put off the Day until absolutely necessary. But ah, it has come.

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RODNEY REYNOLDS
St.Georges Rectory
Battery Pt., TAS.

From-- Equipment Exchange Bulletin
P.O. Box 177
Sandy Bay, Tasmania
Australia

//Registered at the G.P.O. Hobart, for transmission by post as a periodical//

EQUIPMENT EXCHANGE BULLETIN

P. O. Box 177, Sandy Bay, Tasmania, Australia

PUBLISHED CONFIDENTLY EACH MONTH TEN CENTS PER COPY. 60c yearly, worldwide

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A DIGNIFIED JOURNAL OF NEWS AND OPINION ON RECENT ADVANCES IN PSEUDOCONDUCTOR AND SEMICONDUCTOR ENGINEERING

++

STAFF: Worries- R.L.Gunther, Arrangements- C.K.Pallaghy, Stencils - K.Cho, Draughting - B. Robinson, Printing- D.F. Dainton, Advisors - R.S.Maddever, R.A.J.Reynolds, etc.,Emeritus- B.J.(RIP), Morale- E.L.Foster.

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BACK ISSUES for 1966 are 30c per quarter. No more Vol.I(1965), sorry.

SUBSCRIPTIONS are accepted for only one year at a time, and begin with the current issue only.Back issues are extra.Please write name and address legibly.

YOUR RENEWAL DATE for 1966 is indicated on your address label. If you don't renew,you won't receive any more EEBs. So do it now if due. Thank you.

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CONTENT.

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Editorial. There's nothing like a good dose of humility to cure arrogance. When B.J. was doing the stencils I was full of critical comments. WhenII had to do a couple months issues myself, things just didn't seem so important anymore,though it was nice to be able to make last minute changes in text while typing.Still — it wasn't worth it. Now we have been deluged with offers of typing assistance, and our cup runneth over. This month we employ Mr. Cho, whose typing speed is quite unbelievable. Next month we'll try another candidate. To those who applied, and whom we don't use, don't despair, we probably will eventually! Many thanks.

There is certainly a temptation to compose directly onto the stencil, thereby eliminating the need for a stencil typist, but I have tried this a number of times, and the results are invariably poor. Somehow it turns out differently, and mistakes made on a stencil are so permanent, particularly if you change your mind several paragraphs later.

I have an additional comment to make on the matter of the voltage rating of condensers across the Mains. The other evening I was testing some paper condensers for leakage at maximum rated working voltage, and noted to my dismay that some of them showed definite instability at that voltage.Could this not be the simplest explanation of the reason for failure of '600WV'

Editorial (continued)

condensers on the 240V Mains? I also noted that this leakage was regenerative and increased constantly once it started. The implications are obvious.It would seem, therefore, that one practical alternative to using condensers in series, would be to test a '600WV' condenser at 600V d.c., with a microammeter and large resistor (to protect the meter) in series with it. If the reading exceeds, say 10μA, or shows instability at any current reading, it could be unwise to use that condenser on the mains for suppression of transient over-voltages. If a constant small leakage is obtained, be sure to increase supply voltage to make up for the drop inthe series resistor (according to Ohm's Law).

-- RLG

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Letters to the Editor

This section is becoming something of a problem. We are receiving many fine and interesting letters, some of them technical dissertations. But this surfeit plus a considerable backlog of articles simply will not fit comfortably in a ten-page issue. You may have noticed that the past three issues(and this one !)have been running to 12-14 pages, which means $3 to $6 an issue more than income. We shall probably have to charge, say 80 cents per year beginning in January(but pls don't renew now just to save money!),to solve this problem. But not $1. It is at the $1 level that a bargain ceases to exist, while 90-95c is merely a euphemism for 100c.In any event,until January,then we shallhave to keep 'Letters' smaller than desired.

1).. I like the articles in the EEB -- the best mag on semiconductors I have come across. I have been experimenting with transistor transistor transmitters, but have found that the transistors have to be good,to perform well....

-- J.Adams, VK3ARJ,Wangoom,Vic.

2) (Regarding) your proposal to 'gloss up' the EEB-- I'm all for it... I would gladly pay any increase in the subscription which this must necessitate. And I do not think that the EEB need necessarily lose any of its amateur flavour in the process. A glossier presentation and perhaps additional articles (three cheers!) need not imply a change in format.But any rate, keep up the good work.The EEB is a very welcome addition to my monthly reading list... I agree with P.Nesbit, VK3APN (P.66 EEB,July 1966)regarding valves.By all means concentrate on transistorised equipment please, and forget about valves. Valve equipment has been adequately dealt with in the past, and still,in my opinion receives disporportionate emphasis in some publications.... I have been..disappointed by .. 'Electronics Australia' although they are at last starting to show some signs of improvement.

-- B.Grossman,Mt.Yokine,W.A.

((Our 'Literature Review' this month shows that Electronics Australia is doing very well indeed, as we have maintained, but now we can advance proof. But don't disparage valve circuitry too much. Valves appear to be a lot easier for the beginner at first, and it is hard enough for a beginner to get a 'standard' circuit working,without benefit of problems with critical voltages and currents, temperature instabilities, and excessive non-linearities associated with semiconductors.Although we have not included them in our 'Review', Electronics has an ample number of basic receivers,

Letters (continued)

transmitters, amplifiers, and instruments, and good for all that! How many times has a beginner asked 'where can I find a good circuit for...?'And there they are. But I insist that Electronics has far more value for us than the number of transistors per page, and should be read by everyone.The many fascinating and useful discussions in 'Answer Man','Serviceman' and above all 'Forum' are well worth digesting.And in their 'Technical Books and Publications' you can keep up with excellent descriptions of the best in current electronics.

For a defence of Electronics by the Editor,see P.81 of the Aug.issue --Ed.))

3)... I think, even at One Dollar per year, you will not be able to cover costs of Lithographic production.Consider:250 subscribers x $1 = $250.Divide by 12, to get $20.83 per issue.Impossible. May I make a suggestion?Raise the subscription to One Dollar or $1.20 p.a. and buy yourselves an electric duplicator... -- David James,Crows Nest,N.S.W.

((Have you ANY comprehension of the cost of those fancy electric duplicator things? The cheapest simplest kind is above £250, and the stencils for it still cost 50c or more, each. Why complicate life? Better to pay that to a typist. --Ed.))

4) Regarding your Editorial in EEB for July, would you consider having a couple of pages in Amateur Radio each month? They are crying out for articles and have all the printing arrangements. Your articles are just the thing to get the true amateur experimenter moving, instead of playing with commercial gear.I do not want to see the end of EEB,but did you read the VK4 Division notes in the last AR?...

((Not likely, too formal, printing deadlines too definite, too serious, Great Responsibilities and all that. Besides, it's hard to read that fine print. Still.... what do you think, Tom?--Ed.))

5. My comment on the proposed change to Glossy Paper for the EEB: I like the way it is, as well as the price. -- W.Mc Mahon, Bendigo, Vic.

6)... Regarding your question about improvements to EEB -- print more articles. Who cares for gloss, as long as you can read it. Interest is the important thing. Regarding the August '66 edition, I would like the idea of the inclusion of a feature describing contents of the current Transistor Kits. As to combining the two publications, sure, provided the EEB doesn't become too formal. The informality of the whole affair makes it very interesting...
-- K.Burlinson, Plympton, S.A.

((Reader Burlinson also included an interesting literature review on electronic ignition systems, which we shall publish later. He also had a few words about Electronics with which I disagree. This is discussed above. In addition, the listings in our Review certainly shows that there are ample 'constructional projects', and no real tendency towards 'expensive,specialised projects.' All that stuff about 'Audio Topics' etc. can be very useful if you will bother to read it through, if you are interested in audio (as I am). As for TK, we'd like a feature describing current contents, too...--Ed.))

7) Keep up the good good, and keep EEB cheap and interesting. Gloss and expense does not make an informative magazine. -- D.Long,Lang Lang, Vic.

8) An acquaintance wrote recently saying that he had written to the EEB for Back Issues and subscription, but that although the cheque has been paid in

Letters (continued)

he has not heard from youor received any acknowledgement of his subscription. I wrote saying that you had possibly lost his address or something but on second thoughts you were possibly waiting for the July issue to come out.

This is only a small point, but I think an immediate reply strengthens contact with subscribers, even if it costs a little more due to individual handling and increased mail costs. After all, I think I waited about 5 weeks before hearing from you, then nearly 3 months went by before receiving the Bound Volumeof EEB.

There is one other matter which may interest you. I have heard of a printer who wants to start a new national magazine to compete with Electronics Australia. He has aprinting business, and would print 20,000 initially for free distribution. Maybe this would be a good opportunity for you to get in on something good?It would certainly seem to be a very good way to start expanding.

--C.Witchell,Moorabbin,Victoria.

((Reply by Editor: Yes, OM, you are right. Our performance with respect to promptness and schedules has been terrible. In this case,the offended party had not heard about his subscription because the July issue came out in August, though the August issue came out about 10 days later. But the Vol.I and Back Order situation is the worst of all. We have been saving them up for a spare moment,but it never arrives, and the delay has become embarrassing.Either we shall have to speed up Back Issues, or send out an acknowledgement for each subscription and Back Issue order received. The former depends on volunteer help,and the latter costs money.Since it costs slightly over 5c to turn out one EEB of 10 pages(and more for more pages),it would seem logical that we push the help and selves.Will do. Again, apologies to you all.

((As for the new competing magazine, the answer is an emphatic NO! We won't have any part of it. As I explainedcarefully onp.87 of the August EEB, there is hardly any need for competing with the national magazines. Electronics presents a glittering array of subjects, and if individual authors want a more extensive outlet for their talents, they are free to send articles to Amateur Radio or Break-In. The latter publications treat semiconductor subjects frequently and are in constant need of authors, so why the new competition? What can it serve? There are not all that many people in Australia, and the only motive I can see for this sort of thing is an attempt to grab a share of the lucrative advertising market.

((We are not interested in expanding to fill a national market. This is a hobby -- remember?? A hectic hobby for us to prepare the magazine, and a lovely hobby for you to write for and to it. Who needs more? -- RLG)).

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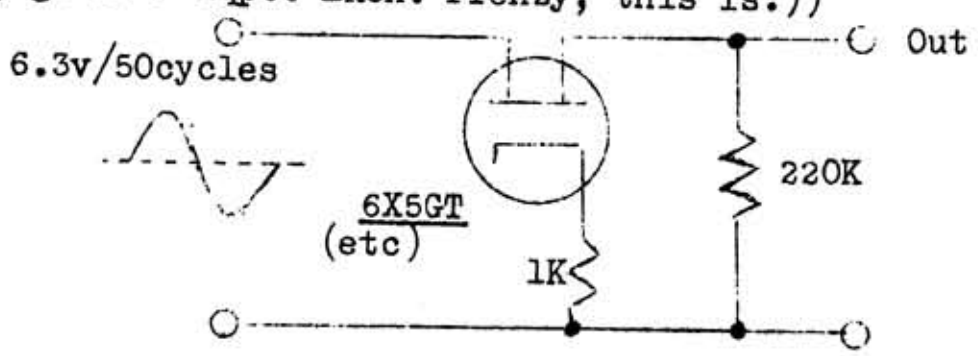
WAVESHAPING CIRCUIT[x] -- by K. Collins

((please add this item to the 'Contents' on page 91. We can't, because I'm typing this just as David is finishing the printing of page 91 ! Eqpt. Exch. Frenzy, this is.))



[x]From Radio-Electronics, Dec.'65,p.55

LITERATURE REVIEW -- RLG

Faced with an ever mounting pile of periodical literature, I have hit on a clever method to force meto keep up with it.I can list here the articles which seem interesting to me. Although this will tend to minimise the mention of RTTY (but look through CQ and 73 for frequent treatment of this),and of well meaning reviews of commercial equipment, and of elegant and terribly clever transmitters and SSB configurations--still the more simpleminded amongst you may find it useful.Lest you think this an injury,bear in mind that the whole EEB approach is a simpleminded one,reflecting, I suppose, my own confusion with this elegant and complicated technological society... Anyhow,let us know whether you think this feature is worth the space,won't you?

The number of magazines which could be covered is vast,and obviously I don't pretend to cover all.If you happen to subscribe to a different journal, you are welcome to send an analagous list regularly,and we can include--maybe. It will help considerably if you read the features 'Technical Comment' and 'Technical Notebook' which appear regularly in Break-In(See July EEB,p.67), because these will give you a very nice review of certain parts of the experimenter literature, for the most part omitting CQ. On the other hand, Amateur Radio frequently reprints interesting overseas articles or occasional reviews, for the most part omitting 73.Thus do events of pith and moment(and some of the rivalries) wend their way to our humble shores.

Abbreviations are necessary,and although this tends to make the text rather terse, I suggest that you go through and read it anyhow,and look up anything that interests you particularly.Most abbreviations will be obvious --Tx for transmitting, Rx for receiving, Tr for transistorised, Di for diodised, W for Watt, M for metre, fb for very nice, dis for discussion, etc. Arrangement is by magazine, but if you write to give your opinion about this, you might mention whether you would prefer arrangement by subject instead;the latter would be more compact, but less specifically informative....There seem to be some issues missing,possibly under my messy desk, or maybe they didn't arrive since I have looked rather hard for them. All of the following are 1966 issues.

AMATEUR RADIO (VK)

May. Tr.100mc xtl osc
June.Imprvd hang AVC
July.Di pwr spplies
(but see Sept.Letter)
Aug.Tr ham Rx,vy fb
6M Ant + fb TVI dis
Xtl lattice fltrs
Sept.Tr ham Rx,II
Tr Amp design,vy fb
15W 80/40M Tr Tx,but
see corrections,Oct.

BREAK-IN (ZL)

May. Tr. Keyer
Improved simple BFO
Varicap Di dis
June.Overtone Xtls
Interesting 20M Ant.
Hams,ITU and God.
Toaster dummy loads!
GDO using sig gen,fb

BREAK-IN (cont.)

July.Simple mobile ant
Simple TR switch relay
Nice Tr Tester!
432mc and 2M convertrs

CQ (W)

May. VOM,VTVM dis fb
Regulated dc conversn
Car noise suppressn
FET preamp for 144mc
Improved CW monitor,fb
June. Tr 23W transcvr!
Sylvia
Regulated dc conversn
July. 10-40M Beam Ant!
All about CROs
Tr af meter
Tr 2M rf amp
Tr af clipper for mod.
Rx sig/noise dis,fb.

ELECTRONICS AUSTRALIA!

(not including many fine non-experimenters articles each mo)
Jan.Model radio control(pt Tr)
Improving the Deltahet Rx,fb.
TRIAC Lamp Dimmer.Super SCRs!
Vy wide band beam antennas.
Valve type nomenclature.Good.
Feb. 4 channel af mixer,all Tr.
Nice VTVM
Af dis:lines and networks
UJT Code Practice Osc(could also use PUJT here?)
March.Tr.12W HIFI af pwr amp
SCR Motor speed control,fb.
Subjective Reality, Ha Ha Ha.
Probes for the Feb VTVM
Interesting battery dis.
Several basic Tr ckt using-printed Veroboard. Vy fb!

Literature Review (continued)

ELECTRONICS AUSTRALIA (contd)

March (continued)
Capacitance Measurements
FETs in af amps
Complementary hi Z Tr!
April. An important and troubling article on the-humanistic meaning of the-Computer in society.
D.c. Transformer!
Protected univ.d.c.pwr, regulated, Tr.fb.
Improved 2 x 5W af Tr amp
Electric Pendul Clock! fb
May. Editorial:Computers
Tr R-C Bridge. Very fb!
Std. Semiconductor symbols
Battery charger, Di.
Fairchild Transistor char.
15-160M 10 noise convertr
June. Marry ur own Computer
Computers, I.fb dis.
Simple regul pwr. Easy.
Cycles vs Hertz!!! Silly
Tr, UJT 100kc Xtl osc
Kits and Servicemen,heh.
Temp coeff of Crickets!
Various interesting Tr-Reader Built Stuff, fb.
PWM, Pro and Con,maybe.

July Computers, II.Fb.
Valve Sig Tracer,not bad.
SSB pro and con,maybe.
Af distortion meter,Tr.fb.
Zener Di dis, I
Tr Af meter, fb
More about batteries,fb.
Modifying speakers for hifi
Aug. True 3D photos!!I have seen one,truly amazing.
Computers, III, fb.
Simple Tr VFO. Nice.
Science, ugh (p.79)
Electronics Australia: a defence of policy,p.81
UJT explored
Tr VOX for Tape recrdrs!!
Tr Reflex BC Rx.
Gramophones -- dis.
PWM pro and con? II
Sept.Cheap Anodeon Tr Char.
More on 3D photos
Computers, IV,fb
Tr osc, big dis,vy fb.
Electronic flash, I
Speakers in parallel,hmm
Ni-Cd Battery Charact.
Tr + UJT simple af/rf osc
Zener Di ckts, II. Fb.
PNPN Di dis
PWM Pro and Con, III.
Gramophones, II.
IARU Conference,for hams

-- Staff

QST(W)
April. Radio Noise, dis.
Improved keying Monitor
Simple SSB Exciter, 40M
Hi pwr Tr Tx, 36W on 160M
An important article on-ham bands and ITU.R.I.P.
May. SWR Bridge, adjust Z.
Multiband Zepp ant.
Radio Noise,II, dis. fb.
June. How to use junk box!
Tr 100Kc Xtl Std osc etc
Simple Tr keying ckt
Electronic Organ QRM!
Telephone QRM from SSB!
2M Tr. pocket Rx
Tr Rx Noise locator,heh.
Tr 432 mc preamplifier
July.5 Tr 6M Rx, fb.
AF filters for speech, fb
Digital ac voltmeter,fb
180W DSB Tx, interest.
FET a.f. sig gen.fb.
µwave osc dis
Wavemeter/SWR Bridge
Tr 12V Regul pwr spply

OH, that's enough,I can't stand any more of this, and also the typist is waiting impatiently for copy of this issue.More next month,alphebetically.

You should KNOW Better!

Wherein we present a series of vignettes describing the activities of experienced technicians who have done their bit in contributing to human frailty, not always intentionally. If you have a contribution to this column, by all means send it in. It will be printed anonymously -- of course!

1) It was required to wire a largish battery outside of a small transistor radio, to allow extended operation of same. The Operator carefully wired to the battery a set of terminals from a discarded small 9V battery, and just to make certain he got the polarity right, he compared it with the stated polarity of a standard battery. When the set was hooked to the extra terminals, nothing happened. Know why? Of course you do. The proper polarity for an outboard plug to be connected to the original plug (for the 9V battery) is the reverse of the one in the set. Obvious, isn't it....? Fortunately the set was not damaged, so it is not always true that reverse polarity damages a radio. Don't ask me why.

GRANDMA'S TEST FOR SEMICONDUCTORS. -- by RLG
-- Part IV: Testing diodes.

It is considerably easier to test diodes than transistors. In order to understand what youare doing, however, it helps to read the basic principles of operationof diodes. This can be found in nearly every elementary text on semiconductors, e.g. the ones by G.E., R.C.A., Mullard, or Philips. A particularly lucid treatment of the subject is found in the Selected Semiconductor CircuitsHandbook, edited by S. Schwartz.

REVERSE CHARACTERISTICS

The PIV of a diode is tested in a manner similar to the BVcbo of a transistor -- increase reverse voltage until reverse current becomes appreciable. The machinery involves any simple power supply feeding a potentiometer from which is taken voltage applied to the test diode through a series current limiting resistor (A practical power supply for this will be described next month, together withsome fine points of testing).The series resistor is necessary to limit the maximum current to a reasonably safe value for the diode. For ordinary small HT silicon diodes this value could be -50μA, but might be as high as 500μA for 50V/0.75A ones, or even several milliamperes for 20-50Amp diodes. The actual maximum depdepends on the shape of the reverse characteristic, and on the forward current rating of the diode.

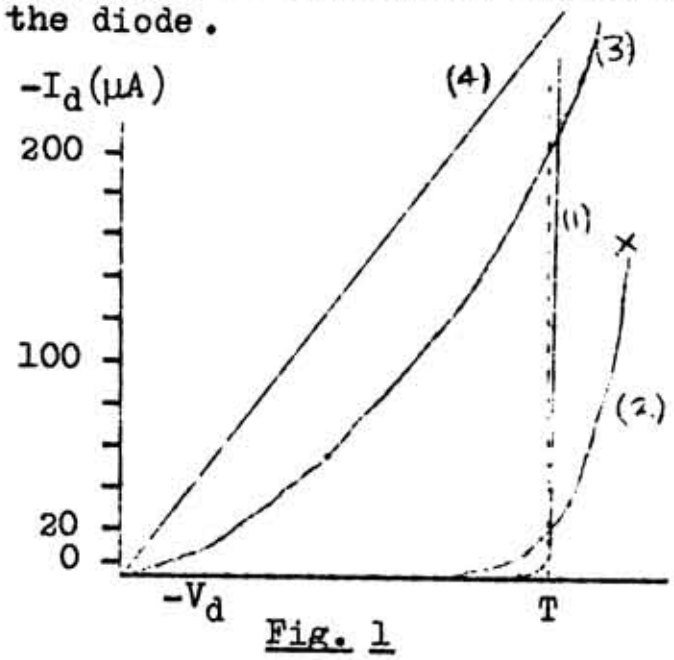


Fig. 1

In Fig. 1 let us define point 'T' as the 'Turnover Point', the reverse voltage at which the reverse current starts to rise appreciably rapidly. You can estimate this point quite well by watching the current meter at the same time as the voltmeter, while the voltage control is advanced; it helps to place the two meters as close as possible to each other.

If a curve of type 1 is obtained, it won't much matter whether you test the PIV at 10μA or 50μA, because voltage will be about the same. This is a Zener characteristic, and is important; it will be discussed in more detail in a forthcoming EEB article.

Curve 2 is the type of reverse voltage current curve usually found in diodes, and although it rises less rapidly than Curve 1,it is more susceptible to desctructionat high reverse currents, as indicated by 'x'. When 'x' is reached, the diode is likely to perish, because its holes suddenly fill up with electrons, and a short circuit results. It is safe to test a diode as long as you remain below 'x', and the safe level varies fromone diode to the next. 50μa is generally safe, but as mentioned above, this depends on several factors. If the curve stats to rise fairly rapidly at 10-30μA, it is wise to assume the Turnover Point in this region, and not to go higher.If the Turnover Point appears to be higher than 50μA, it isprobably a type 3 curve. For a type 2 curve,the rated PIV can be assumed at about 80 per cent of the Turnover Point.

A type 3 curve does not show a sharp increase of current at low currents, but seems to wander up and up as voltage is increased. This curve is less critical to transient overvoltage than are types 1 or 2, and therefore PIV canbe rated for a higher reverse current. This curve is rarely found in HT diodes, more frequently inLT ones, particularly in surplus items. In general , too, at LT a higher leakage can be tolerated because higher forward currentsare usually involved. Atype 3 curve can be safe to as much as 300µA continuously if it rises slowly, and is still rising at about the same rate at 500µA. You might take the PIV at 200µA, but the exact value will depend on how rapidly the curve rises. This can be estimated by increasing the voltage control smoothly and evenly while watching the meters. By running the control back and forth you will get a good idea of the shape of the curve. It is, however, important initially to increase the voltage slowly, to make certain that you don't run off the end of a type 1 or 2 curve.

If the current appears to rise essentially linearly with voltage, a type 4 isindicated, inwhich the PIV might be taken at a reveree current of 500µA, if it is under 200V, and if the current is still rising slowly at 1.6 times this voltage. If the current starts to rise more rapidly above 500µA, rate the PIV at 300µA reverse current.

If a type 4 curve gives a reverse voltage above 200V at 500µA, and if the current is still rising slowly at 1.6 times this voltage, rate the PIV at 400µA. if, however, the current rises appreciably more rapidly above 400-500µA, rate the PIV at 200µA current...

These considerations apply to diodes up to 1 Amp forward current rating. For larger diodes, higher reverse currents may be involved. This discussion has also applied only to silicon diodes. Germanium diodes have a different characteristic, and appreciably higher leakage. They will be discussed next month. For all diodes, the leakage current goes up as the diode gets hotter, and it gets hotter as the forward current through it inrease.Therefore you cannot expect both maximum forward current rating and maximum PIV rating to apply at the same time. At least one of them must be decreased severalfold if the other is maximum. See the Mullard Reference Manual of Transistor Circuits for the derating curve. (P.106).

Instabilities must also be taken into account. If, at a given reverse voltage the reverse current tends to creep up rapidly, or to show marked instability, reduce the voltage until the characteristic is again stable, and call this the PIV, even though you are well back on the curve.

It is worthwhile to experiment forthrightly with the voltage control for several different types of diodes, to get the feel of the reverse characteristic, even though you might destroy a few diodes in the process. In the long run it can still save youproblems from unreliable surplus suppliers, or money by using diodes at actual ratings. If you test diode PIV yourself you will increase both the flexibility and reliability of your applications, particularly for surplus components. In any event, PIV is usually rated for the most pessimistic value by manufacturers, and by testing them yourself you can usually find higher values in any given lot. But remember that the valuesyou find by this method are ABSOLUTE MAXIMUM voltages, and therefore require at least 50 per cent PIV safety factor in application, plus a transient suppressed a.c. source (e.g.a 0.0µF across transformer primary) Personally I think it is better to rate diodes this way rather than for

Grandma's Diodes (continued).

some 'working' voltage, because that voltage will depend on the application to which you put it, unless the assumed safety factor is enormous.

For example the peak voltage on a diode in a half wave circuit with condenser input filter is twice the peak voltage on a diode in a bridge having the same a.c. secondary supply. 'Working' diode voltage for the half wave circuit will obviously be twice that of the bridge giving the same output voltage.

Forward Characteristics.

The maximum forward current through a diode will depend strictly on the amount of heat it produces through I^2R loss. This heat must be conducted away rapidly enough to keep the diode at temperature low enough to keep the semiconductor junction happy. The old selenium 'Metal' rectifiers were rated at much lower currents for a given size, than modern silicon diodes, because voltage drop was higher for a given current (P = VI), and because the selenium oxide could not stand temperatures as high as those of silicon. The silicon junction, however, definitely suffers at temperatures exceeding 150°C, and in consideration of the difference in temperature between inside and outside of the diode, it is generally wise to ensure that a silicon diode does not exceed a case temperature of 100°C (boiling point of water!). Evidently, somewhat more current can be passed if the case is kept cool by the use of a heat sink, or a larger heat sink, but this is limited by the rate at which heat can be transferred from inside to the environment ('thermal resistance'). Thus, a '3 Amp' diode is essentially a 0.75Amp diode fitted with a screw to allow connection to a heat sink; without any heat sink, the '3Amp' diode will be good only for the lower value, or perhaps a little more (1 Amp) because of its slightly larger area. But where a '3Amp' diode will function adequately with 6 sq. in of heat sink, you will not be able to extract appreciably more rating by increasing the sink to 10 sq. in, because of thermal resistance. If mica washers are used, this resistance is even higher; the use of silicone grease between all relevant surfaces reduces thermal resistance. In general, as a good approximate rule of thumb, you can assume one square inch of heat sink (having two sides) for every watt of power a diode (or transistor) has to dissipate, to result in a semiconductor case temperature 60°C above ambient (viz., above room) temperature.

But, how many watts per ampere? The silicon junction usually drops a reasonably constant voltage in the range 0.9V to 2.5V at rated current, but usually about 1.2V. Since a Top Hat metal diode can dissipate about 1W in air (with adequate ventilation), it is rated at 0.75A if this current results in less than 1.4V across the diode. On the other hand, if the forward voltage of a particluar diode rises as high as 2V at 0.5A, it cannot be rated higher than 0.5A (i.e., 0.5A x 2V = 1W). A small black 'epoxy' diode can dissipate somewhat less power, say 3/4W, so its rated forward voltage ought not to exceed about 1.1V at o.75A, or 1.5V at 0.5A. And so forth.... A '3A' diode should not read more than 1.5V at 3Amps (but don't apply 3 Amps to the diode more than 15 seconds at a time unlessit is firmly mounted on a heat sink), and not more than 2.5V to a 2A diode. If a '3A' diode reads 2V, simply rate it at 2A.

The final test of the current rating of a diode or transistor will be the heat test. Pass a certain amount of current (not too much) through it, and after a little while feel the case temperature. If the semiconductor is

Grandma's Diodes (continued).

too hot to touch, reduce current until you can touch it at least for a short time, and call this the rated current. For very small diodes (eg. glass types), the surface of a toughened male index finger may not be sufficiently sensitive; use a little finger, or the back of hand, or palm as convenient. The lip is an excellent heat-senser, but must obviously be used only after test by finger. Warm to the lips is about 40°C, hot to the lips about 55°C, though this can depend on one's outlook and sex...[/] An additional complication is the fact that your skin can absorb considerable heat from a tiny diode, so the first impression should be the deciding one.

If you apply the above commonsense heat test to a diode whose current rating is already known, you will probably find that it will not get more than moderately warm at rated maximum current. This is explained by the fact that there is a certain amount of safety margin provided for operation in enclosed spaces, and by the practice (as mentioned above) of rating semiconductors for the most pessimistic level. In your own rating, it could be wise to rate pessimistically too, if the semiconductor is likely to be installed in a location (as often happens) where air circulation is restricted, and/or where other hot components are present (resistors, valves, transformers, other diodes).

The ratings obtain by these methods for forward current testing apply to resistance loads only. If the load is capacitative or battery, the forward current should be derated (reduced) by 25 per cent, because of the high peak currents involved.

Diode testing is basically simple, but can have many ramifications. For a more thorough treatment, see the article 'Silicon Diodes and Common Sense,' CQ Magazine, September, 1965.

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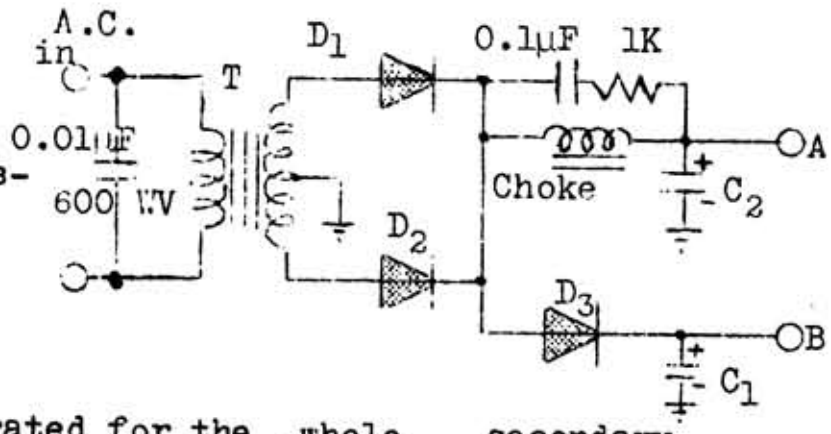
SIMPLE DUAL VOLTAGE POWER SUPPLY[x]



Diodes D1 and D2 form a full wave rectifier for output A. Diode D3 conducts on each cycle and is thus superior to the traditional dual supply which takes the extra diode from the transformer secondary directly. C1 charges to the peak voltage of half the secondary winding. The voltage at terminal B is approximately 40 per cent higher than at terminal A, with normal component values. Both outputs have low ripple and good voltage regulation. D1 and D2 must be rated for the whole secondary peak voltage (plus 1.5 factor of safety), but D3 need only be rated for half the secondary peak (ditto) -- another advantage over the diode-from-secondary configuration (which would require the normal PIV of the whole secondary). We (EEB) have here added the transient suppressing condensers across mains and choke for obvious reasons.

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TAKE NOTE![xx] '... Jan Marcus, 15, WB2MRM, was killed when he touched a high voltage power line while attaching a guy wire to an outdoor antenna.'

[/] Remove lipstick first, if necessary, as the case may be!
x Reprinted from QST, June 1966, p. 75, NASA Tech Brief 66-100002. Text modified.
xx Reprinted from 'Auto-Call,' August 1965, p. 18.

ADVERTISING, ETC.

We are going to try an experiment. The amount we have beencharging for casual advertisements has been so small that it is obvious that it is merely a token. Why bother? Let's say that you canplace a personal (not business) advertisement free, up to about four lines per issue,but above that, it will cost 25c per line, $1 per half page, $1.50 per page, which latter figure is in fact our own cost too. Obviously we reserve the right to omit copy for which we have insufficient room. Copy is good for one issue at a time, only, and must be resubmitted for each issue.

CLIVE WITCHELL INDUSTRIES, 2-6 Ethel St., Moorabbin, Victoria offers RIGID PVC. Thismaterial is similar to perspex, but with many additional advantages. It can be bent to 180° without cracking or splitting, and it can be cut in two for posting (please state if youprefer sheet left intact). The sheets are 1/16 in think and come inclear only; they can be painted any colour. PVC is ideal for making boxes to house transistorised equipment. All you need to do is to cut out the sides, clean up with fine sandpaper,and glue. Ethylene Dichloride is a solvent for PVC, and will also make a perfect joint when applied to both surfaces to be joined. Acetone and Sellys Tripple Purpose glue are also adequate. -- 3x15 inch sheets:15c each. Solvent 15c bottle. P+P 10c per order.

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NEW BATTERY - operated 4-speed Philips Record Players. Type NG1012, 6V operation, improved crystal head. A real bargain at £4.10.0 for one, or £9 a pair. Or swap for L-Bridge. Write-- Dept. A, c/- EEB, Box 177 Sandy Bay,Tas.

FOR SALE. All parts to build, Mullard Type 'C' Tape Pre Amplifier $40. RTVH Feb. 64 W.P. Grid Dip Oscillator with Modulator, $30. O.S.5AR Transistor Radio Control Relay Receiver, $16. Write - R.P.Singe, 29 E.Crescent, Hurstville, N.S. W.

HALLARD ELECTRONICS offers a Broadcast Receiver Booster Kit-Set,transistor -ised, various components at greatly reduced prices, Transistor MK4 Receiver most reasonable prices. See June 1966 EEB, p.60 for details, or write Hallard Electronics, Box 58, Campsie, N.S. W.

TAPE RECORDING is a fascinating hobby. Contact the Australian Tape Recording Society, P. O. Box 9, Crows Nest, N.S.W. for full details, discounts, etc.

TELL YOUR FRIENDS about the EEB (but don't tell them too much, and don't tell them before January when bur' subscription rate goes up). Why not?

Advertising, etc. (continued)

FROM Australian Electronics, 76 View Street, Hobart, Tasmania:
== Please delete from our Catalogue (See July EEB) the following: 30 V/0.16A, 100V/0.16A, diodes, 1200/0.75A, 1800V/0.75A, 800V/5A diodes, 200V/10A SCRs. The 1A SCRs and 2N2990 15W high frequency transistors have not arrived yet, but we have had notice that they are definitely on the way. By the way, the 2N2990 probably have an f_T higher than 40mc/s; we measured their maximum oscillation frequency at about 25mc/s on a Hartley with 25% tap, and subsequent thinking we have done on the subject indicates that this shows an f_T of at least 75mc/s. Nice, eh?... The situation with Transistor Sockets is really amusing. The reason we got them originally (as with some of our other stock) was the fact that they were so difficult to obtain from regular commercial sources. We were told that 'there is no demand' and have heard the same thing elsewhere too. But we simply cannot keep them in stock long enough when ordering by the hundred, so we shall take a plunge and order a thousand. That ought to keep you happy! But that won't come for another three weeks or so, so we are temporarily out of stock of these lovely items. They are certainly the most sturdy and useful of any transistor sockets we have seen. And only 18c each, for you. Our own cost isn't much below that, but we're having fun... Ckt Boards are in again.==How come all this activity if we are planning to close up shop? Why not? That will be next year, remember, and we're still in business. Fact is that we won't close up entirely. Just eliminate or greatly reduce advertisements. Then business will drop to the trickle it should, to buy an occasional beer or transistor. After all, whenwe order parts for you, we also get them cheaper -- and our many friends! (Curses.) But after Jan, we'll definitely drop diodes and probably most SCRs too. Will keep Circuit Boards, a few, T. Sockets, and Books. Ah, BOOKS, yes indeed That seems like a fitting activity for a firm that doesn't want to get rich. So we ordered a few dozen of various kinds a couple ofmonths ago. They arrived a few weeks ago, and right away we put them into our Catalogue. The result? We have received so many orders that we are not going to advertise them here! At least not this month. Perhaps people like the low prices (our tradition) and great usefulness of our transistor cirucit handbooks, transistor manuals, etc etc. etc. etc. If you wat to add to the frenzy you can ask for a Cat, but please send an envelope at least 4x9 inches, with your address on it - and a stamp too if you feel charitable.
== THE X-10 PROJECT. Believe it or not, the following story is true, and you can benefit from it. About a year ago we put in a stock of the remarkable X-10 Pulse Width Modulated audio amplifiers. At that time it was a new and promising thing: 10 Watts from a couple of tiny transistors, with good quality and low price. We entered into a partnership with a chap who was going to make up some nice cabinets with silk-screen figures, and to construct power supplies to use the X-10's off of the mains if desired. The project dragged on and on and on, and not only did the promised cabinets fail to materialise, but four of the kits and a good handful of parts disappeared into the hands of said partner; we have word that at least one of these kits was sold to another party. Nice profit, eh?

As we discussed in the EEB a few months ago, we don't regard money as the final thing in life, but it does hurt to lose it in large hunks. Now we are disillusioned (that's what comes of having illusions), and simply want out. You can have the X-10's as-is, with parts and instructions for the basic unit for £8 each, Post Free. We could make it our original cost, £7-10-0, but we shall have to buy the missing components. This is a good opportunity for you to obtain a good

Advertising etc. (continued)

quality low power HI FI a.f. amplifier.

Now you have read quite a lot about PWM in Electronic Australia, but youmust maintain a sense of proportion about it, just as one does when listening to someone insist that it is impossible to get REALLY good sound with any amplifier less than 75W capability. Electronics is working pretty hard to prove their point, and the amount of argument about it is anindicationofthe fact that it is not a simple situation (eg see p.113 of the August Electronics). In this case, it can be resolved downtoto a simple statement: The output power is not 10W, as claimed by the manufacturers, it is 5W, and peak at that -- not RMS. Apparently the American rating of amplifiers has now migrated to the UK. This figure was obtained from our own tests, but is verifiedby the correspondence to Electronics. Within this limitation, the amplifier is nice indeed, efficient (95%), very small, and sounds nice if you don't try to use it onthe Oval. The final test of performance must be how it sounds, and this amplifier sounds like a high fidelity unit, presumably because it is run Class A, and avoids cross-over distortion altogether.

The other major disadvantage of the X-10 was the fact that the output silicon transistors got too hot. We have solved that nicely by fitting them with Wakefield Heat sinks (they look like little cog-wheels). It diminishes the attractiveness of the manufacturer's claim that no heat sinks are necessary, but increases their reliability 100%, without appreciably affecting the miniature size.

We have also included the modification which prevents damage to the transistorsif the output is accidentally shorted. This then, answers the criticisms of the X-10, and the improved unit is a practical system. It is small, and so efficient that it canwork well off of batteries -- that can be useful. And for a good 5W Amplifier, £8 is hardly excessive is it?

Characteristics:

Number of transistors: 11
Overall size: 6 x 3 x 3/4 in.
Input sensitivity: 1mV
Tone controls: Trebble and bass, boost and cut(outboard).
Total Harmonic distortion: Less than 0.1%under 5W pk.
Frequency response: 5c/s-20kc/s ±1db
Speaker impedance: 15 ohms.
Damping factor: greater than 100
Quiescent consumption: about 100mA
Supply voltage - 12V
Battery life: 3 months, approx, from Lantern Cells
Output efficiency: ca 95%.
What other 5W amp can you operate from batteries?

We can also supply youwith parts for mains-operated low-hum power supplies fully regulated (and with lower ripple than the supply from the mfr), or the completed supplies, at a modest price. Say $4 for the kit(you supply chassis), $8 for the prewired supply. By adding one pot, you can make it into a nice general variable power supply, up to 12V/1Amp. Pls add 15%for post.

== LT TRANSFORMER for battery charging, transistor power supplies, very useful. Characteristics: 18V at 0A, 15V at 2A, 13.5V at 3A. 3 Amps max continuous, 5 Amps intermittent, 9.5 Amps instantaneous. 2-3/8 in high x 2-3/4 in x 2 in. $3.30 Post Free, Tax Paid, delivered to your door!

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CONTENT.

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Editorial.

A bit late this month, but I have proved to my satisfaction that one can't maintain responsibilities while playing about in the workshop. Usually it is the workshop that suffers, but this time I rebelled, and the result has been enough good material for a stack of EEB articles, two of which are already on stencil! Of course a small group of you who know about this project could ask 'did he walk, or was he pushed?' But it was fun anyhow -- now back to work:

We wish to apologise for the typing in the September issue-- just one of those things. It is particularly difficult to find whole lines omitted, though we caught most of them. We apologise further for those we didn't. I'm typing most of the material this month, because all but a small part is already duplicated or on stencil.

We wish to extend our sincere appreciation to the Tasmanian Division of The Wireless Institute of Australia, for their efforts in helping us obtain local talent for typing stencils. From the results, it would seem that there are more people who read seriously the Bulletin of the WIA than of the EE.

Very interesting two paragraphs here deleted, because I'm impatient this month.

Surely someone must want a duplicating machine in good working condition, cheap? Free delivery anywhere in Tasmania. In fact I could put it on the Princess, and if you live in VK3 you could pick it up at the other end, Melbourne. The things you can do with a hand-operated machine are marvelous; astound all of your friends by sending them all good letters, and just fill in personal details at the bottom. Or volunteer to turn out propaganda for your local Church or Monastery.

Iditorial, continued

Limitless possibilities. You could even publish technical material..... You see, we want to sell this machine so that we can get a motor-driven one. It is going to become increasingly necessary as the EEB subscription list grows.

If anyone out there does any business with New Zealand, could you please write us? We'd like to make it easier for ZL subscribers (and their poor tattered economy). No time for Literature Review this month.

-- RLG

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Letters to the Editor

1) .. I have an idea about transformers for the Mains. Often these are far too bulky in wrong shape. I suggest the usual E-I laminatibns shaped so that you can put three separate bobbins on the arms of the E. The outer two perhaps 120V each, thus in series for 240V, and the middle one for anything else. Perhaps this could have an advantage? Standard coils could slip on and make up a transformer to suit one's own needs, or wind one's own coils. Insulation could be good, all coils minimum diameter, and the package much easier to fit on a printed circuit board. Are any good ferrite cores of appropriate type available, or are they too expensive and inefficient to use at 50c/s, oops Hz?

-- R. S. Maddever, Corio, Victoria.

((Dunno, what do you think Art or Clive? -- Ed.)) ((Richard keeps muttering something about Litho processes in his letters, but I generally skim it, particularly the part about '$1200'; somehow the 10c stencils don't seem very impressive beside that. On the other hand, if his group is getting one of those Machines, maybe we'll be able to present an occasional photograph or something in the EEB. --RLG)) (("Why don't you type or write directly onto a Litho stencil and get some backyard printer to run off the sheets for you? The paper can be cheaper..." -- Funny,the little backyard printers seem to want a lot of money for this privilege, at least in Tasmania))

2)... The EEB is ideal for the experimenter, as you are not swamped in one issue with too many things to try, a quantity which would prevent you from ever doing anything. Rather, the REGULAR (heh, heh) appearance of the EEB with its little pearls sprinkled liberally through a smear of ink, provides enough incentive to play around, but not enough to completely intoxicate the reader.

Again, Electronics Australia is now putting out some good material on fundamentals of semiconductors, so within another twelve months or so, I reckon that if you compiled a reference list to E.A. and EEB on fundamentals, you would not have to continue pushing these ideas in the EEB, but rather move on to their application in all sorts of devices. The experimenter will be able to work off of the reference list if he still hasn't a grasp of fundamentals. Maybe I'm biased.., but I am very insistent that fundamentals should be grasped as firmly as possible. But once you have them, then you should be bold enough to try something more complicated, whilst all the time looking for the fundamentals in actu, in the circuit.... I always like to go to the principle of a circuit, device, etc, and work up from there. Once you grasp this, the circuit is generally a pushover..... For five years I worked, using all sorts of sophisticated equipment, and operating on their results. And yet I never really knew exactly what was going on, why I took particular tests, why I drew significant data from significant readings etc. Yet now, with five years philosophical training behind me, I cannot understand how on earth I ever managed to fix anything without knowing what was going on. I am firmly convinced that the greatest equation in electronics is Ohms Law, and even today I marvel at times when you see it in operation. I believe you could write a book on it, and indeed if we could only

Letters (continued)

understand it in its fullness, then our knowledge of electronics would be vastly better...

-- Br. Julian, Templestowe, Vic.

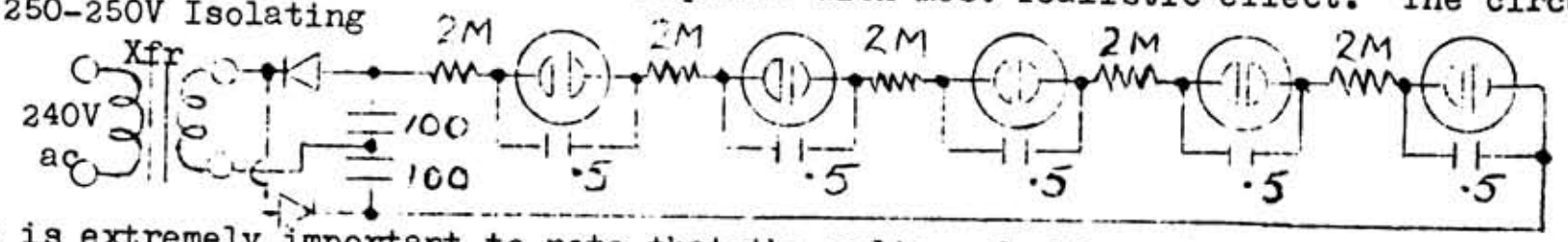
((Of course you could write a book on Ohms Law; what do you think the EEB is? That's all. I get much amused when people tell me with awe that it must be nice to know so much, and yet look at the stuff I write, and all the mileage I get from E=IR and $I_c=\beta I_b$, that's all. I am in utter, complete, and perfect agreement with everything Julian says--oops, nearly everything. Somehow I get the impression that one of us is wasting an enormous amount of good talent. I wonder which...? Cogitas ergo sum))

3) Next year, you will get a description of a fully transistorised SSB Exciter, to save me the trouble of paying of a subscription then.

-- D. G. Long, Lang Lang, Vic.

((GOOD! Now that that's in print, you'll have to keep your promise. Even if it is only SSB, ugh. To borrow a statement by a friend concerning something else 'it seems like an excessively complicated way to do something simple.' -- Ed.))

4) You may be interested in my own application of neon lamps (ref EEB, July 1966, p. 69). It was a window display I made some years ago. It was called 'electronic fireflies,' and consisted of six small butterflies made of wire and silk (purchased at a novelty shop), each of which had a small neon attached to its tail. The lights flashed on and off in disordered sequence with most realistic effect. The circuit:



It is extremely important to note that the voltage doubler gives nearly 650V input, and if this display is to be used in a location where it could be touched accidentally, it is absolutely necessary that adequate safety precautions be included to prevent trouble. Larger bridging condensers can be used for slower blink. The erratic blinking is quite intriguing.

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

5) I have checked some of the extra small transistors (TO-18 case) appearing on IBM Computer Circuit Boards, using a Tektronix Curve Tracer, and find that β varies from 10 to 40, and that although BV_{cbo} may be 20V or more, the BV_{ceo} max is about 6V for practical purposes. Zener breakdown starts at BV_{ceo} of 10 to 12V (some as high as 20V). BV_{ebo} = 1.5-2.5V, which is rather interesting, since this figure is ordinarily higher for other transistor types. All of this makes the TO-18 case transistors difficult for use as ordinary amplifiers, but they are definitely better for very low power fast switching applications. I am planning to use them in a frequency standard and synthesizer, incorporating a number of flip-flop type frequency dividers. The total number of transistors involved may rise to as many as 400.

-- A. Gregory, Strathfield, N.S.W.

((Editor's comment: In the course of a considerable amount of subsequent technical correspondence, Mr. Gregory has elaborated on the above observations, pointing out that these transistors were made specifically so that their switching characteristics favoured certain properties not suitable for ordinary amplification, because of non linearity, and because their most favourable performance occurs at high I_c. In switching circuits, high pulse currents are harmless because of short duration,

Letters (continued).

but in amplifiers the average currents must be much less than the switching peaks, to avoid excess P_c. Furthermore, he maintains, it could be hasardous to use TO-18 types in oscillators, because the high peak voltages arising from L/C could drive I_c into the irreversible destruction region (see following article). If BV_{ceo} for TO-18 types enters its zener region at 10V, it is certain to be exceeded in an oscillator with a 9V supply.

((On the other hand, I have ascertained that BV_{cer} for TO-18 types exceeds the median value $(1/2)(BV_{ces} + BV_{ceo})$ when $R_{be} \leq 50K$. Therefore it is conceivable that the TO-18s could be used in oscillator or amplifier circuits where base circuit resistance was 25K or less -- a likely resistance when conventional base bias stabilisation is used-- and where supply voltage did not exceed, say 4.5V. This could be practical, since the TO-18 (small case) types still tend to have $f_T \geq 100mc/s$ even at $I_c=1mA$; this is appreciably better than 015, 065 types (which would be better for amplification). Furthermore there are several useful low level situations where Ic could be driven near the the BV_{cer} zener or neg. resistance level, and where nonlinearity could be tolerated, eg in receiver r.f. amplifiers or oscillators, with L/C tanks whose flywheel effect would restore symmetry to the wave.)) ((Note to confused readers: Please reread the above discussion after reading the following article)).

++++++++++++++

GRANDMA'S TESTS FOR SEMICONDUCTORS -- by R. L. Gunther

Part V: Transistor voltage ratings, reexplored.

In this series of articles we have been investigating several commonsense ways of looking at semiconductor tests and properties, using Grandma's Test for Bad Eggs: If it doesn't feel (or look) right, it's not right. For transistor voltage tests, however, we are faced with a situation of considerable sophistication, and Grandma is swimming in a sea of Depletion Layers, Pinch Effects, and Nasty Boundry Conditions. Let us, therefore, try to rescue her from this terrible plight, before embarking on the description of a Universal Diode/Transistor testing device.

Terminology

In order to save a lot of trouble with the typewriter, I shall make the following abbreviations: BV_{ces} = CES: Breakdown voltage from collector to emitter with base shorted to emitter. BV_{cbo} = CBO: Breakdown voltage from collector to base, with emitter open. BV_{cer}= Breakdown voltage from collector to emitter, when a resistance, R, is placed between base and emitter; abbreviated CER. BV_{ceo} = CEO: Breakdown voltage from collector to emitter when base open (not connected externally).

Analogy with Diodes

In last month's EEB, we described the various diode parameters and characteristics involved in testing forward and reverse voltage and current ratings. The Breakdown voltage of a transistor is tested in a similar manner to the PIV of a diode, inasmuch as a transistor can be considered as two junction diodes connected together in a special way. As with diodes, the collector voltage breakdown is taken as the inverse voltage at which the collector junction current first begins to avalanche. Up to a point this won't hurt the semiconductor, but at a certain critical current, irreversible damage ('Second Breakdown') occurs nearly immediately. The technique of testing voltage breakdown characteristics of semiconductors lies in keeping below that point of no-return.

Difference from Diodes

For transistors, unfortunately, the various breakdown voltage ratings can be rather more complicated than for diodes, because of the interaction between the elements. I can

Grandma's Voltage Ratings (continued)

only mention this subject relatively briefly here, and for a much better and more thorough (yet very readable) study, you should consult Ch. II of the Motorola Power Transistor Handbook (available from bookshops, or through Cannon Electric, Melbourne)

BV_{cbo}.

CBO is the most common way of specifying transistor voltage ratings, perhaps because it looks so impressive (it is the highest of the ratings), but also because it is the easiest to measure, just like the PIV of a diode. CBO usually occurs for I_{cb} of about 10μA for small silicon transistors, 100μA for small germanium or large silicon ones, 500μA-2mA for medium germanium transistors (2N250, 2N256l, etc), and perhaps 6-8mA for very large germanium transistors (2N174, 2N1100). You can assume the limits stated sufficiently well for the small (TO-5 case) transistors, but should consult the manufacturer's specifications for the large ones.

BV_{ces}

Somewhat more useful is CES. It is the rating upon which the voltage of the protective zener diode is based in transistorised ignition systems (zener voltage about 25 p.c. less). As for CBO, CES may be determined by watching for the collector voltage at which collector current starts to increase appreciably. But this should be done carefully, because in some (but not all) transistors, particularly power types, the collector voltage starts to decrease as collector current is increased: a negative resistance (see Fig. 1). This region should not be entered very deeply (though it can be entered without damage to the transistor), for fear of running into the region of irreversible damage ('Second Breakdown'). For most small transistors, however CBO = CES, while for large transistors, CES is usually 20-30p.c. less than CBO. This difference increases with gain, h_{FE}.

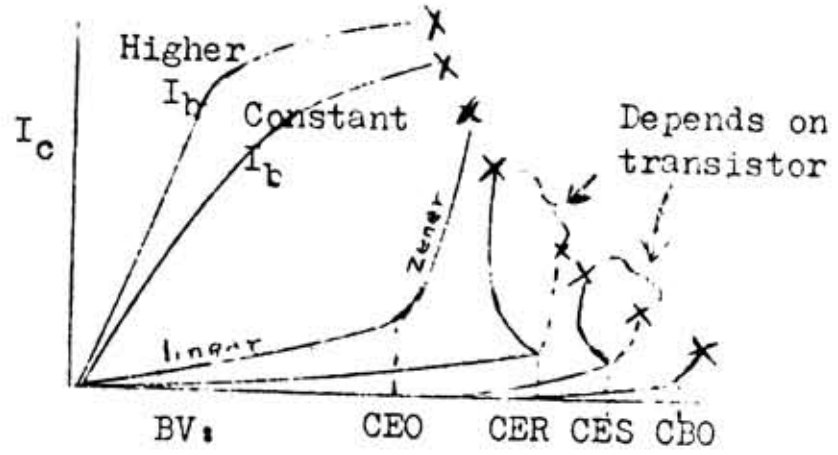


Fig. 1

BV_{ceo} and BV_{cer}.

Since transistors are ordinarily operated with the potential mainly between collector and emitter, the BV between those two elements is most relevant to rating for practical circuits. And this gets complicated. If you put a variable resistor between base and emitter, at zero resistance you have CES. As it is increased from zero, the collector-emitter breakdown voltage falls, till finally when R is some very large value (eg. ∞), the value of BV_{ceo} is reached (see Fig. 2). CEO is usually in the range of 25p.c. to 40p.c. less than CES or CBO, and depends inversely on gain:

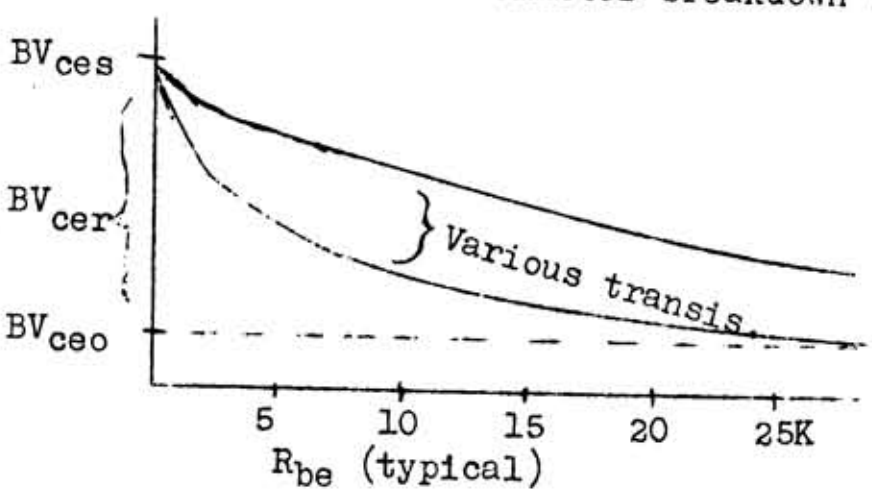


Fig. 2

$$BV_{ceo} = BV_{cbo} / \sqrt[3]{1 + \beta}$$

CER is the breakdown voltage at a point intermediate between CES and CEO (Fig. 2). For ordinary transistors, CER is halfway between CES and CEO when R is some value between 3K and 35K or so; this value varies widely from one transistor to another. For TO-18 VHF types (eg 2N705, 2N711 or similar)

Grandma's Transistors (continued)

it may be as high as 50K, or for power transistors it may be only a few hundred ohms. Thus you can see that for ordinary circuits for which a reasonably low resistance exists in the base circuit, the breakdown voltage can be appreciably higher than CEO.

Note that in the unstabilised transistor amplifier circuit present in simple systems, the base is biased simply by a resistor to the supply. This is a bad bad method of biasing, not only because it invites thermal runaway, but because it also reduces the breakdown voltage to essentially the CEO level.

Measurement and interpretation of BV_{ceo}, and BV_{cer}.

The BV_{ceo} curve of I_c vs V_{ce} (Fig. 1) has two main regions. Up to a certain voltage, the collector reverse current rises linearly with voltage, and above this point it rises sharply at the zener breakdown region, which turns into the irreversible breakdown region ('X'). There appears to be some confusion about just where on this curve one ought to take the proper maximum BV, and transistor manufacturers are not always clear on the subject either. Motorola, however, is fairly explicit in assigning CBO to the zener region, and this would accord with the similar methods I have discussed for measuring maximum allowable peak voltages, in diodes and transistores. A. Gregory informs me that the maximum operating voltage ought to be half this value, and that does seem reasonable in terms of the general philosophy of operating semiconductors.

It is, however, an unfortunate fact that in some transistors the transition from linear to zener character is difficult to discern, and it is also difficult to determine whether or not the curve is linear from d.c. measurements. Therefore, for best results, an oscilloscope method (c.f. pp 33, 159, Motorola Handbook) should be used. This is also wise for CER, because like CES it possesses a negative resistance region (when it does), and V_{ce} must be advanced cautiously there too to avoid second breakdown 'X').

Thus, only CBO, and to a lesser extend, CES are relatively well defined and easily measured by d.c. methods. Since, however, CEO and CER are most useful practical parameters, it would be most feasible to calculate CEO from the above formula, and estimate BVcer from a relationship of the type shown in Fig. 2. Very approximately, you can assume that for an ordinary low power transistor, for $R_{be} \leq 3K$, $CER \geq (1/2)(CES+CEO)$ -- though this threshold of R_{be} can be determined to best advantage by measuring it. In practical terms this means simply decreasing external base-emitter resistance until BV_{ce} reaches a value consistent with the requirements of your circuit, and practical values of R_{be}. Conversely, given a certain circuit with a certain base circuit resistance, you can determine what will be BV_{ce} for a transistor in that circuit by setting up the transistor in the BV_{cer} circuit (to be discussed here), and adjusting R_{be} to the same value as in the original circuit.

More I_c lowers BV_{ce} !

All of the above measurements are assumed to be taken at some small value of collector current (I_c); see p. 109. If, however, the base current is constant at some value leading to an appreciable collector current (the most common mode of operation), the BV_{ce} decreases. This means that CES measured at very low I_c defines an upper limit for BV_{ce}, and must be reduced considerably as collector current is increased. A rough estimate of the appropriate derating curve of absolute maximum BV_{ce} can be obtained from a plot of collector current vs voltage (Fig. 3), by drawing a line between I_c at V_{SAT} and I_c at BV_{ces}. V_{CE-SAT} is

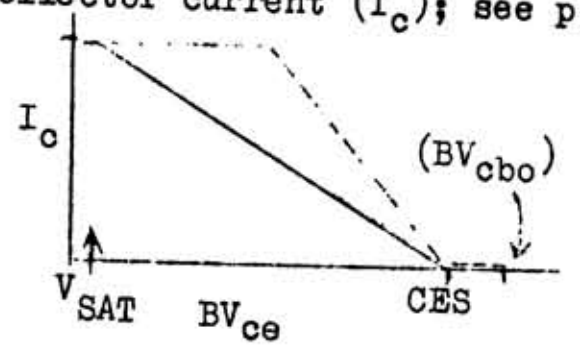


Fig. 3

(Fig 1)

Grandma's Confusion (continued).

the collector-emitter voltage at maximum rated continuous collector current. The solid line shown in Fig. 3 is a somewhat pessimistic one, while the dotted curve is the one given in the Motorola Handbook (p. 31) for typical power transistors. But the dotted curve requires knowledge of the specific boundry conditions for each transistor, and these are not always available. The solid line, on the other hand, can be drawn after making two simple measurements within the scope of any experimenter, and after all-- a pessimistic estimate is always better for semiconductors. This line should be treated as an absolute maximum, above which it is perilous to go, particularly at the higher values of BV_{ce}.... Although I cannot find specific reference to it, I presume it reasonable to assume that CEO and CER would be derated similarly, in proportion to their relationship to CES.

So?

All of this appears to indicate that if you intend to use transistors at fairly high voltages, you have to know what you are doing, or else allow an enormous factor of safety. It doesn't help at all that in a circuit containing inductance, the actual peak collector voltage can exceed the supply voltage. Indeed, this kind of behaviour coupled to the problem of parasitic oscillation is the bane of design of transistorised power r.f. amplifiers. Unless you can make preliminary measurements on an actual circuit under test under reduced voltages, using a good CRO, you can only follow designs found by others to be satisfactory in practice. For example, in the September 1966 issue of 'Amateur Radio' there appears an article reprinted from CQ[x] describing a nice relatively high power transistorised transmitter for the LF amateur bands, using two PADT50 r.f. power transistors in the output stage. These are listed in the Book as BV_{cbo} = 70V, BV_{ces}=75V. Now aside from the fact that this relationship between the BV ratings is impossible, according to Fig. 3, above, the maximum low current breakdown voltage is going to be somewhere in that region. The maximum supply voltage is about 25V, and therefore this voltage rating of the final transistors in the circuit is adequate, by definition (it works)-- assuming that you have no parasitic oscillations ((!)). But the PADT50 is a germanium PNP transistor, and as we shall see later here, the germanium junction has an appreciably sloppier reverse characteristic curve than does silicon (say more like Curve 3, Fig. 1, p.97 of last month's EEB), so I might make the gratuitous assumption that occasional 70V peak transients could occur.[xx] If then, you were to use a silicon transistor like the 2N2991 or 2N2992, you would have to use an appreciably higher voltage rating, to ensure 100p.c. reliability, perhaps 100V or 150V. I don't know for certain, but I have some of the latter transistors, and hope to try it out. If the November EEB is also tardy, you'll know what happened! By the way, the 2N2991 is NPN, and will require turning part of the 'AR' circuit voltage supply upside down.

If you are building a new circuit, and have no idea of the true BV_{ce} your transistor will stand, you ought to make the tests suggested in this article. Lacking that you might assume a maximum collector-emitter breakdown voltage at about one-third of BV_{cbo} (you must measure that, at least), and hope that the transistor will take the potential you apply to it (if inductance in circuit), particularly if it is expensive.

This subject will be discussed somewhat further in a forthcoming detailed article on computer board transistors, with R. Maddever and A. Gregory. I am particularly indebted to Mr. Gregory for much interesting and useful information on transistors.

[x] Reprinted complete with every error in the original article, some of them disasterous. Be sure to see the corrections note appearing in the October issue.

[xx] However, according to Fig. 3, the actual BV_{ce} at the 400mA per transistor used in the circuit, will be less. But the same argument applies in proportion, for the silicon.

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The costs of producing this 32-page manual are illuminating, to show the problems faced by small businesses. Quotes for offset printing ranged from $78 to $150, and each firm said that 'this is the lowest we can possibly do.' It seems that overhead rates vary from one printer to the next. We had to hire our own staff for collating, stapling, and cutting. Thus you might get an idea of the kind of problem that would face the EEB if they decided to produce each issue by Offset process. The nett result of our endeavours has been the production of a useful manual at a price appreciably less than you might find elsewhere. We are so certain that you will be pleased with the Manual, that we shall offer it at a guarantee: your money refunded if not completely satisfied! But the return of the unharmed manual must be made within 5 days of receipt, to satisfy the guarantee. We'll trust your

→(continued after the circuit board article)

Owing to numerous requests for technical information on these boards, we here summarise a body of information derived from the November 1965 and March 1966 articles in the Equipment Exchange Bulletin+, from our own researches, and from numerous suggestions and data kindly furnished by customers.

===Why? These boards may have appeared on the surplus market, because they have been superseded by more modern types in new computers, but also because entire boards are replaced when a defect appears anywhere within them. These may be hairline cracks in the wiring, defective components, or even wrong components placed on the boards initially! In any event, it is evident that it would be wise to test all components or circuits on a board before depending on it. Obviously it is impractical for us to guarantee circuit board components, but the yield of good material is high, and customers have been most satisfied with the boards.

===Components. Most components are 1pc or 5pc, are usually clearly marked, and are of the miniature, LT type. Some are colour coded, some have printed ratings.

Resistors-- Frequent. Largest are 2W carbon, or 3-10W wirewound. Smallest, 1/10W.? The half-watt ones are the usual size. Sometimes miniature potentiometers, screw adjust.

Condensers-- The ordinary type appear to be of high quality construction, but attain their small size mainly by low voltage ratings. It is important not to confuse them with large resistors. The condensers have more colour bands (standard coding), and of course test 'infinity' on an ohmmeter. Electrolytic condensers are of the tantalum type, and are built for reliability and relative freedom from temperature effect. Label= µF, WV.

Coils-- ±5pc. A few µH to several hundred µH. Green body if colour coded, µH.

Transformers-- Rare, except for the pink box on some of the four-transistor boards. This is a pulse transformer (at high frequency) having two centre-tapped windings, by which a symmetrical amplifier drives some kind of phase sensitive or rectifier system. Construction is torroidal. Some torroid types are labelled with turns ratio.

Fuses, Outboard printed circuits, Thermistors, etc-- Various, rare.

Diodes-- Relatively frequent, though not on every board. Most of them are of the miniature, glass-encapsulated type, capable of continuous power dissipation of abt 300mW. Most seem to be of the silicon junction type, analagous to OA200, with voltage rating about 30PIV, current 160mA or more, poor zener characteristics but excellent rectifiers. When used for detection, some work better than others (no apparent relationship to low frequency rectification efficiency or PIV), to about 25mc/s. When used for meter protection, some work better than others, depending on the sharpness of the forward conduction curve. Although some protection will be obtained simply by placing the diode across a meter (in the forward direction), optimum protection will occur when a resistor is also placed in series with the meter itself, of sufficient resistance to cause diode conduction when meter current slightly exceeds FSD.... The germanium diodes will detect up to 100mc/s or better, but are not suitable for meter protection. Silicon diodes have a broad conductor at the internal anode (and a forward voltage drop of 0.5V or more, at +10mA), while the germanium diodes have a very fine internal anode wire (and a forward drop of only a few tenths of a volt).... Large plastic case diodes are rare, but are silicon, 300mA, 400-800PIV rating. The PIV of these should be tested carefully if HT.

Some of the diodes are encapsulated in long black strips, sealed with epoxy resin. These are used in logic switching processes, but would be good for only about 30mA forward current, because of their high voltage drop. Germanium, copper oxide, selenium??

Transistors. Most of the transistors are in 'TO-5' cases, of the 2N1300 series, with power rating about 150mW (25°C case), current 100-300mA (at saturation), BV_{cbo} 35-130V, β from 20 to 250, I_{co} ordinarily less than 2µA. On the top of many is a type number, usually beginning with '0'. The other numbers appear to be irrelevant. In the Chart

NOTE: BV_{ceo} generally 25-65pc of BV_{cbo}.

+ Equipment Exchange Bulletin, P.O. Box 177, Sandy Bay, Tasmania. Subscription 60c/year.

shown below, we summarise some of the other characteristics of the most frequently found transistors on the boards. We hope later to fill in the blank spaces, and to add more types. The great majority are germanium. We have found an occasional silicon transistor on the boards(but most rare.). If the collector lead is welded to the case, it is likely to be silicon, but if the base lead is welded to case, it is still germanium (but be caseful of unintentional contact between case and other components). Before coupling a transistor to chassis for heat sink (to multiply power rating severalfold), be sure to check whether the case is electrically isolated from the leads... 'Sym' means that BV_{cbo} (maximum reverse voltage between collector and base, with emitter open) is about the same as BV_{ebo}. 'Asym' means that whatever BV_{cbo} is obtained, the BV_{ebo} is low, having a zener type characteristic, at about 10V, but with rather poor dynamic resistance, eg. 100-400 ω. This corresponds to a zener power rating of only about 25mW. This subject will be discussed in more detail in a forthcoming issue of the EEB. For now it is sufficient to note this relationship, in order to know the limit of reverse voltage which can be placed on the base-emitter junction. 'f_{osc}' is the practical limit of oscillation freq., as determined by operation in a conventional tapped-coil oscillator. / In a random sampling of the boards, about half of the transistors were PNP, half NPN, and a given type of circuit will not always use transistors of the same polarity. On some boards, too, NPN will be alternated with PNP, in an obviously complementary symmetry arrangement. This is particularly obvious where large (TO-5) transistors alternate with the miniature (TO-18) ones. The small transistors are definitelyLT 150mW types, with BV_{cbo} of the order of 20V (reverse current for testing must not exceed -10μA), and linear BV_{ceo} of about 6V (zener BV_{ceo} 10V to 12V), with BV_{ebo} = 2.5-3.5V. They are not, therefore, very suitable as ordinary amplifiers, but are good for low power very fast switching, which in this instance is hardly surprising. The 11-transistor boards, which contain a number of these small transistors, consist of a number of common-emitter stages in various arrangements, and can be converted to decade or multiple binary counting operation, by adding condensers and diodes. Miniature transistors are likely 2N705 or 2N711 (Ic 50mA)

Number	NPN	PNP	Sym	Asym	f_{osc}
015*		x		x	30-50mc
016		x		x	30-50
025		x	x		6-12
026		x	x		6-12
029	x			x	
033*		x	x		6-12
034*		x	x		6-12
035		x	x		10-20
N593		x	x		10-20
063	x		x		6-12
065*	x			x	30-50
066	x			x	30-50
075	x				6-12
083*	x		x		6-12
(TO-18 case)	x			x	45-65
013		x	x		6-12
030		x	x		6-12
082	x			x	30-50

There are a few transistors twice as tall as the TO-5 case type, and these are 2N1038, 2W, 3A (sat), 30-90V, 20-50β. Some transistors are of the OC26 type, with analagous characteristics. A few curious transistors are those which appear to be of the 'TO-5' size, but which are imbedded in large flat heat sinks with numerous fins. 5W perhaps?

*These are the most frequently used types.

=== Circuits. The number of circuits involved is bewildering, but most are relatively standard logic types, of the 'NOR' or 'AND' configuration. Since many of them are various permutations of common emitter amplifiers, either cascaded or with leads brought out to the ends of the boards, they are readily modified for use as amplifiers or oscillators right on the boards, although substitution or addition of components will be likely. The circuit for the frequently seen 5 and 6 transistor boards consists of two sets of three (or less, for fewer transistors per board) commonly blocked NOR-gates. The bases come out to the edges of the board, through resistors or directly. Each collector goes to the midpoint of two resistors forming a voltage divider, with all the dividers connected in parallel. Collectors themselves are also brought to the edge.

It is altogether impractical for us to describe other types of circuits here, and you are invited to trace them out for yourselves. This can be done with minimal difficulty, marking each board connection as you draw it (preferably on a blackboard for easy modificationn) There is room for small components to be added to the boards, or with tag strips, etc.

===Stripping techniques. If you wish to strip the boards for components, it can be done by using conventional unsoldering techniques, but some suggestions here might make it easier. In any event, apply heat from a hot iron, quickly, with minimum heating of parts.

1) It is desirable first to remove the plastic coating. This can be done by soaking the bottom of the board in a flat dish with acetone (caution, very inflammable !), but the acetone should not cover the components themselves. After a time, the coating will dissolve, or can be wiped off. Or, the coating can be buffed off by wire brush or wheel.

2) The major problem will be to remove the transistors. For this it can be convenient to make a three-prong desoldering tool. Pull on the transistor while heating from the bottom.

3) A motor driven wire brush wheel can be used to buff the solder by abraison, but be sure to buff off the solder from leads in the same direction as the leads are bent, or trouble will ensue. There is no mechanical damage if done carefully. Static electricity should give no trouble, because of the low impedance of the transistors.

4) When the plastic coating has been removed, solder can be removed efficiently simply by placing lightly tinned wire braid (as used for shielding wires) on the connection, then pressing down on it with a hot soldering iron. The solder melts and is promptly sucked up into the braid as to a sponge, leaving the terminal underneath clean of solder. A given spot on the braid can only be used once for this operation, whence a new spot adjacent to it can be used. Braid is not inexpensive, but since this operation would be most useful for transistors, it would not have to be done for all of the connections on the board. Other components can be removed by the usual expedient of heating one end (from the bottom), and pulling that end of the component clear from above.

5) A sharp knife or other suitable tool can be used simply to pare away the solder on each side of a bent transistor lead. Then push the knife under the end of the lead and bend it up. When all three leads have been straightened, gently pull the transistor out. This is obviously a simple method, and has the disadvantage merely of tedium.

6) The transistors can be obtained intact with a piece of circuit board attached, simply by using a fine saw to separate them from each other and from the rest of the board after other components have been removed. This avoids difficulties of desoldering transistors, and the rather short leads that would result. It also provides a piece of board forming convenient connections to which one can solder without difficulty. If the piece of board attached to the transistor is large enough, it can also be drilled for mounting by a screw and lug. If, on the other hand, transistors are desoldered, they can be installed without difficulty into three-conductor transistor sockets of the round type.

7) The printed circuit wires may be stripped off, and the holes used to mount components as desired, connecting them with ordinary wire. It would be desirable to leave as many transistors on the boards, as appropriate to the design of the proposed circuit. For this, a razor blade should be used to cut the wiring leading to the transistor terminals. Then, when the rest of the wiring is removed, the transistors are left with their contacts intact, and without necessity for desoldering. They can then be tested for characteristics, and excess or unsuitable ones can be removed.

8) Simplest method: Heat tr leads simultaneously with large bit, pull transistor firmly. strip

=== Testing Components. Resistors, condensers, etc, can be tested by ordinary methods. The testing of diodes and transistors can be complicated, though the use of simple techniques and some Common Sense can furnish useful data. The main instruments are a variable power supply, some resistors, potentiometers, and meters. This subject is discussed at length in the series of articles "'Grandma's Test for Semiconductors" which began in the April 1966 issue of the EEB. We must mention one important caution here: Do not use an ohmmeter for testing semiconductors, unless you are absolutely certain that the current or voltage imposed by the ohmmeter will not exceed the ratings of the items being tested !

In general, the breakdown voltage of diodes and transistors may be tested by measuring the voltage developed across the component when a small amount of current (eg.100μA for

TO5 germanium transis.) is passed through it in the back-biased direction./ The usual (But exactly depends on shape of curve)
rating of a transistor is taken between collector and base, with the emitter open, but other arrangements of the leads will result in lower ratings, and depend very much on the specific use to which the transistor is to be put. Forward current rating of a semiconductor will depend on the voltage developed across it for a given current, and will be limited by the amount of power the device can dissipate. Current gain of small transistors is often measured for a collector current of 1 mA, and is defined by $\beta = \delta I_c/\delta I_b$, where δI_c is the change in collector current produced by a change of base current, δI_b. It is approximately equal to $h_{FE} = Ic/I_b$, assuming a nominal voltage applied between collector and base. If you don't have a microammeter of sufficient sensitivity to measure small changes in I_b, I_b can be calculated from Ohm's Law, and the values of supply voltage and series base resistor. If supply voltage is low, you will have to take into account the fact that about 0.2-C.4V (for germanium) or 0.4-0.7V (for silicon) is developed across the base-emitter junction in any event.

Determination of frequency response of an amplifier is not simple, but can be approximated by determining the maximum frequency at which a transistor will oscillate. The oscillation can be followed with a GDO or diode+meter connected so as to load the system minimally. The common-base configuration gives the best high frequency response, and will generally be three to ten times higher than the frequency obtained from a common emitter amplifier. f_T for the latter is approximately 4 times the max freq. of an oscillator with a 25pc tap... The situation is further complicated by the fact that the frequency limit of a transistor also depends on its collector current and voltage. Frequency goes up as collector voltage goes up, but passes through a minimum as collector current is raised from zero....

=== <u>In General</u>, if you wish to know the characteristics of transistors or other components, it is far more useful to test them on the workbench, than to spend a lot of trouble to ascertain the characteristic numbers. Most of the transistors on the boards are in the 2N1300 series, but that won't tell you much. For one thing, you don't know to which of the series a given transistor belongs, and for another the variation in characteristics of transistors within a given type rating can be greater than the variation between types! Those type numbers (2N..., OC...) are guides to approximate characteristics only, and unless your circuit is quite uncritical, it is always wise to test each transistor as relevant. Indeed, if you do not know its polarity beforehand, you <u>must</u> test it for NPN/PNP, or dire consequences may result; very simple: (eg. for 100uA)
Apply voltage through a large resistor, between collector and base. If it is NPN, more current will flow when collector is negative with respect to base, vice versa for PNP. Even characteristics curves may be obtained by the use of potentiometer and meters, and these will enable you to compute load lines, linearity, optimum operating points, etc. For serious experimenters we recommend to you the 'Grandma' articles in the EEB, and follow the basic articles published in <u>Radio Constructor</u>, and elsewhere.

We have received requests for information about Computer Design and circuitry. This is altogether outside of our field of competence. Information on this subject can be found in technical libraries, and in leading bookshops. A surprisingly large number of technical reference works contain chapters on computer principles and design. In addition, the magazine, <u>Electronics Australia</u> has initiated a series on the subject, beginning with the June 1966 issue. A general Reference List for computers appeared in the <u>Equipment Exchange Bulletin</u> for July 1966.

We wish to extend grateful acknowledgement for assistance and information furnished by the following parties, and others.

E. Foster	R. Maddever	R. Reynolds	PLEASE NOTE: A new and amplified article on characteristics of Circuit Board components is in preparation, for the <u>EEB</u>. Jan?
R. Gunther	T. Ohsberg	T. Vieritz	
E. Kershaw	H. Pfeifer	G. Petherick	

↓ PARTICULARLY FOR DIODES.

Advertising (continued)

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IN ORDER TO STIMULATE SALE of our electromechanical kit parts we are now offering a Catalogue plus SAMPLES of electronic parts, gears, pinions, etc, to give a visual indication of the range and size of these items. Catalogue and samples cost you 70c (the samples alone are worth $1), or the Catalogue alone may be obtained by sending 16c in stamps, to cover postage and printing. Available from CLIVE WITCHELL INDUSTRIES, 2-6 Ethel St., Moorabbin, Victoria.

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WHAT A GHASTLY SITUATION! for Australian Electronics (76 View St., Hobart, Tas, specialising in the finest surplus components and literature, all post free; send for Free Cat) to be squeezed into such a small advertising space. Ah well.

Well-- we have this month a gorgeous Universal LT Transformer for a wide variety of applications. Six separate windings. 3V at 1.5A each, 10% less voltage up to 3 Amperes each, maximum. Can be paralleled to get 3V at 9A, or 18V at 1.5 A, or combinations of 6, 9, 12V inbetween in a variety of current combinations. The versitality of this transformer is enormous. Use for conventional filament supply, transistor power, d.c./d.c. conversion, etc etc etc! 240V Pri (with 220V Tap if requested), 50cps. Flying leads (labelled). A mere $3.50 each, Post FREE, ex stock. Why build your own when you can pay us to do it for you? Much easier, heh heh.... We also still have a few Calibrated Power Chokes left, 5-7 Hy±0.5% at 1kc/s, 0mA; or 220mA d.c., 100Ω, $2.60 ea., Post FREE. Also RF Chokes π-wound, 1-1/4mH, 125mA, new. $0.15 each, Post Free, ten for a dollar. We even have one of those 105kc/s electromechanical filters still around, 1000cps band pass with a shape that looks like a cliff; £6/$12.... BUT PLEASE do not order any more X-10 Kits or Power Supply Kits! They were snatched up by return of post, and we had to turn several people away, what a pity. Grrrr. Had a chat with the young chap responsible for so much of our grief; he said he was going to reform; we'll believe it when we see it.... In any event it also appears that a number of people are skeptical about the X-10 controversy. If, by the way, any of the rest of you have obtained X-10s elsewhere, you might be interested in a discussion sheet we prepared, treating various design and substitution problems involved.

We also have a number of books of all kinds, all very useful, as you may imagine, knowing our bias toward the cheap and practical. They are selling very well indeed, but if you want a list of contents etc please send SAE.

We have a few 3A diodes again, just arrived, and our very last stock of this useful item; 100V/3A for 4/6, oh nuts $0.45, up to about 800V. Ditto some 20Amp diodes, 50V/20A for $0.90, up to HT. Both 3A and 20A need only to be attached to heat sink-- no heat sink adapter necessary, no sales tax to add, no postage...

CIRCUIT BOARDS, $15 per hundred transistor worth, all other components free. We have nearly completed a thorough investigation into the properties of Circuit

Board components, particularly transistors. The results are shown in part, in the enclosed 'insert' which we dignify by the name of advertisement, since we sell the things; but who ever heard of doing so much work to sell something that sells itself? The 'insert' also contains some previous material reprinted from the EEB, to provide continuity.... A number of comments and corrections ought to be added to those sheets (which were printed several months ago), but none is really serious, and most can wait for the big article. But we must mention that it appears that the f_T for a transistor used as C-E amp will be from 1 to 2 times (not four times) the max freq of a Hartley osc having a 25% emitter tap. The reasons for this are interesting, but why worry; the f_{osc} is a far more useful criterion of practical frequency capability than the frequency at which the gain, β, falls to 1.0 (∴the transistor becomes useless).... And some people find it easier to remove solder by heating and brushing it off, then prying up terminals. But remember to keep heating of transistor terminals to the minimum possible; they fry easily.

STOP PRESS! Buy, beg, or borrow the Oct. 1966 issue of Radio-Electronics, for the article therein on Computer Circuit Boards. Or we can buy it for you (75c Post Free).

RODNEY REYNOLDS
St.George Rectory
Battery Pt., TAS.

from: THE EQUIPMENT EXCHANGE BULLETIN
P.O. Box 177, Sandy Bay, Tasmania

//Registered at the G.P.O. Hobart, for transmission by post as a periodical//

EQUIPMENT EXCHANGE Bulletin

P.O. Box 177, Sandy Bay, Tasmania, Australia

PUBLISHED..... TEN CENTS PER COPY Yearly Subscriptions: $A0.85, NZ8/-, Stg8/-, $US0.95

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A BULLETIN OF NEWS AND DETAILS ABOUT OHM'S LAW, $I_c=\beta I_b$, Editorials, AND SO FORTH

++

STAFF. Worries, R.L. Gunther; Stencils, Jill McLennan; Draghting, B. Robinson; Arrangements, Ann Gray; Printing, D.F. Dainton; Advisory, R.S. Maddever, A. Gregory, R. Reynolds. ARTICLES earn free one year sub. Author's Copyright. All opinions those of authors; we guarantee nothing. SUBSCRIPTIONS are accepted for only one year at a time, and begin with the current issue only. Please write name and address legibly. BACK ISSUES are 10c each, after some delay! YOUR RENEWAL DATE is indicated on your address label. Your last issue will be sent the month prior to that date; take note. If your renewal date is January 1967, this will be the last issue you will receive unless you send in your 85c. We can't afford special reply envelopes or anything like that, so if your renewal is imminent, please attend to it, the instant you put this issue down. Payment may be made with Postal Orders, Cheques, or Postal Stamps. Thank you.

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CONTENT.

Me seemes the world is runne quite out of square,
From the first point of his appointed sourse,
And being once amisse growes daily wourse and wourse. -- Edmund Spenser.

Editorial.

The reason for the expanded dissertaion on renewals, here above, is the fact that a large part of our readership's subscriptions expire in January 1967. We expect every one of you to resubscribe cheerfully, inasmuch as most of you would have been the group which paid 3/- for your subscription for two years. In the meantime the publication has grown and grown, likewise the subscription price. You got a pretty good value for money, yes?, so please return the favour. As we explained on P. 92 in the September issue, we refuse to raise the sub to $1.00, in spite of the difficulties of sending negotiable sums for 85c. This will prevent us from changing over to an Addressograph system of mailing labels, but it is worth it, for the sake of keeping the sub rate at the bargain level.

Editorial (continued).

Look at the page number at the last page of this issue. We should have been able to afford ten pages per issue this year. 10 x 12 = 120. But many issues have managed to exceed this limit, because of an abundance of material to publish. Therefore we take this opportunity to catch up, in several senses, and combine November and December issues. The next issue will be January, 1967, with some more on semiconductor testing, and a nice article on a practical Transistorised a.c. Millivoltmeter. You won't want to miss that, will you?, nor any of the other goodies we have planned for 1967. By the way, with your renewal, please make some note of your opinion of our publishing every other month. If we did this, each issue would be somewhat larger, and we could afford photographs of equipment, etc. Or we could make subscriptions run for 18 months instead of 12. A bimonthly schedule would have two other advantages: it would reduce the pressure* on us, and it would also reduce the burden of assimilating information. With the pressure one has in reading publications nowadays, it can be a problem to find enough time to read them more than superficially. Our material is too good to skim, and deserves prolonged study! A bimonthly schedule might afford that opportunity. What do you think?

Fascinating comment by a friend. "I'm not quite sure about the EEB. It is very worthwhile now. I wonder whether it will have done its job in another year. Unless it has an enthusiast behind it -- as now, of course -- it could be a bit of a mental millstone..." Well, I'm not sure either. For one thing, I'd be surer if I knew just what was the 'job' of the EEB. Right now it just appears to be a big picnic for everyone. The one danger might arise if it became serious. You'll know that that happened when the subscription price exceeded $1.

On the other hand, I feel confident that the EEB will 'succeed' because it is your enthusiasm that lies behind it. True, it needs me to push it, but you should see the enthusiastic letters arriving with renewals (many of which also say 'keep EEB as it is, to heck with gloss'). And descriptions of projects for articles. It seems to me that after another year of this, the EEB will take off like a baloon, and my job will be to keep it from expanding, from getting bigger and busier, from approaching that $1 level. We already have about 6 solid months worth of articles, and another 6 months worth of half finished ones. If we are going to go downhill, it will not be within a year, nor in a direction I can visualise at present.

The only direction I can start to discern, is the fact that I like to present articles which don't merely tell how to put this resistor onto that transistor. But I like to describe design details which assist you in designing things for yourself. But this might change, who knows? It will depend largely on what you send in.

But it is true that I could often use competent help to review articles, prepare features, etc. Anyone with a (tender) feeling for words, a moderate technical knowledge, and a passion for doing things as correctly as possible -- you're impossible. But write us anyhow, if you exist, and join the fun.

— RLG

Letters to the Editor.

1) Proximity relay circuit has now been finished, and it works! I still can't get over it. Question. do you want the article now, or wait a bit longer for improved version? ... About that transistor with a β of 500 (EEB, Aug. 1966, p. 80). I eventually measured its leakage, and it was many mA. This could either strengthen the high β, or

* For example, the situation with regard to our finding time to take care of back issues is ghastly, as those of you know who have been waiting for them.

(Letters continued on P.128)

Just pretend that this issue was divided into two 8-page instalments, combined in one month!

GRANDMA'S TESTS FOR SEMICONDUCTORS. -- by R. L. Gunther
Part VI: A Diode (or Transistor) Voltage Testing Device

Now let's get down to an actual gadget to make the various tests described for the past two months of EEB articles. This, too, will have to be serialised, but at least we can make a start here.

The Equipment

The basic requirement is simply a brute force power supply, to provide adjustable d.c. from 0-1000V/2mA, and a source of low voltage high current, up to the rating of the diodes or transistors to be tested. Current output must be measured at the same time as voltage, and the voltmeter ought to draw as little current as possible. For only a few items to be tested, this is really all that you need. If however, you want to set up a proper piece of equipment, the following design incorporates a number of refinements which make testing easier and more reliable. After all, how about those leads that so easily become shorted accidentally while testing? Furthermore, if you have the device available you are more likely to use it, and this can save you a lot of reliability. The ratings of commercial semiconductors are often stated pessimistically in order to cover the worst possible case. By testing them yourself you can design your applications specifically to best advantage. The general circuit:

*Always test your Mains plugs to make sure that Red is Active, Black is Neutral.

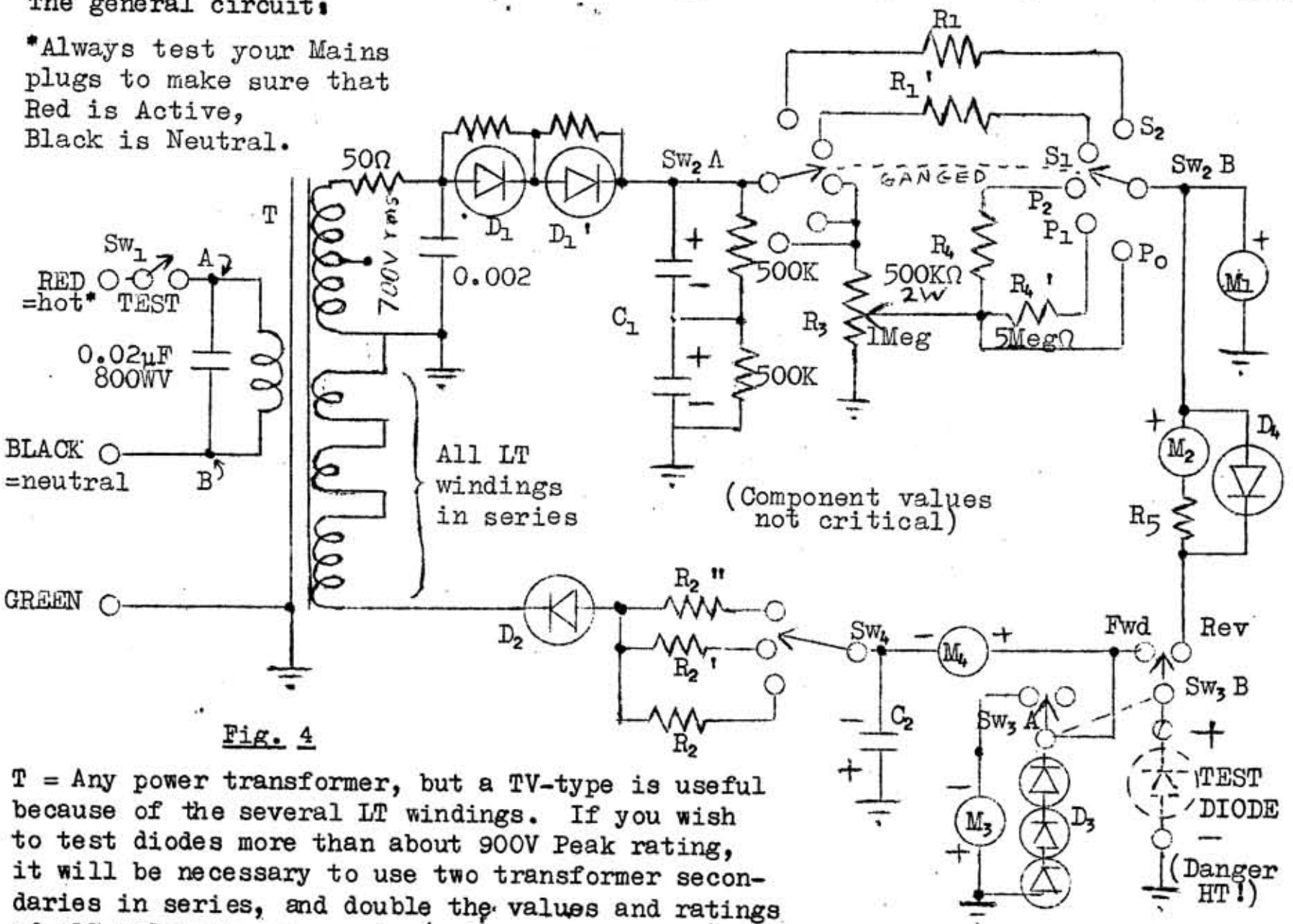


Fig. 4

T = Any power transformer, but a TV-type is useful because of the several LT windings. If you wish to test diodes more than about 900V Peak rating, it will be necessary to use two transformer secondaries in series, and double the values and ratings of all relevant components (using common sense). This may be quite a practical step, because of the availability of HT diodes now at reasonable prices.

D1 = Diodes amounting to at least 3000PIV combined rating (for a 700V RMS Xfr) (700 x 1.4 = 1000V. 1000V x 2 = 2000V because of half wave. 1.5 safety factor = 3000V.) with the individual diodes connected in series as necessary to achieve this value, each diode being shunted by 10Meg per 500V or so. Thus to use three 900V diodes and a 300V one, each 900V should be paralleled by an 18Meg resistor, and the 300V one by a 5.6Meg resistor. These resistances may sound large, but 900V/10 Megs = 90μA, which is about ten times larger than the reverse diode current at the rated PIV. If more than two diodes are connected in series, they should also be paralleled by an HT condenser of capacity about C = 3000/R, where C is in pf, and R is in Megohms. Exact value of C is not critical, and can be nearest standard value.

D2 = 150PIV or more diode rated for maximum forward current to be tested.

D3 = These protect the voltmeter, M3 in event of a bad connection to a diode, or an open diode. These can have a total PIV of at least 50V, and a current rating at least as large as that of the largest diode which would be tested (eg 20A). Three diodes are suitable for protecting a 2.5V movement, 6 for a 5V movement. Alternative (cheaper, though more trouble) would be always to switch M3 to a higher scale between tests.

C1 = Condensers in series, amounting to a working voltage of at least 1000V. The exact capacity is not very important, as long as both are the same, and at least 4μF.

C2 = 2000μF or more (if available) at wrking voltage 1.4 x full LT secondary combination. Its exact value is not critical, but ought to be at least 1000μF per ampere to be passed. Alternative is to eliminate C2 entirely, and this has certain practical advantages. This places pulsating d.c. on the diode or transistor under conduction test, and reduces considerably the average power dissipated by it. But it would require multiplying the d.c. readings of both M3 and M4 by 3.1, to obtain the true peak readings. The various values of R2, by the way, should be chosen by calibrating with a known ammeter, not by calculation, particularly if C2 is used.

R1 = Current limiting resistor for shortcut testing. See Procedure C(Part VII). R_1 is chosen to give typical current at PIV, thus allowing direct reading of PIV on meter M_1. Only really works well for zener or relatively sharp rev. curves.

R2 = Choose a value sufficient to limit current to the rated forward value for the diode being tested, assuming about 1V drop across the diode. Suitable ranges for SW4 could be. 150mA, 750mA, 3A, but this will depend very much on the contact resistance of SW4; a banana plug system could be more suitable. This is essentially a constant-current system, if you have at least 12V worth of LT windings, so that the voltmeter, M3, will read directly the forward voltage across the load. Rated forward current can be applied to Top Hat and other heat-sinkless diodes or transistors without worry. But full current should be applied to Studs (requiring heat sink) for not more than 10 or 15 sec if no test heat sink is provided. Therefore M3 should be read quickly.

R3 = This is the main output voltage control for testing the reverse characteristic. If a smaller or larger HT supply is used, R3 and R4 can be changed in proportion.

R4, R4' = These limit the maximum current available from R3, for obvious reasons. R4 is used for LT diodes where reverse current may be appreciable, and R4' for HT ones. For a given setting of R3, a good relative idea of the shape of the reverse characteristic curve may be obtained by switching S2 from P1 to P2, since this will increase the current appreciably. This simple test would, however, have to be done with some discresion, to avoid destructive current flowing on the P2 position.

R5, D4; D4 protects the current meter, M2 against overload, and is quite necessary in an installation like this one. D4 can be any good silicon diode, PIV irrelevant. R5 is chosen so that M2 reads about 1p.c. low when FSD current is being passed through it; total FSD voltage across the diode will then be about 250mV. This gives

excellent protection of M2 for very little trouble or expense. R5 can be 0, but then M2 will only be protected to 3-5 x FSD; it won't burn out the meter, but it could bend the needle.

SW1 = Pushbutton or microswitch type. This is the main 'TEST' switch, and should be not too difficult to activate. I have found that a pushbutton of the type ordinarily found in electronics suppliers stocks has too strong a spring pressure. It is, however, easy to take it apart and replace the spring with a weaker one. The alternative is a microswitch with suitable lever projecting through the front panel; this is what I use.

SW2 = Chooses Mode of operation. See discussion. S2 and S3 must withstand the HT.

SW3 = Chooses between Forward and Reverse characteristic tests. Self explanatory. Must have low resistance for high current.

M1 = Voltmeter with the usual scales, to maximum PIV to be tested. For ordinary purposes, an ordinary 20K/V multimeter should be quite satisfactory, as long as you remember that the current through R1 or R4 is the sum of that through both the meter, M1 and the diode under test. This means that if R1 or R4 is chosen to limit the maximum diode current to a certain value, it will also limit the maximum voltage available to test the diode. The more current M1 draws, the lower will be the maximum voltage for a given R1 or R4. It is, therefore, best to use a VTVM (valve voltmeter) for M1, if you have it. Even an 11Meg VTVM is not really very good on the HT ranges, however, and in Section C(Part VII) I shall discuss a better design for a VTVM with really high input resistance.

M2 = 50µA to 10mA FSD, depending on application. For ordinary small diodes and transistors, it must have a sensitivity of at least 100µA FSD.

M3 = 2.5V or 5V d.c. meter, as available. But refer to discussion about condenser C2.

M4 = Ammeter, as appropriate. See discussion under R2.

++++++++++++++++++++ (to be continued)

YOU SHOULD KNOW BETTER!

Where we present a series of vignettes related to competent technicians who ought to Know Better. Have you any? Annonymously, of course.

2) An outboard potentiometer was wired to a three-terminal tag strip. The tag strip was screwed down to a chassis. Results were impossible. The cause was found after an hour of trouble shooting: the centre terminal of a three terminal tag strip is continuous with the mounting lug. The centre terminal of the potentiometer was thus connected to chassis, therefore to earth. You wouldn't make such a stupid error, would you?

==========

RAMBLINGS - by 'Old Peth'

Now that 'Joystick' (Antenna) thing (see EEB, 'Letters' of August 66). A veritable tempest in a teacup. There are Joysticks and Joysticks*, and some people get better results than others. Of course you read the testimonials of the former. My own seems much of a dud on transmitting, though very good on receiving. It has dragged in Europeans on 20M at S8 on occasion, and that is not bad for a few turns of wire on a broomstick! though they can be high priced turns. On transmitting, like the Mfr sez, I probably didn't remove all resonant structures in the area. The only trouble is that my neighbour is going to get wroth if I pull down his short wave aerial, not to mention what the XYL will do if I disembowel our clothesline. Still -- a friend says he gets particularly tremendous results from his Joystick (Antenna) on SSB, for some reason. But another friend says he is going to drop his into a hole in the ground. Seems to me, though, like that's an awful waste of 45µH of wire. Yet another local has run comparisons between the Joystick and a single-bed wirewove. The bed consistently produced reports of 2-3 S-points higher, over a 40 milo path!

*What's this about 'noun or alone'?? Have you seen Joystick advertisements?

4 TRANSISTOR AMPLIFIER. -- by C. Witchell

We have all seen circuits for simple 4-transistor amplifiers in one form or another. What we have not been able to do, with ease, is construct them. Generally the holdup lies in the matching transformers or the output transistors. These difficulties have all been overcome in this design since every part is available in Aust. even to a neat printed circuit board for mounting the parts.

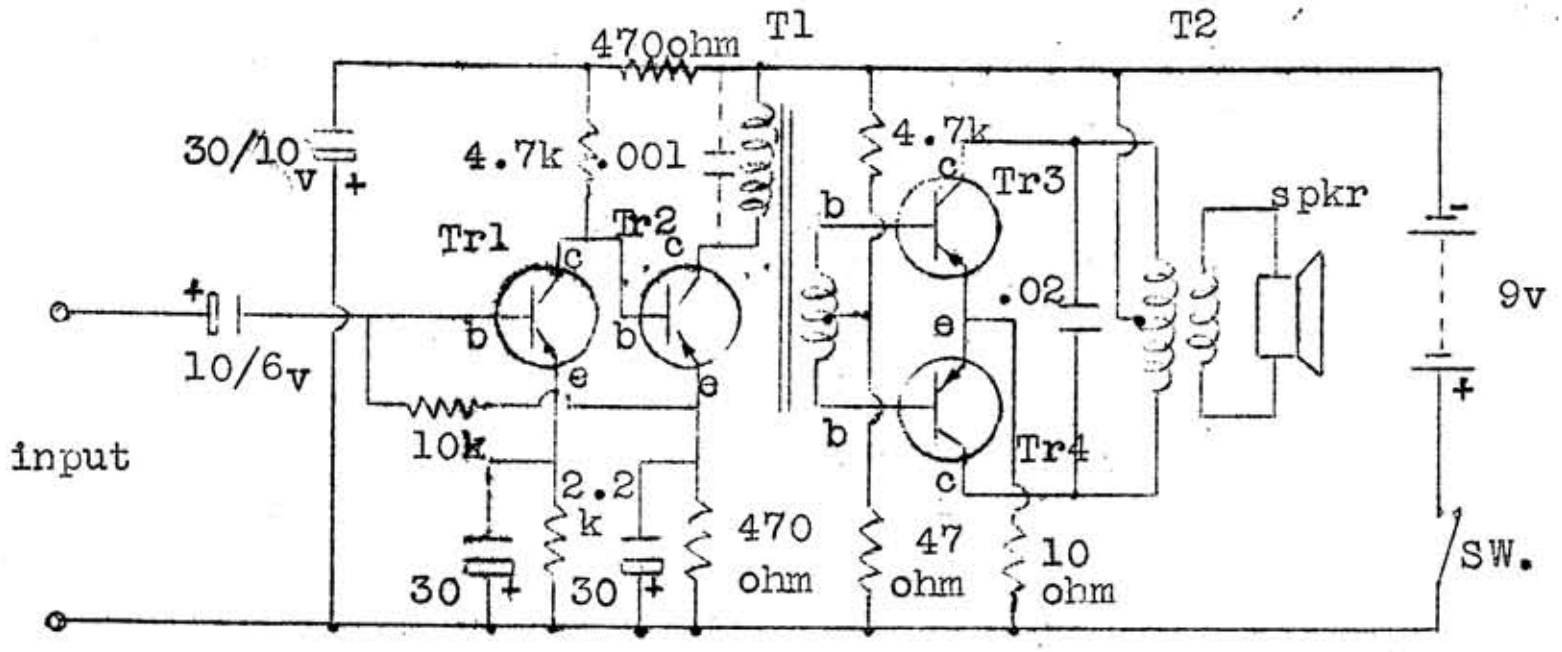
Right from the infancy of transistors it was known that two transistors in push-pull mode gave high output power with surprisingly high efficiency (max.eff.78% compared to a single transistor output — class A — having max. eff. of 50%). The output power (power handling capabilities) of a pair of transistors in push-pull is about 5 times the rating of a single transistor. Out of the many 4 transistor circuits,,described over the years, we have chosen the best qualities of each to result in the accompanying circuit. The first novel feature to be noticed is the direct coupling of the first transistor to the second. This arrangement enables the first two transistors to be temperature stable. This can be explained as follows:. Suppose the first transistor were to heat up. This would make it conduct more heavily and bring the base of the second transistor toward the positive rail. Now positive on the base of transistor 2 causes a reduction in the current flowing in its collector-emitter circuit. It may be hard to see, but the 10k resistor is being brought closer to the positive of the battery by the action of Tr2 so that Tr1 has an increasing positive potential applied to its base. This reduces the current in Tr1 and tends to off-set the original temperature rise. A reduced current in Tr1 causes an increased current in Tr2 and so this interchange goes on continually between the two transistors as they seek an equilibrium position; somewhat independent of the temperature rise of the surrounding air.

Further technical details will be discussed in forthcoming articles. A synopsis of the points to be discussed include: The construction and operation of T1 (phase splitting transformer; bifilar wound secondary, why? effect of dc component on working condition). Part played by 47 ohm (at top) 30/10mfd combination; emitter resistors; 30mfd electrolytics; 47 ohm resistor; 10 ohm resistor; ceramic capacitors — in fact every component will be discussed.

Construction is really quite straight-forward. The holes for each transistor are identified with letters C B E on the underside of the board and no difficulties will result here. It is always a wise precaution to check that the transistors are inserted correctly, especially the output pair. Refer constantly to the schematic diagram to see that each component is being inserted correctly. The holes for the 4 trans. are positioned so that they line up with the lead configuration of the transistor.

Use $\frac{1}{8}$" spacers on the transistor leads & electrolytic leads to keep the components up off the board and slightly protected when soldering. All the other components are placed as shown in the diagram.

4 TRANSISTOR AMPLIFIER

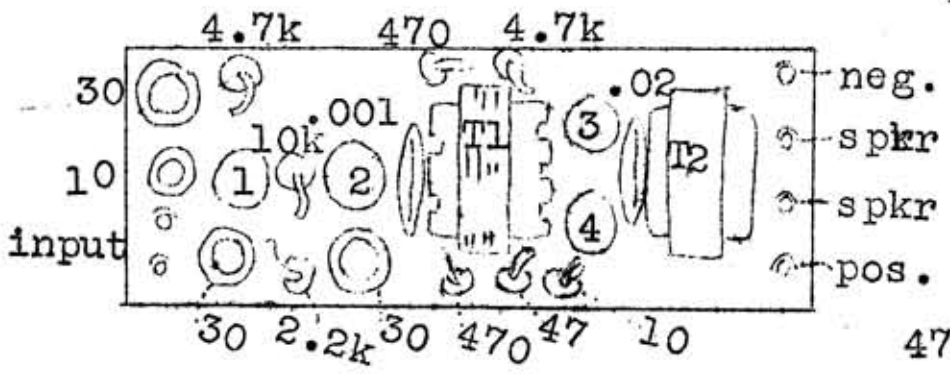


Schematic Diagram

Suggested uses for the amplifier include:

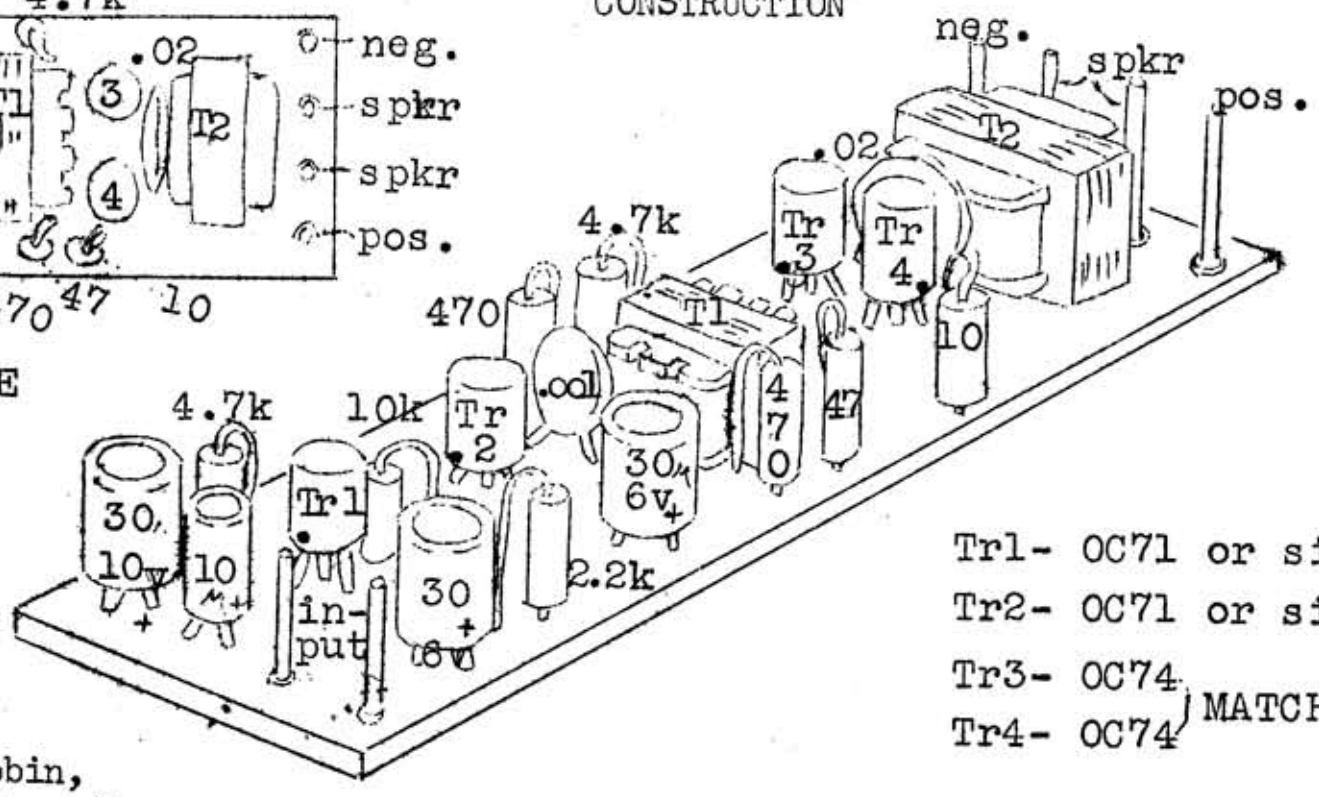
Tuner Amplifier
Miniature Public Address Unit
Tape Replay Amplifier
Stereo Amplifier
Monitor Amplifier
Paging System

Amplifier requires approx. 75-100millivolts input to deliver 1 watt into an 8ohm speaker.



ACTUAL SIZE

PRINTED CIRCUIT BOARD CONSTRUCTION



NOTE: A complete kit of parts for the amplifier strip is available, as well as all accessory components, from C.W. Industries, 2-6 Ethel St., Moorabbin, Victoria. SAE for information.

Tr1- OC71 or sim
Tr2- OC71 or sim
Tr3- OC74 } MATCHED
Tr4- OC74

LITERATURE REVIEW -- RLG

Ugh, what have I got myself into. Still, can't be an educated person without keeping up with the Literature, so let us forge on. Several people complained that the treatment in the September issue was too terse. I agree, but I was trying to catch up over several months for a number of Journals. On that account, it was definitely worthwhile for you to take a little time and read the Review carefully, e.g., pondering over the fact that 'Tr ham Rx, vy fb' could mean that here was a first class article on a well designed transistorised radio amateur receiver, and it was well worth looking up in the current articles in 'Amateur Radio' in which it appeared.

Tx = transmitting, Rx = receiving, Di = diodised, fb = Nice, dis = discussion, etc. Continued from September'r Review. (ordinary valve-type transmitters and receivers and conventional stuff is ignored here).

AMATEUR RADIO (VK)

Oct. A.c. supply, portable 240V.
Antenna, improved directional for 20M.
Tr Amplifier design, II, fb.
Tr ham Rx, III, vy fb.

BREAK-IN (ZL)

Aug. Tr converter for 432mc/s!, 144mc.
Rx, Double conversion, dis, fb.
Sept. A Solar Heated Ham-Shack, vy fb, indeed. See also RTVH few years ago.
Xtl Osc, improved overtone type.
Tr Xmtr design dis, a must for hams.
Oct. Tr Xmtr design dis. Interesting to show Tr's better for CW, not Fone.
FM Demodulator design.
UHF Ant: Dish Reflector design.
Di Power Supply Design, sort of.
1-Tr Xtl osc up to 30mc/s.

CQ (W)

Aug. Tr Touch Keyer, II. Paraboli c Ant.
VHF Conical Monopole Ant; 4:1 Freqs!
Understanding Field Effect Transistors.
All about CROs, II, with photos.
75 Minibeam, no bigger than 20M
Measuring a.c. current (wattmeter).
All about Standing Wave Ratios, fb.
Sept. Integrated Circuits for hams!
Sylvia.
Tr Rx Freq synthesizer, phase locked.
FET, II, dis, vy fb.
CRO, III, di s, with pretty pictures.
Rx: Dual triode mixers.
Lasers: sources, applic, dangers.
Ant: Economical all band vertical.

ELECTRONICS AUSTRALIA (VK)

Owing to limitations of space here, and to the ready availabitity of this publication, we shall discontinue the review of its contents. Our presentation of typical contents of interest in the Sept. Review ought, however, to convince you cynics that amongst its many pages of (interesting!) extracurricular material, there are often hidden many gems of real interest to the experimenter. Subscribe to and read this fb magazine, -- and don't miss the articles on Tr Osc or SCRs in the October issue.

QST (W)

Aug. Rx. Simple 9-Tr for 80 and 40 M.
UHF Osc: experimental using new Tr.
Simple 50mc TVI filter for Tx.
Ant: Directional phased ground planes!
Defence of 'Cycles per second'!
Amateurs, emergency, and public service ...
Sept. Home made cabinets with simple tools
Direct reading C-meter (good, but note tt C of electrolytics not whole story).
VFO Stability, dis. Fb.
Ant Matching networks, hmmmm.
More about Hertzes, heh.
Ant Design for DX, vy fb.

RADIO-ELECTRONICS (W)

Note - ELECTRONICS-WORLD is similar to R-E, with many good circuits, but I couldn't afford time and money for both. If anyone takes E-W, please write a Review.
March. Tr A.C. Voltmeter, sensitive, stable.
HI-FI vs. LO-FI. Fascinating!!
Tr Ignitions and cold weather starting.
All kinds of articles on tape recording.
Tr Hi-Fi Preamp, simple, nice.
April. Communication via light beams!
SCR Lamp Dimmers, simple style.
Hi-Fi Emitter-follower Z transformation.
Tr D.C. Voltmeter, not bad. With a very ingenious Tr LT voltage standard reference.

Literature Review (continued)

RADIO-ELECTRONICS (continued)

April (continued)
All about potentiometers
New HT type transistor

May. Cathode, emitter, etc. followers.
All about capacitor colour codes!!
Ne lamp operated from 1.5V.

June. ALL about Integrated Circuits!
I.C.'s are simply astounding.
Transistor Ignitions, rediscovered.
Z stepup with common base.
Tr (UJT) small organ.
TESTING Tr with CRO. This article goes will with October EEB article.
Slave Photoflash.
5-Tr Gen purpose reg pwr supply (2A)

July. 2 x 30W Tr pwr hifi amp. (OTL)
Use of vectors in electronics.
Simple a.f. squelch ckt, Di.

Aug. Simple Digital Voltmeter, Tr.
CRO distortion (in the CRO!)
CRO electronic switch, 2-Tr.
Car Tachometer, no transistors!
CRO sweep triggering, 13-Tr, fb.

Sept. Lasar communic (but cf Sept CQ)
Zener Di used as VARICAPS! Fb. (see also July 1966 issue of 73)
Computer circuits for general control use by experimenters, fb.
Using vectors for modulation. Fb.
One-c/s Amplifier with Regl Tr Pwr Sply
5-Amp 8-Tr Regl Pwr Supply.
The Silicon Unilateral Switch, and you know what THAT is? It is the commercial version of our old PUJT!!!!P.76.
Fixing burned-out ohmmeter ranges.

Oct. Electronic photo shutter analyser.
Using Computer Circuit Boards for ckts!
Simple Tr conversion of multimeter to TVM (see also, March and April articles)
SCS electronic switch. Why not use PUJTs? (See EEB, May and June 1966).
Ant rotator, phase sensitive bridge, fb.
Simple low power OTL amplifier, 4-Tr.
Delta-Y transformations, very useful.
Neons for analysing intermittents.

ELECTRONICS-WORLD (W). Please see note about this under 'Radio-Electronics.'

May. R Attenuators, Pad.
How to select RF Chokes.
UJT Interval Timer, FB. Why not use PUJT?

RSGB BULLETIN (G)

Jan. Tr tunable IF for VHF converters
Tr r.f. cascode amplifier, fb.
d.c/d.c. converter using filament xfr, 2-Tr.

Feb. 7Tr elaborate regul pwr supply. All of the complicated transistorised regulated pwr supplies appearing in the recent periodical literature are very nice indeed, but in Autumn the EEB will publish articles on the design of simple Tr regul pwr supplies!

March. Tr Tx, 10W, 160 metres (5-Tr) w. Mod. Tr. Wien Bridge Osc better than Clapp, etc. 'Technical Topics' in the RSGB Bull reviews many interesting items from other mags, and it is worthwhile to follow it, and Bk-In(ZL). Heartbreaking, but must limit coverage here.. The Butler Osc for improved overtone! Using and etching surplus Xtals. Mounting rotatable aerials.

April. Tr. Base-Dip Oscillator, vy fb. (We have an even better one coming up in a forthcoming EEB). Tr converters for UHF.

May. This issue appears to have grown legs, and we can't find anyone in Hobart who subscribes to it either! Can someone please loan it to us for a day?

June. A Phase-locked 2M VFO, this is a nice idea for good VFO stability.
Ant: all about earths, grounds, vyfb, A very important article indeed.
Ant: Simple all-band wire.
Tr Xtl calibrator (3-Tr), fb.

July. 8-Tr SCB Exciter, Quack quack
2Tr 100kc/s Xtal Marker.
1-Tr Vackar High Stability VFO.
More transistorised transmitters.
Torroidal Balun.

Aug. Tr SSB Exciter, II, including another 5-tr regul pwr supply.

Sept. Accurate Freq Measurement at VHF.
Improved FET mixers (r.f.), etc.
'Technical Topics' worth price of mag.
STABLE Tr VFOs, reexplored. Vy fb.

'73' MAGAZINE. This part of the Review is going to be something of a problem. This Magazine contains such a plethora of interesting constructional articles, that it is quite hopeless to do justice to them in this kind of Review. You should, there-

Literature Review (continued)

'73' MAGAZINE (continued)

fore, subscribe to it, in spite of the sometimes-ridiculous ideas of its Publisher - Hi.

June. Integrated Circuits in a Keyer!
4-Tr 2M Converter, vy low noise.
Plus several other VHF converters.
The Last Word in Q'5ers, but not least.
Literature guide to Surplus Convers.
Quad vs Yagi Ants (Letter)
A comprehensive Catalogue of Surplus, available in U.S.A.; remember Customs Duty up to 90 p.c., however.

July. Wayne wants us to go QRO. Ugh.
Bent Yagi Ant for space saving, 15M.
Precision Freq measurements, fb.
More on (VHF) Parametric Trs, fb.
Very nice Transistor Tester.
FET Voltmeter (22Megs), fb.
FET Audio Compressor, fb.
Another Tr Keyer.

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NEXT ISSUE OF EEB. Reviewing some Tech Applications Notes of the larger semi-conductor manufacturers, with a pithy comment on the conditions of availability.

'73' MAGAZINE (continued)

USE OF CROOK Tr's as ZENERS, VARICAPS
(see also Sept. '66 Radio-Electronics)
DESIGNING Tr R.F. POWER AMPLIFIERS!
UB5UG's 5-Band Vertical Ant, fb.
Coaxial Transmission Line Handbook.

Aug. Simple Diode mixer.
6-Tr 150mW 2M Xmtr with Audio, fb.
Plug-in Circuit construct for tentative modification of eqpt. Vy fb.
Tone-operated Squelch, vy fb.
Using 400cps generators, hmmmm.
Curtain Ant, smaller than long wire.
Diode protection of meters (but see Diode Testing Dis in this issue EEB)
COAXIAL CONNECTOR HANDBOOK

==========

Somehow the Jan, March, and May 1966 issues of 73 have also grown legs. We wish to look at them in preparation for a series of articles on transistors in Class C equipment we are preparing for next year. We have sent for replacements but they will take a while to arrive. In the meantime, will anyone please loan us theirs for a day? Write first, pls. Thank you.

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Letters (continued from P. 120).

show the inaccuracy of measurement..... I also had a good go with a series capacitor on the mains. This was a 600V one in series with the transformer for the El. Aust. "Current Limited Power Supply Design." When the capacitor blew, so did all four diodes in the secondary bridge rectifier. What a waste.... Grandma's Diodes very nice, must start testing. -- D. Brown, Gosford, N.S.W.

((Send the article now if the improved version is indefinite. Better a bird in.... When I want to build a current-limited supply, I generally put the series condenser in the secondary circuit, or operate it directly from the mains (making certain that the Neutral lead is truly neutral!). Possibly you have experienced a situation involving resonance of the series condenser with transformer? Prevention would be to use a different capacity or a damping resistance across thetransformer-- Ed.))

2) ... I find that the EEB is an improvement over some publications, as the articles are easier to follow. I should not use the word "simpler," as this not quite correct, but you do present complicated subjects fairly clearly.... I am still exchanging DX news with VK4SS for my own DX Bulletin and his column in 'Amateur Radio.' Have not worked a VK yet, but most of the stations that one could work on AM are now on SSB, and that is hopeless unless you are 5-9+. Personally I think that SSB is spoiling the bands, because it makes it too easy for you to work them (if you are also SSB), and great 'pile-ups' result... -- J. Cobte, Northumberland, England

((Jim has an amateur call, but I must apologise for not having it at hand to mention. Oh-- SSB is OK, I suppose, though it is a rather elaborate method for doing something simple.?.Ed))

TAPE-RECORDER REVIEW

by Lionel James

"AKAI" 1700

Submitted for inspection and report by the distributors, Magnecord Australasia Pty. Limited, 210 Clarence Street, Sydney.

A VERSATILE STEREO MACHINE

As the first "Akai" tape recorder that we have inspected this one truly puts Akai higher on our recomendation list.

The 1700 is capable of 4 track stereo record and reproduction with a rated 10 watt total output. Three general speeds are incorporated and are adjustable by the situation of a metal sleeve which fits over the motor spindle. $1\frac{7}{8}$ is obtainable by removing the sleeve and switching the two-speed induction motor to "low speed". For $3\frac{3}{4}$ i.p.s. the switch can be moved to "high speed" or left on low and the sleeve fitted over the spindle. For the higher speed of $7\frac{1}{2}$ i.p.s. the motor should be switched to "high" and the sleeve fitted. Fifteen inches per second is available by purchasing a larger optional metal sleeve.

Tape motion is governed by two levers situated just below the take-up spool. The upright position for both levers indicates a stationary position and playback and record are controlled by the left-hand control and fast-forward and rewind by the right. Accidental erasure is guarded with the use of a safety button below the pressure roller on the deck.

Between the two control levers is a slide switch which selects either auto stop or manual stop and this action is controlled in conjunction with the device situated after the tape leaves the capstan. If the tape breaks or the supply expires this device returns to it's lower position and thus cuts out the motor.

The tape in transit passes only three stationary objects, thus reducing wear or magnetisation of the tape. These objects are the record/playback head the erase head and the auto switch lever. The first tape guide uses a moving sleeve which spins with the tape.

Should one wish to listen to recordings via headphones a jack is provided for the connection of high quality stereo 'phones with a binaural type jack fitting. We recomend the Akai ASE 8S.

The deck has the sockets for dynamic microphones and the audio controls are of the stacked type, situated below the head cover, the volume adjustable by the outer knob and the tone by the inner. As incorporated in many Akai tape recorders, the 1700 has a "Left/1-4, Stereo, Right/2-3" switch for selection of the type of record or reproduction desired.

Only three minor factors displeased me with the 1700. (1) The level indicator is one meter used for both channels, a switch being provided for select-

REVIEW (continued)

ion of channel required. (2) The instant stop lever tends, when activated, to tip the machine over unless it is raised slowly which, in turn, produces "wind-up" on playback. After a little practise it is possible to master this situation almost entirely. (3) Unless flush plugs are used for extension speakers the machine cannot be used in the horizontal position.

Back to the favourable points, the rear panel provides for the connected of auxiliary equipment such as another tape recorder, power amplifier or pick-up inputs.

It is possible to switch the speakers on or off by a switch on the rear panel. This is designed when used for recording through another item with it's own inbuilt speakers.

Monitoring is not possible via the inbuilt (or external) speakers but this may be attained by using stere headphones.

Overall, this machine carries our endorsement as a moderately priced, stereo, high quality and lightweight tape recorder.

David James

MANUFACTURER'S SPECIFICATIONS

Power supply:	:100-240 volt A.C. 50/60 c/s
Power consumption:	:80 watts
Recording System:	:New AC bias
	:(Patent No. 233093)
	:Four track stereo in line
	:Monaural four track system
Recording Indication:	:2-channel VU meter
Tape Speed:	:7½, 3¾, 1⅞ i.p.s.
Motor:	:Two speed
Distortion Ratio:	:Less than 2% high frequency
	:distortion (at 1,000 cycle 0 VU)
Wow & Flutter (Playback):	:Less than 0.18% RMS
Equaliser:	:NARTB standards (playback)
Fast Forward and Rewind Time:	:Each 150 seconds (1200 feet tape 50 c/s) Each 120 seconds (1200 feet tape 60 c/s)
Frequency Response:	:40 to 18,000 c.p.s. at 7½ i.p.s.
Output Power:	:5w maximum per channel (10W total)
Vacuum Tube:	:12AT7x2, 6BM8x2, Silicon Diode 150Dx2
Speaker:	:5" x 7" x 2
Dimensions:	:13½H x 13½" x 9"D (case closed)
Weight:	:33lbs
Retail Price:	:$304.75 (£152.7.6)
Member's Price:	:On Application

FREE COLOUR LITERATURE AVAILABLE BY WRITING THE SECRETARY
——— QUOTE "AKAI" 1700 ———

THE AMATEUR RADIO MOBILE SOCIETY *

Before leaving New Zealand we made enquiries as to the possibility of obtaining an amateur radio licence in the UK. By a coincidence I spoke to the Secretary of the ARMS, Edgar Wagner, G3BID, and from there on, his group was a tremendous help in advising us on how to obtain such a radio licence.... The aim of the Amateur Radio Mobile Society (ARMS) is to foster mobile operations in the UK and to stand up for the rights of the mobile amateur operator on a world-wide basis. Since its formation early in 1959, amateurs have joined from all corners of the world and now membership extends to more than 30 countries. The society call-sign G3NMS, has its headquarters in London, organises its own mobile rallies, meetings, and assists in judging competitions, etc. Since 1959 the achievements of the society have been very heartening for mobileers. The first break-through occurred in 1963, when members in Belgium and Holland obtained mobile licences for United Kingdom amateurs to operate in those countries. In July 1964, the ARMS obtained permission for US amateurs to operate its station G3NMS at a mobile rally. Following these concessions the Postmaster announced on 16th March 1965 that Great Britain would enter into reciprocal licensing agreements with other countries. Forms for the 'application of membership' are available from the Hon. Secretary, Amateur Radio Mobile Society, N.A.S. Fitch, G3FPK, 79 Murchison Rd., Leyton, London, E.10 England.

The Club also publishes a monthly magazine, 'Mobile News', which is supplied to all members.

((EEB Editor's Note - In Australia we owe undoubted gratitude to ARMS, largely through whose efforts the reciprocity logjam was broken in the U.K., and no doubt here subsequently as well. One hopes only that the independent nation of New Zealand will soon follow this progressive trend .... By the way, the 'ARMS News' is more than a compilation of minutes of the Society -- it often contains excellent constructional articles of interest to radio amateurs, and not only mobileers.))

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QUOTE WITHOUT COMMENT:

"This inverter provides slightly more than one kilowatt of power at 117V a.c. for a d.c. input of 12 volts. Using the inverter to operate a linear mobile, has enabled the author to cut through the QRM with ease."

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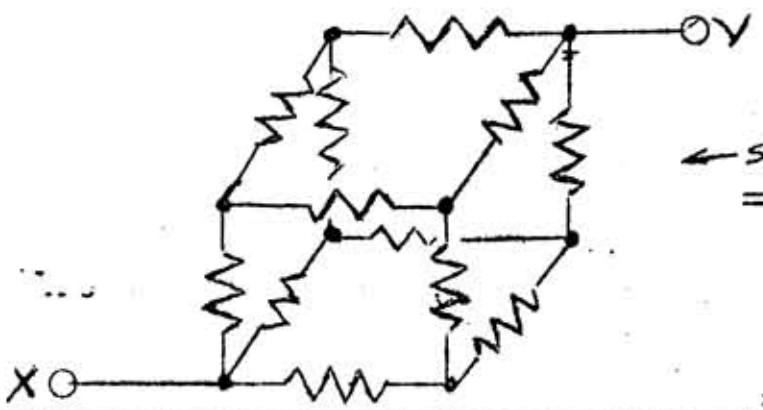
PUZZLE

A Cube of 12 resistors, each 1.0 ohms resistance. What is the resistance between points "X" and "Y"? ((This was sent in by 'Old Peth' who swears that three people got three different answers. Doesn't seem all that hard. What do you think?))



← supposed to be a cube!

IMPORTANT CORRECTION: On P.121, Fig. 4, this issue, please note that the diode string, D_3 should be connected directly across M_3, not to Sw_3. Make note of this on Fig. 4 now.

* From "This Amateur Radio World of Ours," by D. Mackay and G. Bradshaw, "Break-In," July 1966, p. 186.

ADVERTISING =

Personal advertisements free, up to about four lines per issue, 25c per approximate line above that, $1 half page, $1.50 per page (our cost too). We reserve the right to omit copy, etc. Copy is good for only one issue at a time, resubmit if necessary.

WANTED Power Transformer for Pye Reporter. Please write to Noel Ferguson, 23 Floral Ave., Mildura, Victoria.

ONE ONLY as new, high impedance X-3 crystal microphone with switch, neck cord, stand socket, 9 feet cable. Black and chrome finish. Suit recorder. Cost £3/15/-, sell for £2. Post Free. Or swap for any of the following in good condition: National WM-2049 Microphone, Pen type signal injector, Miniature transistor broadcast band transmitter -- range 200 ft with telescopic aerial. Laurence Wright, Hunter Springs, Via Scone, N.S.W.

SYDNEY DISCOTHÈQUE!! WE PROVIDE HIGH FIDELITY MUSIC FOR PARTIES OR SOCIALS, ALL TYPES. TWO DISC JOCKEYS, PUBLIC ADDRESS SYSTEM, etc. A FEW OF THE ARTISTS IN OUR RECORD LIBRARY:- The Beatles, The Easybeats, Billy Thorpe and The Aztecs, The Mini-benders, Herb Alpert and the Tijuana Brass, Bert Kaempfert and His Orchestra, Normie Rowe, Herman's Hermits, The McCoys, Mantovani, etc etc etc etc. Charge, $5 per hour, and well worth it. Write for quote or additional literature to:- SYDNEY DISCOTHEQUE, c/- P.O. Box 9, Crows Nest, N.S.W. Or Phone 85-5846 for bookings.

ELECTROMECHANICAL KIT PARTS, samples consisting of gears, pinions, etc, plus Catalogue for 70c (the samples alone are worth $1), or the Catalogue alone for 16c in stamps, from - CLIVE WITCHELL INDUSTRIES, 2-6 Ethel St., Moorabbin, Victoria.

HAVE YOU SENT FOR OUR LOVELY TRANSFORMER MANUAL? Full description in last month's EEB. Build you own transformers, the way you want them, cheaply and easily! Remember, special premarketing offer to EEB readers, $1 (instead of $1.25), post free. Satisfaction guaranteed. C.W.I., 2-6 Ethel St., Moorabbin, Victoria.

SELL OR TRADE two AKAI extension speakers designed for the XIV Recorder. Exchange or trade in on a set of vented bookshelf (8 ohm) speakers. A. Apil, P.O. Box 937, Cairns, Queensland.

THE AUSTRALIAN TAPE RECORDING SOCIETY publishes a monthly bulletin containing material such as the Tape Recorder Review reprinted in this month's EEB, technical articles, services, tape exchange programmes, etc. etc. ATRS, Box 9, P.O. Crows Nest, N.S.W.

AUSTRALIAN ELECTRONICS, 76 View St., Hobart, Tasmania. Tax Paid, Post Free.
Full details on our Universal LT Transformer appear in this issue. Why build your own, why go to all that trouble, when you can get this neat package delivered to your door? But you had better get Witchell's Transformer Manual anyhow, for all those other transformers we don't stock. STOCK - Miniature glass diodes (0.16A, or r.f. to 25mc/s) -- 300 PIV = 8c, 400PIV = 10c, 500PIV = 13c, 600PIV = 18c, while they last. Silicon Controlled Rectifiers (0.5A)--600PIV = $3, 700PIV = $3.50. SCR(0.75A) -- 100PIV = 80c. SCR(4.7A)--$2.50, 600PIV = $4.10. SCR(10A)--50PIV = $1, 100 PIV = $1.50, 600 PIV = $4.65. Note our ever-diminishing stock. Transistors, 2N2562 (PNP, Ge, 20W, 3A, 80V) $1.15, 2N2563 (ditto, but 100V) $1.35. 2N2992B (NPN, Si, 15W, 1A, 200V, 50mc/s! like PADT50) $2.20. New stock of 2N2991, 2N2992 (lower voltage) in Dec. Computer Circuit Boards, special November offer to EEB readers ONLY $13 per hundred, how silly can one get? Out of stock of those marvelous Transistor Sockets until December (?), sorry. We kept getting air mail shipments, finally had to order them by sea, but the supplier is very slow. Worth waiting for ...

UNIVERSAL LT POWER TRANSFORMER: $3.50 ea, Post Free! Australian Electronics
76 View St., Hobart, Tas.

Primary: 240V/50cps = Blue + Red (87 ω)
220V/50cps = Blue + Green (81 ω) when fitted (on request).
Please NOTE-- It is imperative not to connect the 240V Mains supply between the Red and Green leads, or the transformer will be destroyed!
I_e = Magnetising Current = 66mA when no load on secondary, V_{pri}=240V.

Secondary: Six independent identical windings.
Nominal rating of each = 3V (RMS) at 1.5A.
Voltage regulation of each winding:
ØA=3.27V, 1A=3.08V, 1.5A=3.CV, 2A=2.9V, 3A(max)=2.7V.
DC Resistance = 0.1 ω per winding.

Efficiency: 80 per cent at 24W total secondary load.

Dimensions: 2-7/8in long, 2-3/8in high, 2in deep, approximately.

Coding: Primary, as above.
Secondary: Flying leads, enamelled, 4in. The 'start' lead of each winding has been coded, thus-- 1-Red, 2)Yellow, 3)Green, 4)Blue, 5)White, 6)Black. The leads emerge from the former in order of winding, easily determined by inspection.
To connect leads in series, connect the 'start' of one winding to the 'finish' of the next. To connect leads in parallel, connect 'start' leads together, and 'finish' leads together. Never connect two windings in reverse of this arrangement, or they will both be shorted out. To illustrate the phasing (and as part of the tests we make on every transformer), we have twisted together the leads so that all secondaries are in series, when supplied to you.
Essential information has been written on various parts of the transformer, to increase its usefulness. Thus, even though this data sheet may be lost, you will always know the characteristics of the transformer. This is something we always do in our own workshop, and thought you would appreciate it too.

Arrangements: The secondary windings may be connected to give an enormous variety of combinations. For example:

1 x 3, 6, 9, 12, 18V/1.5A.	2 x 6V/1.5A + 3V/3A.	1 x 9V/3A
1 x 3V/9A.	1 x 6V/3A + 6V/1.5A.	2 x 9V/1.5A
3 x 3V/3A.	1 x 6V/4.5A	Etc!
3 x 6V/1.5A	1 x 12V/1.5A + 6V/1.5A	

And twice as much current is available from any combination, for about 10 percent less voltage, if it is acceptable to allow the transformer to run warm.

Applications: The number of applications possible with this transformer are many indeed. It can be used for ordinary filament supply, several isolated filament supplies (useful for regulators, etc), bias supply, transistor power, power converters (dc/dc, dc/ac, ac/dc), etc. Note that filament isolation allows use of valves at various cathode-earth voltages. For transistors, separate supplies can be provided for separate units, for NPN vs PNP, bias supply, etc. In the 18V configuration, peak is 25V, and this is ideal for powering regulators, high fidelity complementary symmetry amplifiers, or transmitters. Where the transistors are rated for it, the higher voltage allows higher output for a given average current, or more linear operation. 18V is a particularly difficult voltage to obtain ordinarily, unless you wind your own, or connect other transformers in series. The former is tedious, and the latter expensive.... If two 9V windings are connected together in series, the full-wave configuration of diodes may be used to give about 13V peak.. Connecting the secondaries in series with primary allows use as boost or buck autotransformer, 222-258V/1.5A with 240V Mains.... Maybe use as universal transis.modulator xfr?

TRANSISTORISED HF TRANSMITTERS

Under prodding by friend Leslie Smith of VK6, we have got interested in presenting a reasonable survey of transistorised transmitters which have appeared in various places, or which could be presented freshly. In regard to the latter, if you have any useful designs or insights about the use of transistors in transmitters, please send them to us before Autumn. Anything at all could be interesting, any power, any simplicity or complexity, any ideas, hints, etc. We shall run a series of articles on this subject, and want to make it as good as possible. Please help.

SCIENCE FICTION, 5 years of 'Astounding', 2 years 'Aeromodeller'. Months of quite fascinating reading! Make offer, all or part. D. Martin, Physics, Box 252C G.P.O., Hobart, Tasmania.

RODNEY REYNOLDS
St.George Rectory
Battery Pt., TAS.

From: THE EQUIPMENT EXCHANGE BULLETIN
P.O. Box 177, Sandy Bay, Tasmania

" Registered at the G.P.O. Hobart, for transmission by post as a periodical"

December 1966 Vol. 2, No. 12 P. 135

EQUIPMENT EXCHANGE BULLETIN =

P. O. Box 177, Sandy Bay, Tasmania, VK7

Published Nearly Every Month 10c per copy

Yearly subscriptions — $A 0.85, NZ 8/-, $US 0.95

A PROMISING NEW ELECTRONICS JOURNAL for nearly everyone

STAFF. Worries, R.L. Gunther. Stencils, Jill Mc Lennan. Draughting, B. Robinson. Arrangements, Ann Gray. Printing, K.M. Kelly. Advisory: A. Gregory, R.S. Maddever, J.A. Hill, R.A. Reynolds.

RENEWAL date is indicated on your address label. If it says '1-67' this is the last issue you will receive unless you send 85c, or have already sent it.

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CONTENT.

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Guest Editorial.

A bird in the hand is seldom wrong.

-- L. Powsner

EDITORIAL —

We delight in the unexpected, so here is an unexpected December issue! We trust that the Christmas season brings you the joy it represents. And that the New Year will bring you creative satisfaction and renewed hope for the future.

I personally am having some difficulty with said hope, but it will probably work out somehow, as always. In any event, the EEB will stagger on, on schedule or otherwise. Just be patient, please, and you will receive your precious copies in due course — but always worth waiting for -- I hope.

We have been offered the use of some duplicating facilities by a devoted reader, and our gratitude is boundless. It ought to make the work easier and/or the content more attractive.

- Lee

Editorial P.S. on Jan 2, 1966 ! --- Ah the best laid plans of mice and men. This issue would have been out to you perhaps a fortnight ago. But we couldn't get P. 136 to print on the Litho machine, though we tried and tried, because it was a 'paper' stencil, and this particular machine just doesn't like to take such. So, back to the Duplicator; the 'metal' plate used for P. 135 is too expensive to use routinely.... In view of the late schedule I'll add some material that would have gone into the January issue, but re the use of ohmmeters with transistors, be sure to see P. 58 of our Vol. II.... I have to attend a meeting in Melbourne the second week of January, and am very busy preparing material for it. So the January issue will be late (so what's new?). --- RLG

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Letters

1) I thought you might be interested in hearing about my travel experiences in VK. I had a nice, if short, visit in Melbourne, tended by hams at every turn. They drove me all around the city, took me out to dinner, and entertained me quite royally. And many thanks to them too !

From Melbourne I took a train up to Bendigo and met a group there. Had lunch, then they drove me up to meet the group from Birchip. Had dinner there and stayed overnight. I was able to work home from VK3ATN easily on both 80M and 20M-- good S9 signals on both bands. Ray has a good 2M antenna too.. It gives him 34db gain, and he is getting signals back from the moon with it, and receiving K6MYC on two meters with it via the moon. The next morning they flew me in a small plane all over Victoria and New South Wales and then to Griffiths, where I got a commercial plane and went on to Sydney. There the VHF gang grabbed me, and the spin began again: lunch, dinners, drives all over town-- visiting hams-- officials, etc. My short stay in each place was jammed to the hilt.

I was surprised, on my arrival in Perth, to find how much Australia has followed the U.S.A. in development. More so than any other country I've visited... My next stops were FK8, VR2, 5W4, KS6, FO8-- and then back to the late autumn in New Hampshire. Sorry to miss VK7, but I couldn't get everywhere. After a few days rest on return to W1, I got on the hunting kick and got a nice deer up in Maine-- spent a lot of time in New Hampshire, but no results this year. Maybe next.

At the Magazine we've been in the process of changing printers, which has kept me hopping to New York, Chicago, and places. We are changing over now-- the February issue will be from the new press. Here it is the 11th of December and no one has the December issue yet. I have been raising h with the printer, but no avail. If the January issue is as late we will have the spectacle of the February issue arriving a day or so after the January. Such a business.

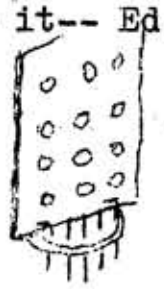
They tell me that there is no problem in getting a license in Australia-- which leads me to wonder why you are not on the air and active?

-- Wayne Green, W2NSD/1, Peterborough, New Hampshire.

((Shucks, I'm too busy editing a new and growing technical magazine; you know how that is ! Not to mention a hectic professional life. But someday, maybe-- if I can find someone to Assistant Edit (so that I can merely publish ! hi). Anyhow, you do my heart good with tales of late publishing schedules of 73. Just like the EEB.-- RLG/VK7RG))

2) Bimonthly, NO ! Twice as big a pill to swallow each bimonth, twice as hard to read the bigger issue. Re-- your 4-transistor amp (November EEB), BAH, who wants transformers? I shall send you a transformerless circuit diagram soon ((see ye to it-- Ed.)).

Now here is something useful. Small modules of transistor equipment may be made up easily for plugging into a standard B9A valve base, using an ordinary 9-pin plug (eg Mc Murdo BLM9USP), and a few inches, say, of 6 hole matrix board. Two pins at opposite ends of a diameter are bent over half way up with taper pliers, and pushed through small extra holes drilled in the matrix board. The board can be held firm to the plug with epoxy glue such as Araldite.. If more connections are needed, 12 pin



Letters (continued)
plugs are available, but the sockets for them would be less likely found in spares boxes than the B9A. This idea could be used to good advantage for plugging small circuit boards into circuits. A major circuit modification (or minor) can be made in a moment, by plugging in the appropriate unit, or removing one for modifications.
-- R. S. Maddever, Corio, Victoria.

3) Yes, I think a bi-monthly production would suit me better. The business of finding time to read and digest is the trouble at present. A larger, less frequent issue would help lots. -- T. Starritt, N.W. Mooroopna, Victoria.

((Generally people do not seem to be much against an every-other month schedule, but we do have an awful lot of articles to publish. More on this next month, in Editorial))
(Letters continued P. 138)

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EEB SUMMARY, VOL II, 1966

January, P. 1-12
More technical bibliography.
Volume compression, Part III.
Tetrode transistors, Part III.

February, P. 13-20
Don't be afraid of transistors!
High input impedance from common emitter.
Tetrode Transistors, Part IV.
Hints for importing.

March, P. 21-30
Computer circuit boards, revisited.
SCR, Part VIII. Improved phase shift.
Voltage ratings of condensers on mains.

April, P. 31-40
The Trichometric Indicator Support.
Volume compression, revisited.
Grandma's Tests, I. Simple transistors.
Laser dangers.
Pressure injected..... dectode.

May, P. 41-50
All about the Joystick device,
More about condensers on mains.
Transistors vs valves.
Grandma, II. Transistor power amps.
Pseudo-Unijunction Transistors!

June, P. 51-64
Where to find transistor literature.
PUJTs!, II.
Grandma, III. Commonsense Tr testing.
SCR, IX. A simple polarity inverter.
Form a Cooperative to buy cheaply! Now!

July, P. 65-76.
Bibliog of Tr eqpt in 'Amateur Radio'.
SCR, X. A simple full-wave lamp dimmer.
Multistable neon oscillator designs.
(July, continued)
Bibliography of computers, for brave souls.
Grandma, IVA. Testing diodes, etc,
More hints about forming Cooperatives.

August, P.77-90
Joystick 'Antenna' revisited.
More strange behaviour of condensers?
Automatic door opener.
Does 'Transistor Kits' still publish?
More semiconductor bibliography.

September, P. 91-104.
'Electronics Australia' is worth reading!
Waveshaping circuit.
Literature review, first of a series, I hope.
You should KNOW better!, I.
Grandma, IVB. Testing diodes.
Simple dual voltage power supply.
HT kills permanently and forever.

October, P. 105-118
Ohm's Law and the EEB.
Multistable neon lamps, revisited.
Grandma, V. Transistor voltage ratings.
Computer circuit boards, again.

November, P. 119-134
Grandma, VI. A semiconductor testing supply.
Joystick, revisited.
4-transistor amplifier unit.
Literature review again. What a job!
(but worthwhile for you to read closely)
Tape recorder review.
You should KNOW better!, II.
The Amateur Radio Mobile Society.
It's easy to work DX when you go QRO.
Transistorised HF Transmitters. Any ideas?

December, P. 135-138?
May we take this opportunity of being sure not to be late, by wishing you a Happy Easter?

EQUIPMENT EXCHANGE BULLETIN

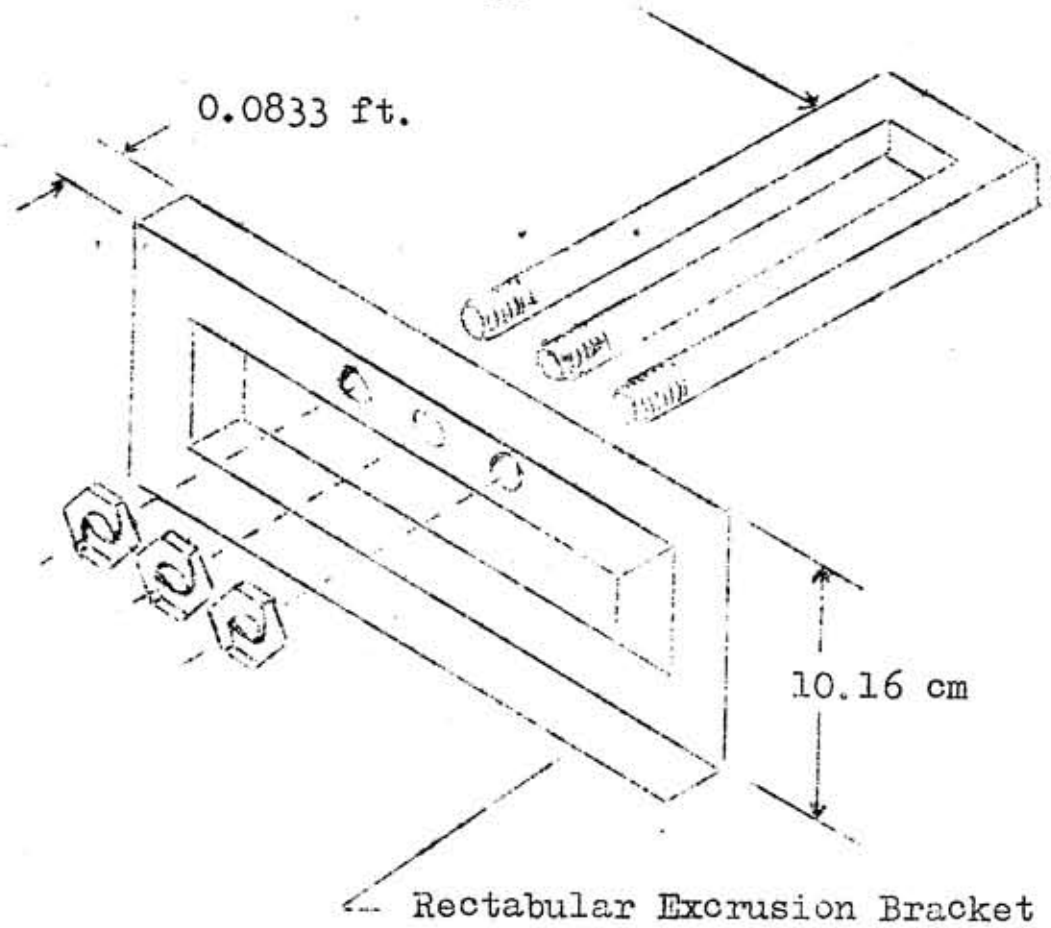
RECTABULAR EXCRUSION BRACKET

-- B.J. Sardine.

In our April 1966 editorial of EEB, we gave you a sneak preview of a unique mechanical aid for your workshops. We now supply you with complete construction details of a Rectabular Excrusion Bracket for mounting the Trichometric Indicator Support.

Please note that the Ambihelical Hex Nut illustrated for attaching the support is of unique design in that it has to be tightened up fully to remove the nut. Materials are unimportant, but we advise you to consider carefully the weight you will place on the support, and then select materials accordingly.

Trichotometric Indicator Support.



Rectabular Excrusion Bracket

We're not quite sure where this idea came from, but we extend grateful thanks for it anyhow. How about your sending us your own ideas for various applications of the Trichometric Indicator Support, preferably (but not necessarily) electronic. We can print the best ones each month. Please draw clearly, preferably with Indian Ink.

ADVERTISING (Free up to four lines. Otherwise a contribution would be appreciated)

FOR SALE-- Dulci 10W Amplifier. This is the commercial version of the famous Mullard 5-10. In perfect working order with full equipment and original instructions. Input sensitivity 40mV (1 Meg) for 10W (14W peak). Output 3, 8, or 15 ω. Make offer. R. S. Maddever, 35 Biddlecombe Ave., Corio, Victoria.

FOR SALE-- (1) Waterworth 500W Slide Projector with strip film carrier and semi-automatic slide changer. $45... (2) 1000W Transformer, 190-250V Primary (tapped 10V intervals), Secondary 0-12, 31, 110V. Meter fitted. $12. L. E. Dunn, 16 Grace Ave., Dandenong, Victoria. (Dandenong 2-0141, ext 245, business hours only).

WANTED -- GDO in good condition. L. Smith, VK6ZGA, W.A.M.C., Carmel, W.A.

SCIENCE FICTION-- MODEL PLANES. What more fascinating subjects could you ask for? Years worth of the best in both subjects. Months of fascinating reading. Write to D. Martin, Physics, Box 252C, G.P.O., Hobart, Tasmania.

Letters (continued from P. 136):

4) I like your work and look forward to your monthly effort. It would break my heart to wait 2 months. -- L.W. Collinge, Chester Hill, N.S.W.

5) ... Any covers for Vol. II coming out like last year?? -- M. Skop, Kew, Vic.
((Yes, but not until we work through the present backlog of Back Issues!--Ed))

6) I find the EEB interesting and useful. I'm a trainee technician, and find most of the information is the kind of stuff which can't be found in books-- only learnt from experience... -- K. Atkinson, Brisbane, Qld.
((Many thanks to the rest of you who sent your congratulations and best wishes! It really makes it all worth it, believe me. But it seems somewhat extravagent to claim that ours is the very best magazine......? -- Ed.))

WANTED: Collaborators to buy some Fairchild transistors with me. They have higher freq, current, or gain characteristics than circuit board ones, as well as low temp effect and high stability characteristic of silicon. Considerably cheaper by the 100. So let's get together and buy cooperatively. Write RLG, c/- EEB, Box 177, Sandy Bay, Tas.

From: THE EQUIPMENT EXCHANGE BULLETIN
P.O. Box 177, Sandy Bay, Tasmania
/Registered at the G.P.O. Hobart, for transmission by post as a periodical/

TO:

RODNEY REYNOLDS
~~St.Georges Rectory~~
~~Battery Pt., TAS.~~

HOBART 7-PM 10 JAN 1967 TAS-AUST

PREVENT BUSH FIRES

Of course the usual capacitative transient suppression was employed at the input. Operation was satisfactory, and no instability was observed after a long period of operation.

Not all SCRs have V_{BO} appreciably higher than PIV, but when they do, you can use it to extend operating voltage. For any PIV, diode protection can allow input peak voltage to be applied nearly up to V_{BO}. We may note that diode protection of an SCR can require an HT diode of sufficient current to match the rating of the SCR, together with heat sink, if necessary, and such diodes are not always readily available. In that event, it is necessary to use unprotected SCR, and incorporate adequate PIV safety factor, as for diodes (though with somewhat greater safety factor). It is interesting that when the PIV of an SCR is higher than V_{BO}, by a factor of at least 1.5, it can be operated with an a.c. input close to the V_{BO} rating, because the margin between a.c. input peak and V_{BO} need be only small compared to that between input peak and PIV.... It is worthwhile to think about these various relationships, because they can assist you to get the maximum performance from economical SCRs having a given set of ratings.

If full-wave rectified output is desired from an SCR circuit, one can use either a full-wave SCR configuration, or a single SCR at the output of a full-wave bridge of silicon diodes. Full wave has half the ripple and 40 per cent more output than half-wave. It should be noted that the output from an SCR fed by a full wave bridge is full cycle pulsating d.c., and is therefore inappropriate for driving obligatorily a.c. devices. On the other hand, although the output from full-wave connected SCRs is true a.c., its waveform is highly distorted, particularly at low average output, and is therefore rather unsuitable for feeding transformers and other components requiring good a.c.; the transient spikes produced by SCR-controlled a.c. feeding a transformer can be formidable. But this output can be used with fans and other motors, and with fluorescent lights under certain conditions. Radio noise suppression is discussed in the GE SCR and Hobby Manuals.

Although every SCR we sell is accompanied by technical specifications, we cannot choose favourable characteristics on request, because that would obviously exhaust stock for subsequent customers.

It is important that the gate not be driven more than 1/4V positive while the anode is negative with respect to the cathode. This condition can be satisfied if a silicon (not germanium or selenium) diode is always placed in series with the gate electrode leading to signal. The diode should be rated to include any possible transient overvoltages from gate supply voltage or output circuit, but its current rating may be very low (eg. 100mA).

Technical applications of SCR can be found frequently in the periodical literature. In Australia this will appear in Philips' Miniwatt Digest, Mullard's Outlook, and in the Equipment Exchange Bulletin (see below). Overseas literature rich in SCR topics includes Radio-Electronics, Electronics-World, and to a lesser extent the radio amateur publications of Britain and America. Electronics Australia treats SCR subjects occasionally.

THE EQUIPMENT EXCHANGE BULLETIN, P.O. Box 177, Sandy Bay, Tasmania

Since we contribute advertisements to the EEB, and as individuals contribute articles to the EEB, we should like to draw your attention to this interesting new publication. It covers a wide range of subjects of interest to the electronics experimenter, and its approach is casual and informative. Contributions by readers are encouraged and received, and the result has been a truly reader-oriented format. Coverage is primarily on semiconductor subjects, but not necessarily. Although all hobby subjects are encouraged, readership seems to be primarily interested in experimenters' electronics. Each monthly issue runs to 10-14 pages, and annual subscription costs 60c; as of January 1, 1967, it will cost 80c. The EEB is a wholly non profit-making endeavour! You are encouraged to send to the above address for a free sample copy, or to subscribe. PLEASE do NOT send subscription orders or payments to Australian Electronics! It confuses the books greatly.