by G. WAREHAM

SHORT CUTS in CALCULATION

PART TWO—THE POWER OF TEN

THERE can be nothing more off-putting to the uninitiated than the profusion of "powers of ten" like 10^{-3}, 10^{9}, $10^{\frac{1}{2}}$ and so on, which occurs in mathematical formulae. Engineers and designers find such expressions of immense value when dealing with very large or very small numbers, particularly when using a slide rule instead of a set of log tables.

Effort is saved in several ways. The first is in writing down numbers which would otherwise have a lot of noughts in them. Instead of 2,000,000, write 2×10^{6}. A positive index number indicates the number of noughts. Instead of 0·00007, write 7×10^{-5}. A negative index number indicates the number of decimal places.

Most of the quantities which occur in radio engineering contain only a few significant figures with a number of noughts or decimal places. One virtue of writing them with index numbers if that one is much less likely to make an error in the decimal factor. Indices come into their own when numbers have to be multiplied or divided. For instance:

$$\frac{5 \times 10^{12} \times 12 \times 10^{9}}{3 \times 10^{9} \times 2 \times 10^{11}} = 100$$

There are only two rules, both very simple. The rules are:

(*a*) To multiply, add the indices,
(*b*) To divide, subtract the indices.

Thus, $5 \times 10^{12} \times 12 \times 10^{9} = 60 \times 10^{21}$
and $3 \times 10^{9} \times 2 \times 10^{11} = 6 \times 10^{20}$

Therefore $\dfrac{60 \times 10^{21}}{6 \times 10^{20}} = 10 \times 10^{1} = 100$

which is all very nice provided you know that $10^{1} = 10$. This may not be obvious, but it does come into a logical sequence:

$$\begin{aligned} 10 \times 10 \times 10 &= 10^{3} \\ 10 \times 10 &= 10^{2} \\ 10 &= 10^{1} \\ 1 &= 10^{0} \\ 1/10 &= 10^{-1} \\ 1/100 &= 10^{-2} \\ 1/1000 &= 10^{-3} \end{aligned}$$

and so on.

One other general point, before we get down to a practical example. Applying the first rule,

$$10^{\frac{1}{2}} \times 10^{\frac{1}{2}} = 10^{1} = 10.$$

but $\sqrt{10} \times \sqrt{10}$ is also equal to 10.

So $\quad 10^{\frac{1}{2}} = \sqrt{10}$.

In other words, raising something to the "power of one half" is just another way of saying: take its square root. Similarly $10^{\frac{1}{3}}$ is a cube root, $10^{\frac{1}{4}}$ a fourth root and so on.

RESONANT FREQUENCY

What is the resonant frequency of a tuned circuit composed of a 150pF capacitor and a 80μH inductor? The formula $f_0 = 1/(2\pi\sqrt{LC})$ assumes that L is in henries and C in farads. Indices come in useful here in avoiding noughts, because $1\mu\text{H} = 10^{-6}\text{H}$ and $1\text{pF} = 10^{-12}\text{F}$. We write 150×10^{-12}F for 150pF and 80×10^{-6}H for 80μH, and forget about decimals. Also $\sqrt{(LC)} = (LC)^{\frac{1}{2}}$, which is just another way of writing the square root. Putting all this into our formula gives:

$$\begin{aligned} f_0 &= \frac{1}{2\pi\,(150 \times 10^{-12} \times 80 \times 10^{-6})^{\frac{1}{2}}} \\ &= \frac{1}{2\pi\,(12{,}000 \times 10^{-18})^{\frac{1}{2}}} \end{aligned}$$

At this point we exercise a little ingenuity so that we end up with a number whose square root is easy to find.

Let's deal with the index number first. Taking the square root is simplicity itself. You simply divide the *index* by two. Thus the square root of 10^{2} is 10^{1}; i.e. $\sqrt{100} = 10$. In the same way, the square root of 10^{-18} is 10^{-9}. We get into deeper water if the index is odd. For example, the square root of 10^{3} is $10^{1\cdot5}$, the value of which is not obvious. It's not as difficult as it looks, as we'll see in a moment, but for the time being note that, when taking square roots, we should if possible arrange for our indices to be even.

In the present example, 10^{-18} has an even index, but we still have to deal with 12,000, a rather large number. We could reduce it like this:

$$12{,}000 \times 10^{-18} = 12 \times 10^{3} \times 10^{-18} = 12 \times 10^{-15},$$

but this gives us an odd index and $\sqrt{12}$, which most of us don't carry around in our heads. Try again:

$$12{,}000 \times 10^{-18} = 120 \times 10^{2} \times 10^{-18} = 120 \times 10^{-16}.$$

We now have an even index, and we have to find $\sqrt{120}$, which is so near to 11 that we can tolerate the small error.

To return to our formula, we can now write:

$$f_0 = \frac{1}{2\pi \times 11 \times 10^{-8}} \text{ c/s}$$

and since $1/10^{-8} = 10^0/10^{-8} = 10^8$,

$$f_0 = \frac{10^8}{2\pi \times 11} \text{ c/s}$$

A negative index denominator equals a positive index numerator. To get the answer in Mc/s, divide by 1 million or 10^6:

$$f_0 = \frac{10^2}{2\pi \times 11} = \frac{100}{2\pi \times 11} \text{ Mc/s}$$

$$= \frac{100}{6{\cdot}28 \times 11} = \frac{100}{69{\cdot}08} \text{ Mc/s}$$

Which is approximately $100/70 = 1{\cdot}4$Mc/s.

Now let us see how we can deal with fractional indices. The commonest one is $10^{0\cdot5} = 10^{\frac{1}{2}} = \sqrt{10}$. This comes into other indices; e.g. $\sqrt{10^9} = 10^{4\cdot5} = 10^4 \times 10^{0\cdot5} = 10^4\ \sqrt{10}$. The thing to remember is that $\sqrt{10} = 3{\cdot}16$. This can sometimes be taken as 3 without serious loss of accuracy, and it can sometimes be cancelled out against π if this happens to come on the other side of the fraction ($\pi \simeq 3{\cdot}14$). Remember that $10/\sqrt{10} = \sqrt{10}$; this often enables $\sqrt{10}$ in the denominator to be transferred to the numerator, where it is less of a nuisance.

UNLIMITED!

IN THIS feature we hope, from time to time, to be able to publish suggestions submitted by some of our readers on the possible improvement of projects previously described in PRACTICAL ELECTRONICS; short contributions on other subjects may be included. The aim is not to find fault or undermine the abilities or knowledge of our contributors. It may well be that the original article is *par exellence* but it could be improved or adapted to suit individule requirements. The views expressed by readers are not necessarily those of the Editor.

FLIP FLOP TACHOMETER

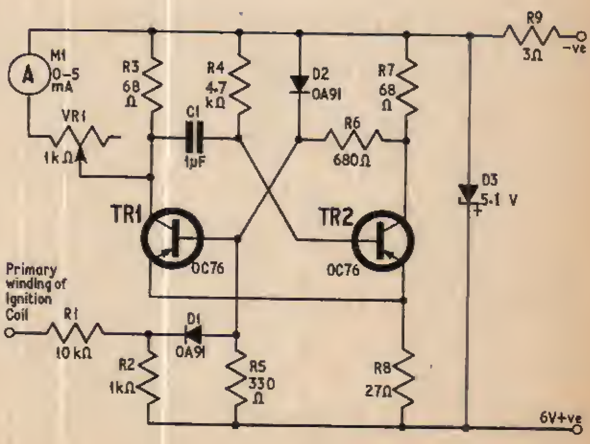
AFTER reading the article on "Logic Design" in the June issue I thought you might be interested in this circuit of a tachometer using a flip-flop.

The circuit is a monostable flip-flop, triggered by the pulse from the distributor, the transient peak of this pulse being 100 volts or more. The effective value of the pulse is reduced by R1 and R2.

In the stable state, TR2 is conducting, TR1 is cut off by the positive bias on its base. The first diode, D1, eliminates the positive half of the input pulse, and the negative half is applied to the base of TR1. TR1 then conducts, applying a heavy positive bias to TR2 base, thus cutting it off. The circuit remains in this state for a time (determined by R and C) and then flops back to the stable state again, thus producing a square waveform of the same frequency as the applied pulses. The 0–5mA meter reads the mean valve of the ensuing waveform, this mean value being proportional to the frequency, as the amplitude is constant.

The Zener diode stabilises the supply voltage so that the meter reading does not vary with battery voltage. The second diode D2 protects the circuit against transient peaks.

H. A. Cook,
Christchurch,
Hampshire.



A.M. TUNER CIRCUIT

I was especially pleased with the A.M. Tuner published in your "Bonanza Board" series in the March and April issues. I am very interested in miniature receivers and your circuit worked very well although the layout was rather critical if the printed circuit was not used.

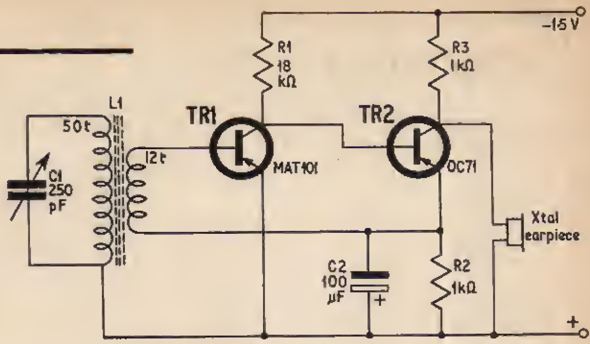
I "played about" with this circuit for some time and some of your readers might be interested in the one which I built as a result of my experiments. It works quite well on local stations driving a crystal earpiece.

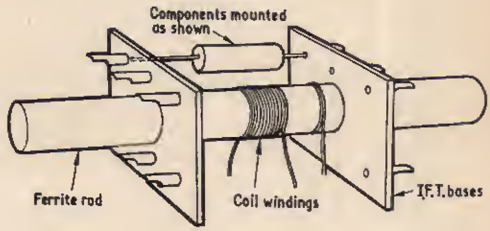
The main problem with respect to how small this receiver can be built is the length of the ferrite rod used to obtain satisfactory reception.—I managed to get reasonable volume from a 1½in length.

Two old i.f. bases were fixed on to the rod and the tags on the bases used to anchor the components. A small 250pF trimmer served as a tuning capacitor. "Red Spot" transistors worked just as well as OC71s in this circuit and an SB305 or any "MAT" type used in the second stage improves the performance.

B. A. Austin,
Solihull,
Warks.

This is a good circuit, almost identical to one I tried. One disadvantage is a poor ratio between base d.c. current and r.f. current in TR1. Another is that the circuit will only operate satifactorily using low voltage power supplies. The crystal earpiece cannot be driven to so high a volume as with BB3, and the circuit does not tolerate a wide variation in d.c. operating conditions. However, the sensitivity of the receiver is very good.—A.J.B.





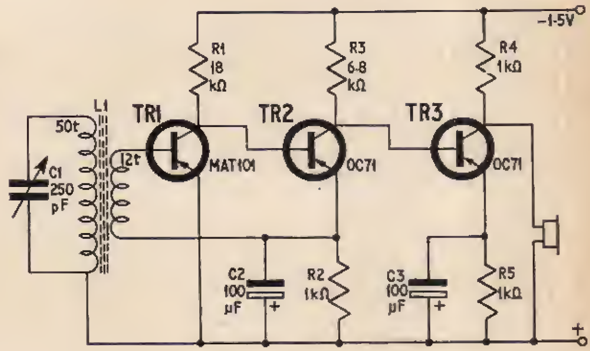


Fig. 1 (top). Simplified A.M. Radio Tuner
Fig. 2 (centre). Ferrite rod component assembly
Fig. 3 (right). Added stage for greater output

ELECTROLYSIS FOR PRINTED CIRCUITS

In your articles on printed circuitry (March Issue), you are constantly stressing the danger of allowing the etching fluid to come into contact with the body. I do not know exactly what this substance is, but I know that nitric acid is also commonly used for etching.

The precautions needed to be taken when using these substances, together with the fear of acids which many people possess, may well discourage many people from attempting printed circuitry.

However, when making printed circuits, I now use a method which I once thought of and used when I had run out of acid during the local holiday week: this was electrolysis.

To make the circuit, simply paint the circuit design onto the laminate board with shellac and allow to dry, then attach a crocodile clip to an unpainted part with a lead running from the clip to the positive terminal of a car battery or low voltage transformer and rectifier unit. Immerse the board in copper sulphate solution and place a piece of copper wire somewhere in the solution so that it does not touch the board or clip. Attach this wire to the negative of the power source and the process will begin.

The unpainted copper will slowly pass into solution. When the current has ceased to flow, the unwanted copper should have all been etched away. If isolated patches of copper remain, it will be found that these are very thin and are easily removed with a pen-knife.

This process is both safe and cheap, as the amount of electricity used is almost negligible and copper is deposited from the solution and onto the negative wire at a rate equal to that at which it is being removed from the board, hence the copper sulphate solution remains at an almost constant concentration and none is lost. The slight increase in concentration is due to some loss of water.

For an average sized board, the length of time needed using 12V, 2oz would be about one hour.

This method has been thoroughly tested and used and I assure you that it is entirely successful.

P. R. Newell,
Blackburn,
Lancashire.

IMPROVED STANDARDS of Accuracy and Reliability!

Modern styling in light grey with legible black engraving.

Constructed to withstand adverse climatic conditions.

Ever ready case including leads, prods and clips.

Improved internal assemblies.

Re-styled scale plate for easy, rapid reading. 2 basic scales each 2.5 inches in length.

New standards of accuracy using an individually calibrated scale plate: d.c. ranges 2.25% of full scale deflection, a.c. ranges 2.75% of full scale deflection.

Available accessories include a 2,500V d.c. multiplier and 5, 10 and 25A shunts for d.c. current measurement.

The Mk. 4 MULTIMINOR is the latest version of this famous Avo instrument and supersedes all previous models. It is styled on modern lines, with new high standards of accuracy, improved internal assemblies, and incorporating panclimatic properties.
The instrument is supplied in an attractive black carrying case, which also houses a pair of leads with interchangeable prods and clips, and an instruction booklet. It is packed in an attractive display carton. Robust real leather cases are available, if required, in two sizes, one to take the instrument with leads, clips and prods, and the other to house these and also a high voltage multiplier and a d.c. shunt.

D.C. Current: 100μA f.s.d. — 1A f.s.d. in 5 ranges.
A.C. Voltage: 10V f.s.d. — 1,000V f.s.d. in 5 ranges.
D.C. Voltage: 2.5V f.s.d. — 1,000V f.s.d. in 6 ranges.
D.C. Millivolt range: 0 — 100mV f.s.d.

RESISTANCE: 0–2M Ω in 2 ranges, using 1.5V cell.
SENSITIVITY: 10,000 Ω/V on d.c. Voltage ranges.
1,000 Ω/V on a.c. Voltage ranges.

For full details write for descriptive leaflet

AVO MULTIMINOR Mk 4

AVO LIMITED AVOCET HOUSE • DOVER • KENT *Telephone: Dover 2626*

MM17

BUILD A HI-FI SYSTEM
WITH WHARFEDALE LOUDSPEAKERS

These Loudspeakers are the actual speakers that Wharfedale use in their world famous cabinet models. Each is fitted with roll surround for low resonance and double diaphragm assembly for extended H.F. response.

Send today for further details of these units plus free cabinet construction sheets to enable you to build a top quality Hi-Fi loudspeaker system.

SUPER 8/RS/DD
Frequency range 40 c/s — 20,000 c/s. Impedance 10/15 ohms.
Power handling capacity 6 watts (12 watts peak) £7.0.0. (tax paid)

SUPER 10/RS/DD
Frequency range 30 c/s — 20,000 c/s. Impedance 10/15 ohms.
Power handling capacity 10 watts (20 watts peak) £11.13.4. (tax paid)

SUPER 12/RS/DD
Frequency range 25 c/s — 20,000 c/s. Impedance 12/15 ohms.
Power handling capacity 20 watts (40 watts peak) £17.10.0. (no tax)

RANK WHARFEDALE LIMITED
IDLE, BRADFORD, YORKSHIRE
Telephone Bradford 612552/3 · Telegrams 'Wharfdel' Bradford

FREE CONSTRUCTION SHEETS

Complete this coupon for 8 page booklet on Wharfedale Speaker Units plus FREE CABINET CONSTRUCTION SHEETS for your own Hi-Fi system. (Dept. PE10)

NAME ....

ADDRESS ....

....

TOWN........................COUNTY..........................

THE MOST FANTASTIC RADIO OFFER EVER!

DUE TO HEAVY FOREIGN SUBSIDY.

GETS WORLD WIDE RECEPTION THOUSANDS OF STATIONS & TRANSMISSIONS!

INDIA

8 WAVE BAND 10 TRANSISTOR PORTABLE RADIO

AUSTRALIA

£10·19·6 OR LOW DEPOSIT

S. AFRICA BOX & POST 4'6 S. AMERICA

ANOTHER GOLD FOR RUSSIA!

What a wonderful Gift!

YES, due to heavy foreign subsidy we offer at this amazing cash price—only £10.19.6, box and post 4/6, or send £3 dep., balance 18 fortnightly payments of 11/11 (total credit sale price 274/6) + post. The impossible has been done! The Russians have triumphed in producing this fantastic 8 wave band Radio that **YOU** can have for hardly more than the cost of an ordinary single wave cheap Transistor! Another proof of the fantastic ability of Russia in the field of electronics! 'H & G' Britain's great discount house, has secured a huge quantity allocated to the U.K. They've just arrived! Brand spanking new and ready for use. YOU GET THIS AMAZING SET FROM US AT A PRICE THAT BEARS NO RELATION TO ITS TRUE VALUE! **Yes, 8 separate wave bands, including Standard Long, Medium and Short to cover the entire world. Unique side control wave band selection unit gives incredible ease of station tuning! Hurry and test for yourself—thousands of stations and different transmissions at your fingertips 24 hours a day, even including amateur 'Hams,'** 'Pirate' radio stations, ships, etc.—truly nothing is secret! **The Radio enthusiast can have the world in the palm of his hand! You must hear it for yourself to** believe it! Listen to the superb sweet tone! Control it from a whisper to a roar that will fill a hall! Runs economically on standard batteries—take it anywhere. **Perfect also for use in your car—any speed, any direction!** SIZE 10½"×7½"×3½". Made to give years of perfect service. Beautifully designed. Attractive contrasting colours. **Complete with internal ferrite rod aerial and 'built-in' telescopic aerial extending to full 38" length.** Also coloured Radio manual, including simple operating instructions, and circuit diagram. **Can also be used as extension amplifier for record player, radiogram, tape recorder or public address. 12 months' guarantee.**

Headquarter & General Supplies

(Dept. PE/9), 196-200 Coldharbour Lane, Loughboro. Junc., London, S.E.5. *(Wed. 1), 37 High Holborn (Thurs. 1), 267 Oxford Street (Wed. 1, Thurs. 8, Fri. 6), 166 North End, Croydon (Wed. 1), 149 High Street, Guildford (Thurs. 7), 121 High Street, Colchester (Thurs. 1), 93 High Street, Bromley.* **Stores 6 p.m. Sat., Fri. 7**

SILICON RECTIFIERS I.R. 1N2374 1000v. 250mA 4/6d. P.P. 1/-. Westinghouse **S10AR2** 1000v. 800mA **9/6d.** P.P. 1/-.

RESISTORS 100 well assorted values and types, ¼w. to 2w., 1% to 10%, hy-stabs, etc. A super buy at **7/6d.** P.P. 1/6d.

CAPACITORS Parcel of **100** well assorted silver micas, ceramics, papers, electrolytics, air spaced variables, etc. **10/-.** P.P. 1/6d.

VALVEHOLDERS
B9A paxolin. **2/-** per dozen. P.P. 1/6d. **I/Octal** low-loss ceramic **11 for 10/-.** P.P. 1/-. **UX4** low-loss ceramic. **6 for 9/-.** P.P. 1/-.

HEADPHONES German made with cushioned ear pads. 5 and 2000 ohm versions. **29/-.** P.P. 2/-.

MARCONI CRYSTAL CALIBRATOR No. 5 MKII. 1 Mc/s precision crystal calibrator complete with spares and handbook. Brand new in transit case. **£7.10.0.**Carr. 10/-.

POTENTIOMETERS 5 kilohm linear, 10K lin, 15K lin, 50K lin, 100K lin, 250K lin, 1M log, 1M lin, 2M log, 2M lin. **1/-** each. P.P. 6d.
With double pole switch 500K log, 1M log, 1·5M log. **2/-** each. P.P. 6d.
With single pole switch 10K lin, 50K lin. **2/-** each. P.P. 6d.
Pre-set potentiometers 5K lin, 250K lin, 300K lin, 500K lin, 1·5M log, 2M lin. **1/-** each. P.P. 6d.

RADIO AMATEURS' EXAMINATION MANUAL 5/9d. post paid.

COMMUNICATIONS RECEIVERS RG-1 £37.10.0, Hallicrafters S38E £15, Eddystone 888 £69, Marconi CR150 £35, Hallicrafters SX140 £27.10.0, R.C.A. AR-88D £55, etc. A large selection always in stock.

BRIAN J. AYRES & CO.
Dept. EA, 8 Hartfield Road
Wimbledon, London, S.W.19
Telephone: Wimbledon 6063

NEW RANGE U.H.F. AERIALS FOR BBC 2 (625) line transmissions

All U.H.F. aerials now fitted with tilting bracket and 4 element grid reflectors.

Loft Mounting Arrays, 7 element, 35/-. 11 element, 42/6. 14 element, 50/-. 18 element, 57/6. **Wall Mounting with Cranked Arm**, 7 element, 60/-. 11 element, 67/-. 14 element, 75/-. 18 element, 82/6. **Mast Mounting** with 2in. clamp. 7 element, 42/6; 11 element, 55/-; 14 element, 62/-; 18 element, 70/-. **Chimney Mounting Arrays, Complete**, 7 element, 72/6; 11 element, 80/-; 14 element, 87/6; 18 element, 95/-. Complete assembly instructions with every unit. **Low Loss Cable**, 1/6 yd. **U.H.F Pre-amps** from 75-/. State clearly channel number required on all orders.

BBC · ITV · F.M. AERIALS

BBC (Band 1). Telescopic loft, 21/-. External S/D, 30/-. "H", £2.10.0.

ITV (Band 3). 3 element loft array, 25-/. 5 element, 35/-. Wall mounting, 3 element, 35/-. 5 element, 45/-.

Combined BBC/ITV. Loft 1+3, 41/3; 1+5, 48/9; Wall mounting 1+3, 56/3; 1+5, 63/9; Chimney 1+3, 63/9; 1+5, 71/3.

VHF transistor pre-amps from 75/-.

F.M. (Band 2). Loft S/D, 12/6, "H", 30/-. 3 element, 52/6. External units available. Co-ax. cable, 8d. yd. Co-ax. plugs, 1/3. Outlet boxes, 4/6. Diplexer Crossover Boxes, 12/6. C.W.O. or C.O.D. P. & P. 4/6. Send 6d. stamps for illustrated lists.

Quotations for special arrays available on request

K.V.A. ELECTRONICS (Dept. P.E.)
27 Central Parade, New Addington
Surrey
LOD 2266

CRESCENT RADIO LTD.
40 MAYES ROAD
WOOD GREEN, N.22
BOWES PARK 3206
LONDON'S ELECTRONIC CENTRE
BEST QUALITY—KEEN PRICES

Some more examples from our large selection of transistors

Newmarket

N.K.T. 217	9/-	N.K.T. 264	3/8
,, 218	4/5	,, 265	3/8
,, 221	5/-	,, 272	3/8
,, 227	9/-	,, 273	3/8
,, 228	4/5	,, 274	3/8
,, 261	3/8	,, 275	3/8
,, 262	3/8	,, 713	6/9
,, 263	3/8	,, 773	5/3
,, 271	3/8	,, 774	5/3
,, 212	4/9	,, 129	5/3
,, 676	4/6	,, 141	6/2
,, 121	9/9	,, 142	5/3
,, 122	6/8	,, 143	5/3
,, 123	5/5	,, 162	5/-
,, 124	8/8	,, 163/25	5/-
,, 216	9/-	,, 164/25	5/-
TEXAS 2G101	3/6	2G381A	1/6
2G417	1/6	2G339B	1/6
2N388A	12/6		

Diodes OA210	9/6	OA70	3/-
OA90	2/-	OA5	5/6
OA91	2/6	OA79	2/-
Zener Diodes VR9E	13/6	VR9F	11/6
VR12E	17/9	VR12F	12/9
VR57B-B	10/6	XU611	3/6

We hold a Full Range of Mullard Zener Diodes in Stock

Special Line Silicon Diodes
125V @ 250M/a........1/6
BY100........5/6

Standard Jack Plugs Black or Grey ....2/6 Screened 3/-

Standard Jack Sockets..1/11 Switched..2/6

Tape Splicer, Duvidal, T635............15/9

International Tape, 7" 2400ft. 24/-, 7" 1200ft. 13/6, 5¾" 1200ft. 15/-, 5¾" 1800ft. 22/6.

We have large stocks of electronic components and feel that a visit to our premises would be to your advantage. Send 1/- for our Catalogue. Please include postage with orders.

6 PUSH-PULL AMPLIFIER

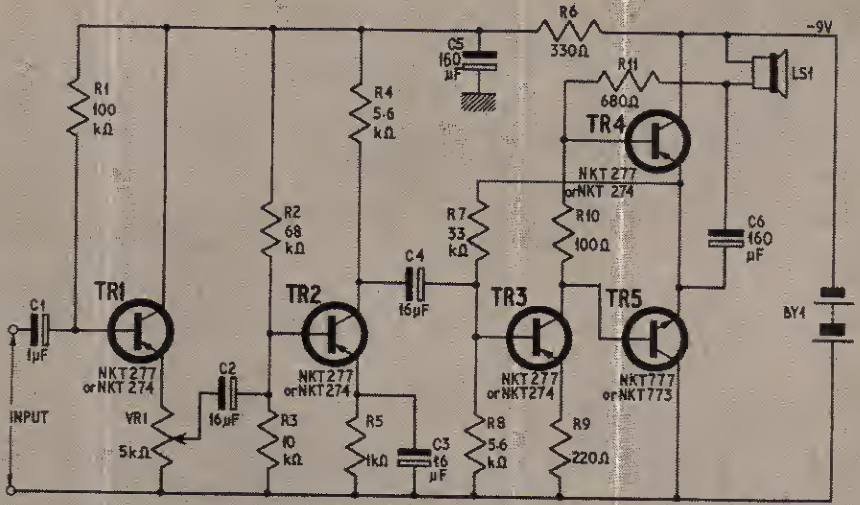


Fig. 1. Circuit diagram of the complete amplifier

THIS, the last of this series of Miniboard projects, describes a five transistor, transformerless, power amplifier, designed to feed up to 200mW to a 25 ohm speaker. The quiescent current of the complete unit is approximately 8mA. The first transistor of the amplifier is connected as an emitter follower, having an input impedance of 80 kilohms, thus making the unit suitable for use as an audio signal tracer, if required. For normal audio amplifier applications, this first transistor can be omitted from the circuit; a pre-amplifier would then be connected across the volume control.

COMPLEMENTARY SYMMETRY

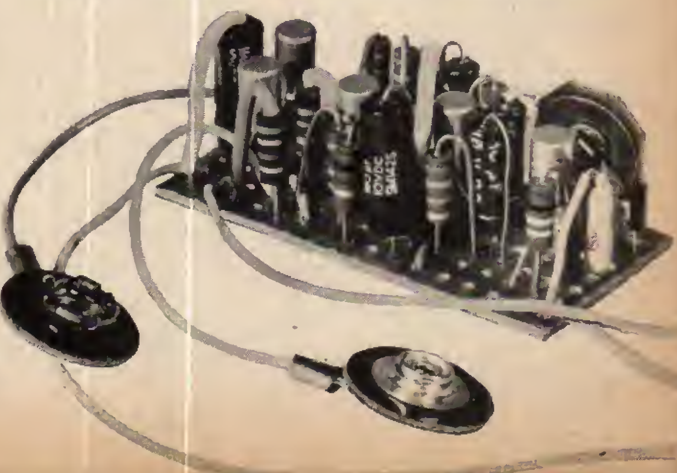
The actual circuit (shown in Fig. 1) uses two output transistors TR4 and TR5, in complementary symmetry mode. TR5 is an *npn* type which is the load in the emitter of TR4 (*pnp*) connected as an emitter follower.

The actual output load R_L is the loudspeaker which is connected to TR4 emitter via C6. As far as a.c. is concerned the negative and positive supply lines are at virtually zero potential, due to the low impedance of the power supply, so the load can be effectively "grounded" to either positive or negative supply lines. The base of TR4 is connected to the signal source (in this case the driver stage output) with a source impedance Z_O.

The output impedance of an emitter follower is given approximately as the source impedance Z_0 divided by the current gain h_{FE} of the transistor. In the actual unit under consideration, Z_0 is 680 ohms and h_{FE} is 200 nominal, so the output impedance is 3·4 ohms nominal. If the output load R_L is made 3·4 ohms, the output voltage (peak) would be limited to half of the input voltage (peak), since the output impedance and R_L are in series and act as a potential divider. A near perfect match is then obtained between the loudspeaker and the source impedance. Similarly TR5 is also connected as an emitter follower with TR4 acting as its emitter load.

Thus, on the negative portion of the signal TR4 conducts and TR5 is cut-off, while on the parts of the signal that are positive TR5 conducts and TR4 is cut-off. R10 is used to give a degree of base-bias to the output transistors and prevent cross-over distortion.

The upper end of the main collector load resistor R11, of the driver transistor, is taken to the negative supply line via the 25 ohm speaker. A degree of negative feedback is thus obtained, which helps to



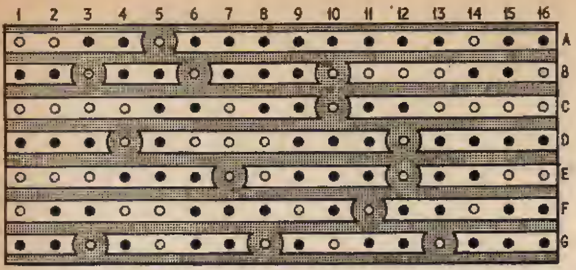


Fig. 2. Underside view of the board showing the copper strip breaks

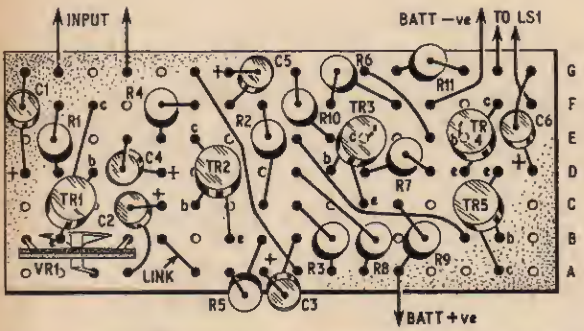


Fig. 3. Component layout on the board and connections for input and loudspeaker

reduce any distortion that could otherwise occur, due to the slightly uneven driving voltages on the bases of the two output transistors. This negative feedback also effectively lowers the source impedance of the driver stage, and thus the output impedance of the output stages. Resistors R7 and R8 form a voltage divider base bias network for TR3.

The upper end of R7 is directly coupled to the common emitter junction of TR4–TR5; d.c. negative feedback is thus obtained, stabilising the working voltages of TR3.

The driver stage is fed, via C4, from the common emitter preamplifier TR2, which in turn is fed from the emitter follower input circuit TR1. The emitter load of TR1 is a potentiometer, VR1, which serves as a volume control. To prevent overall positive feedback and consequent instability, the decoupling network R6 and C5 is inserted between TR2 and the output stages.

CONSTRUCTION

Following the procedure outlined in the introductory article break the copper strips in the sample piece of Veroboard as shown in Fig. 3 and connect the flying leads.

The components are fairly cramped on the board so it is probably best to start assembly by wiring up the output and driver stages. Before connecting the supplies to test this part of the circuit, check the wiring. Connect the 25 ohm loudspeaker; then connect the 9 volt supply with a milliameter in series.

Check that the current, with the base of TR3 shorted to ground via a large value capacitor, is less than 10mA. If a voltmeter is available, check that the voltage between the common emitter junction of the output transistors and battery positive is about 4½ volts. A functional check can now be made by removing the shorting capacitor from TR3 base and connecting an

COMPONENTS . . .

Resistors

R1 100kΩ
R2 68kΩ
R3 10kΩ
R4 5·6kΩ
R5 1kΩ
R6 330Ω
R7 33kΩ
R8 5·6kΩ
R9 220Ω
R10 100Ω
R11 680Ω

Potentiometer

VR1 5kΩ preset skeleton miniature or panel mounting control

Capacitors

C1 1μF elect. 15V
C2 16μF elect. 15V
C3 16μF elect. 15V
C4 16μF elect. 15V
C5 160μF elect. 10V
C6 160μF elect. 10V

Transistors

TR1, 2, 3, 4 NKT277 *or* NKT274 (4 off) (Newmarket)
TR5 NKT777 *or* NKT773 (Newmarket)

Loudspeaker

LS1 25 ohms, 5 inch, round (Plessey)

Battery

BY1 9 volt type PP9

Miscellaneous

Sample Veroboard
Battery connectors
P.V.C. covered wire

input signal to TR3 base via a blocking capacitor. The current will then rise significantly. If satisfactory, wire up and check the rest of the circuit, taking care to monitor the total current of the unit at all times.

VARIATIONS

If the unit is to be used as a normal audio amplifier, either with a microphone, pick-up, or with a radio tuner, omit R1, C1, and TR1 from the circuit, and couple the input, via a 16μF capacitor, to the top end of VR1.

With the component values shown in the circuit diagram, the frequency response of the unit is considered to be adequate for normal domestic use, although the results are by no means hi fi. The low frequency response can be improved, however, by replacing C6 with a 1000μF capacitor.

Using a 25 ohm loudspeaker, about ·200mW of output power is available at reasonable quality; greater output power can be obtained using the same speaker, but distortion then becomes excessive. Undistorted output power can be increased by using a lower impedance speaker, but in this case larger transient currents have to be handled by the output transistors which may be damaged as a result.

Never disconnect the loudspeaker when the power supply is on or the output transistors may be damaged. It should be possible to use this amplifier with speaker impedances as low as five or even three ohms, but in this case a 100mA fuse should be wired in the negative supply line as a safety precaution against damaging the output transistors. The maximum output voltage that is available without distortion is about 7 volts peak-to-peak (approximately 2·5 volts r.m.s.), with a 25 ohm loudspeaker.

If the unit is to be built into a composite piece of equipment, replace VR1 with a front panel mounted volume control and knob. ★

TELEVISION AERIAL for Fringe Areas BBC 2

11 Directors and reflector mat—a really efficient model by one of our most famous makers—must improve results—45/- plus 3/6 post and ins. Low loss co-ax cable 1/6 yd., BBC 2 aerial Amplifier £4.4.0.

STEREO DE LUXE HEADPHONES

Even good music is not everybody's cup of tea—and if your family is in this group then you need these superior phones. Alternatively if you've not experienced the exhilerating sensations these phones can supply from stereo recordings then you are missing one of the fine pleasures available today at low cost—Complete with cushioned ear-pads, bargain price 75/- plus 2/9 post and insurance.

750 mW TRANSISTOR AMP.

4 transistors including two in push-pull input for crystal or magnetic microphone or pick-up—feed back loops—sensitivity 5 m/v.

PRICE 19/6

Post and ins. 2/6.

Speakers 3in. 12/6; 5in. 13/6; 6in. × 4in. 14/6.

TUBULAR HEATERS

New and unused made by G.E.C.—rated at 60 watts per foot—these are ideal in airing cupboards, bedrooms, offices, stores, greenhouses, etc.—curtains or papers can touch them without fear of scorching or fire. Supplied complete with fixing brackets and available in the following sizes. Prices which are about quarter of list price includes carriage by B.R.S.

8ft.—30/-, 10ft.—36/-, 12ft.—42/-

also in twin assemblies (one pipe above the other):

4ft.—40/-, 5ft.—46/-, 6ft.—52/-

SIMMERSTAT HEATER REGULATOR

Suitable to control elements, heater, soldering irons and boiling rings up to 2,500 watt. Complete adjustable, normal price 55/- each, special snip price 12/6 plus 2/- postage and insurance.

THERMOSTATS

Type 'A' 15 amp. for controlling room heaters, greenhouse, airing cupboard. Has spindle for pointer knob, quickly adjustable from 30°—80°F. 9/6 plus 1/- post. Suitable box for wall mounting, 6/- P. & P. 1/-.

Type 'B' 15 amp. This is a 17in. long rod type made by the famous Sunvic Co. Spindle adjusts this from 50-550°F. Internal screw alters the setting so this could be adjustable over 30° to 1,000°F. Suitable for controlling furnace, oven, kiln, immersion heater or to make flamestat or fire alarm. 8/6 plus 2/9 post and insurance.

Type 'D'. We call this the Ice-stat as it cuts in and out at around freezing point. 2/3 amps. Has many uses, one of which would be to keep the loft pipes from freezing if a length of our blanket wire (16 yds. 10/-) is wound round the pipes. 7/6, P & P. 1/1.

Type 'E'. This is a standard refrigerator thermostat. Spindle adjustments cover normal refrigerator temperature, 7/6 plus 1/- P. & P.

SEMI-CONDUCTOR BARGAINS

Type No.	Price	Type No.	Price	Type No.	Price
2N1727	15/-	MAT101	8/6	OC71	4/-
2N1728	100/-	MAT120	7/9	OC72	6/-
2N1742	25/-	MAT121	8/6	OC75	6/-
2N1747	25/-	OA5	5/-	OC76	5/-
2N1748	10/-	OA10	6/-	OC77	7/-
AC107	9/-	OA47	3/-	OC78	5/-
AC127	9/-	OA70	2/-	OC78D	5/-
ACY17	8/6	OA79	2/6	OC81	5/-
ACY18	5/6	OA81	2/6	OC81D	5/-
ACY19	6/6	OA85	3/-	OC82	6/-
ACY20	5/6	OA90	2/6	OC83	5/-
ACY21	6/-	OA91	2/6	OC84	6/-
ACY22	4/6	OA200	3/3	OC139	8/6
AF114	7/-	OA202	4/3	OC140	12/6
AF115	6/6	OC22	10/-	OC170	5/-
AF116	7/-	OC23	17/6	OC171	6/-
AF117	5/-	OC24	22/6	OC200	9/-
AF118	12/6	OC26	7/6	OC201	12/6
AF139	17/6	OC28	15/-	OC202	18/6
AF186	19/6	OC29	17/6	OC203	12/6
AFZ12	15/-	OC35	12/6	OCP71	19/6
ASZ21	15/-	OC36	15/-	ORP12	8/6
BC107	14/6	OC42	8/6	ORP60	5/-
BY100	5/6	OC44	6/-	SB078	6/6
BYZ13	7/6	OC45	4/-	SB305	8/6
MAT100	7/9	OC70	4/-	SB251	10/-

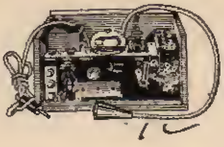
SPECIAL BARGAIN

Special set for amplifier or for output stage comprises OC81D and match pair OC81 only 12/6 post free

INFRA-RED HEATERS

Make up one of these latest type heaters. Ideal for bathroom, etc. They are simple to make from our easy-to-follow instructions—uses silica enclosed elements designed for the correct infra-red wavelength (3 microns). Price for 750 watts element, all parts, metal casing as illustrated, 21/6, plus 3/6 post and ins. Pull switch 3/- extra.

FIELD TELEPHONE UNIT



Officially known as Remote control units No. 1, essentially these are telephones with additional facilities—each unit contains magneto type ringer and bell—as well as transformer—relay and switches. A pair of these will give you two-way communication over distances up to five miles—unused and in good condition 39/6 each plus 7/6 carriage and insurance.

FINE RECORD PLAYERS

and because they have been making record players for so long **GARRARD** are your best choice—big range always in stock.

7/6 for post and insurance

1000	£5.5.0	AT60	£11.11.0
2000	£6.9.6	SP25	£10.9.0
3000	£7.19.6	LAB80	£25.0.0
		SRP12	£3.9.6

Complete with service sheet and template.

THIS MONTH'S SNIP—ELECTRIC BLANKET OUTFIT

A 13yd. 70 watt waterproof element with temperature control by Thermal balance—and a double pole blanket switch in pastel blue bakelite—with enclosed neon on/off indication—both items ideal for renovating a defunct or doubtful blanket—supplied complete with layout and other instructions only 12/6 plus 1/6 post and insurance.

See in the dark INFRA-RED BINOCULARS

These infra red binoculars when fed from a high voltage source will enable objects to be seen in the dark, providing the objects are in the rays of an infra-red beam. Each eye tube contains a complete optical lens system as well as the infra-red cell. These optical systems can be used as lens for T.V. cameras—light cell, etc. (details supplied). The binoculars form part of the Army night driving (Tabby) equipment. They are unused and believed to be in good working order, but sold without a guarantee. Price £2.17.6 plus 10/- carriage and insurance. Handbook 2/6.

GOOD COMPANION Mk V

Saves you work—It's partly built

Like its predecessors this latest Companion has a full fi performance—such as only a good wooden cabinet and hi-flux speaker can give, and due to its being partly built you will have it going in an evening. Note these features:

- All Mullard Transistors including 3 × AF117.
- Two tone Cabinet, size 11in. × 8in. × 3in.
- All circuit requirements Push Pull output—A.V.C. and feed back, etc.
- Printed circuit board all wired only connections, e.g., to Volume control—W1C. Switch and Tuning Condenser.
- Pre-aligned IF stages complete with full instructions. Price only £4.12.6 plus 6/6 post and insurance.

DEAC RECHARGEABLE BATTERIES

These nickel cadmium cells have negligible internal resistance. Will deliver current you require, reduce distortion and are completely reliable. They may be recharged indefinitely. Replacements for PP3 37/-, U7 12/6, U2 32/-, U11 23/- or send for list. Note charger for these types available, 22/6 Cells for building into tape recorders and other equipment: Heavy duty 1.25 v. type 8/6. Heavy duty 9 v. type 44/-. Charger that will deal with both together or separately, £4.15.0.

SUMMER SALE

BARGAINS UNLIMITED

MINIATURE RELAYS with removable covers. Very sensitive (will close on only 20 mA). Coil resistance 10,000 ohms—contacts are three sets; triple set for change over pair to open circuit and the third pair to close circuit—perfect order unused (removed from equipment), 7/6 each.

MAINS TRANSFORMER. Upright mounting with primary tapped 200, 220, 240 v. H T secondary is 250-0-250 v at 100 mA and it has two L T secondaries of 6.3 v. 1½ amp.—unused (removed from equipment), 15/- plus 3/6 post and insurance.

MULLARD SILICON RECTIFIERS. 350 v. 100 mA. Removed from unused equipment, perfect. Ref. BY100, 4/9 each.

REED SWITCHES. A pair of contacts sealed into a glass tube. When a magnet comes close the contacts close immediately and the circuit is switched. For burglar alarms on doors or windows—moving displays for advertising—rev. or batch counting—relay circuits. New and perfect, price is 6/8 each.

½in. **MEG. POTS.** By Erie, standard ¼in. spindle, 1in. long, 7d. each in doz. lots, otherwise 10d.

½in. **MEG. POTS WITH D.P. SWITCH.** Again by Erie. Standard size spindle 1in. length. **10d.** each in doz. lots, otherwise 1/8 each.

MINIATURE PICK-UP. For pop-records—this is made by Cosmocord—has a crystal cartridge and long play sapphire stylus—offered for less than the wholesale price of the stylus only—namely 3/9 each or 38/- doz.

SYNCHRONOUS METER MOTOR. This is self starting and has a cog ended spindle—add a train of gears and you have a clock or hours elapsed meter, or it would drive a little fan to keep equipment cool or similar job. Brand new and perfect, 6/6 each, 54/- per doz.

RELAY SWITCHES. These enable micro switches, delicate thermostats or other low current devices to control up to 30 amps.—ideal to switch thermal storage heaters—motors, etc., made by the famous A.E.I. group these are listed at £25 each—you can buy it if you hurry at a very keen price of 39/6 each and we will include diagrams and data. Mounted on panel size approximately 6 × 7 × 2in. deep.

MAINS FROM CAR BATTERY Rotary generators 12 v. input, 240 v. output, 110 mA. **£2**, 300 mA. **£5**, plus 5/- post.

H.R.O. POWER PACK. Suitable 240 or 115 volt mains, gives 250 v. H.T. and 6.3 v. L.T. Unused but soiled and less rectifier valve, 19/6, plus 6/6 post.

A.C./D.C. AMMETER. 2½in. flush mounting. 0.9 amps. but external shunt easily removed. Offered at silly price, 8/9 each, **£5** doz.

"C" CORE POTTED OUTPUT TRANSFORMER. Made by the famous "Parmeko" company these are the best money can buy—we can offer a bargain 15 watt rating, centre tapped primary with secondary for 3 ohm speaker. Potted and in black stove enamelled case for upright mounting these will make your amplifier or rig look perfect at only 12/6 plus 3/6 carriage and insurance—hurry for these.

FLUORESCENT LIGHT KITS. Comprising choke, lampholders, starter and two chrome tube clips. 40 watt 11/6, 80 watt 17/6, 65 watt 17/6, 20 watt 19/6 plus 3/6 post and insurance.

6.3 v. HEATER TRANSFORMERS, 1½ amps., 5/6.

ARDENTE HEARING AID

If not wanted as hearing aid these could be the basis of radio control units—pocket transmitter—staff locators, etc. They are beautifully made little units and they contain many subminiature parts including crystal microphone, on/off switch—volume control with on/off switch—inter-stage transformer—Mullard valves types DL 66 and DF 64 (2 of). All parts in good order, in fact hearing aids believed to be in working order but not guaranteed so—complete in plastic case with pocket clip only 27/6 (earphone not included).

MEDRESCO HEARING AIDS

Also available similar condition to above used but believed working, only 18/- each.

WALL MOUNTING THERMOSTAT

By Satchwell, intended for use to control tubular or any type of space heaters indoors or in a greenhouse—adjustable over 40/80 complete with mounting screws, 29/6, plus post 2/9 (normal price is at least twice this).

MAINS POWER PACK

MAINS POWER PACK designed to operate transistor sets and amplifiers. Adjustable output 6v.-9 to 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries, PP1, PP3, PP4, PP6, PP7, PP9, and others. Kit comprises: mains transformer-rectifier, smoothing and load resistor, 5,000 and 500 mfd. condensers, zener diode and instructions. Real snip at only 14/6, plus 3/6 post.

Where postage is not definitely stated as an extra then orders over £3 are post free. Below £3 add 2/9.

ELECTRONICS (CROYDON) LIMITED

102/3 TAMWORTH ROAD, CROYDON, SURREY *(Opp. West Croydon Station)*

post orders to: **Dept. PE, SPRINGFIELD ROAD, EASTBOURNE, SUSSEX**

detached particles

JOHN VALENCE

JUST A DREAM

One's heart must go out to Lord Robens and his fellow members of the National Coal Board. With courage and imagination they embarked upon a vast programme of modernisation, calling in all the resources of modern technology. This planning reached a grand climax in the completion of the showpiece colliery at Bevercotes in Nottinghamshire. Twelve months ago the National Coal Board unveiled this, the first remotely controlled mine in the world, with electronically guided and controlled machinery.

What an inspiring picture this presented: here was one of the oldest industries of all—notorious for the severity of its working conditions—boldly deciding to take a gigantic step forward into the 21st century. A shining example for other industries to follow. A glimpse of the future, when all unpleasant and arduous toil would be undertaken by machines with man merely there to supervise their operation.

So we thought. Alas, this remains but a dream.

For some inexplicable reason, the mineworkers seem unappreciative of the new white-coated role they are being offered. A few million pounds worth of equipment including complex electronic installations lies entombed 3,000 feet below the surface, unused, at Bevercotes. The coal that might have been won during these past 12 months is estimated at about a million tons.

OFF THE BEAT?

Computers, infra-red devices, radio, and closed circuit television are some of the electronic aids now being mobilised for action in the campaign against the mounting crime wave.

Will this extended use of science and technology result ultimately in the disappearance from our streets of the "bobby"? I would not myself have thought this at all likely. But no less an authority than the Secretary General of Interpol, M. Jean Nepote, believes this to be so. By 1975, he forecasts, policemen will have vanished from the streets in Britain and their function will have been taken over by television cameras!

Such a state of affairs can hardly be contemplated. Just consider, for one thing, our guests from overseas. Whatever will they do when they want to be directed to say—The Tower, or wish to know when the Changing of the Guard ceremony takes place. And, in particular, let us consider those members of the fair sex one sees in the busy streets of the Capital gazing admiringly upwards into the face of an ever helpful bobby. They surely will find little recompense in the glassy eye of a television camera—even if it is part of an all knowing robot with a computer fed encyclopaedic mind.

RELIABLE SERVICE

The radio and television rental system is hardly known in the U.S.A., where it is limited to such institutions as schools and hospitals. This is in sharp contrast to our own country, where the rental system is becoming increasingly popular with the general public. When colour arrives in Britain (all being well—end of 1967) it is predicted that at least 80 per cent of colour receivers in private homes will be hired on the rental basis. This at any rate was the view put forward by Mr. Robinson, Chairman of Radio Rentals Limited, when announcing a tie up between his firm and The Radio Corporation of America for the production of colour tubes in Britain.

Apart from the very real financial aspect, I suspect that the swing over to rental as opposed to private ownership has been greatly encouraged by the public's suspicion of the "servicing" fraternity. Perhaps this Cinderella of the radio and television trade could learn something from its counterpart in the U.S.A. Over there the private listener or viewer is dependent on the serviceman or "troubleshooter" and, one presumes, has no qualms about calling him in.

ALL-TALKING INSTRUMENTATION

The motorist has benefited very considerably from electronic developments. As readers of this magazine will know quite well, there are a variety of devices designed to assist the driver or to safeguard his vehicle. Nevertheless, what we have seen so far is apparently just the beginning.

For example, the Ford people, I understand, are developing "audio" speedometers and petrol and oil gauges. Miniature tape machines will give pre-recorded warning messages as the needle reaches a danger mark. The idea is to relieve the motorist of the necessity of frequently glancing at the dashboard instruments. I suggest that automatic muting of the car radio when the audio warning comes up is a vital adjunct to such a scheme.

Talking of car radio, the practice of driving along with the accompaniment of broadcast entertainment is so widespread now that it will doubtless surprise many younger readers to learn that the introduction of this amenity was fiercely opposed in some quarters in the early days as being a dangerous distraction. But, paradoxically, it was soon proved that a radio programme can help keep the driver alert, particularly on long solitary journeys.

"No thanks, I already have one"

Readout—
A SELECTION FROM OUR POSTBAG

Where has all the fuzz gone?

Sir—I have completed making the *Fuzz Box* described in the July issue, but have not obtained fully successful results with it.

On connecting up and plucking the guitar string softly, only a very small output can be obtained (far softer than without the fuzz box connected). However, on plucking the guitar string fairly hard, a very loud (much amplified above normal level, i.e. without the fuzz box) fuzzed note is obtained. This is satisfactory, except for the fact that this note lasts only for a few seconds on the bass notes, and even shorter on the treble notes. This, however, I suspect is due to the guitar's lack of sustain on the treble notes) before suddenly cutting out and reverting to the "tinny" output, as before. Just before cutting out, a crackle also appears, with the fuzz. Thus, it seems that whether the unit fuzzes or not is dependent upon the input supplied by the guitar.

In the unit which I constructed I was not able to obtain the correct values for all the components. But, since the margins of error are fairly small, I am not sure whether or not the fault can be traced to any of these.

S. F. Bywaters,
Hornchurch,
Essex.

Slight modifications may be necessary so as to make the fuzz box match the particular guitar output specification. The clipping stage preceded by the pre-amp has a definite minimum threshold input level which can be varied by changing the value of R3, altering the gain of TR2, or trying a different diode as D1. Any signal lower than the minimum trigger input level will not be reproduced at all. The circuit will give an illusion of sustaining the signal because, providing the input signal is over the threshold level, the output signal is always at the same level until cut-off point is reached, when the input level falls below threshold. The true sustain effect is not only unobtainable but also undesirable. If any such unit gave a sustain effect then any note played would carry on to give a cataclysmic discord if the next note was played soon after.—M. S-R.

The Roding Boys' Society

This radio and electronics group for boys has changed the Headquarters location, and the meetings are now held in Waltham Forest, London, E.17.

An expansion of the activities should now take place with the new facilities available to us.

Meetings will continue on Tuesday evenings, plus special activities on Saturdays.

Boys who are especially keen on radio/electronics are particularly welcome to visit the new Centre. If you are interested please contact:—

Ron Marchant,
154, Essex Rd.,
London, E.10.

CAN YOU HELP?

Letters for inclusion under this heading should be as brief as possible. Replies should be made direct to the readers concerned.

Sir—I have been trying to obtain some early issues, Nos. 1 to 10, but have had no luck. I wonder if any of your readers can help? I will, of course, pay the postal rates and charges.
B. Toffoli, 18, Farnley Street, Mt. Lawley, Perth, Western Australia.

Sir—I am interested in purchasing back number 1 to 12 of volume 1 and February 1966 at cost plus postage.
A. Balsillie, Science Dept., Williamwood High School, Seres Road, Clarkston, By Glasgow.

Sir—Can any reader supply me with all back copies for volume 1 as well as numbers 1 to 4 of volume 2?
O. W. Griffiths, P.O. Box 13504, Sinoville, Pretoria, South Africa.

Sir—Can anyone supply me with the first four copies of Practical Electronics? I would pay full price for these to complete my collection.
D. R. Fairbrother, Averill House, King's College, Otahuhu, Auckland, New Zealand.

Sir—Could any of your readers supply me with volume 1 complete with blueprints, etc?
J. A. Daykin, 14, The Avenue, Churchdown, Glos.

Back numbers are usually very quickly exhausted. We strongly advise all our readers that a standing order be placed with their newsagent to avoid any future disappointment.

Noise from the quiet sun

Sir—I read with interest the article on *Radio Astronomy* by C. B. Sibley in the August edition.

I should like to point out that the detection of thermal noise from the quiet sun is not as easy to detect as the writer suggests. The block diagram (Fig. 4) shows a radiometer or full power system which is quite suitable for detecting large solar outbursts and should give good results during maximum sunspot activity.

Trying to detect the quiet sun with this system would be impossible as all forms of man made interference will be shown on the pen recorder. As a result it would be difficult to sort out genuine solar signals from the unwanted ones.

My main purpose of writing this is to prevent any would-be constructors becoming disappointed if their efforts failed, as I have constructed similar equipment without producing any results.

The type of equipment that could be used very successfully by the amateur with a garden of moderate size is the phase-switched interferometer. This system takes more time and effort but the results are most satisfying as I have found with my own equipment.

M. J. Hale,
Secretary of the Radio
Astronomy Section,
The British
Astronomical Association,
London, S.E.9.

"Pop" mandolin

Sir—Having read Colin Greig's letter in the August edition, I think that I ought to make one or two comments in reply.

The first is that the original instrument, the *Electronic Mandolin,* designed by S. Chisholm in the June edition was made originally with the idea of being highly amplified in a "pop" group. Also if it is to be used for this purpose a crystal microphone would be useless as the risk of "feedback" and the picking up of extraneous noises would be too great.

If a crystal pick-up is used the tone would be extremely "tinny" and tend to reproduce the upper register of the instrument more than the lower one.

G. K. Mitchell,
Orpington,
Kent.

Practical Electronics Classified Advertisements

The pre-paid rate for classified advertisements is 1/- per word (minimum order 12/-), box number 1/6 extra. Semi-displayed setting £3 . 5 . 0 per single column inch. All cheques, postal orders, etc., to be made payable to PRACTICAL ELECTRONICS and crossed "Lloyds Bank Ltd." Treasury notes should always be sent *registered post*. Advertisements, together with remittance, should be sent to the Advertisement Manager, PRACTICAL ELECTRONICS, George Newnes Ltd., Tower House, Southampton Street, London, WC2, for insertion in the next available issue.

TRANSFORMERS

TELEVISION:!

From your OWN Car Battery

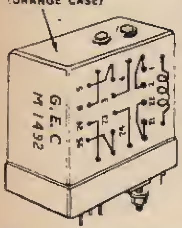
Famous **DELCO TRANSFORMER** transforms 12 or 24v. supply to mains Power for TV, ¼" drills, etc. **NOW ONLY £5-10-0** C.O.D. 2/6 extra.
VIBRATOR POWER-PAK. Step 12v. up to MAINS output. For Universal AC/DC razors, small fluorescent fittings, radios, etc. ....Only **32/6**
HOOVER ROTARY TRANSFORMERS. 6v. input, 250v. output. 12v. input, 490v. output. 32 watts. **25/-**
GENERATING SETS. Brand New. **TINY TIM.** 12v. 300 watts. In packing case. **SELF STARTING.** Normal List Price **£76.** Price Delivered **£35**

Send NOW—Delivery by return

JAMES WALKER, ELECTRONICS DIVISION
School House, Wood Walton, Huntingdon
Phone Abbots Ripton 368. 9 am. to 10 pm.

WANTED

G.E.C. RELAY
(ORANGE CASE)



WANTED

THIS TYPE AND SIMILAR RELAYS, ANY CONDITION. SEND S.A.E. FOR DETAILS TO:

112 GROBY ROAD GLENFIELD LEICESTER

EDUCATIONAL

B.Sc.(ENG.), A.M.I.Mech.E., A.M.I.E.R.E. City & Guilds, etc., on "Satisfaction or Refund of Fee" terms. Wide range of expert Home Study Courses in Electronics, Computers, Radio, T.V., etc. 156-page Guide—FREE. Please state subject of interest. BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY, 124k College House, Wright's Lane, London, W.8.

TELEVISION SERVICING
COMPUTER TECHNIQUES
RADAR MAINTENANCE

Day and Evening Training Courses

Apply:—Director, British School of Telegraphy, 20 Penywern Road, Earls Court, London, S.W.5

STUDY RADIO, TELEVISION AND ELECTRONICS with the world's largest home study organisation. I.E.R.E., City & Guilds, R.T.E.B., etc. Also Practical Courses with equipment. All books supplied. Write for FREE Prospectus stating subject to I.C.S. (Dept. 577), Intertext House, Parkgate Road, London, S.W.11.

EDUCATIONAL
(continued)

HOME STUDY COURSES in Practical Electronics. Free Brochure without obligation from: BRITISH NATIONAL RADIO SCHOOL, Reading, Berks.

A.M.I.Mech.E., A.M.I.E.R.E. City & Guilds, G.C.E., etc. Become a Technician or Technologist for high pay and security. Thousands of passes. For details of Exams. and Courses in all branches of Engineering, Building, Electronics, etc., write for 156-page handbook —FREE. B.I.E.T. (Dept. 125k), London, W.8.

SITUATIONS VACANT

ENGINEER with 30 years' experience in all branches of electronics, manufacturing and retail, seeks servicing or installation post in N.W. London or Herts. Box 6.

UNIVERSITY OF LONDON
GOLDSMITHS' COLLEGE
New Cross, London, S.E.14

Required immediately for Educational Television Research Unit an

ELECTRONICS ENGINEER

(young man or woman) to maintain, adapt, develop and, where appropriate, to originate equipment used in two mobile "Mini-Studios," including a video tape recorder. Starting salary according to qualifications and experience. Post would suit ambitious service engineer, or newly qualified graduate wanting to widen experience, and attracted by pioneer work in a small team. Applications (THREE copies) to Registrar from whom further particulars may be obtained on request.

SITUATIONS VACANT *(continued)*

RADIO TECHNICIANS

A number of suitably qualified candidates will be required for training, leading to permanent and pensionable employment. (In various parts of the U.K. including London, but primarily Cheltenham. Also opportunities for service abroad.)

Applicants must be 19 or over and be familiar with the use of Test Gear and have had Radio/Electronic workshop experience. They must offer at least "O" level GCE passes in English Language, Maths and/or Physics, or hold the City and Guilds Telecommunications Technician Intermediate Certificate or equivalent technical qualifications.

Pay according to age, e.g. at 19 £747, at 25 £962 (highest age pay on entry) rising by four annual increments to £1,104.

Prospects of promotion to grades in salary range £1,032–£1,691. There are a few posts carrying higher salaries.

Annual Leave allowance of 3 weeks 3 days, rising to 4 weeks 2 days.

Normal Civil Service sick leave regulations apply.

Apply

Recruitment Officer (RT/54)
Government Communications Headquarters
Oakley
Priors Road
CHELTENHAM, Glos.

TECHNICAL TRAINING by ICS IN RADIO, TELEVISION AND ELECTRONIC ENGINEERING

First-class opportunities in Radio and Electronics await the **I C S trained man.** Let I C S train YOU for a well-paid post in this expanding field.
I C S courses offer the keen, ambitious man the opportunity to acquire, quickly and easily, the specialized-training so essential to success. Diploma courses in Radio/TV Engineering and Servicing, Electronics, Computers, etc. Expert coaching for:

* **INSTITUTION OF ELECTRONIC AND RADIO ENGINEERS**
* **C. & G. TELECOMMUNICATION TECHNICIANS' CERTS.**
* **C. & G. SUPPLEMENTARY STUDIES.**
* **R.T.E.B. RADIO AND TV SERVICING CERTIFICATE.**
* **RADIO AMATEURS' EXAMINATION.**
* **P.M.G. CERTIFICATES IN RADIOTELEGRAPHY.**

Examination Students Coached until Successful.

NEW SELF-BUILD RADIO COURSES.

Build your own 5-valve receiver, transistor portable, signal generator and multi-test meter—**all under expert tuition.**

POST THIS COUPON TODAY and find out how I C S can help YOU in your career. Full details of I C S courses in Radio, Television and Electronics will be sent to you by return mail.

MEMBER OF THE ASSOCIATION OF BRITISH CORRESPONDENCE COLLEGES.

INTERNATIONAL CORRESPONDENCE SCHOOLS

A WHOLE WORLD OF KNOWLEDGE AWAITS YOU !

International Correspondence Schools
(Dept. 152), Intertext House, Parkgate Road,
London, S.W.11.

NAME ....
Block Capitals Please

ADDRESS ....

....

....10.66

CONTINUED OVERLEAF

RECEIVERS AND COMPONENTS

RECEIVERS AND COMPONENTS
(continued)

LIGHT REACTIVE SEMICONDUCTORS

OCP71 19/6 (or equivalent @ 9/6)
ORP12 9/-. **Photo-power** transistors with circuits 30/- each. ONLY TYPE IN ENGLAND.
300 mc/s PLANAR 2N706 4/9 each or 2 for 8/-.
BY100 Mullard branded 5/- each.
Try us for Mullard transistors: **OC75** @ 4/-, **AC128** @ 4/-. Just two examples, we have many popular types.
SILICON CONTROLLED RECTIFIERS 400 p.i.v. 7 amp 27/6.
THERMISTORS KS31W @ 1/-, G15 type 5/-, cheapest anywhere!!
We cannot print our whole catalogue here but 6d stamp will bring you one. Nine full pages, every device you need, including:—
OUR FAMOUS 25 TRANSISTORS FOR 10/- OFFER.
Thousands of packets sold; Audio types, R.F. types or Switching types, state preference. Includes postage and packing!!

L.S.T. COMPONENTS
23 NEW ROAD, BRENTWOOD, ESSEX

R. & R. RADIO & TV SERVICE

Dept. P.E.

44 Market Street, Bacup, Lancs. Tel. 465

Salvage Valves Good Emission Guaranteed

EF80	1/6	30P4	7/-	30FL1	5/-
ECC82	3/-	EB91	1/-	U801	7/6
ECL80	3/6	EF85	5/-	PL82	4/6
30F5	5/-	30PL1	5/-	PL36	7/-
PCF80	4/-	EY86	4/-	PCC84	4/-
PL81	5/-	6U4GT	5/-	PY81	3/6
PZ30	5/-	PY33	6/-	U301	6/-

SPEAKERS Ex TV 3 ohm imp. 5" Rnd. and 6" × 4" 3/6. 8" Rnd. 6/-. Post 2/6.

BY100, Rectifiers complete with 10 watt res. 6/-. Post 6d. Fireball Tuners, less cover cans 9/- post paid.

Video, printed circuit panels, ideal for stripping 5/6. Post 1/6, 5 for £1 post paid.
TV Tubes from £1, callers only.

Line output transformers, Scan coils, tuners, etc. S.A.E. for prompt reply.

SPECIAL OFFER

1 Watt S.T.C. 300 MC/S N.P.N. Silicon Planer. Transistors. With data. Limited Stocks. £1 for 6.

3/- each. OC44, OC45, OC70, OC71, OC81, OC81D, OC200, Get 16, Get 20.

4/- each. AF114, AF115, AF116, AF117, OC170, OC171.

5/- each. OC139, OC140, Get 7, Get 8, Get 9, XC141, BY100, OA211.

ZENER DIODES

3.9v. to 26 volt, ¼w. 3/6 each, 1.5w. 5/-, 7w. 6/- each.

Send 6d. for full lists: inc. S.C.R. Zeners.

Cursons
78 Broad Street
Canterbury
Kent

RECEIVERS AND COMPONENTS
(continued)

COMPONENTS, VALVES, TRANSISTORS, etc. Call or send 6d. for list. ROGERS, 31 Nelson Street, Southport.

A NEW DIMENSION in ECONOMY and RELIABILITY

These new Silicon Planar NPN ceramic/epoxy resin transistors give extreme reliability at a new low cost. Electrically equivalent to the popular 2N2926, the CS2926 has a dissipation of 300mW max. (an increase of 50%) and has the standard TO-18 terminations.
Prices and selections are as follows:
red, β55 to 110 3/6
orange, β90 to 180 3/9
yellow, β150 to 300 4/-
green, β235 to 470 4/9
This encapsulation is additionally useful for model control and other applications involving severe vibration.
SILICON Power Transistors, type 40250, 50V, 29W max., or 16W @ 100°C case, 17/-
PNP planar 2N3702, β150-300, 6/-
2N3390, NPN 25V, β400 to 800 now 7/6
2N1302, 2N1303, 2N1304, 2N1305 @ 4/3
2N2926, red, orange, yellow or green @ 4/-
Resistors, new, ½W, 5%, 4·7 Ω to 10M, 2/3 doz.
Rectifiers, BY238, 850V PIV, ½A, 4/6

ELECTROVALUE
6 Mansfield Place • ASCOT • Berkshire

SEMICONDUCTORS: Close equivalents—OC35—**4/9**; OC72—**2/-**; OC170—**2/6**; OC44—**2/-**; OC71—**1/9**; OA70—**8d.** P. & P. 9d. A. P. WISE, 19 Harbeck Rd., Bournemouth, Hants.

NEW COMPONENTS

★ **TRANSISTORS**—Matched Output Kit:
OC81D and 2-OC81 .... 10/-
R.F. Kit: OC44 and 2-OC45 .... 10/-
OC44, 45, 70, 72, 81 and 81D Equivalents, each........ 3/6

★ **RESISTORS**—5% Hi-Stab Carbon Film 75 Ω to 1M Ω (½ watt); 10 off, one preferred value 4/-

★ **CAPACITORS**—Polyester Foil: 160 VDC/100 VAC.
33 pF to .1μF:5 off, one preferred value 3/6
.15μF to .47μF:5 off, one value 5/-

★ **ASSORTED RESISTORS**—Hi-Stab. 300 off (5% or better, worth £3) 15/-
(P. & P. 1/6 per order, C.W.O.)

ELMBRIDGE INSTRUMENTS LTD.
Island Farm Ave., West Molesey, Surrey

COMPONENTS BONANZA! S.A.E. for big list! A. J. BASSETT, 28 Park Road, Chorley, Lancs.

BY100 rectifiers **4/-** each any quantity. Post paid. BLAKE, 52A Runcorn Road, Birmingham 12.

SEMICONDUCTOR BARGAINS

Ge. DIODES: OA5, OA7, OA47, OA81, all 1/6 each; GEX66 2/-; GEX941 2/6; AAZ12 3/-; AAZ13 2/6; SX631 3/-; OA10 4/6.

ZENERS: OAZ201 5/-; 27v 600mw 11/6.

TRANSISTORS: OC170 3/6; OC70 5/-; OC71 5/-; OC72 6/-; OC76 5/9; OC83 6/-; OC139 11/6; OC140 15/6; OC200 9/-; OC204 17/-; OCP71 27/6; GET872 3/6; 2N706 5/9. Silicon power transistor 5 Amps, 100v, 50w 37/-; ADY26 55/-.

A top quality silicon bridge rectifier 5 Amp 35v 35/-.

Send for details of our new regulated power supplies:—

25v/½A, 25v/1A, 25v/2A, 75v/½A.

P. & P. 2/6 in the £, minimum 1/6.

ELECTRO PROCESS
6d, SUN STREET, HITCHIN, HERTS.

TAPE RECORDERS, TAPES, ETC.

TAPES TO DISC—using finest professional equipment—45 r.p.m. **18/-**. S.A.E. leaflet. DEROY, High Bank, Hawk Street, Carnforth, Lancs.

MISCELLANEOUS

CONVERT ANY TV SET into an Oscilloscope. Diagrams and Instructions, **12/6**. REDMOND, 42 Dean Close, Portslade, Sussex.

"PRACTICAL ELECTRONICS". Wide Range Signal Generator. Solid State Ignition; and all constructional projects going back to Issue 1. Send s.a.e. for your choice of itemised price lists. AJAX ELECTRONICS, 18A Rumbold Road, Fulham, London, S.W.6.

TRANSFORMERS Rewound. Output or mains. Specials made to order. Reasonable prices. S.A.E. enquiries. RATCLIFFE, 27 Station Road, Holmfirth, Yorks.

BERNIESOUND (AUDIO ENGINEERS)
Design-Build-Repair-Modify
All types of Electronic Equipment
For estimates write to:—
Mr. Brown, 1 Effie Place, London, S.W.6.

BATTERY ELIMINATORS

The ideal way of running your TRANSISTOR RADIO, RECORD PLAYER, TAPE RECORDER, AMPLIFIER, etc. Types available: 9v; 6v; 4½v (single output) 39/6 each. P. & P. 2/9. 9v + 9v; 6v + 6v; or 4½v + 4½v (two separate outputs) 42/6 each. P. & P. 2/9. Please state output required. All the above units are completely isolated from mains by double wound transformer ensuring 100% safety.

R.C.S. PRODUCTS (RADIO) LTD.
(Dept. P.E.), 11 Oliver Road, London, E.17

AERIAL WIRE:—Pure Copper, insulated; still available in 75ft. reels at excellent price of 6/- + 1/- P. & P.
TEST LEAD KIT:—Truly excellent value. Consists of two ideal length test leads with probes, and plug-in attachments (spade connectors, crocodile clips and circuit probes). All in plastic wallet for only **6/9** + 1/3 P. & P.
LOUDSPEAKERS:—We carry a range of speakers to suit every application.
Typical examples are:—

1. Westwell 0.2W; 8ohm; 2½in. dia. **7/9.**
2. Westwell 0.2W; 8ohm; 3in. dia. **9/6.**
3. Norman; 3ohm; 7in. × 4in. elliptical suitable for most car radios **13/6.**

1/6 P. & P. on above speakers.
EXCLUSIVE TO BOTHWELL ELECTRIC SUPPLIES
Due to a massive purchase, we can offer you at the ridiculous price of **8/6** P. & P. 1/- a high frequency horn, suitable for use as a burglar alarm, motor cycle alarm, and all warning devices. Demand for this unique offer is bound to be great, so order now and avoid disappointment. 1.5/4.5 V. D.C. only.
TEST METERS:—Model 200 H: Still the most popular instrument in our wide range of meters and still a wonderful buy for the discerning engineer with a limited budget.
20K. ohms per volt makes this meter as accurate as a valve-volt meter for most applications, measuring voltages, current, resistance, capacitance, and decibels. Only **£4.9.6** post free.
BATTERY ELIMINATORS:—

1. Eagle Model LA—6P with self contained pilot light. 9V d.c. to suit most transistor radios, etc. **23/6** + 1/- P. & P.
2. The NORMAN eliminator replaces even a PP9 battery and is ideal for an experimental bench power supply. Same size as PP9. **29/6** + 1/6 P. & P.

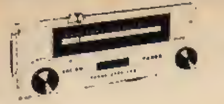
MICROPHONES:—A comprehensive range of mics. always in stock. We also stock external inserts.
SINCLAIR PRODUCTS:—Complete range in stock including the new 12 watt—12 amplifier and power supply. Usual prices—post free.
SEMICONDUCTORS: We carry a range of transistors, diodes, rectifiers and other devices to meet your every need at competitive prices, e.g.

OA81 diodes, **2/3.**
OC44 and OC45 transistors, at **3/4.**
2N2926 Silicon Planer NPN Transistors, **4/6.**
Post free

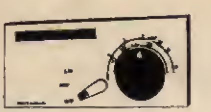
Write or call now for our most recent components list.

BOTHWELL ELECTRIC SUPPLIES (Glasgow) LTD.
54 EGLINTON STREET
GLASGOW, C.5. Tel. 041 SOUth 2904
Member of the Lander Group
Trade enquiries welcomed.

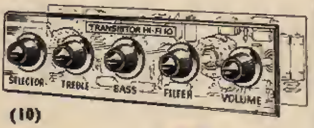
Please mention
PRACTICAL ELECTRONICS
when replying to
Advertisements



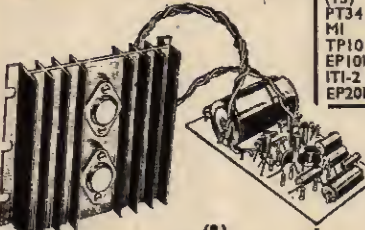
(14)



(12)



(10)



(9)

10 AND 20 WATT MONO AND STEREO TRANSISTOR AMPLIFIERS

(9) POWER AMPLIFIERS. 10 watts RMS output. 100mV input. 30 c/s to 20kc/s ± 1dB. 6-Transistor Push-pull. Panel size 4×2½×1in. H/S 4×4in.
TPA10/3 3-5 ohm spkr. **£4.10.0**, pp. 2/6
TPA10/15 12-16 ohm spkr., **£5.5.0**, p.p. 2/6
(Mains unit for 1 or 2 amplifiers, **59/6**, p.p. 2/6)

The Finest High Fidelity at Unbeatable Prices

(10) PREAMPLIFIERS. 8 input selector. Treble, bass, volume, filter controls. 1½mV to 300mV inputs. Battery operated or from Mains Unit. Output up to 150mV RMS.

MP2 Mono 9½×2½×2in. **£5.10.0**, p.p. 2/6 (grey and gold front panel 8/6)

SP4 Mono/Stereo, 9×3½×1⅝in., **£10.19.6**, p.p. 3/6 (front panel plate 12/6)

● ALL UNITS BUILT AND TESTED

25 WATT AMPLIFIER

New 8-Transistor design. Push-pull output for 7½ to 16ohm speaker. 150mV input. 30c/s to 20kc/s ±1dB. For use with valve or transistor preamplifiers as item (10) above. Size 2⅞×2⅞×6½in.
PRICE BUILT AND TESTED £7.19.6 P.P. 3/-
(Mains unit 79/6, p.p. 2/6)

(12) MW/LW QUALITY TRANSISTOR RADIO TUNER

Fully tunable superhet with excellent sensitivity and selectivity. Output up to ½ volt peak. Complete with front panel, etc. 9 volt operated. For use with any amplifier or tape recorder.
TOTAL COST TO BUILD £3.19.6 P.P. 2/6

(13) MULTI-METERS

PT34	1kV 39/6	TP5S	20kV	£5.19.6
M1	2kV 49/6	EP30k	30kV	£6.10.0
TP10	2kV 75/-	EP50k	50kV	£8.15.0
EP10k	10kV 79/6	500	30kV	£8.17.6
ITI-2	20kV 69/6	EP100k	100kV	£10.10.0
EP20k	10kV 99/6			

(14) VHF FM TUNER

Supplied as 2 Preassembled Panels, plus metal work Superhet design, 88-108 Mc/s, 9 volt operated.
Total cost to assemble **£12.17.6** p.p. 2/6.

(15) GARRARD BATTERY 2-SPEED TAPE DECK

Brand New with R/P head, erase/osc. head, tape cassette and instructions. 2 speed 2-track 9 volt operated.
List Price 13 gns.
PRICE **£8.19.6** P. & P. 3/6

(16) NOMBREX TEST UNITS

150 kc/s—350 m/cs RF Generator All Transistor **£10.10.0**
10 c/s—100 kc/s Transistor Audio Generator **£16.19.6**

(17) 5 WATT AMPLIFIER

6-Transistor Push-pull, 3 ohms. 6mV into 1K. 12/18V supply. 2⅞×2×1½in.
BUILT AND TESTED 69/6 P.P. 2/-
(optional mains units 54/-)
1½ watt version 59/6.
Matching Preamplifier, 6 inputs, treble/bass/selector/volume controls. 6-10mV o/put. 9-18V supply. 79/6, p.p. 2/-
For use with any Transistor Amplifier

HENRY'S RADIO LTD.
303 EDGWARE RD., LONDON, W.2
PADdington 1008/9
Open Mon. to Sat. 9-6. Thurs. 1 p.m.
Open all day Saturday

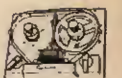
COMPONENTS and Equipment. The largest range in the country. 6/- buys 150 page catalogue with discount vouchers.

HR

(16)

(17)

(13)



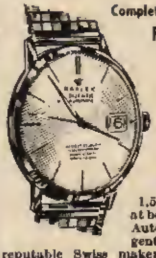
(15)

SEE BACK COVER FOR MORE ITEMS OF INTEREST

MAKE 5 DIFFERENT TRANSISTOR RADIOS

FOR ONLY **35/-**

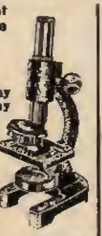
Amazing Radio Construction Set! Become a radio expert for 35/-. A complete Home Radio Course. No experience needed. Parts include instructions for each design, Step-by-Step plan, all Transistors, loudspeaker, personal phone, knobs, screws, etc., all you need. Box size 14"×10"×2" (parts available separate). Originally £6. **NOW 35/-** plus 3/6 p. & p.



Complete unopened Crate of
Fully AUTOMATIC SELF-WINDING
21 JEWELLED
DATE WATCHES
Originally 10 gns.
ONLY **98/6**
You save £5.11.6

1,500 only to be cleared at below half price. Fully Automatic *self winding* gent's calendar watch by reputable Swiss maker. Luxurious gold finish, stainless steel screw back — shock resistant, antimagnetic, waterproof. Unbreakable mainspring — 21 Fully Working Jewels. Electronically timed 7 days' free trial—**send 98/6** plus 3/6 p. & p. (Matching expanding bracelet 10/6 extra). **Brand New with full written guarantee** *and instant money back guarantee.*

Importers stock bought at miles below actual value
WIDE RANGE HIGH POWER MICROSCOPE
ONLY **37/6** not a penny more to pay



Grade A.1 De Luxe model, all *metal* construction in black crackle with plated parts. **Accurate rack and pinion focusing** gives crystal clear definition. 3 *optically polished lenses on revolving turret, giving* **100x, 200x and 300x magnification powers.** Adjustable mirror light, reflector and tilting joint. Ideal for students, hobbyists, nature study, etc. Should last a lifetime—Passed by Japanese Board of Inspection. **Brand new in box,** *complete with set of slides at fraction of real worth* — **ONLY 37/6 plus 3/6 post and safe packing.** *Money back guarantee. Demonstrations daily.*

HIGH POWERED TRIPOD TELESCOPE

For only **45/-**
No More To Pay
750 Only at fraction of true value!

Advantageous Purchase Direct from Importer—A.1 De Luxe model — passed by Japanese Board of Inspection. All Metal construction. Black Crackle finish, plated parts, simulated leather covering. Polished optical lens gives astounding magnification power of 900-1 areas. Single draw focusing tube, study the MOON, PLANETS. With independent view finder, focus miles away or just across the road. New with collapsible tripod at unbelievable price of only **45/-** plus 5/- p. & p. Money back guarantee.

CONCORD ELECTRONICS LTD · (Dept. PE29) · 87 TABERNACLE ST · E.C.2

BAKER 12in. DE-LUXE Mk II

Especially designed to provide full range reproduction at an economical cost. Suitable for use with any high fidelity system.

Maximum Power	15 watts
Bass Resonance	32-38 c.p.s.
Flux Density	14,000 gauss
Voice coil diameter	1½"
Voice coil impedance	15 ohms
Voice coil material	Copper
Useful response	25-16,000 c.p.s.
Cone surround	Plastic
Chassis material	Solid aluminium
Overall diameter	12¼"

Available from all Radio & Hi-Fi Dealers
PRICE £9

Send for New catalogue and enclosure plans

Baker Reproducers Ltd.
(DEPT. P.E.)
Bensham Manor Road Passage, Thornton Heath, Surrey. THO 1665

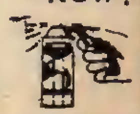
YUKAN SELF-SPRAY

SO PROFESSIONAL . . . THE YUKAN AEROSOL WAY!

GET THIS **AIR DRYING HAMMER FINISH** *NOW!*

Open all day Saturday

YUKAN Aerosol spraykit contains 16 ozs. fine quality durable easy instant spray. No stove baking required. Available in Grey, Blue, Gold, Bronze at 14/11 at our counter or 15/11, carriage paid, per pushbutton self-spray can. SPECIAL OFFER: 1 can plus optional transferable snap-on trigger handle (value 5/-) for 18/11 carriage paid.



Closed Thurs. afternoons

Choice of 13 self-spray plain colours and primer (motor car quality) also available

Please enclose cheque or P.O. for total amount to:

YUKAN · DEPT. PE/10 · 307a EDGWARE ROAD · LONDON · W.2

Published about the 15th of the month by GEORGE NEWNES LIMITED, Tower House, Southampton Street, London, W.C.2. Printed in England by THE CHAPEL RIVER PRESS, Andover, Hants. Sole Agents for Australia and New Zealand: GORDON & GOTCH (A/sia) Ltd.: South Africa and Rhodesia: CENTRAL NEWS AGENCY LTD.: East Africa: STATIONERY & OFFICE SUPPLIES LTD. Subscription rate including postage for one year: To any part of the World £1 16. 0.