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APRIL 1981
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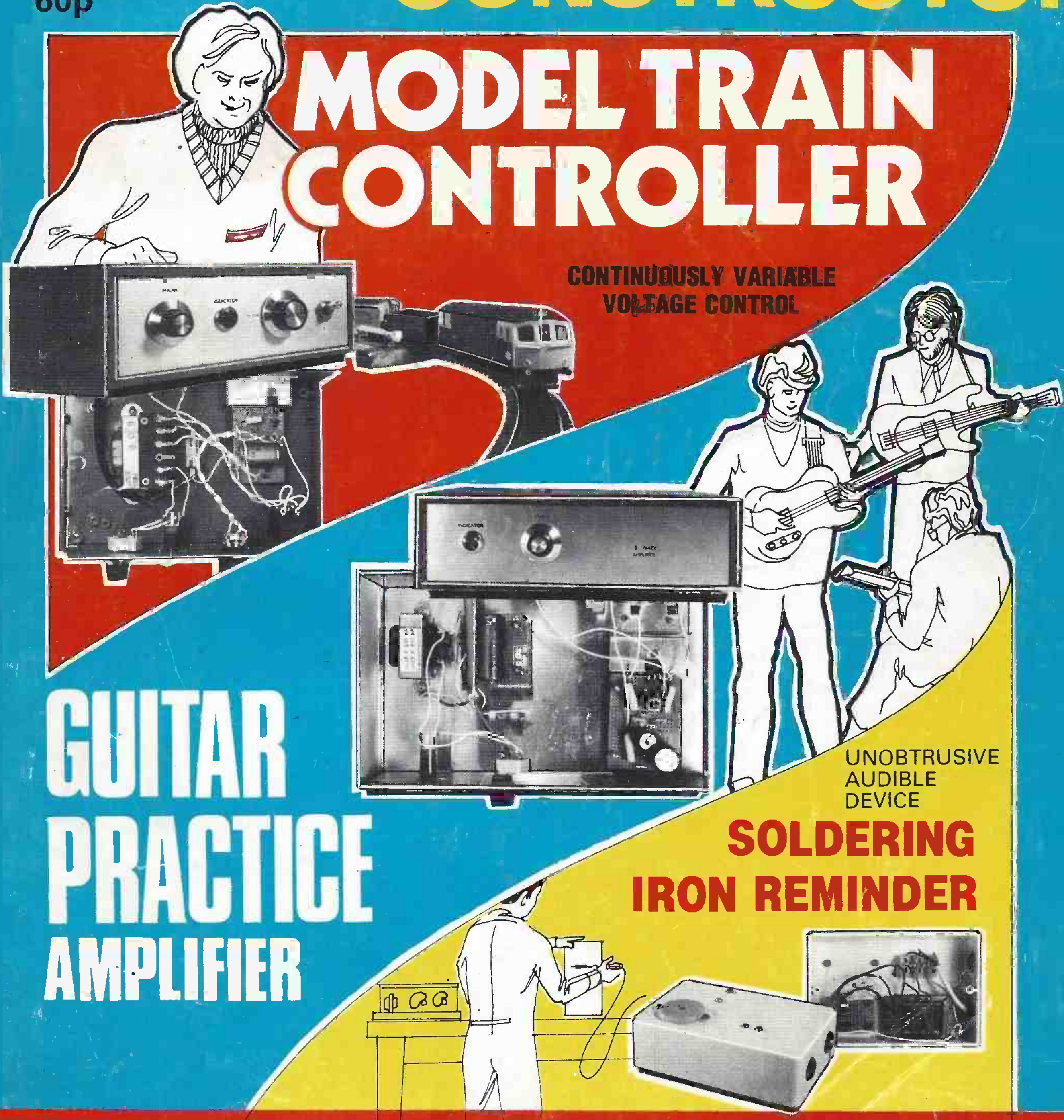

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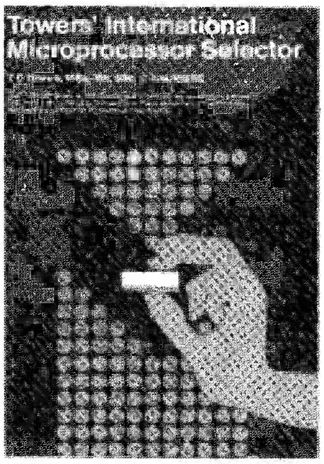

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If you come into contact with microprocessors (whether as hobbyist, student, circuit engineer, programmer, buyer, teacher, serviceman, or just humble reader) you often find you would like data information on a specific microcircuit element. Specifications apart, you may be even more interested in where you can get the device in question. And perhaps even more important still (particularly with obsolete devices), you may be looking for guidance on a readily-available second source or possible substitute.

This microprocessor selector (working on the same basis as the TRANSISTOR, FET, and OPAMP LINEAR-IC selectors already compiled by the author) is designed to provide in one handy reference volume a comprehensive body of readily-accessible, user-slanted essential information across the field of microprocessors.

In the data tabulations will be found set out the essential basic specifications of over 7,000 commercially-available microprocessor 'chips', including not only the microprocessor elements themselves (e.g. MPUs and CPUs) but also the many other LSI 'support' circuits (e.g. ROMs, RAMs, PROMs, clocks, UARTs, I/Os) normally used in harness with the microprocessors proper to produce complete microcomputers or microcontrollers. For ease of reference, the descriptions and control specifications of the individual circuits are set out in the detailed data tables on separate single lines, arranged in alpha-numeric order by type number.

For the newcomer to the very new field of microprocessors, the selector includes a full introductory note on these devices before the data tables.

Besides this, the tables are supplemented by separate appendices giving additional information on: (a) Microprocessor chip applications (and codings); (b) Microprocessor 'families'; (c) Microprocessor LSI chip manufacturers (and codings); (d) Semiconductor LSI technologies (and codings); (e) Microprocessor chip packages (and codings); (f) Microprocessor trainer and development systems; (g) Microprocessor bibliography; (h) Manufacturers' house codes; (i) Glossary of microprocessor terms; (j) Explanatory notes to tabulations.

This selector is fully international in scope and covers not only microprocessors and related devices from the USA and Continental Europe, but also from the UK and the Far East (Japan).

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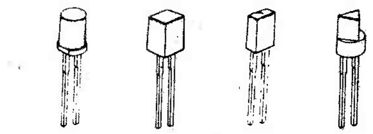

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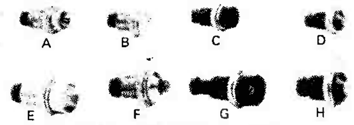

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405	0.68uF	16v	0.11
406	1.0uF	16v	0.11
407	2.2uF	16v	0.12
408	3.3uF	16v	0.13
409	4.7uF	16v	0.14
410	6.8uF	16v	0.15
411	10.0uF	16v	0.16
412	22.0uF	16v	0.28
413	33.0uF	16v	0.50
414	47.0uF	16v	0.55
415	100.0uF	10v	0.55
416	.1uF	35v	0.12
417	.22uF	35v	0.12
418	.33uF	35v	0.12
419	.47uF	35v	0.12
420	.68uF	35v	0.12
421	1.0uF	35v	0.12
422	2.2uF	35v	0.13
423	3.3uF	35v	0.15
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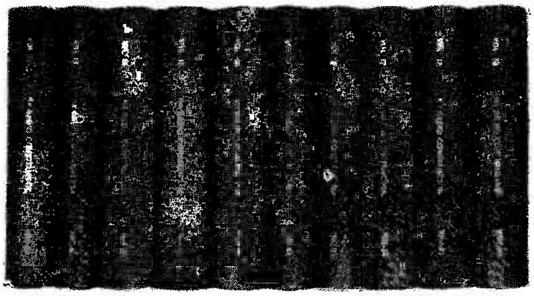

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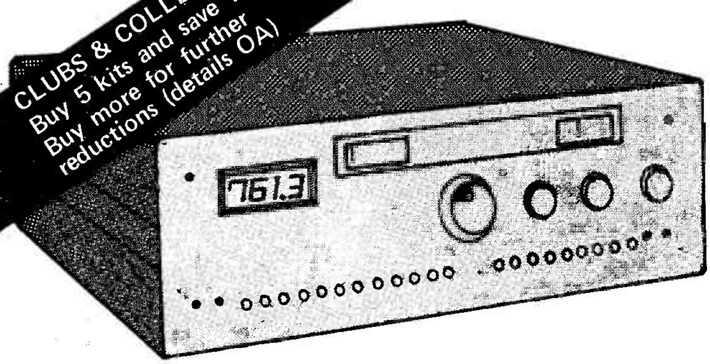

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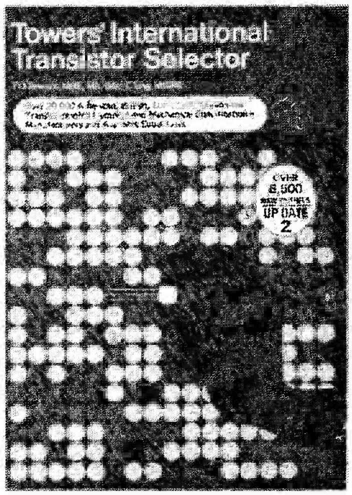
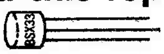


This is dead! 

Would this replace it?



If it takes you longer than 1 minute to find out all about these transistors then you need a copy of TOWER'S INTERNATIONAL TRANSISTOR SELECTOR. It's one of the most useful working books you will be offered this year. And probably the cheapest!

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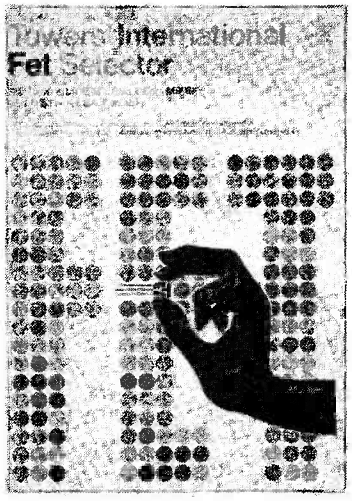
TOWERS INTERNATIONAL FET SELECTOR



If you deal with field effect transistors, or fet's — whether as a student, a hobbyist, a circuit engineer, a buyer, a teacher or a serviceman — you often want data on a specific fet of which you know only the type number.

Specifications apart, you may be even more interested in where you can get the device in question. And perhaps more important still (particularly with obsolete devices), you may want guidance on a readily available possible substitute.

This fet compendium, a comprehensive tabulation of basic specification, offers information on:

1. Ratings
2. Characteristics
3. Case details
4. Terminal identifications
5. Applications use
6. Manufacturers
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BA116	**30p**
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BA148	**12p**
BA182 Varicap	**6p**
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BAX14	**2½p**
BAX20	**3p**
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BAX22 100v 120ma	**3p**
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OA5	**25p**
OA7	**25p**
OA10	**25p**
OA40 40v 50ma	**4p**
OA47 30v 150ma	**7p**
OA51 50v 50ma	**4p**
OA70	**10p**
OA75	**11p**
OA79	**11p**
OA81	**3½p**
OA90 30v 45ma	**4p**
OA91 115v 150ma	**6p**
OA95 115v 150ma	**6p**
OA200 50v 250ma	**2½p**
IGP7	**11p**
IGP10	**11p**
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IN337 200v 200ma	**4p**
IN447 40v 25ma	**3p**
IN604 400v 300ma	**4p**
IN662	**2½p**
IN916 75v 300ma	**2½p**
IN3062 75v 20ma	**3p**
IN3063 (BAV10)	**6p**
IN3064 75v 10ma	**2½p**
IN4009	**2½p**
IN4148 75v 200ma	**1½p**
IN4149 100v 200ma	**3p**
IN4150	**2½p**
IN4151 50v 200ma	**2½p**
IN4152 40v 200ma	**3p**
IN4446 100v 200ma	**2½p**
IN4449 100v 200ma	**2½p**
IN5154 25v 30ma	**3p**
IN5456	**15p**
IS922 150v 200ma	**4p**
IS940 30v 50ma	**3p**
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RECTIFIERS

Type	Volt	Amp	Price
BY126	650	1	5p
BY127	1250	1	5p
BY212	15kv	500ma	6p
BY235	600	1½	7½p
BY236	900	1½	7½p
BY264	300	3	9p
BY265	600	3	11½p
BY266	900	3	15p
BY274	300	5	14½p
BY275	600	5	19½p
BY277	1200	5	27p
BY299	800	2	4p
BY1202	2kV	10mA	6p
BYW55	800	2 (Oxide bead)	15p
BYW56	1000	2 (Oxide bead)	18p
BYX20-200	200	25	72p
BYX22-200	300	1½	25p
BYX38 300R	300	6	48p
BYX38 600	600	6	52p
BYX38 900	900	6	60p
BYX38 1200	1200	6	65p
BYX42 300	300	12	36p
BYX42 600	600	12	46p
BYX42 900	900	12	92p
BYX42 1200	1200	12	£1.07
BYX46 300R	300	15 Avalanche	£1.19
BYX46 400R	400	15 Avalanche	£1.75
BYX46 500R	500	15 Avalanche	£2.00
BYX46 600	600	15 Avalanche	£2.30
BYX48 300R	300	6	47p
BYX48 600	600	6	60p
BYX48 900	900	6	70p
BYX48 1200R	1200	6	92p
BYX49 300R	300	6	35p
BYX49 600	600	6	42p
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IN4004	400	1	4½p
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IN4006	800	1	6p
IN4007	1250	1	6p
IN5059	200	1½	10p
IN5401	100	3	10p
IN5402	200	3	11p
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IN5408	1000	3	19p
IS027	800	1½	11p
IS138	800	¼	2½p
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3052	200	3	11p
16094P	900	2	15p
16492	700	1½	9½p

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AMP	VOLT	Type	Price
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½	1,600	BYX10	**34p**
0.6	110	EC433	**20p**
1	140	OSH01-200	**25p**
1	400V	MDA104	**29p**
1½	50V	WO05	**27p**
1½	200V	WO2 Ex Equip	**15p**
1½	400V	WO4	**28p**
1½	400V	UE4R1	**12p**
1	100V	B40C800	**12p**
1½	800V	WO8	**27p**
1½	1000	W10	**36p**
1½	75V	IBIBY234	**11½p**
1½	150V	IBIBY235	**15p**
2½	100	I.R.	**40p**
2½	350V	9F2	**53p**
2½	500V	9E4	**85p**
3	50	KBS005	**30p**
3	100	KBS01	**30p**
3	200	KBS02	**30p**
3	400	KBS04	**30p**
3	600	KBS06	**30p**
3½	100	B40C 3200	**39p**
5	400	Texas	**85p**
Miniature	Meter	Type	**34p**

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Amp	Volt		
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1	240	BTX30-200	**35p**
1	400	BTX18-300	**41p**
1	700	BT 106	**70p**
2	400	S2710D with heatsink	**40p**
3	600	T3N06C00	**53p**
3	100	T3N1C00	**36p**
4	50	S107F Sensitive Gate	**36p**
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4	600	2N3228	**36p**
4	600	GAK	**36p**
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5	600	S5800M	**44p**
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BZY61 Laboratory Standard 400MW 7v5. Voltage Regulator Diode **12p**
1.3/1.5WT BZX61, BZY97, etc. **11p**
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2.5WT BZX70, etc. **13p**
2v4. 3v6. 3v9. 5v6. 6v2. 7v. 7v5. 8v. 9v. 10v. 11v. 14v. 15v. (8p). 20v. 22v. 26v.
5WT BZV40, etc. **15p**
3v3. 3v6. 3v9. 4v3. 4v7. 5v1. 5v6. 6v2. 6v8. 7v5. 8v2. 8v7. 9v1. 10v. 11v. 12v. 15v. 20v. 33v. 68v. 120v.
10WT Z5D, ZX, IS50, etc. **20p**
4v3. 4v7. 5v1. 5v6. 6v2. 6v8. 7v5. 8v2. 10v. 11v. 12v. 13v. 16v. 18v. 21v. 22v. 33v. 36v. 39v. 43v. 51v. 56v. 62v. 68v. 75v. 150v.
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16	4p	150	6p	1000	20p
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25	4p	200	13p		
30	4p	220	7p		
33	4p	250	8p		

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1	3½p	47	5½p	400	12p
8	7p	50	7p	470	10p
10	7½p	64	7½p	680	8p
15	3p	100	6p	1000	39p
16	7p	150	8p	2200	35p
25	5p	220	7p		
32	5p	250	15p		

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MC830P	4p
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SN76003 5Wt. Amp	36p
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TAA263 Amp (low level)	75p
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TCA830S Ex. Equip A.F. Amp.	18p
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TMS 3409 memory 80 bit shift Reg.	£1.10p
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ZN414 AM Radio Receiver	79p
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Electrolytic capacitors (wire ended)

75 volt					
1	10p	3	10p	100	15p
2	10p	64	15p	220	22p
100 Volt					
3	9p	25	13p	330	11½p
5	7½p	47	16p	680	11½p
20	13p	50	16p		
22	13p	60	7½p		
160 Volt					
1	15p	8	15p	32	23p
4	15p	10	16p	50	23p
4.7	15p	15	7p	80	26p
6.8	15p	16	18p		
200 Volt					
2	15p				
250 Volt					
22	18p	47	23p		
275 Volt					
32	32p				
300 Volt					
2	26p	8	13p (Pack of 5)	10	£1.05p
350 Volt					
1	6p	4	6p	10	8p
2	26p	4.7	26p	16	32p
		22	16p		
400 Volt					
1	32p	10	10p		
450 Volt					
2	22p	16	37p		
4.7	27p	22	37p		
500 Volt					
0.47	32p	4.7	30½p	22	37p
1	23½p	10	20p		

SESCO SECURITY LTD.
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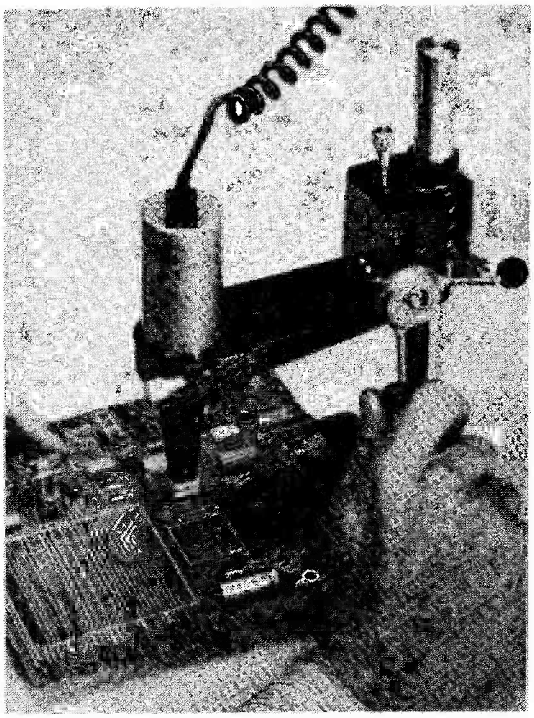
£13.00

NEWS ... AND

NEW TRADE MARK WITH NEW RANGE OF DRILLS



Microflame (UK) Limited, Vinces Road, Diss, Norfolk IP22 3HQ have recently announced the birth of a brand-new trademark and range of low-voltage mini-Drills.

The **'Drillmaster'** range embraces two drills – **'Drillmaster'** Junior and **'Drillmaster'** Senior – and a comprehensive range of accessories for drilling, grinding, polishing, cutting, shaping, carving, engraving, de-burring and similar operations. Both drills are fitted with the latest telephone-type, "curly-tail" flexible cords, and are suitable for battery or transformer operation.

'Drillmaster' Junior has a unique, "curved triangular" shaped body which fits comfortably into the angle between the base of the user's thumb and forefinger, and close control is aided by the provision of a detachable chuck finger-shield. A chuck with 4 precision cut steel collets, 0.6mm, 1.2mm, 1.8mm and 2.4mm is fitted as standard.

'Drillmaster' Junior Drill Stand has a powerful magnifying glass attachment built-in.

'Drillmaster' Senior is supplied with an automatic 3-jaw chuck as standard, and a precision chuck with a set of 5 steel collets, 0.6mm, 1.2mm, 1.8mm, 2.4mm and 3.2mm is available as an optional extra.

In addition to a robust Drill Stand for the **'Drillmaster'** Senior, over 100 accessories are available for use with either the Junior or Senior Drill.

Leaflets and Price Lists are available.

SOLDERING IRONS TO BE BETTER DISPLAYED

S. & R. Brewster Ltd., of 86-88 Union Street, Plymouth PL1 3HG, are sending their famous soldering irons to retail outlets in a different form of packing.

Previously packed for shelf display, the soldering irons can now be seen in very attractive boxes using the more modern hang-up display style. Instead of viewing the soldering irons end-on they can now be seen full length.

The green boxes house the standard Type 1 mains voltage iron, the brown ones contain Type 1 12 volts iron and the yellow one their Model D.

The soldering irons can be supplied direct to individual customers as well as to the trade and the irons can, of course be obtained from many retail outlets.

TECHNICAL STANDARDS FOR TV AND LOCAL RADIO STATIONS

"Standards for Television and Local Radio Stations" – has recently been published by the Independent Broadcasting Authority.

This 72-page book with many two-colour illustrations brings together the current IBA Technical Codes of Practice relating to television studio centres and to ILR studios and OB operations. These are mandatory codes for ITV and ILR programme companies and have special importance also to equipment suppliers and the broadcasting industry generally. For television, these codes will apply to the new ITV contracts from January 1982.

The book is intended for engineers, firms and students directly involved in the field of broadcasting.

IBA Technical Review No. 13, "Standards for Television and Local Radio Stations", technical editor John Lovell, published by IBA, London.

THE RADIO AMATEUR INVALID AND BLIND CLUB

We recently received the up-to-date membership list of the R.A.I.B.C.

The total membership is now 615 of whom 324 are licensed members and 291 short wave listeners. Due to helpful publicity by the R.S.G.B., during the past year, nearly 30 additional clubs and societies have promised their help.

Those of our readers not previously aware of the good offices of R.A.I.B.C. in assisting shortwave enthusiasts who are invalids, or blind, and feel that they could probably help should write to the Honorary Secretary, Mrs. Frances Woolley, 9 Rannoch Road, Adelaide Road, Surbiton, Surrey KT6 4TE, for details.

The club was founded in 1954 and is affiliated to the R.S.G.B. and publishes 6 News Letters per year.

. . . COMMENT

AMSAT NEWS

With this year's AMSAT Membership Renewal Subscription Form, comes a message from Tom Clark, AMSAT's President. As he points out, last year the Phase III Satellite was nearing completion at the beginning of the year, when subscription renewal forms were being sent out; the first issue of AMSAT's magazine ORBIT was on the boards and everyone was looking forward to the dawn of a new era in the amateur radio satellite field. The loss of the Phase III satellite on May 23rd., last year, seemed at first to be a calamity from which AMSAT might well not have recovered, but the support which followed appeals for financial and practical help, enabled a second Phase III to be got on the stocks and AMSAT to come back stronger than ever. As Tom Clark points out, a lot is going on, as the following list of projects shows:-

In September 1981, the University of Surrey's UoSAT, Amateur Scientific Satellite will be launched. Much help for this project has come from AMSAT.

In February 1982, the replacement Phase III satellite will be launched.

In mid-1983, another Phase III type amateur radio satellite will be launched, which at the moment is designated Phase III C.

Sometime in 1984, SYNCART, the first sycchronous amateur radio satellite will be launched.

With such a list of projects in the pipe-line, AMSAT is still appealing for more subscribers and donations. The Overseas Subscription is now $20 and a Life Membership subscription can be had for $200. For those who would find it easier to pay into an account in this country, AMSAT-UK has agreed to accept the AMSAT Corporation subscriptions and donations and forward them on to Washington. They should contact AMSAT-UK's Secretary, Mr. Ron Broadbent, at 94, Herongate Road, Wanstead Park, London, E12 5EQ.

May we take this opportunity of congratulating Dr. Tom Clark, on the recent award to him, by NASA, of a NASA Exceptional Performance Award, for work he has carried out in his professional capacity as a professional radio astronomer. Dr. Clark was leader of a team doing work on "long base-line" radio space surveys.

SONY'S GUIDE TO VIDEOGRAPHY

With UK sales of video recorders forecast to pass the 300,000 mark by the end of the year, Sony has recognised the need both to assist existing owners in utilising their equipment to its best advantage, and also to explain to potential customers the full range of home entertainment which videography now provides.

The company has produced a 48 page full colour handbook containing comprehensive details not only of the best ways to exploit all the facilities of video recorders, but also how to make home video movies, the use of sound and lighting and even the creation of professional style, special effects and titling.

Amply illustrated and using simple non-technical language the handbook – entitled 'How to Video' – is currently on sale at Sony London Showroom, 134 Regent Street, London W.1., price 60 pence. It is also available by post from the Showroom (30 pence extra).

50 MHz QUAD TRACE OSCILLOSCOPE

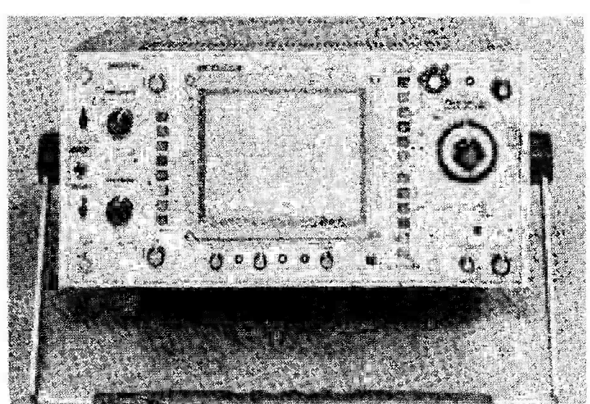
The new leader LBO-517 has all the features expected on a professional 50HMz oscillloscope plus an extremely useful quad trace facility.

Sensitivity is 5mV/DIV for 50MHz, 1mV/DIV (with MAG x5) for 10MHz, and maximum sweep rate is 5nS/DIV with MAG x10.

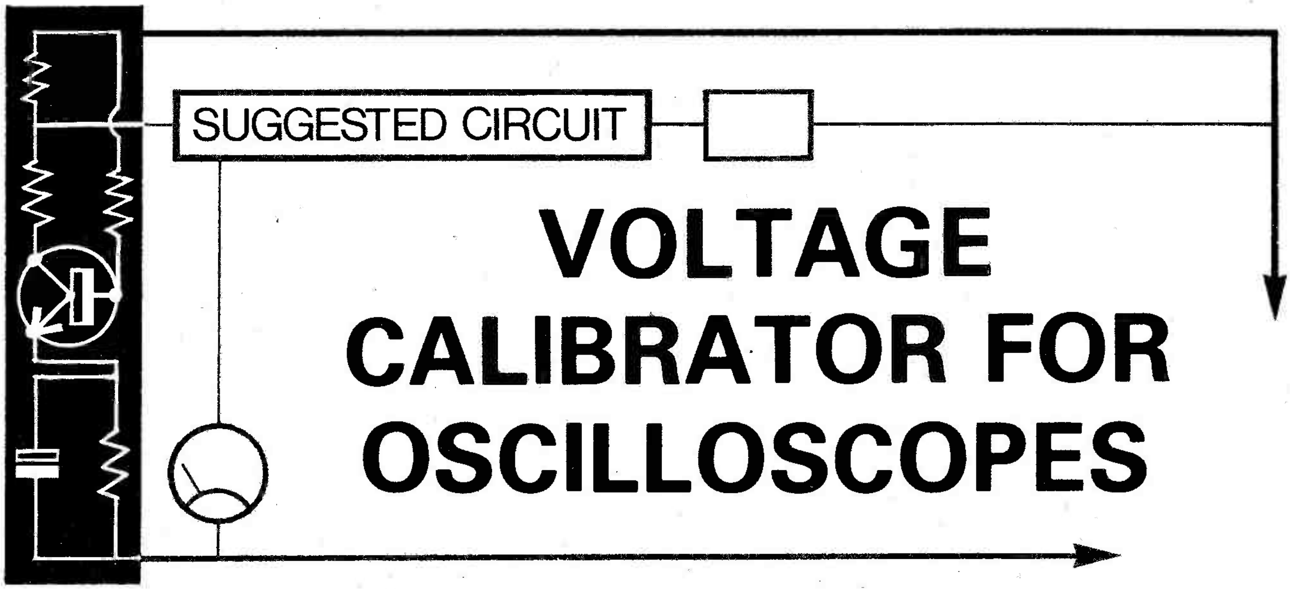
Comprehensive triggering and synchronisation facilities, a full specification calibrated timebase and variable hold off functions (including B ends A) make the LBO-517 ideal for a wide range of applications in R & D, or for servicing TVs, VCRs, computer peripherals, etc.

Performance is further enhanced by the quad trace facility, channels 3 and 4 being accessed via rear panel sockets and controls, and various alarm indicators to eliminate mis-operations.

The 10 x 8cm high brightness display has an internal graticule to eliminate parallax errors, graticule illumination, and additional 10% and 90% scales to facilitate pulse measurements.



Further details can be obtained from: Sinclair Electronics Ltd., London Road, St. Ives, Huntingdon, Cambs. PE17 4HJ.



VOLTAGE CALIBRATOR FOR OSCILLOSCOPES

By G. A. French

From time to time we receive requests from readers for oscilloscope voltage calibrating units. Only a small proportion of home-constructors possess oscilloscopes, of course, and it is for this reason that voltage calibrator circuits appear less frequently than do circuits for more commonly employed items of amateur-built test equipment. On the other hand, oscilloscope voltage calibrator circuits represent an interesting branch of hobby electronics because they demonstrate how high degrees of accuracy can be achieved with only a few components in quite simple designs. Also, an oscilloscope voltage calibrator can double as an audio frequency signal generator!

CALIBRATOR CIRCUIT

The calibrator circuit appears in Fig. 1. In this, IC1 runs as an astable multivibrator whose frequency is controlled by R1, R2, R3 and C1. Because R2 is equal to R3, and R1 is equal to 4 times R2, the multivibrator produces a 50 : 50 square wave. The presence of R1 causes the oscillator frequency to be slightly higher than the calculated value taken from the values of R2, R3 and C1, and in practice it is approximately 1kHz.

The 555 output, at its pin 3, is applied via the constant current device IC2, to the potential divider chain consisting of R5, R6 and R7. A constant current flows through the chain when the 555 output is high, and there is zero current in the chain when the 555 output is low. Thus, a positive going square wave is built up across the chain, its voltage magnitude depending upon the constant current and the resistance values in the chain.

The required constant current is 5mA. It will be seen that the sum of the values of R5, R6 and R7 is 200Ω whereupon, from Ohm's Law, a constant current of 5mA will cause 1 volt to appear across the three

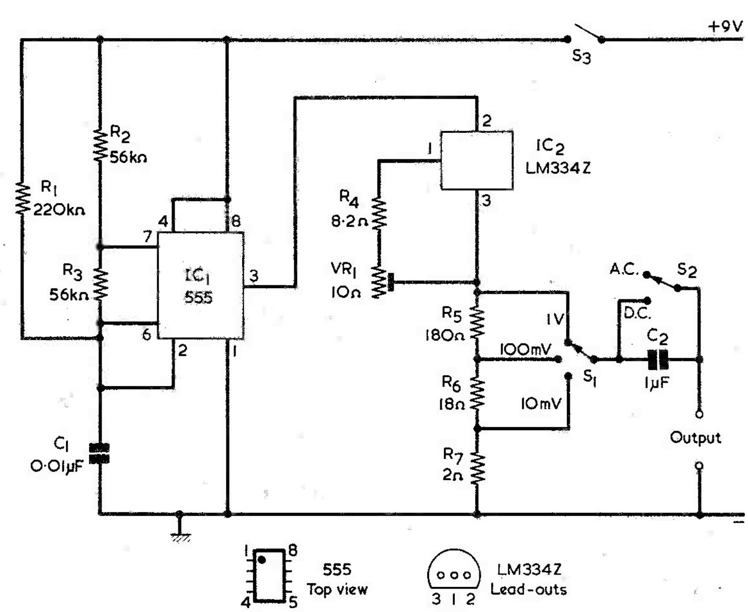


Fig. 1. The circuit of the voltage calibrator. A constant current of 5mA passes through R5, R6 and R7 when the 555 output is high. No current flows through these resistors when the 555 output is low.

resistors. The values of R6 and R7 add up to 20Ω, so that the constant current of 5mA produces a voltage of 100mV across these two resistors. The value of R7 is 2Ω, allowing a voltage of 10mV to appear across it. One of these three voltages is selected by S1 and passed to the calibrator output. The use of a relatively high constant current through the potential divider chain enables the calibrator output impedance to be low, and the d.c. output resistance is 200Ω maximum.

IC2 is an LM334Z and the constant current it passes is controlled by the external resistance between its pins 1 and 3. The current, in amps, is approximately equal to 0.0677 divided by the external resistance in ohms, and the calculated resistance value is equal to 13.54Ω. There is, however, a tolerance of 3% on the current value and it is necessary to make the external resistance adjustable about the calculated value. In Fig. 1 the external resistance is given by R4 in series with the pre-set potentiometer, VR1.

The square wave selected by

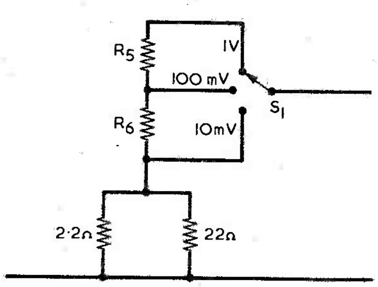


Fig. 2. If difficulty is experienced in obtaining a close tolerance 2Ω resistor for R7, a 2.2Ω resistor and a 22Ω resistor connected in parallel will provide the required resistance.

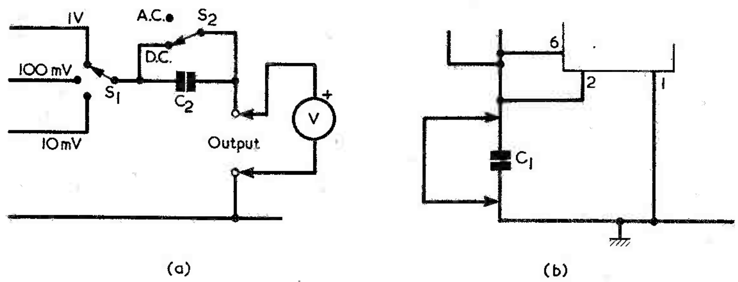


Fig. 3(a). For setting-up purposes, a voltmeter is connected to the output terminals, and S1 and S2 are put to the positions shown here.

(b). A temporary short-circuit is then placed across C1 to drive the 555 output high.

S1 is passed directly to the output terminals when S2 is in the "D.C." position. Setting S2 to "A.C." allows a capacitive output coupling via C2. S3 is the on-off switch, and the current drawn from the 9 volt supply is approximately 9mA.

COMPONENTS

The 555 required for IC1 is, of course, widely available. It should be noted that the CMOS version, the ICM7555, is not suitable for this circuit because it cannot provide the output source current required. The LM334Z required for IC2 is available from Maplin Electronic Supplies. In the inset showing its lead-outs, these lead-outs are pointing towards the reader.

R1, R2, R3 and R4 are all ¼ watt 5% resistors. R5, R6 and R7 are close tolerance ¼ or ½ watt resistors, and these should be 2% or, better, 1% types. If difficulty is experienced in obtaining a 2Ω resistor in close tolerance for R7, a 2.2Ω and a 22Ω resistor can be connected in parallel, as shown in Fig. 2. These give a combined value of almost exactly 2Ω.

S1 is, of course, a 3-way rotary switch. Both S2 and S3 can be s.p.s.t. toggle components. S2 is shown as s.p.d.t. in Fig. 1 for ease of circuit presentation. The two capacitors may be polyester.

Because of its low value, VR1 is not normally available in the usual range of miniature preset potentiometers. A small wire-wound component should be employed here.

The calibration unit can be housed in a small metal case which is common with the negative supply rail. Alternatively a plastic case may be employed and the chassis connection shown in Fig. 1 is then ignored.

SETTING UP

A voltmeter, which can be a multimeter switched to a low volts range, is required for setting up. This is connected to the output terminals with S1 set to the "1V" position and S2 set to "D.C.", as shown in Fig. 3 (a). A short-circuit, as illustrated in Fig. 3(b), is then applied across C1. This causes the 555 output to go high. VR1 is next adjusted for a reading of exactly 1 volt in the meter.

The voltmeter and short-circuit are then removed, after which the voltage calibrator is ready for use. ■

OBITUARY

It is with deep regret that we have to inform readers that our Technical Editor, Mr. J. R. Davies, died on 7th. February after a very short illness.

Mr. Davies was 57 years of age and, prior to becoming a technical journalist, he was engineer in charge of the television component and sub-assembly factory of Ferguson Radio Corporation Ltd., (now Thorn Electric) at Enfield, Middlesex. Before being appointed Technical Editor of this magazine he had frequently written articles which appeared in these pages and his writing and his editing were notable for their thoroughness and accuracy. All of us who worked with him at Data Publications looked upon him as a personal friend and regarded him with affection – he will be greatly missed.

The funeral service took place at Taunton Crematorium on Wednesday 11th. February at which we were represented by the Production Editor and Advertisement Manager.

To his daughter we extend our deep sympathy and condolences. **J.H.B.**

SOLDERING IRON REMINDER

By John Baker

UNOBTRUSIVE AUDIBLE DEVICE

Functions when iron is switched on

A common problem for radio and electronics constructors is that of inadvertently leaving a soldering iron switched on. This usually results in the iron running continuously for many hours before the oversight is discovered, with a consequent reduction in the life of the bit and element. Probably of greater importance is the fact that the soldering iron can present a fire hazard, and the author has some scorched circuit diagrams and carbon papers to illustrate this point. Yet another factor is that one can burn one's fingers or hand by touching an iron which is supposedly switched off. All these points led to the development of the very simple unit which is described in this article.

AUDIBLE REMINDER

In the author's experience there are no difficulties in remembering whether an iron is switched on if it is one of the thermostatically controlled types having an internal bi-metal strip temperature controller. An iron of this nature produces a quiet but clearly audible "clicking" as the bi-metal thermostat switches on and off. The sound helps to remind the user that the iron is switched on, and he is in consequence much more liable to remember to switch off the iron before leaving it.

One solution to the problem, therefore, is to have some form of audible reminder circuit connected in parallel with the iron, so that the user is frequently given a signal that the iron is switched on. Such a reminder can be employed with ordinary irons which are not thermostatically controlled.

It is not necessary for the audible reminder signal to be especially loud or complex, since the unit will be in very close proximity to the user and it would be difficult to miss even a quiet and simple signal. In fact, a loud and complex sound is undesirable because it would soon become very tiresome and irritating! In practice a very suitable signal is a fairly quiet "click" produced at about 10 second intervals – the same sort of sound, in fact, as is given with a temperature controlled iron.

THE CIRCUIT

The circuit finally developed is extremely simple, and is shown in Fig. 1. The unit is permanently connected in parallel with the soldering iron so that it is powered whenever the iron is plugged into the mains supply. The live and neutral mains lines are coupled to the primary of mains transformer T1. The secondary voltage is full-wave rectified by D1 and D2, causing a smoothed voltage to appear across C1. This voltage, unloaded, is of the order of 17 volts. Since the main part of the circuit only consumes some 3mA, the loaded supply voltage is not significantly different.

The rectified supply voltage is by no means critical, and the unit will work just as well with a mains transformer having a secondary voltage of 9-0-9 volts or 6-0-6 volts. It is quite in order to use one of these alternative transformers if the construc-

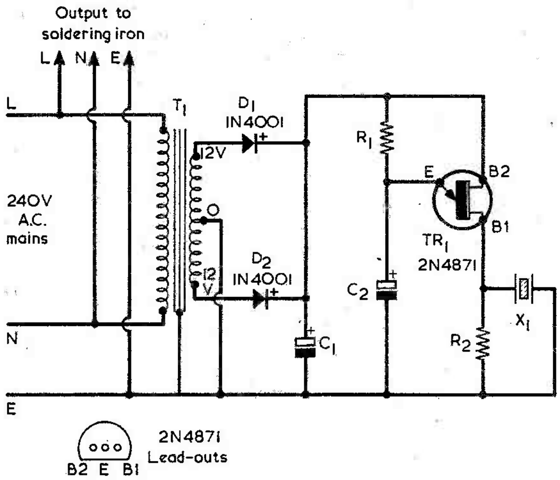
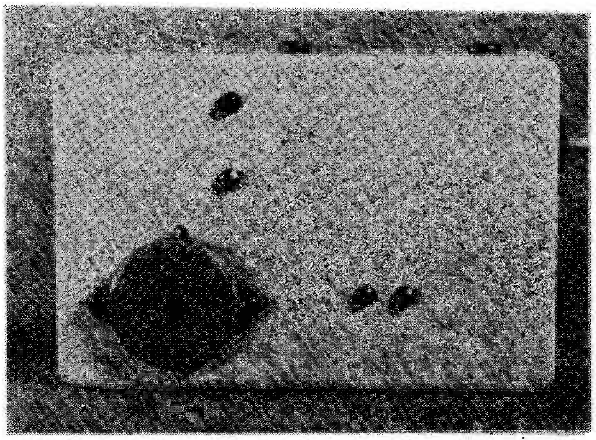


Fig. 1 The circuit of the soldering iron reminder. X1 is a piezoelectric acoustic transducer.



The soldering iron reminder in its plastic case. The ceramic transducer is fitted on the outside.

COMPONENTS

Resistors
(Both ¼ watt 5%)

R1	680kΩ
R2	120Ω

Capacitors

C1	10μF electrolytic, 25V. Wkg.
C2	10μF electrolytic, 25V. Wkg.

Transformer

T1 mains transformer, secondary 12-0-12V at 50mA (see text)

Semiconductors

TR1	2N4871
D1	1N4001
D2	1N4001

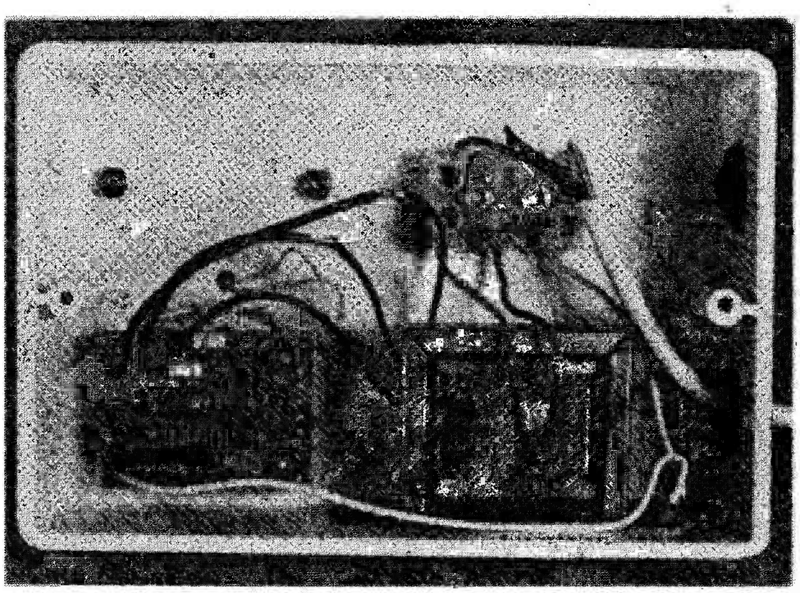
Transducer

X1 ceramic transducer type PB-2720 (Ambit International)

Miscellaneous

Plastic case
Veroboard, 0.1in. matrix
3-way connector block
3-core mains lead
2 grommets
Nuts, bolts, wire, etc.

The 3-way connector block and Veroboard assembly are mounted on the other side of the panel to which the transducer is fitted. The mains transformer is bolted to one side. The mains input lead was not fitted when these photographs were taken.



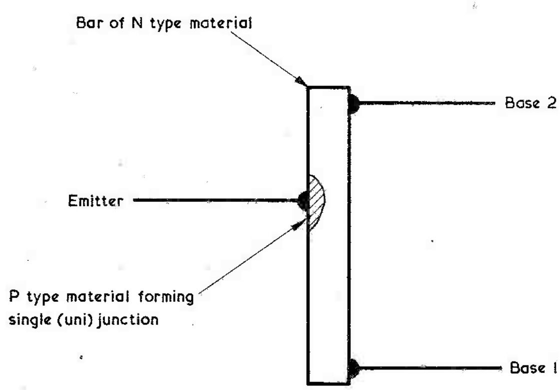
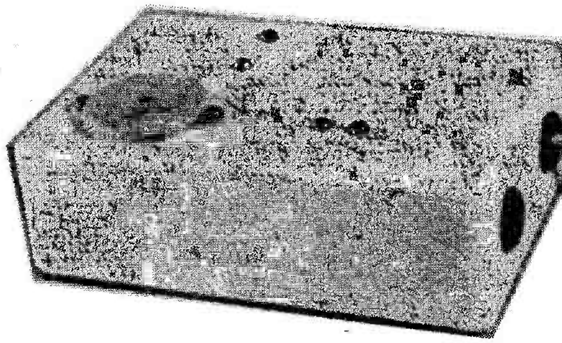


Fig. 2. Basic construction of a unijunction transistor.



The reminder can be positioned at any convenient point on the work bench.

tor happens to have one in the spares box.

A unijunction transistor relaxation oscillator generates the reminder signal. For those unfamiliar with the unijunction transistor, this has the basic construction shown in Fig. 2. There is a bar of silicon between the base 1 and base 2 terminals with an emitter junction nearer the base 2 end of the bar. Normally, the bar is N-type material and the emitter material is P-type. When the base 2 and base 1 are connected into circuit as in Fig. 1, and the voltage at the emitter is low, the bar presents a resistance in the order of 4 to 9kΩ. It therefore functions as a potential divider with a proportion of the voltage between the two bases appearing between the emitter junction and the base 1. This proportion is known as the "intrinsic stand-off ratio".

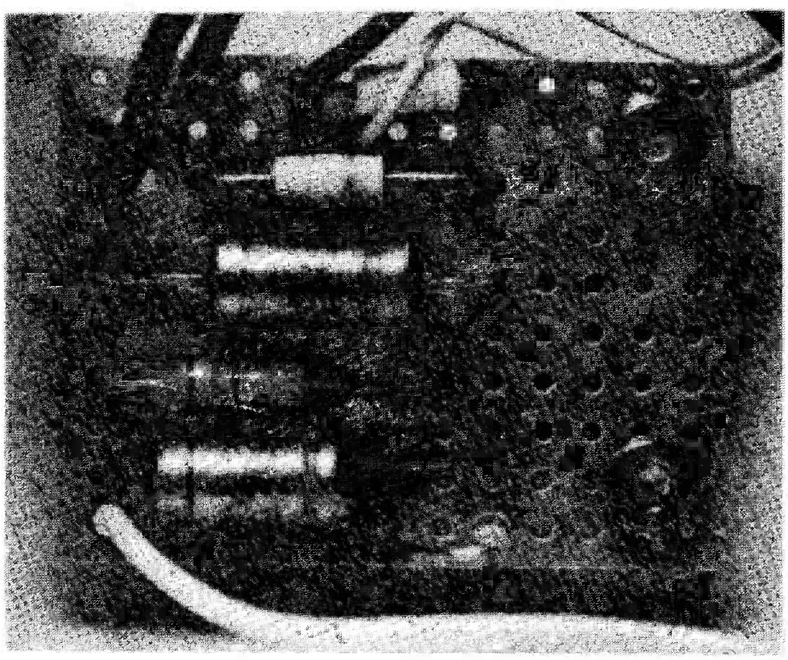
When the emitter is below the intrinsic stand-off level the only emitter current which flows is reverse leakage current in the emitter PN junction. This situation is maintained if the emitter is taken positive, but it changes abruptly when the emitter potential reaches intrinsic stand-off level plus about the 0.5 to 0.6 volt needed for a silicon diode to conduct. The device then exhibits a very low resistance between the emitter and the base 1.

Turning back to Fig. 1, capacitor C2 is discharged at switch-on, and it then commences to charge via R1. The voltage on the unijunction transistor emitter is, in consequence, going positive. When the voltage reaches triggering level the transistor exhibits the very low resistance between the emitter and base 1, causing the capacitor to rapidly discharge into R2. The voltage across the capacitor falls to a low level before the transistor reverts to its previous state, after which the capacitor once more commences to charge through R1.

A sharp pulsed voltage is produced across R2 at each discharge of C2, and this is applied to the piezoelectric transducer, X1. The transducer produces a quiet "click" with each pulse, and the volume was found to be adequate for the application.

The values of R1 and C2 are chosen to give a nominal operating frequency of 0.1Hz, or to produce one "click" every 10 seconds. However, the actual frequency will vary significantly between different units built to the circuit due, mainly, to the wide tolerance in the value of C2, and in the intrinsic stand-off ratio of the transistor. The latter is specified as 0.7 to 0.85 for the particular transistor

Most of the few components required for the circuit are assembled on a Veroboard panel.



employed here. The operating frequency of the circuit is obviously of no great importance and a variation from the nominal value of 0.1Hz presents no disadvantage.

CONSTRUCTION

The prototype was assembled in a small plastic case measuring 114 by 76 by 38mm. This case is a type PB1, available from Maplin Electronic Supplies. Any other small plastic case which can accommodate the components can, of course, be used and there are many suitable types available. The general layout used for the prototype can be seen in the photographs. The transducer is mounted on the case exterior and can be used as a template when marking the positions of the two mounting holes in the case. The transducer mounting holes are very small but they can be enlarged slightly to take 8 or 6BA mounting bolts. A small hole must also be drilled just below the transducer to allow its leads to pass through.

A 3-way connector block is used to take the mains wiring and this is secured to the plastic case with suitable nuts and bolts. These connector blocks are usually sold in 12-way strips, and the 3-way block is cut from one of these with a sharp knife. Two holes fitted with grommets are required in one of the case sides. One takes a 3-core lead from the mains plug and the other takes the lead from the soldering iron.

Apart from T1, which is bolted to one side of the case, the remaining components are assembled on a small piece of 0.1in. Veroboard having 13 copper strips by 10 holes. Fig. 3 shows this board and the other wiring. No breaks in the copper strips are required. Note that there is a solder tag under one of the transformer mounting nuts. The mains earth connects to this tag, as also does the oscillator negative rail. Take care to ensure that all the mains wiring is properly carried out.

When it has been wired up, the Veroboard panel is secured inside the case with two 6BA bolts and nuts, spacing washers being employed to keep the board underside clear of the inside surface of the case. After the wiring has been completed and checked, the soldering iron reminder unit is ready to start "clicking". The lid of the plastic box must always be firmly screwed on when the unit is in use. ■

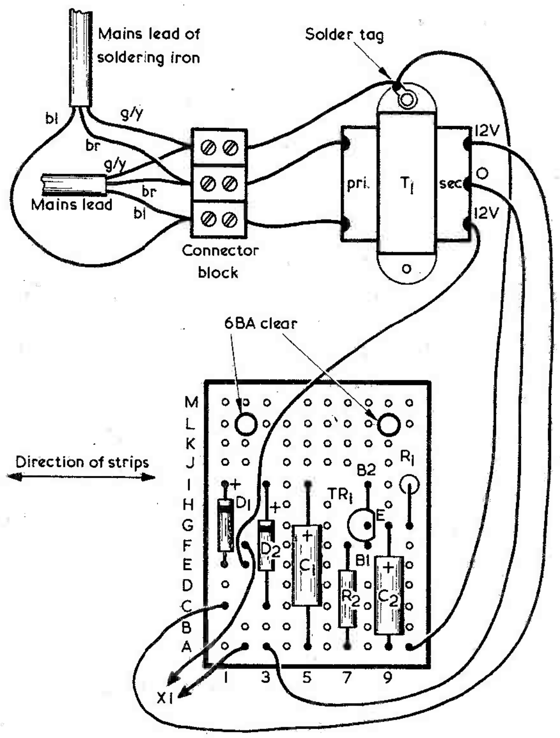


Fig. 3. Wiring up the soldering iron reminder.

TRADE NOTE

RATCHET-OPERATED CABLE CUTTER

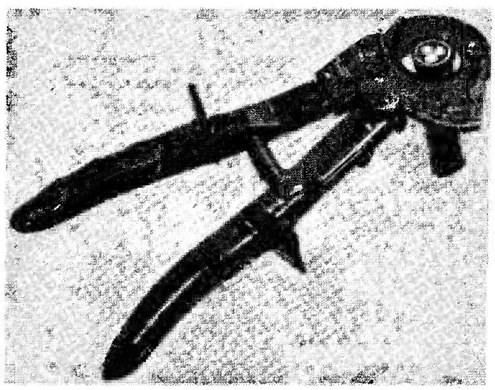
A new hand-held cable cutter, introduced by Klippon, features an integral ratchet mechanism to ensure positive gripping and cutting action when used with a range of copper or aluminium cables with an outer diameter up to 32mm.

The KT 3's unique design enables cables to be cut with a fraction of the pressure normally associated with cable cutters whilst a cutting blade release lever enables the cutting process to be interrupted in any position. A grip locking/unlocking device is provided just below the cutter.

Weighing just 590 grammes, the KT 3 is manufactured from high-quality steel with heavy-duty vinyl protecting the handles and providing a firm grip. Finger-guards are provided on the handles to increase the safety aspects of the tool.

Replacement blades are available.

For further details, contact:- Klippon Electricals Ltd., Power Station Road, Sheerness, Kent ME12 3AB.



The ratchet-operated cable cutter.

Timer With Trigger Action

By F. Craig

Positive feedback gives snap switching.

Electronic timers normally employ a resistor and capacitor to provide the timing period. A typical timer circuit is illustrated in Fig. 1(a), in which RA and CA are the timing components. Some form of voltage comparator is required to sense the voltage across the capacitor and this can be an operational amplifier with one input connected to the junction of the capacitor and resistor and the other input connected to a reference voltage which could, conveniently, be half the supply voltage.

CHARGING CAPACITOR

At the start of the timing period the capacitor is discharged. In our example the capacitor is connected to the non-inverting input of the op-amp and so the op-amp output is low and the transistor following the op-amp is cut off.

The capacitor is then allowed to charge. When its voltage closely approaches the reference voltage at the op-amp inverting input the op-amp output starts to go high. Due to the very high level of voltage gain in an operational amplifier the relatively slow rise in voltage across the capacitor is translated into a much more rapid voltage swing at the op-amp output, whereupon the transistor is turned on and the relay is energised. The timing period is then at an end.

The arrangement of Fig. 1(a) is acceptable for long timing periods with heavy duty relays and can be employed for periods up to about a minute or two with lightweight relays such as the popular 410Ω "Open Relay" which is available from Maplin Electronic Supplies and other sources. When longer periods with a lightweight relay are required, the change in op-amp output voltage at the end of the timing period, although reasonably fast, is still too slow for reliable relay operation. With the Open Relay just referred to, the gradually increasing relay current at the end of the timing period can cause noticeable relay "chatter", with the armature moving irregularly between its two contacts.

This problem can be overcome by introducing positive feedback as shown in Fig. 1(b), where the feedback is provided by the two resistors RB and RC. When, during the timing period, the voltage across the capacitor is low and the op-amp output is similarly low, the voltage applied to the non-inverting input is equal to the fraction of the capacitor voltage which is given at the junction of RC and RB. As, with the capacitor charging, this voltage closely approaches the reference voltage at the inverting input the op-amp output starts to go positive. In doing so it causes the voltage at the non-inverting input to go positive as well, making the op-amp output more positive again. This positive feedback results in the op-amp output swinging rapidly high and thereby causing the relay to energise quickly without risk of chatter or any other similar effect.

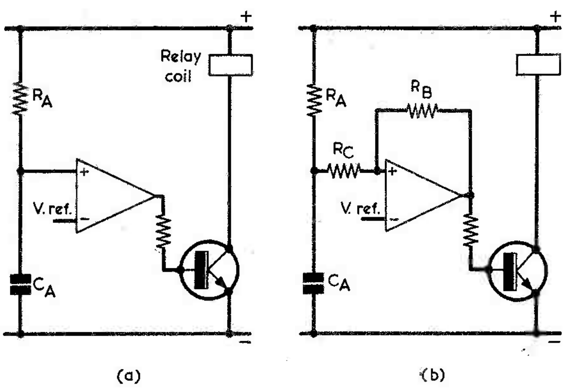


Fig. 1(a). A typical electronic timer. Capacitor CA is discharged at the start of the timing period, the length of which is controlled by the values of CA and RA

(b). Irregular relay operation at the end of very long timing periods can be eradicated by incorporating positive feedback around the voltage comparator

WORKING CIRCUIT

The full working circuit of the timer is shown in Fig. 2. The operational amplifier is a CA3140E, which has very high resistance MOSFET inputs. A reference voltage equal to half the supply voltage is given at the junction of the equal value resistors R4 and R5, and this voltage is applied to the inverting input at pin 2. The timing resistance is given by R2 and VR1 in series, and the timing capacitance consists of whichever capacitor is switched into circuit by S1. The feedback resistors, RB and RC of Fig. 1(b), are now given

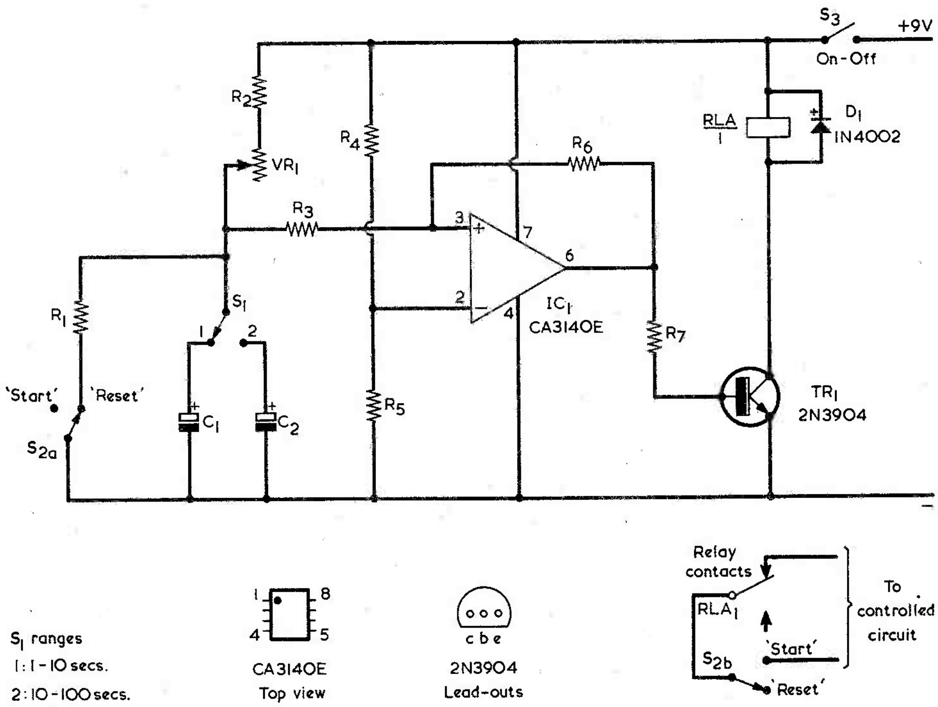


Fig. 2. Full working circuit of the timer with trigger action. The ranges selected by S1 are nominal, but should be within the travel of VR1 with most electrolytic capacitors

by R6 and R3 respectively. The op-amp output is coupled to TR1 base by way of R7, and the relay coil is connected in the transistor collector circuit. D1 is the usual protective diode which prevents the formation of a high back-e.m.f. when the relay de-energises.

S2(a) (b) is the Start – Reset switch. When this is in the Reset position, S2(a) short-circuits the timing capacitor selected by S1 via the current limiting resistor, R1. At the same time, S2(b) keeps the controlled circuit open. Setting S2(a) (b) to Start takes the short-circuit off the timing capacitor. Also, S2(b) completes the controlled circuit by way of the break contacts of the relay.

The timing capacitor now charges. After a period dependent upon the value of the capacitor and the resistance inserted by VR1, the voltage at the non-inverting input of the CA3140E closely approaches that at the inverting input. The positive feedback effect just described comes into action and the relay energises rapidly. Its break contacts break the controlled circuit and the timing period is over.

TIMING COMPONENTS

Due to the presence of R6 and R3 the timing period comes to an end when the voltage across the capacitor is 0.55 times the supply voltage. This calculates as 0.8 times the time constant of the timing components. However, since the timing capacitors are electrolytic with a typical tolerance on value of –10 +50%, it can be expected that the actual values of C1 and C2 will be in excess of their nominal values. Because of this fact, it can be assumed that the length of a timing period is roughly equal to the time constant of the timing resistance and capacitance (which, in seconds, is equal to megohms multiplied by microfarads). Timing ranges can then be calculated by

COMPONENTS

Resistors
(All fixed values ¼ watt 5% unless otherwise stated)
R1 10Ω
R2 6.8kΩ
R3 1MΩ
R4 100kΩ
R5 100kΩ
R6 10MΩ 10%
R7 10kΩ
VR1 100kΩ potentiometer, linear

Capacitors
C1 100μF electrolytic, 10V. Wkg.
C2 1,000μF electrolytic, 10V. Wkg.

Semiconductors
IC1 CA3140E
TR1 2N3904
D1 1N4002

Relay
RLA Open Relay, 410Ω coil, changeover contacts

Switches
S1 s.p.d.t. toggle or rotary
S2 d.p.d.t. toggle
S3 s.p.s.t. toggle

Miscellaneous
9 volt battery
Pointer control knob
Wire, solder, etc.

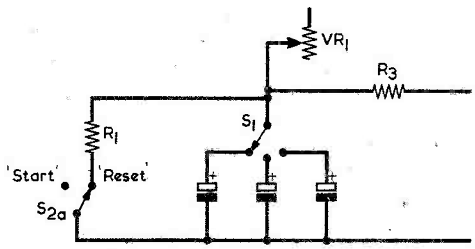


Fig. 3. Alternative ranges can be incorporated by simply choosing different values of timing capacitor. Here, S1 is changed to a 3-way switch, offering three timing ranges

assuming that the minimum timing resistance is 10kΩ and the maximum timing resistance is 100kΩ. Since R2 is considerably lower in value than 10kΩ, it should be possible to obtain, within the travel of VR1, the ranges quoted with most electrolytic capacitors. It is unlikely that C2 will be precisely 10 times C1, whereupon it will be necessary to provide two scales for VR1. To make up the scales some four well spread out calibration points are found on each range, and the scales are then marked out from these. The calibration points are found by checking timing periods with a watch having a sweep second hand or a digital display.

Any capacitance values other than those specified can be employed. If desired, there could be three ranges, as illustrated in Fig. 3, with S1 being 3-way rotary. When there are two ranges, S1 can be rotary or toggle. S2(a) (b), on the other hand, must be toggle.

To withstand initial charging currents, VR1 should be a ½ watt potentiometer. This is the normal rating for a standard sized linear carbon track potentiometer. Because of its MOSFET inputs, care should be taken to ensure that the CA3140E is not damaged by high static voltages, and it should be soldered into circuit with an iron having a reliably earthed bit. Alternatively, an 8-way d.i.l. holder can be used, and the CA3140E plugged into this after all wiring has been completed and checked.

The 410Ω relay specified for RLA has contacts with a maximum rating of 5 amps at 24 volts d.c. or 240 volts a.c.

The current drawn from the 9 volt supply is approximately 1.5mA during the timing period. This increases to some 23mA when the relay energises at the end of the period. The prototype timer was checked with a temporary timing capacitance which produced a period in excess of 5 minutes. The relay energised quickly and properly at the end of this period. ■

Further Notes on Some Recent Receivers

Part 2 (Conclusion)

by Sir Douglas Hall, Bt., K.C.M.G.

More modifications to enhance the performance of recent receivers.

THE "DORIC"

This multi-band receiver appeared in the four issues between August and November 1979. The only problem encountered with this design has been that the volume control on the amplifier, when adjusted very nearly at its maximum position whilst listening on the short wave bands, has an effect on reaction. The snag is easily overcome by putting a 3.3kΩ resistor between the short wave tuner and the amplifier as shown in Fig. 3.

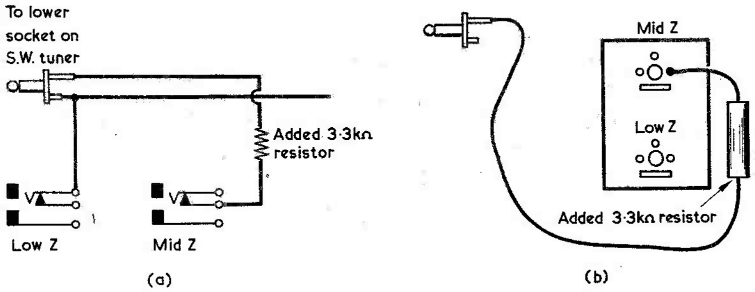
In some circumstances on some of the short wave bands it may prove advantageous to set the length of the aerial to suit selectivity, adjust VR3 to a suitable setting and use VR1 as a very smooth vernier reaction control.

"LISA"

The article describing this receiver appeared in the magazine issues for September and October 1980. If for any reason it is found that the wavebands are not

Fig. 3(a). The "Doric" receiver can have a 3.3kΩ resistor added to prevent slight interaction between volume and reaction controls on short waves.

(b). Showing how the added resistor is wired into circuit.



properly covered the values of C3 and C4 can be altered accordingly.

C10 and C11 are included in the interests of stability. In most cases C10 may be removed and C11 changed to 0.1μF (using the C10 component), giving equal stability and a slight improvement in output quality.

Provided that it has proved possible to set up the receiver so that the reaction control does not have to be moved through more than about 20 degrees to maintain the receiver on the threshold of oscillation throughout the whole of the medium wave band it is worth carrying out the following modification. Change the value of VR3 from 2.2kΩ to 1kΩ and wire the slider of this new component to the outer unused tag of S1(b) instead of to the centre tag. When this 1kΩ component is properly adjusted it should be found that reaction comes in extremely gradually. The altered wiring causes a little extra resistance to be included in the reaction circuit when switched to long waves, in order to maintain proper control on this band with the new pre-set potentiometer.

F.M. BANDS IN GENERAL

Finally, it might be useful to provide a few notes on problems which can arise when listening on the f.m. band with the "Jubilee," the "Band II Portable" or the "Doric". The comments also apply to any of the earlier receivers described by the author which provides an f.m. band and use a self-contained telescopic aerial, and to many similar non-superhet receivers in addition.

Excessive hiss or hand-capacitance effects nearly always mean that there is insufficient signal, either due to distance from the transmitter or screening. Different positions should be tried for the receiver. Sometimes there is one part of a room where the reception is much better than in other parts. Also, try different lengths of aerial, as well as different angles and changes in the direction in which the aerial points. Aerial length can sometimes be quite critical in bad reception areas. The only other likely cause of excessive hiss and hand-capacitance effects is a faulty transistor. In the author's designs the culprit will be the Spontaflex amplifier – the one with the diode in its emitter circuit. This transistor is more critical than the input amplifier, to which the aerial is connected through a capacitor. On at least one occasion a marked improvement has been effected by swapping the two transistors round.

Other problems can arise when the receiver is in a very strong signal area, close to the transmitter. Here again the length of the aerial can be quite critical, this time to avoid overloading. Sometimes the receiver will work best in these conditions with the aerial completely closed or even removed altogether. Generally, however, some 12in. of aerial, carefully orientated, will give best results.

(Concluded)

"He's my remote control".

Mail Order Protection Scheme

The publishers of this magazine have given to the Director General of Fair Trading an undertaking to refund money sent by readers in response to mail order advertisements placed in this magazine by mail order traders who have become the subject of liquidation or bankruptcy proceedings and who fail to supply goods or refund money. These refunds are made voluntarily and are subject to proof that payment was made to the advertiser for goods ordered through an advertisement in this magazine. The arrangement does not apply to any falure to supply goods advertised in a catalogue or direct mail solicitation.

If a mail order trader fails, readers are advised to lodge a claim with the Advertisement Manager of this magazine within 3 months of the appearance of the advertisement.

For the purpose of this scheme mail order advertising is defined as:

"Direct response advertisements, display or postal bargains where cash has to be sent in advance of goods being delivered."

Classified and catalogue mail order advertising are excluded.

MODEL TRAIN CONTROLLER

By M. V. Hastings

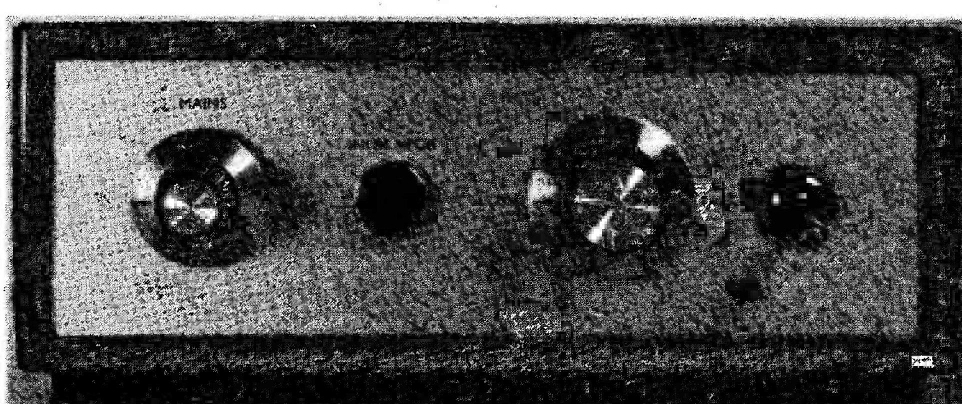
Low impedance "constant voltage" output.

* * *

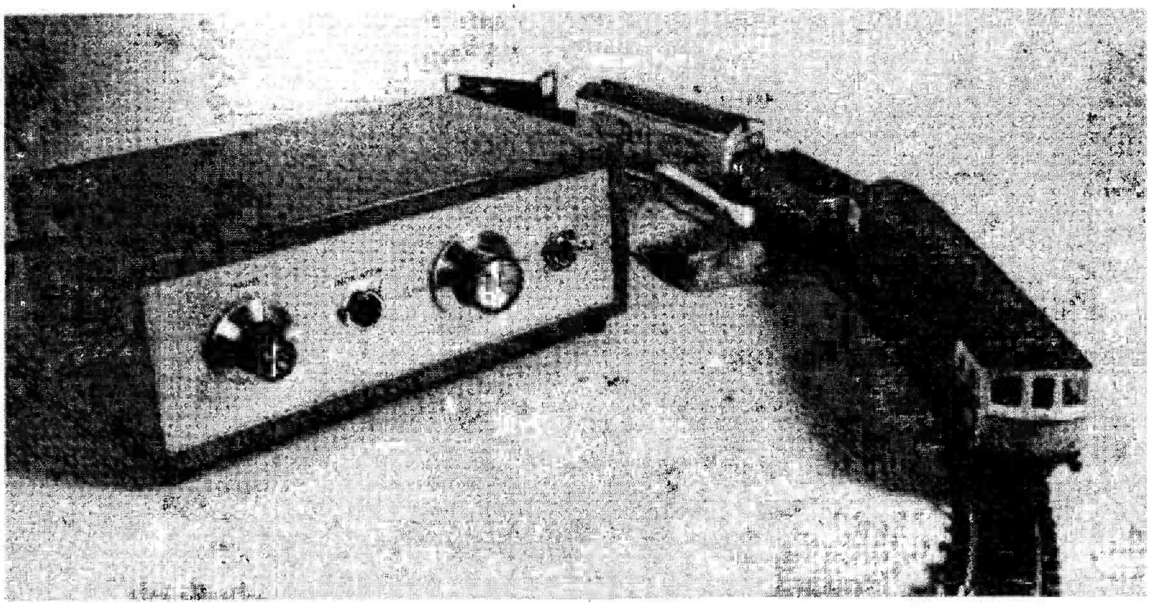
Continuously variable voltage control.

* * *

Low cost mains operation.



On the front panel, from left to right, are the mains on-off switch, the pilot lamp, the output voltage control and the Forward-Reverse switch.



The train controller in action as the 10.55 from Waterloo negotiates a bend in the tracks.

This simple model train controller has been designed for use with an inexpensive train set which was originally supplied with a combined battery box and controller. This employed six HP11 cells and, while their cost was not too high initially, the expense soon started to mount up as replacement sets became necessary. Battery operation became, in consequence, uneconomic in the long term. The controller section also had the intitial advantage of being very inexpensive but the control it exerted was rather limited, in that it only had three speed settings. These were "Stop", "Slow" (with four cells switched into circuit) and "Fast" (all six cells switched in).

These factors led to the design and construction of the mains powered controller which is described here. This can be built at reasonable cost and provides a continuously variable full range of speeds. It also gives a low output impedance at all output voltages, whereupon a good performance is given even at low running speeds.

TYPES OF CONTROLLER

The simplest type of mains driven controller giving a full range of speeds merely consists of a transformer to give isolation and step down the mains voltage to the required level, a rectifier to produce a pulsating d.c., and a large variable resistor in series with the output to vary the output current and act as a speed control. Some form of polarity reversal switching is usually incorporated so that the direction of the train can be altered.

A serious problem with this arrangement is that the output impedance of the controller becomes high at low speeds due to the relatively high resistance inserted by the variable speed controller. This is apt to lead to the train running fast down slight gradients and stalling when trying to climb a gradient.

The reason for this effect is that the output impedance of the controller and the impedance of the train motor effectively form a potential divider. When the train attempts to climb a gradient its motor impedance reduces with the increased loading, and the voltage across it falls. Whilst this causes the current fed to the motor to be increased, the high output impedance of the controller results in the actual power applied remaining roughly the same or even decreasing! With the train requiring increased power, but getting the same or decreased power, it is not surprising that it should stall and come to a halt.

An opposite effect is given when the train runs down a gradient, with the motor requiring less current and having increased impedance. This results in a small decrease in the supply current which is counteracted by a rise in the voltage across the motor. The power fed to the motor therefore remains much the same or increases slightly, resulting in the train accelerating.

Another, related, problem with this type of controller is a poor starting performance. Slowly advancing the speed control from zero does not result in the train starting off smoothly, and gradually accelerating up to full speed. Instead, nothing happens at first and then the train suddenly starts off at high speed.

This last effect is caused by the motor having a very low impedance when it is stationary and a comparatively higher impedance when it is running. Thus, there is very little voltage across the motor at first, and when the train does begin to move the voltage across the motor rises dramatically, resulting in a start at a fast rate.

One way of obtaining improved performance is to use a controller of the so-called constant voltage type. This employs a variable voltage regulator in place of the variable resistor, so that the voltage across the motor does not vary when its current consumption changes due to loading. If the motor tries to draw more current when the train is climbing a gradient it is therefore able to do so, and the increased power causes the risk of stalling to be greatly reduced. Conversely, if the motor tries to consume less current and power it is again able to do so. Improved starting is also given, and with a little skill and practice it is possible to have quite realistic starting. It is a train controller of this type which is described in this article.

CONTROLLER CIRCUIT

By taking advantage of an integrated circuit power amplifier it is possible, as is shown in Fig. 1, to make up a controller having only a small number of components.

S1(a) (b) is the on-off switch, and it controls the mains supply to the isolation and step-down transformer, T1. PL1 is a pilot lamp, and consists of a panel-mounting neon indicator with entegral series resistor suitable for 240 volt a.c. operation.

The rectified output from D1 and D2 is smoothed by C1. It is not necessary to have a smoothed d.c. supply for a d.c. electric motor, but the voltage control circuitry requires a reasonably well smoothed supply, and it is for this reason that C1 is included.

IC1 is primarily intended to function as an audio power amplifier, but it is quite suitable for a wide range of other applications. It is very much like an operational amplifier, and has both inverting and non-inverting inputs. Unlike an operational amplifier which, in most cases, can provide an output current in the order of milliamps, the TDA2006 specified for IC1 can provide output currents up to a few amps. The i.c. is available from Maplin Electronic Supplies.

The output of the TDA2006 is connected directly to its inverting input, and the consequent 100% feedback causes it to function as a voltage follower. The output voltage, which is at low impedance, is then (within limits) equal to the voltage at the non-inverting input. The voltage at the non-inverting input can be varied from zero to the full supply potential by adjusting VR1. The output of the

COMPONENTS

Resistor
VR1 10kΩ potentiometer, linear

Capacitors
C1 1,000μF electrolytic, 16V. Wkg.
C2 10μF electrolytic, 16V. Wkg.
C3 10μF electrolytic, 16V. Wkg.

Transformer
T1 mains transformer, secondary 9-0-9V, 1A

Semiconductors
IC1 TDA2006
D1-D4 IN4001

Switches
S1(a) (b) d.p.s.t., mains rotary switch
S2(a) (b) d.p.d.t., toggle

Fuse
FS1 1A fuse, quick blow, 20mm. cartridge

Lamp
PL1 panel-mounting neon indicator with integral series resistor

Socket
SK1 4mm. insulated socket, red
SK2 4mm. insulated socket, black

Miscellaneous
Verocase type 75-1411-D (see text)
2 control knobs
Chassis mounting fuseholder, 20mm.
Veroboard, 0.1in. matrix
18 s.w.g. aluminium (for heat sink)
Nuts, screws, wire, etc.

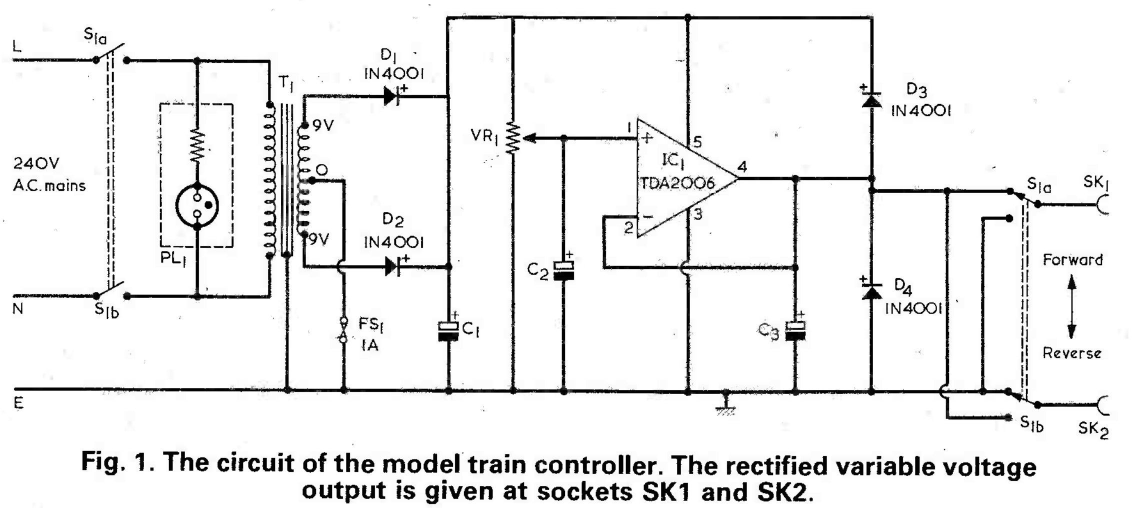
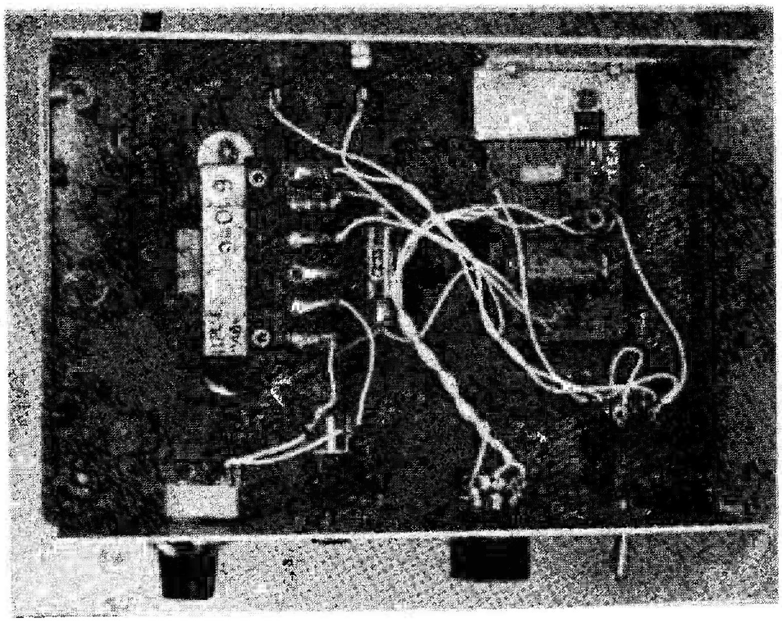


Fig. 1. The circuit of the model train controller. The rectified variable voltage output is given at sockets SK1 and SK2.

Secured to the bottom of the case are the mains transformer and the fuseholder.

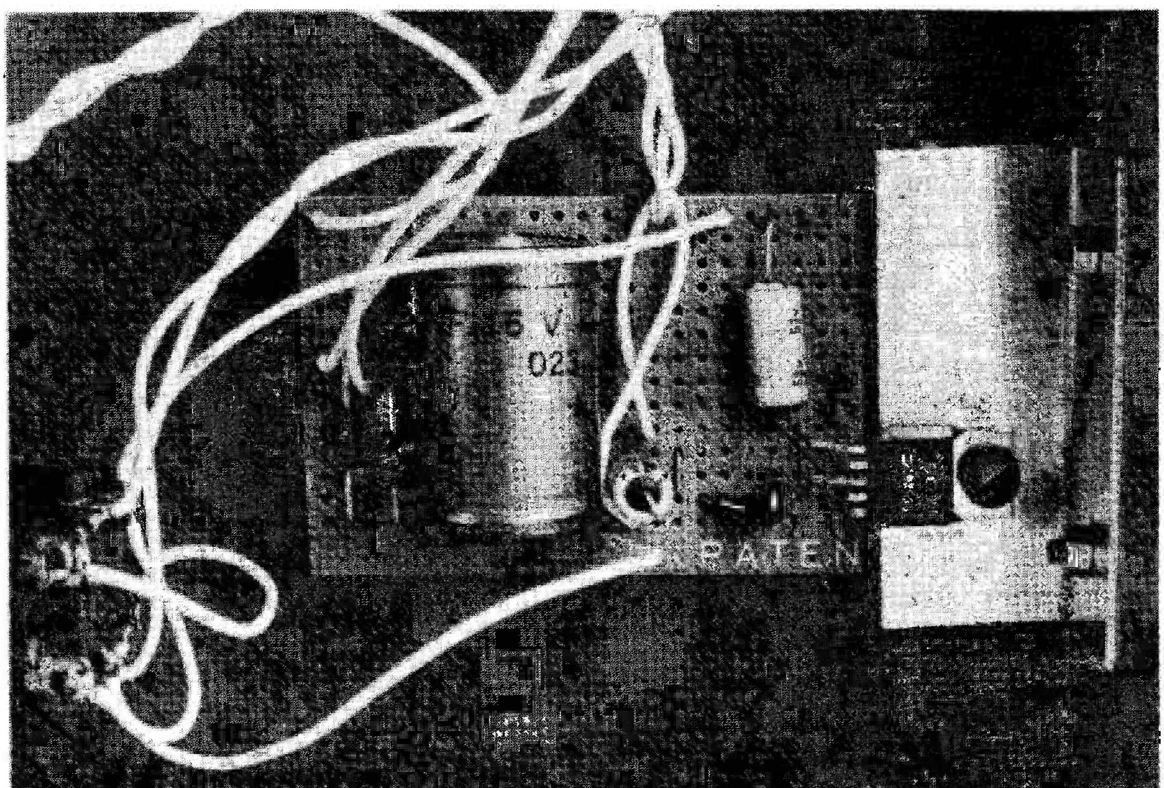


TDA2006 cannot quite reach either of these extremes, but it comes close enough for satisfactory results in the present application. VR1 thus operates as the speed control.

C2 and C3 are needed to aid circuit stability. D3 and D4 are protection diodes. S2 is the forward-/reverse switch, and it alters the polarity of the supply fed to the output sockets when it is changed from one position to the other.

In common with most units of this type, a truly constant output voltage is not provided since loading of the output causes the rectified voltage across C1 to fall. This results in a slight drop in the voltage at VR1 slider. However, the output impedance of the unit is still quite low, and the output voltage is more than stable enough to give good results.

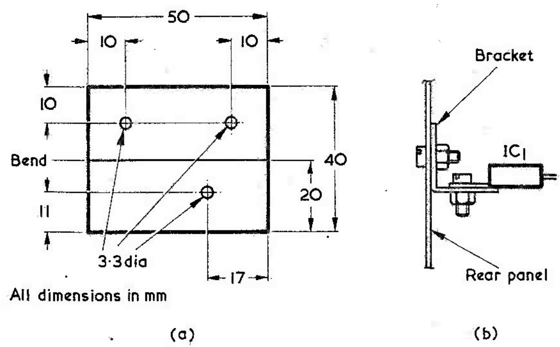
IC1 incorporates output short-circuit protection circuitry which prevents damage in the event of most overloads. A prolonged overload will cause fuse FS1 to blow and protect the components from damage. IC1, incidentally, also has built-in thermal shutdown protection.



The Veroboard component assembly. The L-shaped bracket bolted to IC1 heat tab is secured to the rear panel of the case.

Fig. 2(a). The L-shaped bracket before bending. The material is 18 s.w.g. aluminium and the bend is at right angles, with the upper section being bent towards the reader.

(b). After bending, IC1 heat tab is secured to the bracket section having one hole. The remaining section, with two holes, is bolted to the rear panel of the case. Bolts and nuts are 6BA or M3.



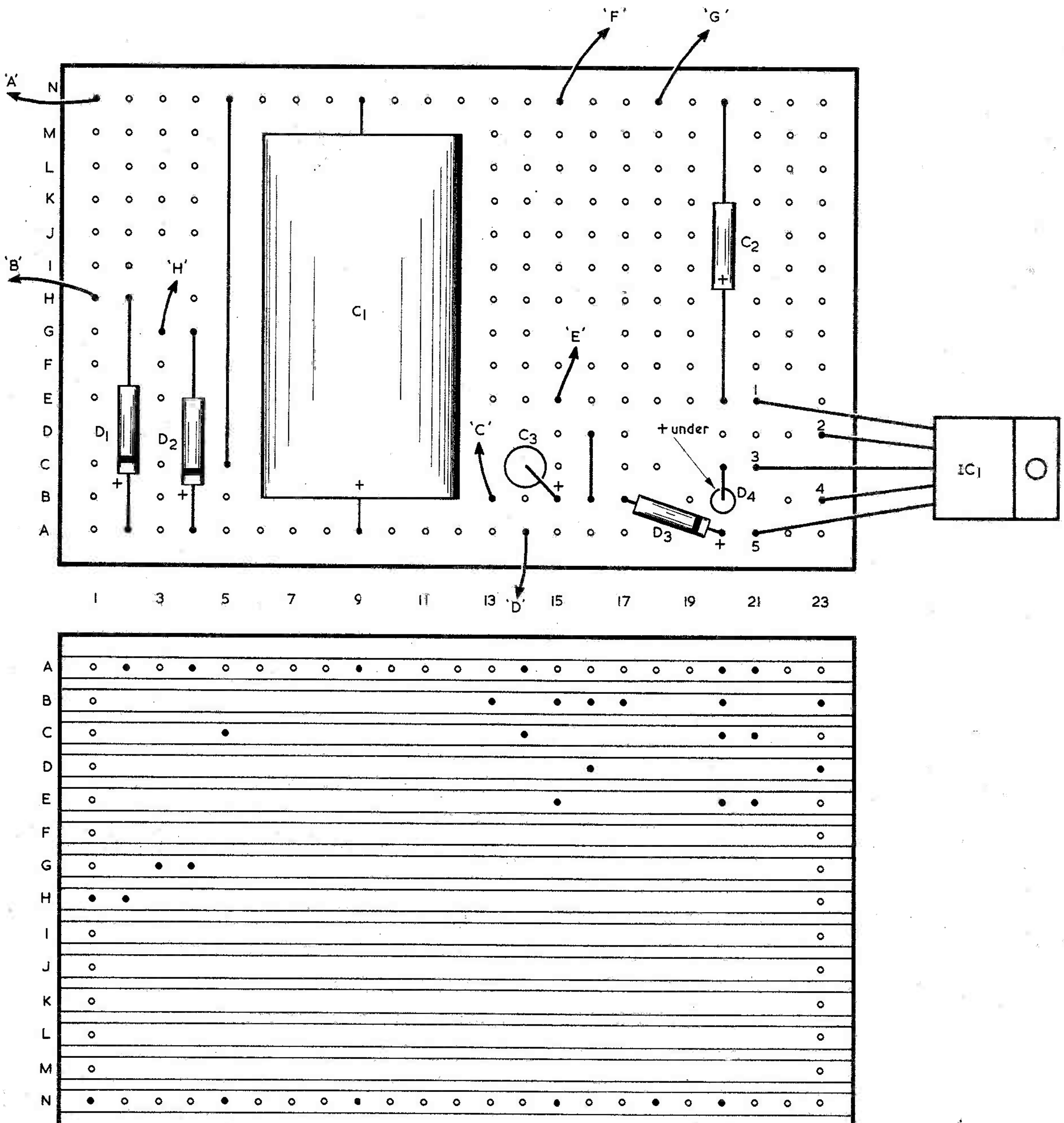
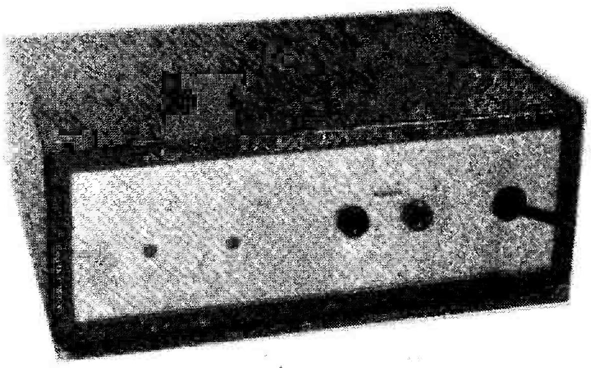


Fig. 3. Wiring up the components on the Veroboard panel. The letter references from "A" to "H" correspond with the similar references in Fig. 4.

CONSTRUCTION

The prototype is housed in a Verocase type 75-1411-D, which has dimensions of 205 by 140 by 75mm. Before obtaining the case it is advisable to check the dimensions of the particular transformer to be employed, to ensure that the case height is adequate.

Layout details are shown in the photographs. On the front panel, from left to right, are switch S1(a) (b), PL1, VR1 and S2(a) (b). The output sockets are 4mm. insulated types and are mounted on the rear panel. The component panel is also secured to the rear panel by way of an L-shaped bracket which functions as a heat sink for IC1. This bracket is made from 18 s.w.g. aluminium and has the dimensions shown in Fig. 2(a). The bracket is fitted to IC1, after the component panel has been wired up, in the manner illustrated in Fig. 2(b). Also required in the rear panel is a hole, fitted with a grommet, for the mains lead.



The two output sockets are mounted on the rear panel. This also has a hole, fitted with a grommet, for the mains lead.

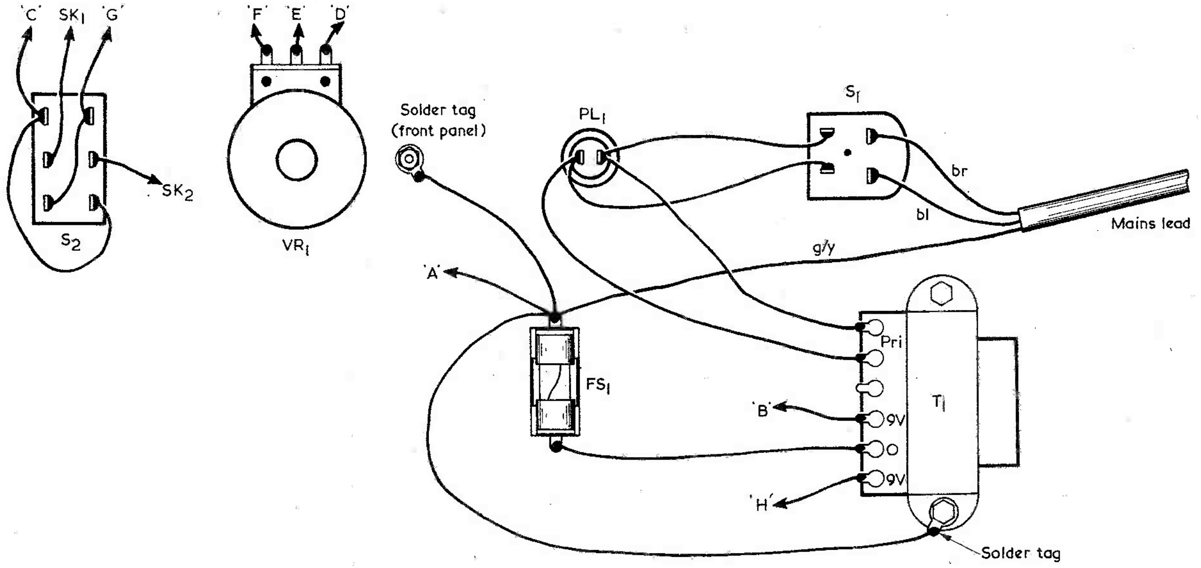


Fig. 4. Wiring external to the Veroboard. Check the tag positioning of S1 with a continuity tester before wiring to this component.

The mains transformer is secured to the base of the case behind S1(a) (b), with the fuseholder alongside it on the component panel side. A solder tag is held under one of the transformer mounting nuts to allow its frame to be earthed. A solder tag, secured with a countersunk 6BA bolt and nut, is fitted to the front panel at any unobtrusive point to allow this to be earthed as well. The rear panel is automatically earthed by way of IC1 heat tab, which is common with its negative supply pin.

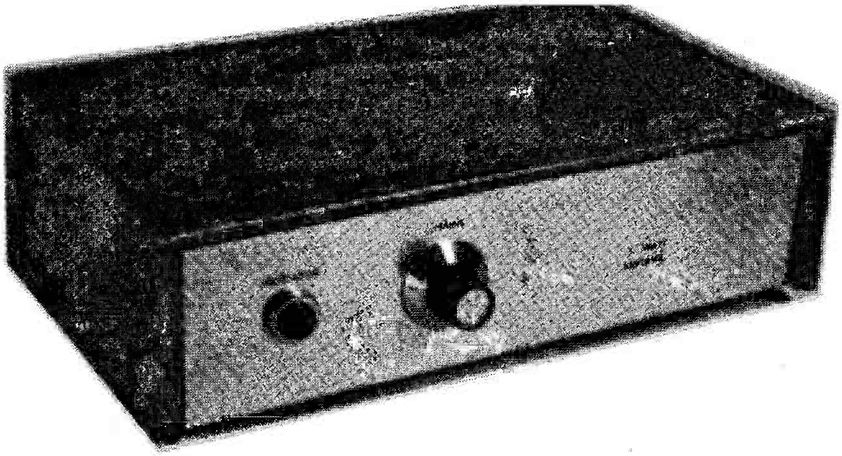
VEROBOARD PANEL

The remaining components are fitted to a 0.1in. matrix Veroboard having 14 copper strips by 23 holes. This has to be cut down from a larger board, using a small hacksaw. The Veroboard layout is illustrated in Fig. 3, and there are no breaks in any of the copper strips. IC1 has preformed lead-outs and these have to be opened out somewhat to fit into the appropriate Veroboard holes. After wiring on the Veroboard is completed the heat sink bracket is secured to IC1 as already described. The component panel is not finally secured to the rear panel of the case until the wiring illustrated in Fig. 4 has been completed. It will be found that the Veroboard is held in place quite adequately by the heat sink, and no further mounting arrangements are required.

The train controller is then ready for use.

SHORT-CIRCUITS

Model train systems are prone to short-circuits from time to time due to derailments and similar mishaps. Since the controller incorporates a 1 amp fuse it might be thought that this fuse would blow for short-circuits of this nature. In practice the fuse does not blow with derailments, partly because the resulting short-circuits are too short in duration and partly because of the current limiting effect of IC1. The prototype controller has had quite a lot of use and, although derailments have occurred, the original fuse is still fitted and has not needed to be replaced. ■



The practice amplifier as seen from the front. The only items mounted on the front panel are the on-off switch and the neon pilot light.

Gui
Am

• Single i.c. design • 3 mixed

The acoustic sound output of solid electric guitars is quite small, and it is necessary to use an amplifier and speaker to boost the sound even when practicing, espeecially if two or more people are playing together. Stage equipment can be used when practicing at home, but it is better in most instances to use a low power amplifier specifically designed for this application.

Such an amplifier is described here, and it has an output power of up to about 3 watts r.m.s. into an 8Ω speaker. The circuit has a built-in mixing facility and has inputs for three guitars. Since normal electric guitars are fitted with volume and tone controls such controls are not provided with the amplifier, giving a consequent simplification in design.

MIXING CIRCUIT

The amplifier employs an integrated circuit which is rather like an operational amplifier having a Class AB output stage, and which has inverting and non-inverting inputs. Fig. 1(a) shows an operational amplifier working in the inverting mode. The non-inverting input is biased to a mid-supply voltage by RB and RC. The input signal is applied to the inverting input via d.c. blocking capacitor CA and RA. RD provides feedback from the output to the inverting input. An inherent feature of an operational amplifier is that, in a circuit of this nature, it functions to keep the inverting input at the same voltage as the non-inverting input. Because of this action, the voltage gain of the amplifier is equal to RD divided by RA. If,

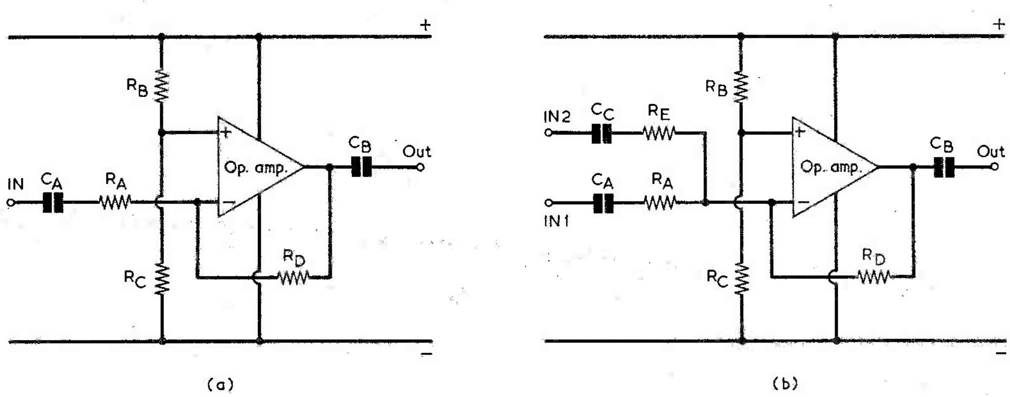
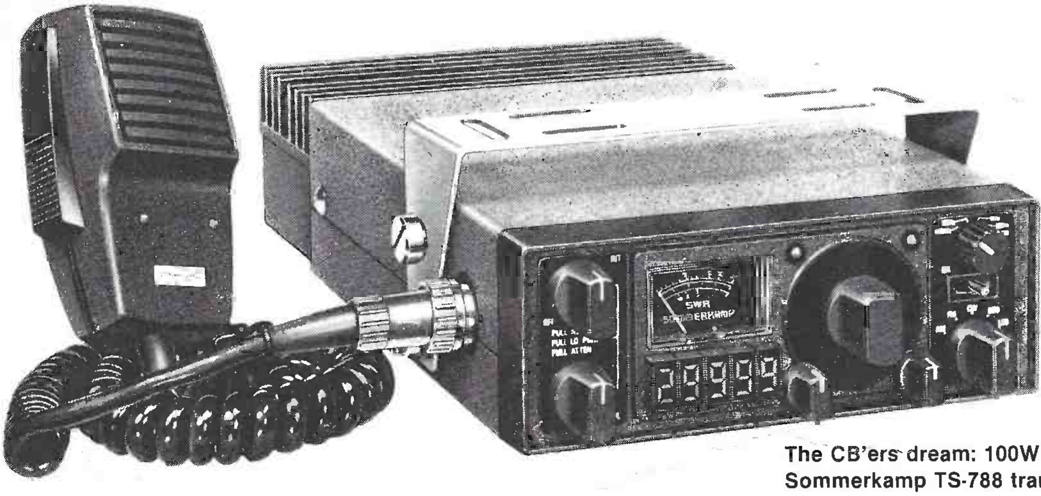


Fig. 1(a). An operational amplifier connected in the inverting mode. Voltage gain is equal to RD divided by RA, and there is a virtual earth at the inverting input.

(b). A second input can be mixed with the existing input by simply adding another d.c. blocking capacitor and input series resistor. The virtual earth at the op-amp inverting input prevents interaction between the two inputs.

The winning of the war...

Following Eire's decision to adopt 27MHz, 40 channel FM for the basis of its CB system, the much delayed decision from the UK seems to have been arrived at for the worst possible reasons:



The CB'ers dream: 100W all modes Sommerkamp TS-788 transceiver

The Voice of the People

Depending on your viewpoint, it is not at all clear whether or not the UK CB phenomenon of the past year has been a gratifying example of beaurocracy overcome by sheer practical commonsense — or yet another unedifying example of the irresistability of large scale organised civil disobediance.

The practical realization of a personal communication facility with a minimum of administrative beaurocracy is a logical extension of any 'libertarian' democracy — provided it conforms to the usual criteria by which democratic 'freedom' has been established.

Namely, CB radio should not interfere with the freedom of any other citizen to pursue his legally established rights. The fact that 27MHz CB radio (particularly AM mode operation) has grossly undermined the safety and confidence of the aero modelling fraternity was grudgingly recognized at the start of the year, when the Home Office allocated the almost universal 'Euro' band of 35.005 to 35.205MHz to UK radio modellers — although restricting its use to airborne applications only. At the same time, the first step towards CB was taken by the broad deregulation of the erstwhile 27MHz model control band.

A victory for commonsense, but what a shame so many CBers are/were so badly informed on the subject of their responsibility to aero modellers in the first place. It's not enough to simply stay away from a channel when the characteristic buzz of digital proportional RC can be heard in the receiver — since the aircraft can hear a CBer over a range many times that which can be covered from the RC transmitter to the CB receiver *(Fig. 1)*. The airborn antenna of the aircraft receiver can hear an enormous number of additional groundwave transmissions — so the answer is to stay clear of the RC spot channels at the very least. *(Table 1)*. The use of intermediate or split frequencies is not really very common, and will probably die out as serious users migrate to 35MHz.

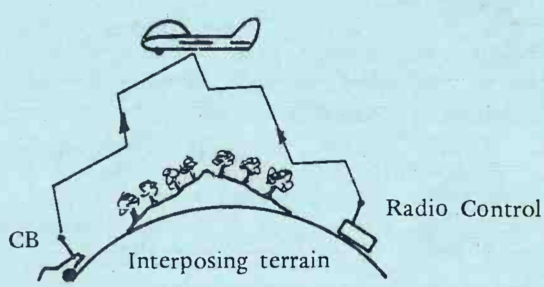


Figure one: Remember that a CB transmission will affect an airborne receiver over a much bigger area than served by the RC transmitter at ground level

RC colour code	CB channels to avoid	Freq. MHz
Black	(1)	26.945
Black/brown	2	26.975
Brown	(2/3)	26.995
Red/brown	6	27.025
Red	(7/8)	27.045
Orange/red	10	27.075
Orange	(11/12)	27.095
Yellow/orange	14	27.125
Yellow	(15/16)	27.145
Green/yellow	18	27.175
Green	(19/20)	27.195
Blue/green	22	27.225
Blue	23	27.255

(Channel numbers in brackets indicate adjacent channels)

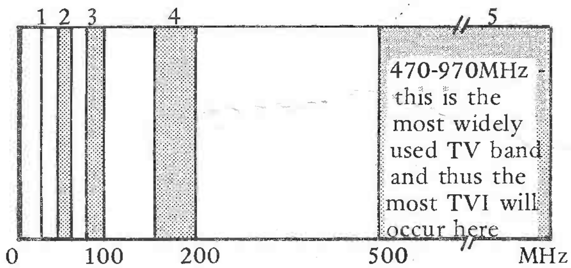
Table one: RC versus CB

Interference to other TV/Radio/Audio equipment

Public enemy number one for the CBer and the Home Office is/will be interference to the democratic right of the public to watch TV. Even if the CB set is fully approved and in accordance with the regulations laid down, there will still be a great deal of scope for the inadequacy of most types of 'front end' used in UK TV sets to be brought into relief by the presence of a large number of strong RF fields. *(Fig. 3)* The fact that the RF field is at a frequency far removed from UHF band 4 TV makes little difference. The basic problems results from simple overloading of the input of the TV, and is not as a result of harmonically related spurii (multiples of the 27MHz frequency).

Figure two: Know your broadcast frequencies.......

Broadcast bands above 27MHz:



1: 27MHz 2:45-68MHz Band 1 VHF TV
3: 88-108MHz Band 2 FM broadcasting
4: 175-230MHz Band 3 TV 5: Band 4 UHF TV

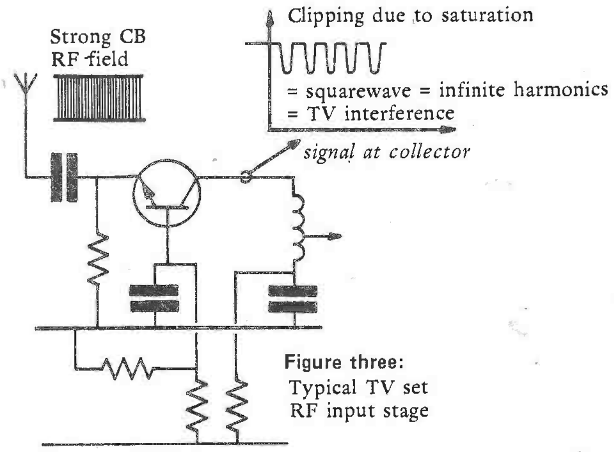


Figure three: Typical TV set RF input stage

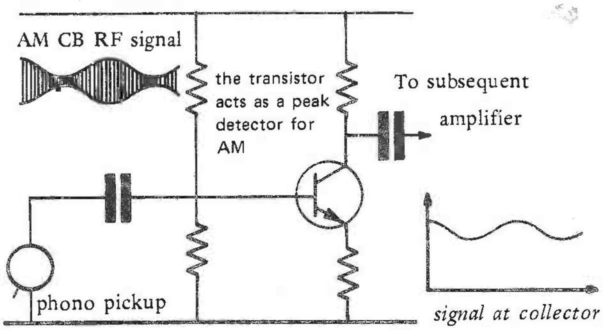


Figure four: AM CB in an audio amplifier

Table two: Harmonics of the 27MHz band to 1000MHz			
Number	Reference	Upper limit	Lower limit
1	27.000 MHz	27.405 MHz	26.965 MHz
2	54	54.81	53.93
3	81	82.215	80.895
4	108	109.62	107.86
5	135	137.025	134.825
6	162	164.43	161.79
7	189	191.835	188.755
8	216	219.24	215.72
9	243	246.645	242.685
10	270	274.050	269.650
11	297	301.455	296.615
12	324	328.860	323.580
13	351	356.265	353.545
14	378	383.670	377.510
15	405	411.075	404.475
16	432	438.480	431.440
17	459	465.885	458.405
18	486	493.290	485.370
19	513	520.695	512.335
20	540	548.100	539.300
21	567	575.505	566.265
22	594	602.910	593.230
23	621	630.315	620.195
24	648	657.720	647.160
25	675	685.125	674.125
26	702	712.530	701.090
27	729	739.935	728.055
28	756	767.340	755.020
29	783	794.745	781.985
30	810	822.150	808.950
31	837	849.555	835.915
32	864	876.960	862.880
33	891	904.365	889.845
34	918	931.770	916.810
35	945	959.175	943.775
36	972	986.580	970.740
37	999	1013.985	997.705

Exact details of UK broadcast frequencies are obtainable from the IBA and BBC:

IBA Eng. Inf. Dept.,
Crawley Court,
Winchester,
Hants SO21 2QA

B.B.C. Engineering
Information Dept.,
Broadcasting House
London W1A 1AA

The use of AM and SSB (both basically modes of speech that vary the transmitted output power in accordance with speech level) will also lead to interference in such unlikely things as HiFi and ordinary domestic MW receivers, where a powerful RF field can readily be rectified and amplified in the audio stages — regardless of what the RF selectivity may do. *(Fig. 4).*

FM modulation at least alleviates the problem of interference with HIFi — but it doesn't necessarily eradicate it altogether. An FM transmission can still drive an audio stage into non-linearity (and hence distortion), but the reason the CBer gets away with it, is that there is no actual speech coming from the amplifier since the RF carrier level is constant. FM CB will still give TV sets the 'wobblies', but since the match of the set to it's antenna is not so critical as with AM, the scope for really grotesque interference arising from the mismatch of an AM transmitter is rather less.

In fact, FM CB has many advantages from a technical viewpoint, although the predominance of AM and SSB CB equipment as the historical result of the USA's policy has left a legacy that will be hard to 'phase out'.

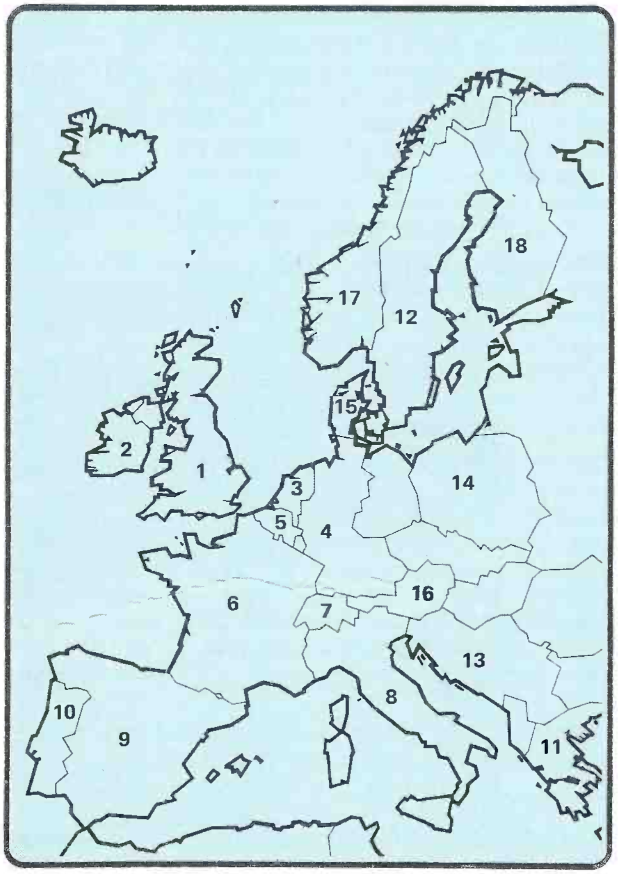
~CB~CB~CB~CB~CB~CB~CB~

Euro-CB on 27MHz

The fact that most of Europe already uses 27MHz for CB was obviously an influential force in the UK choice- but as you will see as we unwind each country in the course of this series - actual standards vary widely.....

No.	Country	Channels	Mode(s)	Output
1	UK	(?)40	FM	(?)4W
2	Eire	40	FM	4W
3	Holland	22	FM	0.5W
4	W. Germany	22	AM/FM	0.5W
5	Belgium	22	AM/FM/SSB	0.5W
6	France	22	FM	2W
7	Switzerland	12	AM	0.1W
8	Italy	23	AM	5W
9	Spain	22	AM	5W
10	Portugal	40	AM/FM/SSB	5W
11	Greece	40	AM/FM/SSB	5W
12	Sweden	25	(SSB)/AM/FM	2-5W
13	Yugoslavia	32	AM	2W
14	Poland	40	AM/SSB	4W
15	Denmark	23	AM/FM	0.5W
16	Austria	12	AM/FM	0.5W
17	Norway	23	AM/FM	0.5W
18	Finland	24	AM/FM	0.5W

Please note that one country's channels do not necessarily relate to those of another. A much more detailed analysis of Euro-CB will follow in subsequent issues.



CHANNEL v FREQUENCY — FOR THE STANDARD 40 CHANNEL SYSTEM USE 'LOW' COLUMN

CH	FREQUENCY IN MHZ		
	HI	MID	LOW
1	28.500	27.415	26.965
2	28.510	27.425	26.975
3	28.520	27.435	26.985
4	28.540	27.455	27.005
5	28.550	27.465	27.015
6	28.560	27.475	27.025
7	28.570	27.485	27.035
8	28.590	27.505	27.055
9	28.600	27.515	27.065
10	28.610	27.525	27.075
11	28.620	27.535	27.085
12	28.640	27.555	27.105
13	28.650	27.565	27.115
14	28.660	27.575	27.125
15	28.670	27.585	27.135
16	28.690	27.605	27.155
17	28.700	27.615	27.165
18	28.710	27.625	27.175
19	28.720	27.635	27.185
20	28.740	27.655	27.205

CH	FREQUENCY IN MHZ		
	HI	MID	LOW
21	28.750	27.665	27.215
22	28.760	27.675	27.225
23	28.790	27.705	27.255
24	28.770	27.685	27.235
25	28.780	27.695	27.245
26	28.800	27.715	27.265
27	28.810	27.725	27.275
28	28.820	27.735	27.285
29	28.830	27.745	27.295
30	28.840	27.755	27.305
31	28.850	27.765	27.315
32	28.860	27.775	27.325
33	28.870	27.785	27.335
34	28.880	27.795	27.345
35	28.890	27.805	27.355
36	28.900	27.815	27.365
37	28.910	27.825	27.375
38	28.920	27.835	27.385
39	28.930	27.845	27.395
40	28.940	27.855	27.405

R&EC and CB

Now that CB is here to stay, REC will ensure that all the adherents enjoy the maximum benefit — with minimum interference to the liberty of others. Which broadly means that your neighbours should be able to watch Crossroads without crosshatch — whilst you are able to hook the DX, without resorting to the sheer brute force and ignorance of illegal power boosters.

Contributors to this regular monthly supplement include the most knowledgeable people in the business of world CB. But furthermore, we think that CB will be an introduction to the broader spectrum of interests in Radio and Electronics for a good many CB enthusiats who find the topics of a CB-only publication just a little restrictive and subjective. Write and tell us what you want — and what you think.

~CB~CB~CB~CB~CB~CB~CB~

The Evolution of CB

AM CB grew up in Europe (and much of the rest of the world) from the purely commercial expedient that a lot of surplus gear was available at very low cost as a result of the Boom and Bust of the US CB market in the 1977/8/9 period. The whole point of CB is that the user frequently doesn't care much about the technicalities of his rig — as long as it is cheap and enables him to talk to a passable number of other enthusiasts.

And the other reason is the naive reluctance of the Post Office (as it then was) followed by the Home Office (who took over the Post Office's responsibility for radio spectrum usage), to recognize that CB existed. Or even acknowledge the inevitability of a formal CB system in the UK — if only as a result of the frequently repeated experiences of the rest of the world.

The Post Office greedily guarded its communications monopoly; and the Home Office uttered dark things about the potential for illegal use of CB. It's hardly likely any criminal would be stupid enough to use the most populated frequency on the airwaves, when it is nearly as simple to obtain far more discrete amateur or private mobile/portable radio equipment. The experience of the USA bears out the simple fact that CB is a far more constructive medium than the UK authorities would like to admit.

After a while, the interminable buck passing in the Home Office during the last Labour administration led to the attraction of CB as an election issue. The Conservative Party — being nominally the party of individual freedom and against state monopoly agreed to the idea 'in principle' — and thus won the support of the CB Association. Not surprisingly, with the election in the bag and more pressing matters afoot, the CB lobby was conspicuously ignored while the Home Office replayed its usual round of worn out excuses:

Number one: *"There isn't a demand for the service....."*

Not to anyone's great surprise, this old chestnut quickly passed into disuse.

Number two: *"There is no suitable frequency....."*

This was one that the 'boffins' used most successfully to bamboozle the politicians. After all, the average MP will probably admit to having his scientific acumen strained when asked to change the batteries in a torch — so the 'blind 'em with science' ploy was very successful. The fact that the rest of the world found a frequency eventually got the better of the argument, although the wimpering continues with talk of the 'special factors' that apply to the British Isles.

Number three: *It would be impossible to regulate the illegal misuse of CB, and people might say Rude Things.."*

Oh dear, oh dear. The BBC and IBA somewhat preempted this argument by the saturation broadcast coverage of just the sort of thing that the anti-CB brigade claimed would undermine the nation's morality. Even the so-called responsible radio amateur fraternity have been thoroughly disgraced by the behaviour of some moronic souls on the 2 metre band in particular. Never mind, there is always that quaint switch marked 'Off'.

Number four: *"The problems of interference to other users will be insurmountable....."*

Now even the most ardent CB proponent must concede some ground here. Technical advances over the past couple of years have certainly reduced the chance of the CB set causing problems — and the ease with faults and problems can be identified and rectified. Nevertheless, the problem of simple overload cannot be ignored. The answer is to provide sufficient revenue from the CB licence to pay the relevant authority to go out and settle problems. Existing CB groups are already well organized, so that trouble shooting such problems should be quite an orderly affair. Most such problems conform with very standard phenomena, that are cured by equally standard solutions. With 2.4 million unemployed persons, the shortage of manpower to handle these situations is scarcely a convincing argument — albeit a fairly minimal degree of training will be required.

But all these were all eventually ground down to the point at which Mr. Whitelaw made the infamous 'Open Channel' green paper available for discussion. The almost universal derision that this attracted from practical realists (be they fans of CB or otherwise) clearly underlined that 928MHz was ludicrously inadequate as an answer to the growing band of illegal 27MHz CB operators — hence the first crack in the facade appearing with the 35MHz aero modellers' allocation. 928MHz was simply the next most negative suggestion the Home Office could come up with compared to 'No CB at all'.

As country after country in Europe adopted the 27MHz band, it was inevitable that the UK could not pretend it could avoid the question any longer. Cars and trucks fitted with CB from the continent simply could not be regulated, and the underground movement had acquired nearly 250,000 illegal sets. Not as the result of any careful planning or consideration, 27MHz has simply happened.

The availability of another as yet unused 928MHz frequency offers some opportunity for the future, when equipment for these frequencies will become more viable and attractive as 27MHz clogs up.

Conclusions

No one can really be proud of the way CB has arrived here. There is very little scope for UK manufacturing to benefit — and we have a very indifferent technical solution compared to the system we could have had if the decision had been just two years ago. The capitulation to mass disobedience will lead to further erosion of public respect for politicians and the 'good sense' of authority.

In such circumstances there can be no victory — we have all lost something in this unseemly affair. Gleeful CBers might like to reflect on the other Great American 'democratic right' supported by a similar campaign of public obstinacy in the shape of the ludicrous gun laws. The ownership of firearms is a fait-accomplis, enshrined in as much law as can feasibly be enforced — and stoked along by some unashamedly commercially biased considerations.

Next month AM to FM conversions examined
928MHz — our objective assessment

Supplement printed by Delafield Reprographic Service Brentwood Essex

tar Practice plifier

By R. A. Penfold

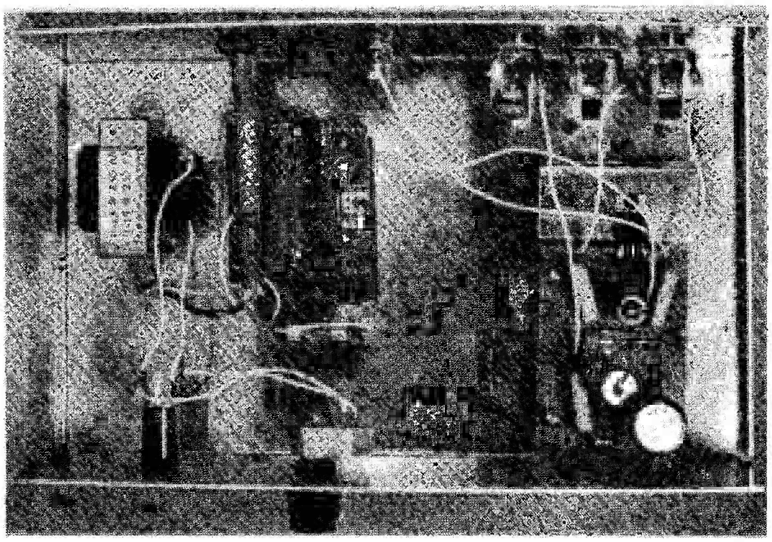
inputs • Ideal for solo or group practice. •

for instance, RD has twice the value of RA, an input signal going 1 volt positive would cause the operational amplifier output to swing 2 volts negative. The actual voltage change at the inverting input itself would be very small and it can be looked upon as providing a "virtual earth." The input impedance of the circuit is then equal to RA.

To obtain a mixing action at the inverting input it is merely necessary to add a second d.c. blocking capacitor and series input resistor, as are given by CC and RE in Fig. 1(b). The output now corresponds to the sum of the two input signals and the required mixing is obtained. Also, since the inverting input provides a virtual earth there is negligible interaction between the two inputs. In the present application, this ensures that adjustments to the volume and tone controls of one guitar will have no effect on the output of another guitar connected to the second input.

Another advantage with this type of circuit is that it can accept any number of inputs within reason, without any adverse effect on performance. It is merely necessary to add a d.c. blocking capacitor and series resistor for each input required.

How the two Veroboard panels and other components are laid out inside the case.



AMPLIFIER CIRCUIT

The circuit of the guitar practice amplifier is given in Fig. 2. This is basically similar to Fig. 1(b), but there are now three inputs. Guitar pick-ups need to work into a reasonably high impedance and they do not provide a very high output signal level. R1 to R3 give the circuit an input impedance of 33kΩ at each input, and the value of feedback resistor R7 is chosen to give a voltage gain of about 46dB, or 200 times. This gives an input sensitivity of about 24mV for full output, and any normal guitar pick-up will provide an output of adequate magnitude.

Unlike the operational amplifier in Figs. 1(a) and (b), the input impedance of the i.c. employed in the amplifier is not very high, and is comparable with the value of R7. Because of this, the non-inverting input cannot be biased to a mid-supply voltage by simply connecting it to the junction of two equal value resis-

COMPONENTS

Resistors
(All fixed values ¼ watt 5% unless otherwise stated)
- R1 33kΩ
- R2 33kΩ
- R3 33kΩ
- R4 8.2kΩ
- R5 47kΩ pre-set potentiometer, 0.1 watt horizontal
- R6 22kΩ
- R7 6.8MΩ 10%

Capacitors
- C1 0.47μF polyester type C280
- C2 0.47μF polyester type C280
- C3 0.47μF polyester type C280
- C4 330μF electrolytic, 25V. Wkg.
- C5 2,200μF electrolytic, 16V. Wkg., single-ended (see text)
- C6 100μF electrolytic, 25V. Wkg.
- C7 0.1μF polyester type C280
- C8 2,200μF electrolytic, 25V. Wkg. (see text)

Semiconductors
- IC1 TDA2006
- D1-D6 1N4001

Transformer
- T1 mains transformer, secondary 15V at 500mA (see text)

Fuse
- FS1 500mA cartridge fuse, 20mm.

Switch
- S1 d.p.s.t. rotary mains switch

Lamp
- PL1 panel-mounting neon, with integral series resistor

Sockets
- SK1-SK3 ¼in. jack socket
- SK4 3.5mm. jack socket (see text)

Miscellaneous
- Metal case (see text)
- Control knob
- Chassis-mounting fuseholder, 20mm.
- Veroboard, 0.1in. matrix
- Aluminium, 18 s.w.g. (for IC1 heat sink)
- 3-core mains lead
- Nuts, bolts, wire, etc.

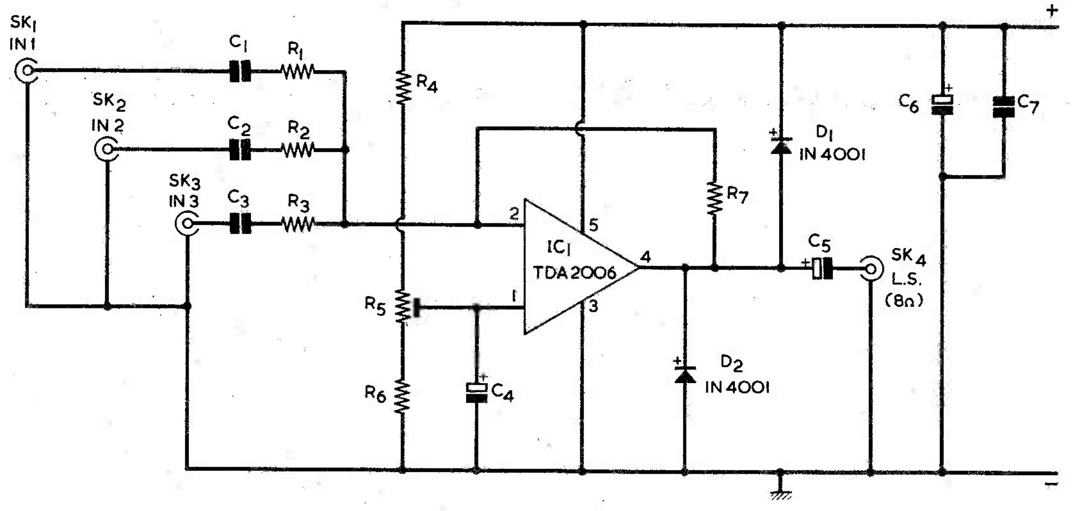


Fig. 2. The circuit of the a.f. section of the guitar practice amplifier.

tors, and it is necessary to provide an adjustable bias voltage here. The bias voltage is given at the slider of pre-set potentiometer R5, which is adjusted for a mid-supply voltage at the amplifier output.

The non-iverting input is bypassed to chassis by way of C4. This capacitor is given a relatively high value to ensure that no hum or noise from the power supply is passed into the non-inverting input. The amplifier is designed for use with a non-stabilized supply, and the high value of C4 causes quite a stable bias voltage to be given even when there are substantial fluctuations in supply voltage with high level signals. C4 prevents a form of positive feedback which could cause the biasing to be forced well off centre by strong sudden signals, resulting in clipping of one set of half-cycles.

D1 and D2 are protection diodes, and C6 and C7 are supply decoupling components. The amplifier has a quiescent current consumption of about 40mA, but this rises to some 300 to 350mA at full output.

POWER SUPPLY

The supply current required by the amplifier is much too high to be provided economically by batteries, and a mains power supply is required. The circuit of the supply used with the amplifier is shown in Fig. 3.

S1 is the on-off switch and is, incidentally, the only control for the unit. PL1 is a neon indicator with integral series resistor intended for operation from the 240 volt a.c. supply. T1 provides isolation from the mains supply and offers a secondary voltage of 15 volts at 500mA. (Some important notes concerning this transformer are given later under the heading "Components").

The secondary voltage is applied via fuse FS1 to the bridge rectifier consisting of D1 to D4, and the rectified voltage is smoothed by capacitor C8. It might be thought that the initial surge of current at switch-on, as C8 charges, could cause the fuse to blow, but it has been found in practice that a quick-blow fuse withstands this surge, and there is no necessity to employ an anti-surge fuse for FS1.

COMPONENTS

The amplifier is assembled in a vinyl covered metal instrument case having dimensions of 229 by 133 by 63.5mm, and this is a case type TP4 available from Maplin Electronic Supplies. Also available from Maplin Electronic Supplies is the integrated circuit type TDA2006 and suitable electrolytic capacitors for C5 and C8. C8 is an axial lead capacitor whilst C5 is a single-ended (i.e. both lead-outs are at one end) capacitor intended for printed circuit mounting. Both the Maplin capacitors will fit into the layout and case specified.

As will be evident from Fig. 3, the mains transformer has its two 15 volt secondaries connected in parallel. Mains transformer secondaries with the same nominal voltage should never be connected in parallel unless the transformer manufacturer states that it is safe to do so. This is because the transformer can overheat if one secondary should happen to have one or more turns in excess of the other. The author employed a transformer having two 250mA secondaries, but this may be difficult to obtain and a satisfactory alternative is a 10VA Miniature Transformer with two 15 volt 330mA secondaries which is listed by Maplin Electronic Supplies. It is also in order, with this particular transformer, to connect the two secondaries in parallel. It would also be in order,

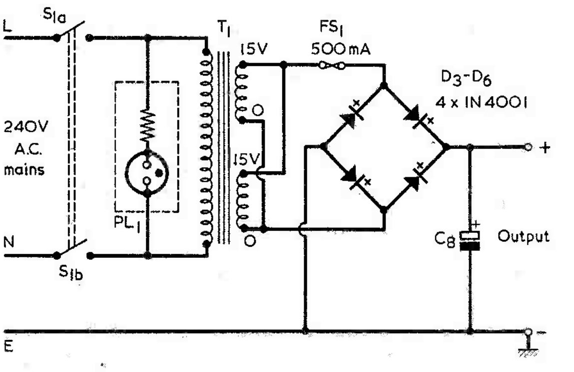
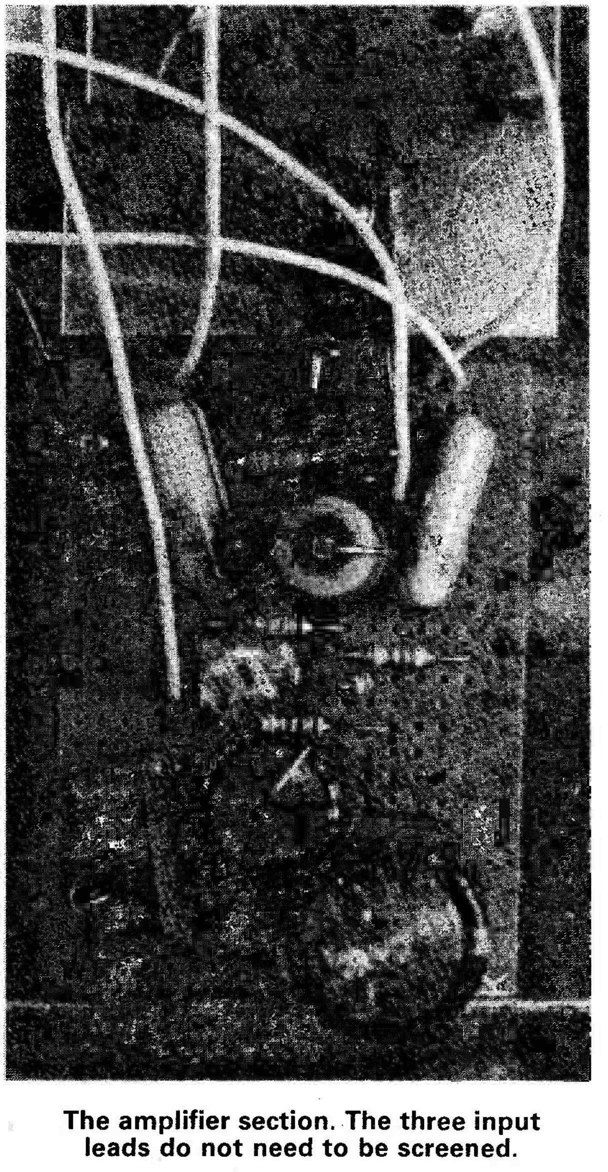


Fig. 3. The power supply section. There is no necessity for a stabilized supply.



The amplifier section. The three input leads do not need to be screened.

of course, to use a mains transformer having a single 15 volt secondary rated at 500mA or more. Such a transformer may require a metal case of greater height than that used for the prototype unit.

CONSTRUCTION

As can be seen from the photograph of the internal layout, the use of a relatively large case allows the mains transformer to be mounted well away from the amplifier board, thereby causing minimal stray pick-up of hum in the amplifier circuitry. Looking into the case from the front, the mains transformer is to the rear at the extreme left, with the power supply board to its right. On the right hand side of the case is mounted the amplifier board. On the front panel, to the left, is PL1 with S1 to its right. The chassis-mounting fuseholder is secured to the case bottom between S1 and the power supply board.

Output socket SK4 is fitted to the centre of the rear panel. A 3.5mm jack socket was used in the protoype but any other type of 2-way socket or connector which may be preferred can be used instead. SK1, SK2 and SK3 are all ¼in. jack sockets and are mounted behind the amplifier board. A hole with a grommet for the mains lead is provided at the power supply end. The mains lead should be secured inside the case with a plastic or plastic-faced clip.

SUPPLY BOARD

Many of the power supply components are assembled on a piece of 0.1in. Veroboard having 19 copper strips by 18 holes, and this is shown in Fig. 4. There are no breaks in the copper strips. The two mounting holes are 3.3mm, in diameter and take 6BA or M3 screws.

As is shown in Fig. 4, a solder tag is secured under one of the mounting nuts for the transformer, and this provides the chassis connection for the mains earth lead as well as the negative output of the power supply. Before connecting to S1, confirm relative tag positioning with a continuity tester in case the particular switch employed has a different tag layout to that shown in the diagram. An insulated lead about 150mm. long is soldered to the Veroboard at the

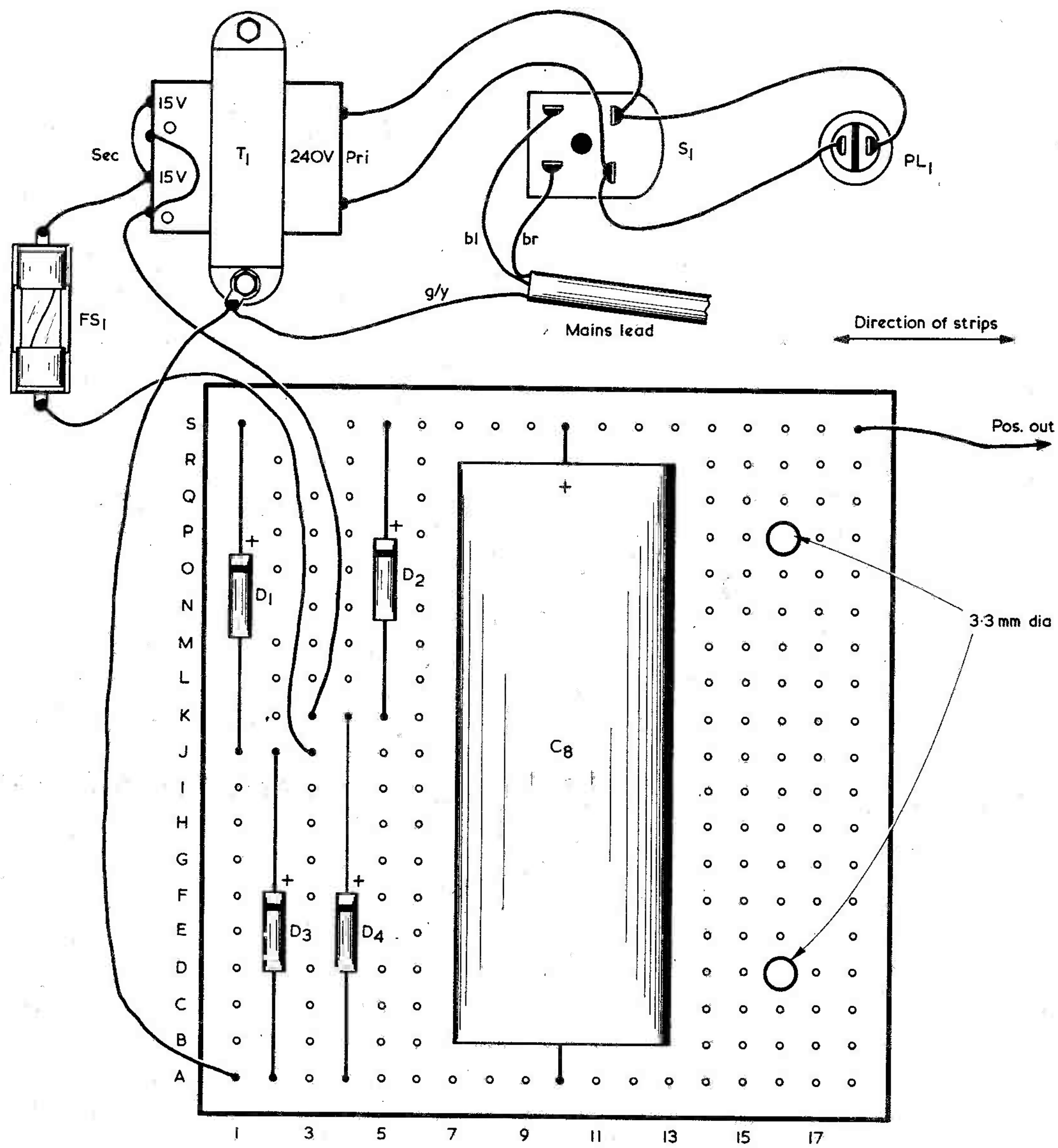


Fig. 4. Wiring up the power supply. There are no breaks in the Veroboard copper strips.

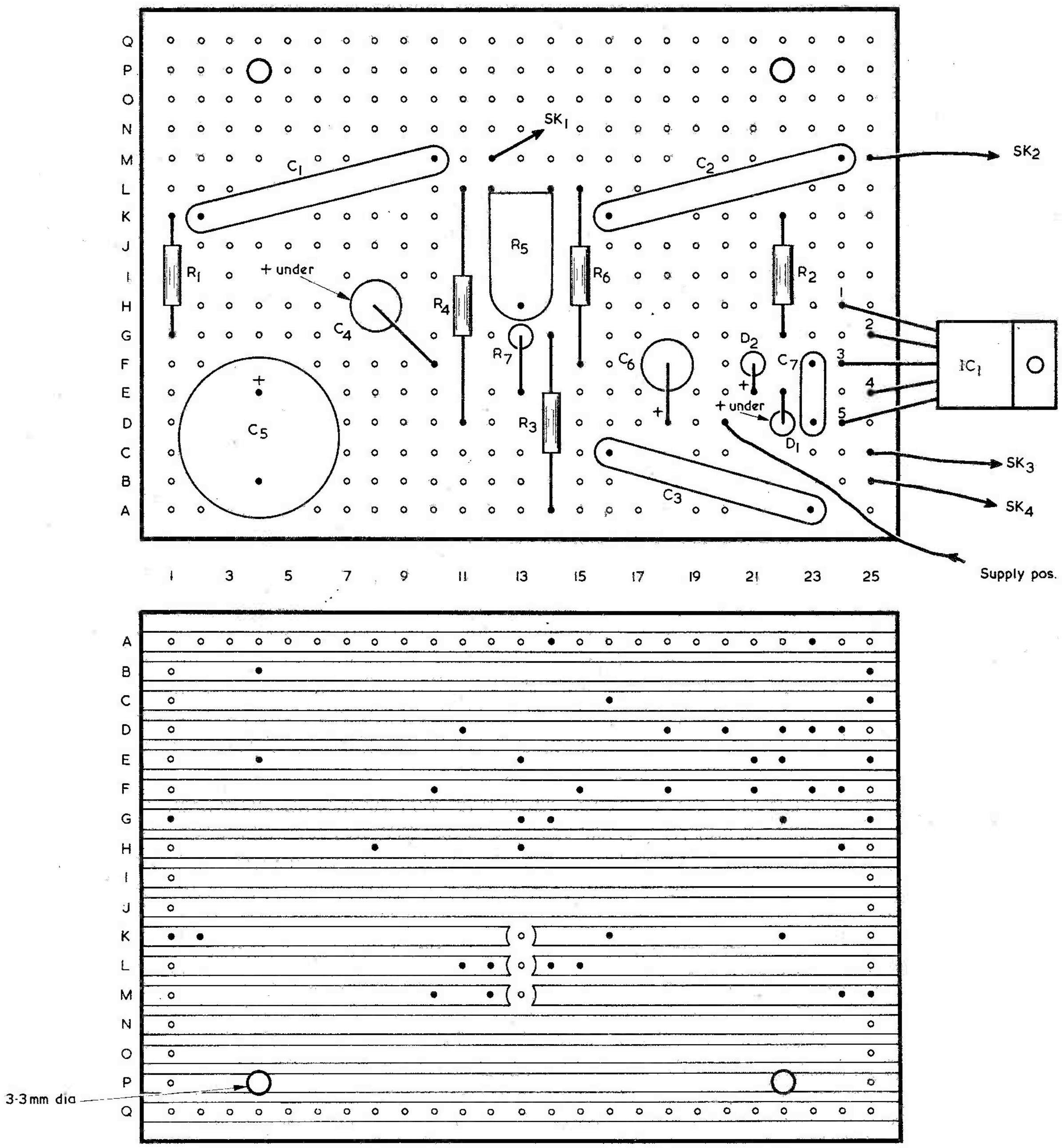


Fig. 5. Component layout on the amplifier Veroboard.

positive output, for later connection to the amplifier board. The power supply board is secured to the case bottom with strip "A" towards the front of the case. Spacing washers 12.5mm. long on the mounting bolts keep the board underside well clear of the inside metal surface of the case.

AMPLIFIER BOARD

A second 0.1in. Veroboard is used for the amplifier, and details of this are given in Fig. 5. The board has 17 copper strips by 25 holes and there are three breaks in the strips. The lead-out wires of the TDA2006 are preformed, but will not fit the 0.1in. matrix board unless they are splayed out slightly. The i.c. requires a small heat sink which is made up as shown in Fig. 6. Fig. 7 gives a side view, illustrating how the heat sink is bolted to the i.c. and to the bottom of the metal case. The heat sink is made of aluminium of about 18 s.w.g., and it also provides the negative supply connection to the amplifier by way of the i.c. heat tab.

The completed amplifier board assembly is mounted at the extreme right hand end of the case, so that it is well away from the mains transformer and the mains wiring. Spacing washers 12.5mm. long are used on the screws securing the board. If this is temporarily mounted in place the two holes for the heat sink can then be marked out using the heat sink itself

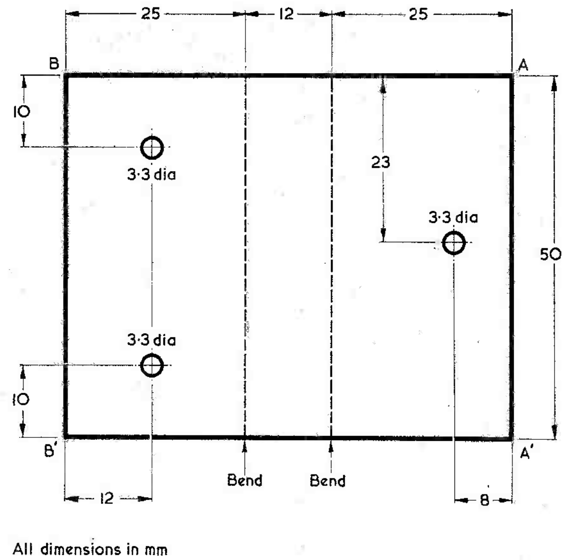
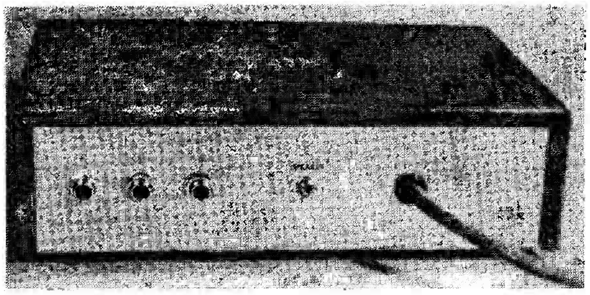


Fig. 6. The heat sink for IC1 is made from a piece of 18 s.w.g. aluminium. The two bends are at right angles and the sink is shown, after bending, in Fig. 7.

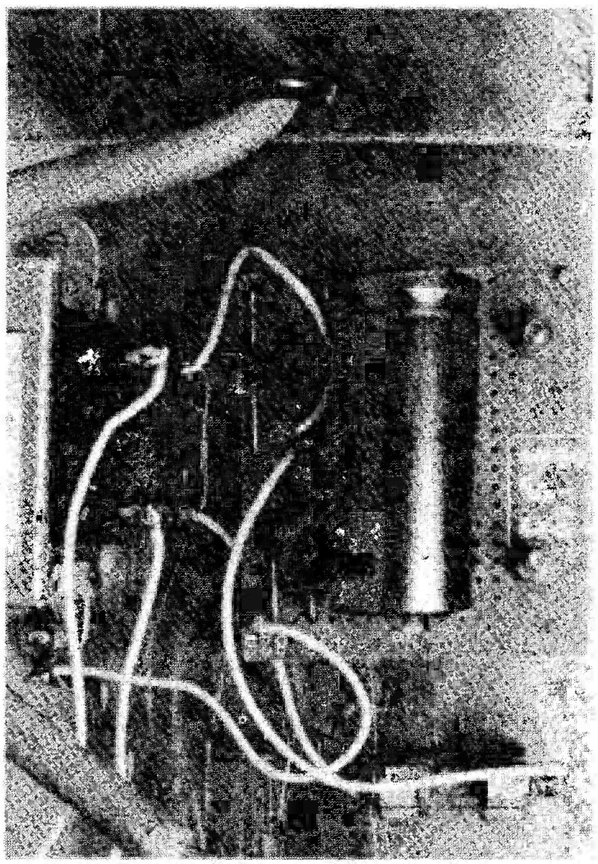


The rear panel. The three input sockets are to the left, and the output socket is positioned centrally.

as a template. The assembly is mounted with the heat sink to the rear.

The positive supply lead is connected to the amplifier board, as also are the leads to the four sockets. Because the amplifier is in a metal case the leads to SK1, SK2 and SK3 do not need to be screened, but they should be kept as short as is reasonably possible. All the jack sockets pick up their chassis connection by way of their mounting bushes and nuts. The non-earthy tags of the sockets can be determined by visual inspection.

If an alternative output socket is employed it may require a wired chassis connection. This can be provided by a solder tag under the nearer nut securing the heat sink to the case bottom.



The mains transformer and power supply panel.

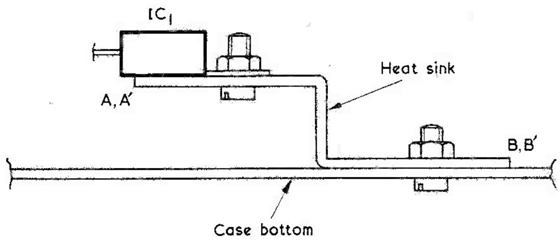


Fig. 7. How the heat sink is secured to the integrated circuit heat tab and to the bottom of the metal case.

ADJUSTMENT

After the amplifier has been completed it needs to be checked and R5 has then to be adjusted. Initially, R5 should be given a central setting. A guitar is connected to one of the inputs and an 8Ω speaker to the output socket. Note that there is a short delay of a second or two after switch-on before the amplifier becomes fully operational, since some of the capacitors have to charge to their working levels. In its present state the amplifier should function reasonably well.

Next, set a multimeter to a suitable d.c. volts range (25 volts f.s.d. or more), connect its negative lead to chassis and its positive lead to the output of the TDA2006. A suitable point is the lower wire of R7 as shown in Fig. 5. R5 is then adjusted for an output voltage of 11 volts.

If a multimeter is not available, it is quite acceptable to simply adjust R5 to the setting which gives the highest audible output before clipping and consequent severe distortion occur.

After R5 has been adjusted the case lid is fitted. The amplifier should always be employed with the lid firmly screwed in position. ■

SHORT WAVE NEWS
FOR DX LISTENERS

By Frank A. Baldwin

Times = GMT *Frequencies = kHz*

As the winter period comes to an end, signals from the Far East will fade out and those from the Latin American area will tend to build up – at least that is the usual pattern of events for those of us here in the U.K. and Europe. Instead of listening from around 1500 and 2200GMT for those elusive transmissions from the East, we must instead strain our ears for the African signals from 1730 onwards and the Latin American transmissions from around 2200 through to 0600 or so – providing one has trouble with sleeping at nights! Insomniacs make good LA specialists!

Some LA signals heard of late have been –

●COLOMBIA

La Voz del Norte, Cucuta, on **4875** at 0415, OM identification in Spanish followed by local announcements in which Cucuta was mentioned several times. The schedule is from 0930 to 0500 variable, reportedly closing sometimes at 0630. The power is 5kW.

Radio Guatapuri, Valledupar, on **4815** at 0722, local-style music, OM with station identification at 0726 and again at 0736. Local announcements, some with the echo-effect much beloved by the LA's. Still on the air as late as 0745. The schedule is from 0930 to 0600 and the power is 10kW. Reportedly edentifying as "Radio Favorita" it was "Radio Guatapuri" on both the above occasions.

●ECUADOR

Radio Federacion, Sucua, on **4960** at 0319, OM with announcements in Spanish, YL with folk songs. The schedule is from 1030 (Sundays from 1100) to 0300 (Saturdays until 0400, Sundays until 0100). The power is 5kW.

●SURINAM

Radio Apintie, Paramaribo, on a measured **5006** at 0305, light music European-style non-stop through to 0330 when announcements in Dutch. The schedule is from 0830 to 0430 and the power is unknown.

●ALGERIA

Algiers on a measured **15033** at 2057, OM (Old Man = Male announcer) with announcements in French, local-style music. At 2100, 5 pips time-check, OM with station identification and details of frequencies with transmission times (this channel not mentioned) in English. Algerian frequencies are subject to constant variations.

●PORTUGAL

Radio Renascenca, Lisbon, YL (Young Lady = Female announcer) in Portuguese with the programme for Portuguese catholics abroad, scheduled from 1830 to 2230 on this particular channel.

●YEMEN ARAB REPUBLIC

Radio Sana'a on **9780** at 1950, Arabic-type music, YL with songs in the Home Service which is entirely in Arabic. The schedule on this frequency is from 0300 to 0700 and from 1000 to 2130, on Fridays additionally from 0700 to 1000. The power is 50kW.

●KUWAIT

Radio Kuwait on **11650** at 1830, OM with station identification followed by news of the Arabic world in the English programme intended for Europe, scheduled on this channel from 1800 to 2100. Also directed to the Arabian Gulf area.

●BULGARIA

Radio Sofia on **9700** at 1954, YL with the English programme for the U.K. and Eire, scheduled from 1930 to 2000 – all about mineral springs in Bulgaria on this occasion.

●EAST GERMANY

Radio Berlin International on **21500** at 1839, OM with station identification, frequencies and times details in the English programme for Europe and West Africa, scheduled from 1800 to 1845.

●ETHIOPIA

Addis Ababa on **7165** at 1512, xylophone music. At 1515, OM with a talk in English until 1520 then into a programme of European-style dance music until pips time-check at 1530 and a newscast after station identification by YL. All in the English programme, scheduled on this channel from 1500 to 1600.

●SOMALIA

SBS Mogadishu on **9585** at 1932, OM with news of African affairs in Somali (place names identified) then local music and songs by YL chorus. Lots of co-channel QRM (interference). This is the External Service which is scheduled from 1000 to 1930 (extended on this occasion). Domestic Service programmes are carried on this channel from 1530 to 1630.

●**ROMANIA**
Radio Bucharest on **9690** at 1957, OM with a talk about the libraries of Romania in the English programme for Europe, scheduled from 1930 to 2030.

●**KENYA**
Mombasa on a measured **4934** at 0341, OM with a religious service in vernacular, choir with hymns in the North Eastern and Coastal Service, scheduled on this frequency from 0330 to 0630 and from 1400 to 2005. The power is 20kW.

●**MALI**
Bomako on a measured **4838** at 2207, African-type orchestra, YL with songs, OM's with chants. The schedule is from 0600 to 0800 and from 1800 (Friday to Sunday inclusive from 1830) to 2400. The power is 18kW and this one is listed on **4825.**

●**NETHERLANDS**
Radio Nederland on **9895** at 0948, OM with the English programme intended for Europe and scheduled on this channel from 0930 to 1020.

●**INDONESIA**
RRI (Radio Republik Indonesia) Ujung Padang on a measured **4719** at 1520, OM in Indonesian with Sousa march interludes. The schedule here is from 0830 to 1230 but has been noted here closing as late as 1532 on several occasions. The power is 50kW.

RRI Jakarta on a measured **4774** at 1526, OM in Indonesian, short interludes of military music, almost certainly in parallel with Ujung Padang on this occasion. Jakarta transmits special events on this channel and is scheduled from 2200 to 0200 and from 0830 to 1600. The power is 50kW.

RRIBukittinggi on a measured **4828** at 1528, OM in Indonesian, signal just audible. This one operates from 2300 to 0300, 0500 to 0715 and from 0930 to 1600, is listed on **4827** and has a power of just 1kW.

RRI Yogyakarta on **5045** at 1535, OM's with a discussion in Indonesian. The schedule is from 0100 to 0300, from 0455 to 0800 and from 0955 to 1700. The power is 5kW.

●**CHINA**
Radio Peking on **9860** at 1920, OM with the English programme for Europe, scheduled from 1900 to 2000. All about the mistakes made during the "Great Cultural Revolution."

Radio Peking on **9880** at 1918, Chinese music in the Portuguese programme for Europe and Africa, scheduled from 1900 to 2000.

Radio Peking on **9920** at 1915, OM with the Cantonese programme to Europe, scheduled from 1900 to 2000.

Radio Peking on **9945** at 1912, OM with the Romanian programme, scheduled from 1900 to 1930.

Radio Peking on **3220** at 2150, OM in Chinese in the Domestic Service 1 programme scheduled from 2000 to 2300 and from 1318 to 1733.

●**CHINA – REGIONALS**
Kunming, Yunnan on **4760** at 1524, YL in Chinese, piano music. This is Yunnan 1 operating from 2150 to 0600 (Tuesdays until 0800) and from 0920 to 1600. An English language lesson is radiated from 2200 to 2230. (Yunnan People's Broadcasting Station = "Yunnan Ren-min Guang-bo Dian-tai" as identified in Standard Chinese).

PLA (People's Liberation Army) Fuzhou on **4045** at 1514, OM and YL alternate in Chinese. This transmitter radioes the Network 1 programme to Taiwan and other offshore islands from 2100 to 0145 and from 1000 to 1800.

Lanzhou, Gansu on **4865** at 2215, YL in Chinese. The schedule is from 2145 to 0100 (Sundays until 0600), from 0320 to 0600 and from 1000 to 1600.

Xizang, Tibet on **4750** at 1544, OM in Chinese, local-type classical music. The schedule is from 2230 to 0645 (March to September from 2300) and from 1000 to 1545. "Hsi-Tang Ren-min Guang-bo Dian-tai."

Haerbin, Heilongjiang on **4840** at 2226, OM and YL in Chinese, OM with songs. The schedule is from 2040 to 0630 (Thursdays until 0510) and from 0830 to 1530.

●**THAILAND**
Bangkok on **4830** at 1530, OM song in Thai with local orchestral music. Radio Thailand operates from 2240 to 1630 on this channel. The power is 10kW.

●**NORTH KOREA**
Pyongyang on **9977** at 1315, OM with a newscast, YL with a song in Korean in the English programme for South East Asia, scheduled from 1300 to 1450.

●**VIETNAM**
Hanoi on a measured **9986** at 1345, YL with announcements in the Cambodian programme for South East Asia, scheduled from 1300 to 1400.

Hanoi on a measured **4944** at 2208, OM in Vietnamese in the Home Service 1 programme, scheduled on this channel from 2100 to 1615 (variable closing time, reported closing sometimes at 1630).

●**MONGOLIA**
Ulan Bator on a measured **4763** at 2221, OM and YL alternate in Mongolian, also logged in parallel on **4830.** This transmitter radiates the Home Service 1 from 2200 to 0100 and from 1030 to 1500; relays the R. Moscow Mongolian programme from 0600 to 0650, 0930 to 1000 and from 1200 to 1245; the Foreign Service in Russian from 1330 to 1400. Although scheduled to open at 2200, it has always been noted here as opening at 2202 with the National Anthem (the tuning signal commences at 2200). The power is 50kW.

●**IRAQ**
Radio Baghdad on **9745** at 2130, YL with station identification and opening announcements in the English programme for Europe, scheduled from 2130 to 2230. This item according to one of our regular readers, A. Dupres of Cardiff, an enthusiast just 16½ years of age – have we any younger fans? I must listen to Baghdad sometime, I lived there for some time and know it well – but I never saw any magic carpets!

Alastair also logged AIR Delhi on **11620** at 1915, at which time every Saturday he listens to "Quiz Time" and has sent in some questions of his own.

Another of his regular loggings is United Nations Radio on **15230** at 0800 when they transmit a newscast in English to Africa.

Medium and Short Wave Radio

By
I.M. Attrill

Medium waves plus 25, 39 and 49 metre bands. Special grade ferrite aerial. Low cost design.

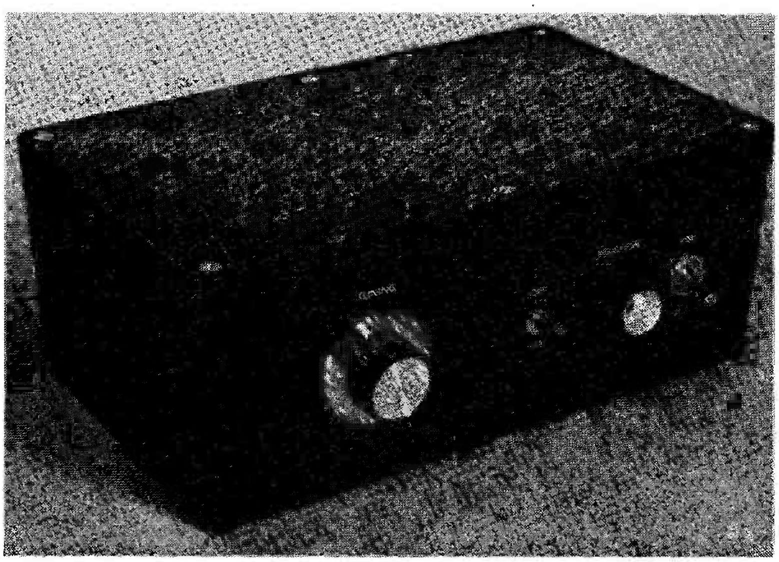
This unusual 3-transistor radio covers the standard medium wave band and the short wave broadcast bands within a frequency range of approximately 5 to 12MHz. This range takes in the 25, 39 and 49 metre bands. The output is intended for high impedance magnetic headphones (2,000Ω or 4,000Ω) or a crystal earphone, and there is plenty of volume from any reasonably strong signal.

Medium and short wave receivers usually employ a ferrite aerial for medium wave reception and a telescopic aerial for short waves, but this design uses a ferrite aerial for both wavebands. The ferrite rod grade normally encountered in portable receivers has a useful range for efficient reception from around 150kHz to 2MHz and covers the medium and long wave bands. The ferrite rod used in the design to be described is a special F16 grade, with a range from 500kHz to 12MHz. This allows the receiver to cover the medium wave band and the short wave range just mentioned.

THE CIRCUIT

The receiver employs a t.r.f. circuit in which all amplification before the detector stage is carried out at signal frequency. This is as opposed to a superhet which first converts the received signal to an intermediate frequency, this being passed into an i.f. amplifier before detection. Since the i.f. amplifier works at a fixed frequency it can provide a high level of sensitivity and selectivity, and the performance of a superhet is superior to that of a t.r.f. receiver in these respects. On the other hand a superhet is much more complicated than a basic t.r.f. receiver and, on completion, requires careful alignment. As can be seen from Fig.1, the circuit of the t.r.f. receiver to be described is quite simple and it requires only a small number of components. A further advantage is that, after completion, it requires no alignment whatsoever and is ready for immediate use.

L1 and L2 are the medium and short wave aerial coils respectively, and they are connected by



The prototype medium and short wave receiver is housed in a plastic case with the controls mounted on one of the longer sides.

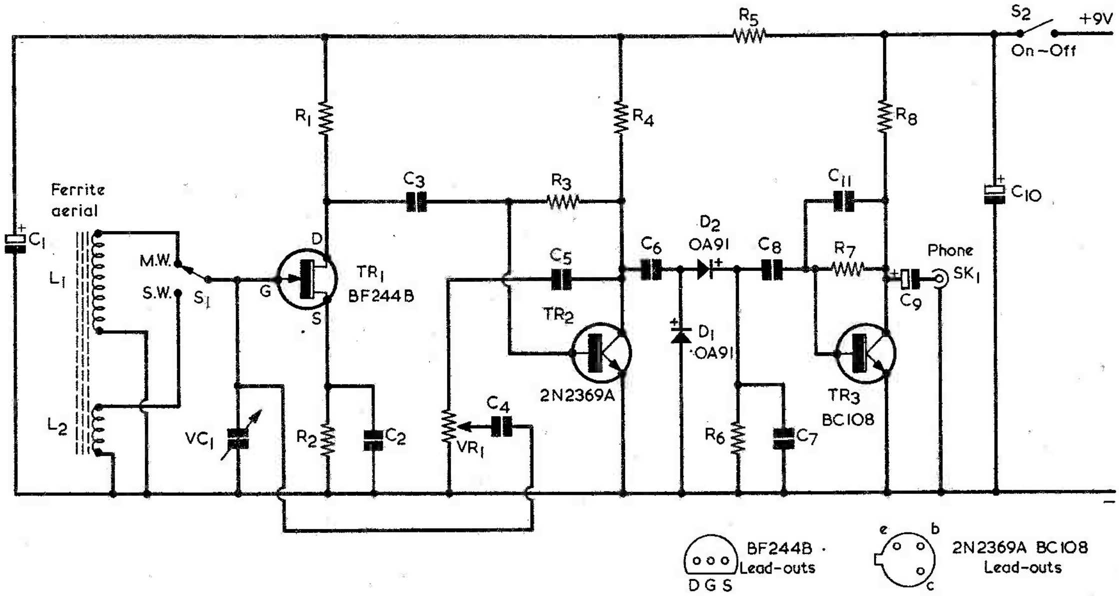


Fig.1. The circuit of the medium and short wave radio. The aerial uses a special grade ferrite rod which is suitable for short wave reception.

wavechange switch S1 to tuning capacitor VC1 and the gate of TR1. This is a Jfet having a very high input impedance, with the result that the aerial tuned circuit can be connected directly to the gate and there is no necessity for coupling windings. The coil specified for L1 has a coupling winding which is not shown in Fig.1. and no connections are made to this winding.

C3 couples the amplified signal from TR1 drain to the base of TR2, which functions as a broadband untuned r.f. amplifier. The aerial signal is inverted both by TR1 and by TR2, so that the signal at the collector of TR2 is in phase with the signal at TR1 gate. This allows positive feedback (known as reaction or regeneration in this application) to be provided from TR2 collector, through C5, VR1 and C4, back to TR1 gate, the level of feedback being controlled by VR1. This feedback increases the effective Q of the aerial tuned circuit by an extremely high level, allowing the receiver to have good selectivity and sensitivity. For normal reception, VR1 is advanced to the stage where TR1 and TR2 are just short of going into oscillation.

COMPONENTS

Resistors
(All fixed values ¼ watt 5%)
R1 330Ω
R2 1.5kΩ
R3 680kΩ
R4 330Ω
R5 1kΩ
R6 22kΩ
R7 1MΩ
R8 3.3kΩ
VR1 100kΩ potentimeter, linear

Capacitors
C1 100μF electrolytic, 10V. Wkg.
C2 0.01μF polyester type C280
C3 0.0068μF ceramic plate
C4 2.2pF ceramic
C5 100pF ceramic plate
C6 0.047μF polyester type C280
C7 0.015μF ceramic plate
C8 0.1μF polyester type C280
C9 10μF electrolytic, 10V. Wkg.
C10 100μF electrolytic, 10V. Wkg.
C11 560pF ceramic plate
VC1 variable air-spaced (see text)

Inductors
L1 medium wave aerial coil type MWC2 (Ambit)
L2 see text

Semiconductors
TR1 BF244B
TR2 2N2369A
TR3 BC108
D1 OA91
D2 OA91

Switches
S1 s.p.d.t. toggle
S2 s.p.s.t. toggle

Socket
SK1 3.5mm. jack socket

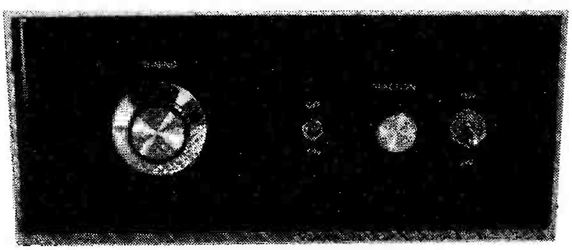
Miscellaneous
F16 grade ferrite rod, 200mm. x 9.5mm. (Ambit)
2 clips type FRPC (Ambit)
Plastic case (see text)
9-volt battery type PP3
Battery connector
1 large control knob
1 small control knob
Crystal earphone or high impedance headphones with 3.5mm. jack plug
Wire for L2 (see text)
Nuts, bolts, wire, solder etc.

The signal at the collector of TR2 passes through C6 to the detector circuit comprising D1, D2, R6 and C7, and the detected audio signal is fed via C8 to the audio amplifier, TR3. C11, between the collector and base of TR3, provides negative feedback at the higher audio frequencies and thus rolls these off. The result is a lower noise level and a reduction in adjacent channel interference. C9 is the output d.c. blocking capacitor.

Supply decoupling is provided by C1, R8 and C10. The current consumption of the receiver is only about 3.5mA, and a small PP3 battery is adequate.

COMPONENTS

The F16 grade ferrite aerial rod has a length of 200mm. and a diameter of 9.5mm. and is available, together with two mounting clips type FRPC, from Ambit International. Ambit International also supply the medium wave coil type MWC2. The BF244B required for TR1 is available from several retailers as are the 0.0068μF and 0.015μF ceramic plate capacitors, C3 and C7. Tuning capacitor VC1 can be any air-spaced variable component having a value between 200 and 250pF. The author used the front (208pF) section of a 208pF plus 176pF 2-gang capacitor. The receiver has to be housed in a plastic case to ensure that the ferrite aerial is not screened, and this has to be large enough to take the rather long ferrite rod. The case employed by the author has dimensions of 215 by 130 by 85mm. and is a case type MB4 available from Maplin Electronic Supplies.

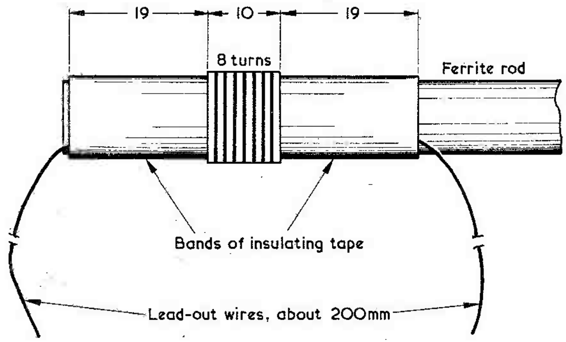


On the front panel the tuning control is on the left. S2 is mounted approximately central with the potentiometer and S1 to its right.

SHORT WAVE COIL

The short wave aerial coil is wound by the constructor using multi-strand p.v.c. covered connecting wire. The author used 7 x 0.2mm. wire and this is listed by Maplin Electronic Supplies as "Hook-up Wire". However any similar wire should give practically identical results provided that the length of the coil is about 10m. The winding is illustrated in Fig.2.

Start by anchoring the wire to the end of the ferrite rod by a length of insulating tape 19mm. ($\frac{3}{4}$in.) wide, leaving a lead-out wire of adequate length, say about 200mm. Then wind exactly 8 turns of wire around the rod, closely spaced so that the winding is about 10mm. long. A second piece of insulating tape is then used to anchor the free end of the coil to the rod and to prevent the coil from unwinding. The free wire is then cut to a suitable length. The two lead-outs of the coil can be cut to their final length during the wiring of the receiver.



All dimensions in mm

Fig.2. The short wave coil is home-wound and uses ordinary stranded connecting wire as described in the text.

PRINTED BOARD

Most of the components are assembled on a printed circuit board, which is shown full-size in Fig.3. The board is prepared in the usual way.

The ferrite aerial is fitted to the board after the other components have been soldered in place. The two mounting clips are secured to the board by means of short 6BA bolts and nuts. The short wave coil takes up the position relative to the board which is shown in Fig.3. and the medium wave coil is fitted to the other end of the ferrite rod. It is positioned so that only about 2mm. of the rod protrudes outside the end of the coil former and is then taped in this position.

The parts are mounted in the plastic case referred to earlier. This is rather larger than is really required, but it is necessary for it to have a dimension which will accommodate the ferrite aerial rod.

The front panel controls are laid out as shown in the photographs. The tuning capacitor is to the left, and on its right, slightly right of centre, is the on-off switch S2. The next control is VR1 with S1 on its right. The precise positioning of these controls is not critical. The tuning capacitor requires a hole of about 16mm. diameter for its spindle and bush. It will have 4BA tapped holes on its front plate and corresponding 4BA clear holes are needed in the front panel. A piece of paper with a $\frac{1}{4}$in. hole in it is passed over the spindle of the capacitor and the positions of the three holes marked on it in pencil. The paper can then be used as a template to mark out the corresponding holes in the panel. The three 4BA bolts holding the capacitor in place must be very short since their ends must not pass more than fractionally beyond the inside surface of the capacitor front plate. Should the bolt ends pass too far into the capacitor the moving or fixed vanes may be damaged.

The printed board is fitted to the case bottom by means of two 6BA bolts and nuts, with spacing washers to keep the board underside clear of the inside surface of the case. The board is not finally fitted in place, however, until it has been connected to the controls, output socket and battery clip. The wiring should be kept reasonably short and direct. Try to keep the two non-earthy leads to VR1 fairly well spaced and not running closely side by side, otherwise

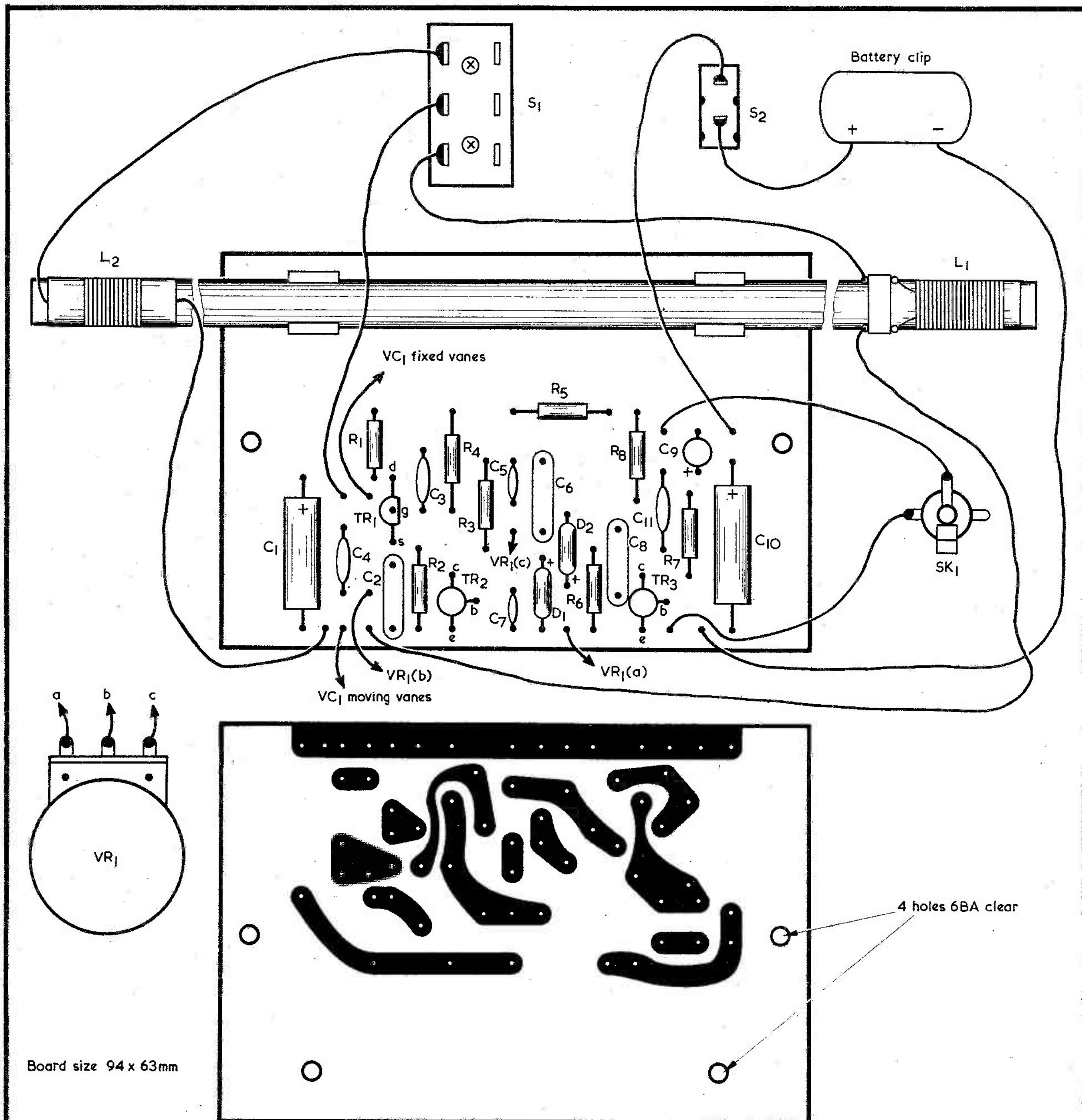
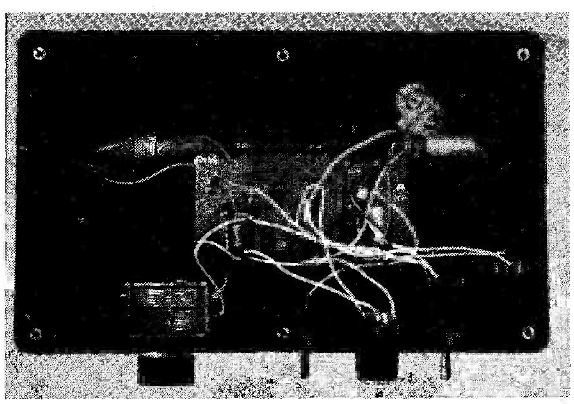
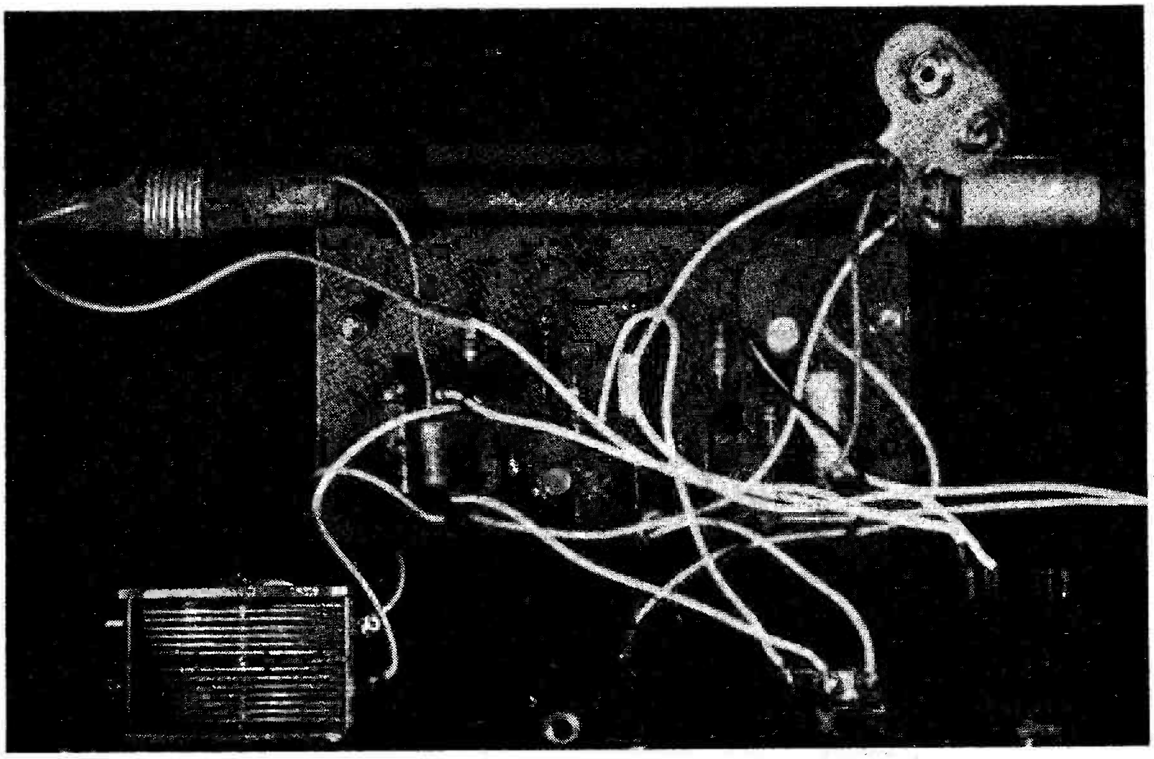


Fig.3. The majority of the components are assembled on a printed circuit board which is reproduced full size.

The printed board assembly is fitted to the bottom of the case with the ferrite rod aerial away from the panel controls.





A closer look at the printed board assembly

stray capacitance between them may render VR1 unable to control the level of regeneration properly. These are the two wires which connect to tags B and C of the potentiometer, as shown in Fig.3.

On the front panel, VC1 should be fitted with a large control knob. A smaller knob will suffice for VR1.

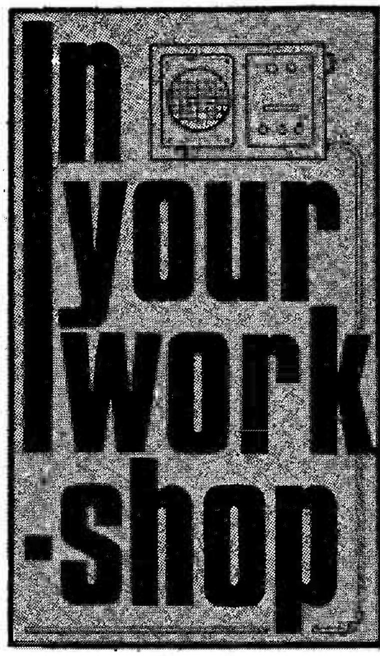
USING THE SET

With a crystal earphone or high impedance headphones plugged into SK1, VR1 backed well off (i.e. turned anticlockwise) and S1 set to the medium wave position, it should be possible to tune in a few stations by means of VC1. Sensitivity and Selectivity will probably both be rather poor, and advancing VR1 clockwise will give improved results. If VR1 is advanced too far the circuit will oscillate, causing beat notes to be produced when tuning through a station, and satisfactory reception will be impossible. For optimum results, VR1 should be backed off slightly from the point at which oscillation starts. The best setting required for VR1 will alter slightly after any significant adjustment of VC1. It will probably be found that, with VR1 advanced as far as possible without oscillation occurring at any setting of VC1, quite good results will be obtained over the entire medium wave band.

The receiver is operated in the same way when S1 is set to select short waves. The short wave broadcast bands are quite easy to locate as they provide what are normally the strongest signals, but reception on each band will vary somewhat according to the prevailing conditions. It is unlikely that there will be a single setting for VR1 which will give good results over the whole short wave tuning range, but it should be possible to find a setting for each broadcast band which gives good results over that band.

If, at some point on one of the tuning ranges the level of regeneration is excessive even with VR1 fully backed off, the gain of the r.f. amplifier must be slightly decreased. This can be achieved by increasing the value of R3 to 1MΩ. ■

"I just wonder if he is so crazy with that bamboo radio of his – he's exchanging QSL cards now!"



A Session of Puzzles.

No. 1.

Puzzle along with Dick and Smithy.

"But there's nothing to flaming well do!"

"We could," suggested Smithy, "have a game of swear-words Scrabble."

"No, thank you," replied Dick bitterly. "You know more dirty words than I do and most of the ones I do know I don't know how to spell."

"How about tidying up your bench?"

"I've tidied it up."

"Couldn't you knock up some little gadget to pass the time?"

"I can't think of anything to knock up."

A FEW PUZZLES

Dick squatted morosely on his stool and scowled at the Serviceman.

"Well," said Smithy, "I have to agree that things have been pretty quiet for the last few days and that we've completely cleared up everything that's in for repair."

"Exactly," confirmed Dick moodily, "and now there's nothing whatsoever to flaming well do. I'm bored rigid!"

Smithy pondered for a moment, then brightened.

"I've just had an idea," he said cheerfully. "I'll set you a little puzzle and we'll see if you can solve it."

"A puzzle? What sort of a puzzle?"

"An electronics puzzle."

"That doesn't sound a bad idea at all," stated Dick, quickly enthusiastic. "What's the puzzle going to be?"

Smithy pulled his note-pad towards him.

"Come over here," he said, taking a ball-point pen from his pocket, "and I'll show you."

Dick carried his stool over to Smithy's bench and perched on it while the Serviceman carefully drew out a circuit. (Fig. 1).

"There you are," said Smithy, putting down his pen. "Here's a simple circuit with four batteries and eight resistors in it."

"What am I supposed to do?"

"Find out the current which flows in the circuit. Everything is in series and so the same current flows through all the resistors and all the batteries."

(Would you, gentle reader, like to puzzle along with Dick and Smithy? If so, read no further and see if you can determine the current which flows in Smithy's circuit. Then come back to the events of the Workshop and discover whether your answer is the same as that reached by our servicing pair).

"I could start simplifying things a bit, I suppose," said Dick doubtfully, "by changing the four pairs of resistors to single resistors. For instance I could replace R1 and R2 by a single 3Ω resistor."

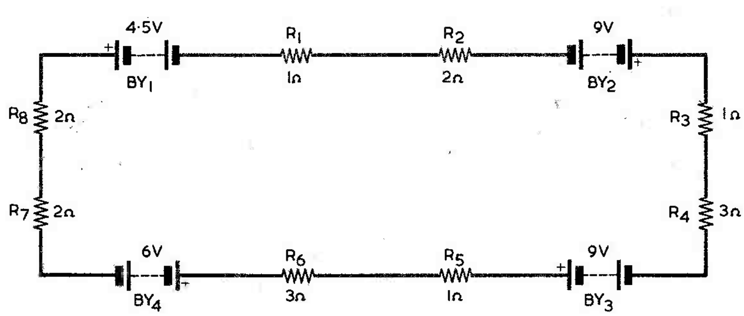


Fig. 1. If, this month, you would like to puzzle along with Dick and Smithy, avert your eyes from the following diagrams and their captions and proceed straightaway to the start of the text. This is the first puzzle which Smithy put to Dick.

"You could do that," agreed Smithy, "but it wouldn't help you much."

"It's those darned batteries," complained Dick. "You've got no less than four of them distributed throughout the circuit."

"If the batteries are worrying you, try simplifying **them**."

"How can I?"

"Think about it. To give you a hint I said just now that the same current flows through all the resistors and all the batteries."

"Which must of course be true," mused Dick. "Hang on a jiff! Will the same current flow if I take a battery out of one part of the circuit and insert it at another place?"

"Of course it will. Provided, that is, you don't reverse its polarity."

Dick picked up Smithy's pen and proceeded to draw in Smithy's note-pad.

"Then," he said excitedly, "I could move BY2 to the left so that it's next to BY1. And I could also move BY3 to the left so that it connects directly to BY4."

He quickly completed the new version of the circuit and showed it to Smithy. (Fig. 2(a)).

"Keep at it," said Smithy. "You're on the right lines."

"I think I'm nearly there now. Well, BY1 and BY2 have their two negative ends together, which means that BY1 subtracts 4.5 volts from the 9 volt BY2. So I can replace them with a single 4.5 volt battery having the same polarity as BY2. There's the same sort of thing with BY3 and BY4, and these can be replaced by a single 3 volt battery with its negative end connecting to R6." (Fig. 2(b)).

"That's perfectly correct. Now shift the lower battery so that it's next door to the upper battery. Be careful with its polarity."

"I'll bring it round to the left hand side of the upper battery." said Dick. "Now, the positive side of the lower battery points in the clockwise direction so, when I bring it round, its positive end will be to the right."

Dick scribbled out the new rearrangement of the circuit. (Fig. 2(c)).

"And that," said Smithy, "is very nearly the final step. The two batteries are series-aiding and so they provide a total voltage of 7.5 volts. The next thing to do is to add up the values of the resistors."

"I'll do that next." said Dick. "Let's see what it is. Ah yes, the grand total comes to 15Ω."

"Which means that we've got 7.5 volts pushing a current through 15Ω. What will that current be?"

"It will be 7.5 volts divided by 15Ω. Which works out at half an amp?"

"Correct," confirmed Smithy. "The current which flows in the circuit is half an amp."

CIRCUIT ERROR

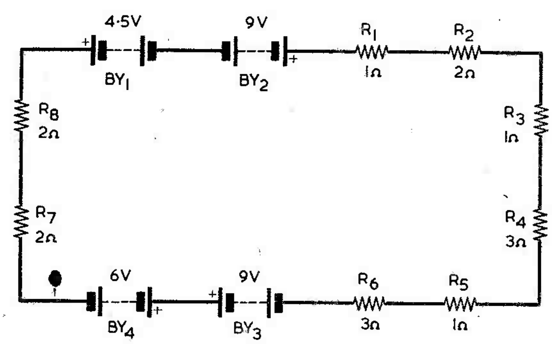
"This is great," said Dick, pleased at his success. "Let me try out one on you."

"Okay," said Smithy equably. "See if you can catch me out."

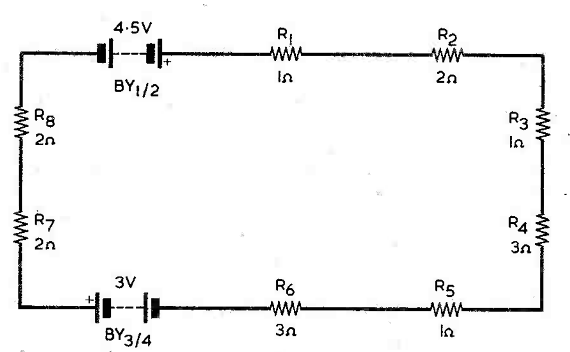
Dick walked over to his bench and returned with a sheet of paper.

"Here we are," he said. "I was making up a transistor phase splitter the other day and I got some very funny voltage readings. I made a note of them, and here they are."

Dick showed the paper to



(a)

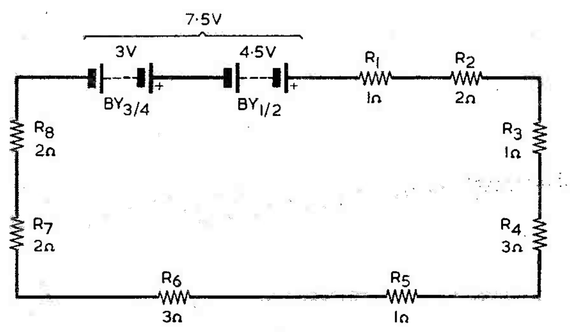


(b)

Fig. 2(a). First stage in simplifying the circuit. BY2 and BY3 are moved left to connect directly to BY1 and BY4 respectively.

(b). The circuit is now effectively powered by two batteries.

(c). The final simplification consists of bringing round the lower battery. (Some solvers may have simply added and subtracted battery voltages, according to polarity, to arrive at the same solution as results from this diagram).



(c)

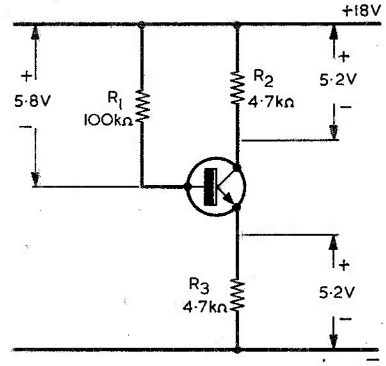


Fig. 3. There is a single error in this diagram.

Smithy. (Fig. 3).

"Dear me," stated Smithy. "I must say that those voltages are **very** peculiar."

"There is one single error in that circuit drawing," said Dick. "I found out what it was later."

"Did you use an incorrect value resistor?"

"No."

Were the queer voltage readings due to a low resistance voltmeter?"

"No. I used a very high resistance voltmeter."

"Is it a silicon transistor?"

"It is," stated Dick, "and its base connects to R1, its collector to R2 and its emitter to R3. What you have to find is the single error which exists in the circuit."

(Can you, as you read this, spot the single error? You already know that all resistor values are correct. See if you can find the error before Smithy does).

Smithy gazed thoughtfully at Dick's circuit.

"Do **you** know what caused these funny voltages?"

"I know what the error was because I was able to put it right," said Dick a little uncomfortably. "But I don't know why the error caused the voltages to appear!"

"What happened," stated Smithy with complete certainty, "is that you made up the circuit with a p.n.p. transistor instead of an n.p.n. transistor."

Dick looked crestfallen at Smithy's quick solution to his problem.

"Yes," he said sheepishly, "That's exactly what I did do. After I got these queer voltages I checked the transistor marking and I found I'd soldered in the wrong type."

"So the error in the circuit drawing," said Smithy, "is that the emitter arrow is pointing in the wrong direction. To get the voltages shown, the emitter arrow should be pointing inwards instead of outwards."

"That's exactly right. Now you tell me why the voltages appeared!"

"All right," said Smithy. "Well, if it **had** been an n.p.n. transistor there would have been a voltage drop of 0.6 volt only between the base and the emitter. But in your drawing there are 5.8 volts across R1 and 5.2 volts across R3. Subtract the sum of these from the 18 volts supply voltage and you're left with 7 volts across the base emitter junction. So that junction must be reverse biased. From which it follows that you used a p.n.p. transistor instead of an n.p.n. one."

"If the base-emitter junction is reverse biased," queried Dick, "why does it pass any current at all?"

"Because" replied Smithy," the base-emitter junction of most silicon transistors has a breakdown voltage in the region of 6 to 10 volts. When that breakdown voltage is reached the junction acts like a zener diode. The transistor you used happened to have a breakdown voltage of 7 volts. Now, because the transistor was p.n.p. instead of n.p.n. the collector-base junction was forward biased, and that explains the 0.6 volt difference between the voltage across R1 and the voltage across R2. Let's redraw the circuit using zener diode and ordinary diode symbols. This is how it looks."

Smithy picked up his pen and drew the equivalent circuit. (Fig. 4).

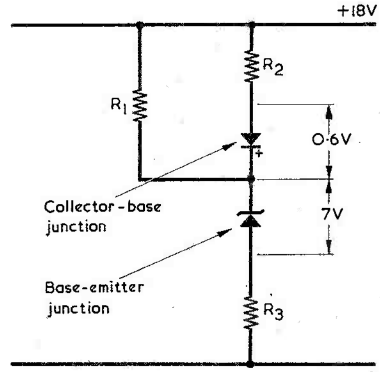


Fig. 4. An equivalent circuit incorporating diodes.

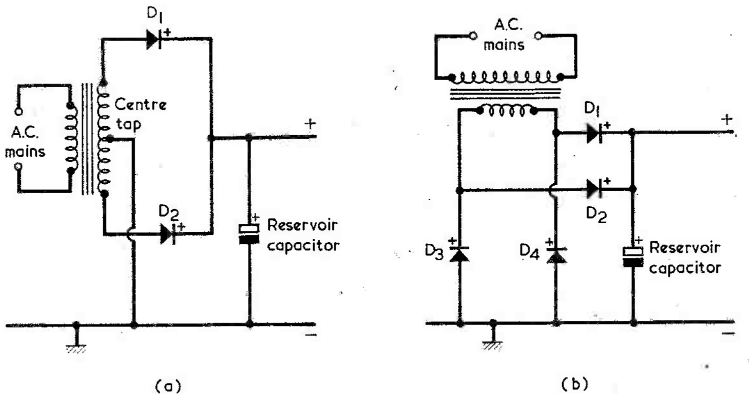


Fig. 5(a). A standard full-wave rectifying circuit in which the mains transformer has a centre-tapped secondary.

(b). By adding two rectifier diodes it is possible to obtain the same rectified voltage with only half the secondary winding.

STRANGE RECTIFIER

"Well," said Dick. "You've answered my little puzzle, so how about setting me another one?"

"All right," replied Smithy obligingly. "What I'll do is introduce you to an unfamiliar power supply rectifier circuit."

Dick settled himself more comfortably on his stool.

"Righty-ho," he said cheerfully. "Fire away!"

"As you know," said Smithy, drawing once more on his note-pad, "the usual full-wave rectifier circuit has two rectifier diodes connected to the outside ends of a mains transformer secondary. The secondary is centre-tapped, and the centre tap goes to the negative rectified supply rail. Like this."

He pointed to the circuit which he had now completed. (Fig. 5(a).).

"That's basic enough," commented Dick. "On half-cycles when the upper end of the secondary is positive diode D1 conducts, and on half-cycles when the lower end is positive diode D2 conducts. Both diodes cause the reservoir capacitor to charge and stay charged."

"Fair enough," said Smithy. "Now, it's possible to get the same full-wave rectifying action and the same rectified voltage with only half the secondary winding which is required in the ordinary full-wave circuit. All you have to do is to add two more rectifier diodes, giving you a circuit like this."

Smithy drew a further circuit. (Fig. 5(b).).

"How does that work?"

"It works like this," said Smithy. "We've got our original two diodes, D1 and D2. And I've now added two more diodes, D3 and D4. Let's see first what happens on half-cycles when the right-hand side of the transformer secondary is positive. Diode D3 prevents the left-hand side of the secondary going negative of chassis by any significant voltage, so virtually the full secondary voltage is applied through D1 to the reservoir capacitor. On the alternate half-cycles the left-hand end of the secondary is positive. This time, diode D4 prevents the right-hand end going negative of chassis, and virtually all the secondary voltage is applied through diode D2 to the reservoir capacitor. So, just by adding two diodes we get the same full-wave rectifier action as we had with the centre-tapped transformer secondary, and we only need half the secondary winding to give the same rectified voltage."

"But that's a marvellous rectifier circuit," stated Dick. "Why don't we see it used in practice?"

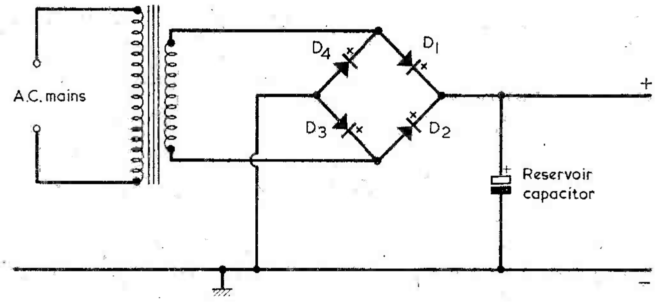


Fig. 6. The familiar bridge rectifier.

"There's the mystery," replied Smithy. "See if you can fathom it out!"

(And can **you** fathom it out? On the face of it, Smithy's rectifier circuit cannot help but work. Can you remember it being used in a practical application? Be warned, there's a catch).

"There's something fishy here," said Dick suspiciously. "I think you're reverting to your usual devious tactics."

Smithy presented an expression of utter innocence to his assistant.

"No, I'm not." he said. "I've drawn out a working rectifier circuit and it functions exactly as I've described it."

"Then why," queried Dick scowling, "haven't I seen it used in practice? Or have I?"

Smithy remained silent.

"Four rectifier diodes and an untapped mains transformer secondary," muttered Dick. "Now let me think about this."

He picked up Smithy's pen and traced the lines in the rectifier circuit. Suddenly his brow cleared and, decisively, he drew another rectifier circuit. (Fig. 6).

"You crafty devil," he grinned. "You really had me there! That circuit of yours is just a standard full-wave bridge rectifier!"

"It had you fooled for a bit though, didn't it?"

"I'll say it did." agreed Dick. "It just shows how you get used to seeing circuits drawn out in a standard fashion. Now let's see if I can dream up another puzzle for you."

Dick and Smithy complete their session of puzzles next month.

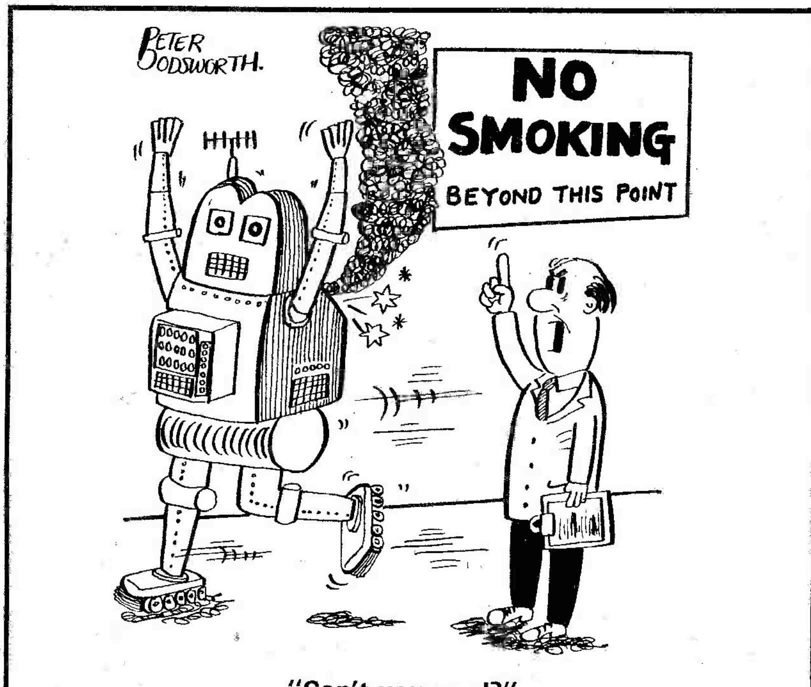
AGILE TARGETS

Under a contract from the Ministry of Defence, EASAMS Limited, a member of the GEC-Marconi group of companies, is studying the feasibility of providing highly manoeuvrable and realistic "agile" targets for anti-tank weapons training.

Using a practical knowledge of the terrain, training programmes and support facilities on each of the Army's firing ranges, the EASAMS commission is to bring an imaginative approach to new and existing target system concepts. This will take into account the financial and logistic limitations within which the target system is to operate. EASAMS' task is to determine whether technically and economically feasible compromises can be reached among a number of conflicting requirements.

Anti-tank weapons are now able to engage modern armoured vehicles which are fast and highly manoeuvrable. New moving targets capable of varying speed and direction during a target run are required to train tank crews, anti-tank gunners and missile operators in the use of the new weapons. Many training techniques, such as simulators and non-firing manoeuvres are available, but there is no substitute for live firing against realistic targets in the appropriate environment.

An ideal target should look and behave like the armoured vehicle it represents and react realistically when hit. It should provide a cheap easily controlled solution, immune to intentional weapon strikes and to adverse range conditions. Also, it should make minimal demands on range facilities and manpower.



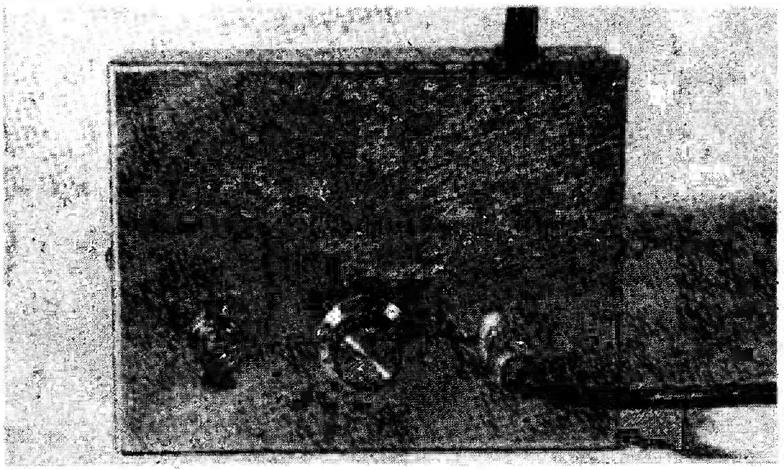
"Can't you read?"

RADIO & ELECTRONICS CONSTRUCTOR

MAY 1981

IN NEXT MONTH'S ISSUE

CRYSTAL CALIBRATOR



Eight frequency decades – 1Hz to 10MHz
Harmonic-rich square wave outputs.
Receiver calibration and digital applications.

3-STAGE M.W. SUPERHET

Two high gain transistors and an integrated a.f. amplifier.

Low component count. Full speaker output.

BURGLAR ALARM WITH ENTRANCE DELAY

Suggested Circuit

A SESSION OF PUZZLES No. 2.

In Your Workshop

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AM to FM conversions examined
—an objective assessment

PLUS MANY OTHER ARTICLES

Radio Topics

By Recorder

Molex Electronics Limited announce a touch switch with a difference. Instead of controlling circuits by way of electronic semiconductor devices, the Molex switch simply causes two electrical surfaces to come into physical contact with each other. Touch pressure to operate the switch is only 6 to 10 ounces.

The switch has been made feasible by the development of a special process which allows a conductive silver polymer ink to be deposited on a flexible substrate. Two sections of thin flexible polyester sheet with conductive surfaces facing each other are separated by a thin insulated spacer layer with holes, and the whole assembly is sealed. It may be mounted on a flat surface whereupon, when the outer layer is lightly touched, the two conductive surfaces come into contact with each other and complete the circuit in which they appear.

The outer surface can be covered by a graphic overlay showing numbers, letters or words printed in an attractive design. As many individual switches as may be required can be provided in a given area, so that touching, say, the printed figure 1 on the overlay causes circuit 1 to be actuated, touching number 2 completes circuit 2, and so on.

The new product is known as the 10900 Membrane Switch and is intended for low energy logic level switching applications. Switch systems can be custom designed for any particular function, and the manufacturers are Molex Electronics Limited, Holder Road, Aldershot, Hampshire.

PROBES AND PULSES

Of assistance in servicing and developing digital circuitry are two new probes available from OK Machine & Tool (UK) Limited, Dutton Lane, Eastleigh, Hants, SO5 4AA. Both items are housed in narrow diameter cylindrical casings which can be held in the hand, and are provided with prod tips for connection to digital equipment on either side of the printed board.

The first item is the PRB-1 Digital Logic Probe, which costs less than £30 but has all the features of much more expensive units. It detects pulses as short as 10 nanosecond, has a frquency response of better than 50MHz and automatic pulse stretching to 50 nanosecond. The Logic Probe is compatible with r.t.l., d.t.l., h.t.l., t.t.l., MOS, CMOS and microprocessor logic families, and it also features 120KΩ input impedance, power lead reversal protection and over-voltage protection up to 200 volts positive or negative. The supply voltage range is 4 to 15 volts, and an adaptor type PA-1 can be supplied for use with voltages from 15 to 25 volts.

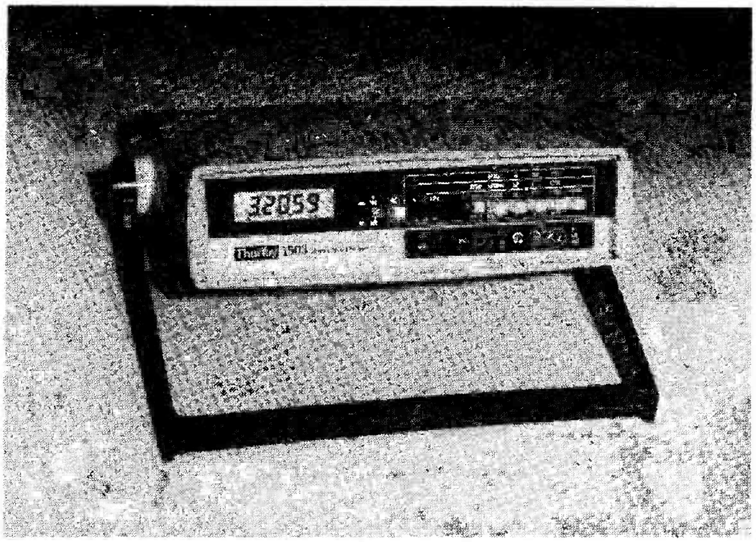
The PLS-1 is the second item. This is a multi-mode high current pulse generator. It will superimpose a dynamic pulse train at 20 p.p.s. or a single pulse onto the circuit points under test, without having to unsolder pins or cut printed circuit traces, even when the circuit points are being clamped by digital outputs. It can source or sink sufficient current to force saturated output transistors in digital circuits into the opposite logic state. Signal injection is by means of a pushbutton switch near the probe tip. When the button is depressed a single high-going or low-going 2 microsecond pulse is delivered to the circuit under test. Pulse polarity is automatic, and high level points are pulsed low and low level points are pulsed high. Holding the button down causes a series of pulses at 20 p.p.s. to be delivered to the digital circuit. The PLS-1 is ideally suited for use in conjunction with the PRB-1 probe and it also costs less than £30.

LONG SCALE MULTIMETER

The photograph shows the new $4\frac{3}{4}$ digit multimeter Model 1503 which has been introduced by Thurlby Electronics. This has an unusually long scale of 32,768 (2 to the power of 15) counts or 15 bits on d.c. voltage and resistance, 16,384 counts or 14 bits on a.c. voltage and 8,192 counts or 13 bits on current. It is stated that the long scale length gives the 1503 much greater resolution and higher accuracy than competitive $3\frac{1}{2}$ and $4\frac{1}{2}$ digit meters.

Thirty measuring ranges are provided, covering the five basic functions of d.c. and a.c. voltage, d.c. and a.c. current, and resistance. In addition a diode test and crystal controlled frequency measurement up to 3.9999MHz are included. Resolution is within 0.1kHz, and frequency measurements can be extended to 7MHz with display overflow. The 1503 has very high sensitivity figures of 10μV, 10MΩ and 0.001μA, and an input impedance of

The Model 1503 digital multimeter manufactured by Thurlby Electronics. This has an exceptionally long scale length of 15 bits on d.c. voltage measurements, providing very high resolution and accuracy



1,000MΩ can be selected for low voltage readings as an alternative to the standard 10MΩ. Maximum voltage input is 1,200 volts and currents can be measured up to 25 amps.

The multimeter combines a clear liquid crystal display with low power circuitry to give hundreds of hours of operation from a set of batteries. The casing is tough knock-proof ABS plastic and the multi-tilt stand doubles as a carrying handle. In the laboratory the 1503 can be operated from its a.c. mains adaptor, or from batteries for near infinite common mode rejection.

The manufacturers are Thurlby Electronics Limited, Coach Mews, St. Ives, Huntingdon, Cambs, PE17 4BN.

LOW COST MICROCOMPUTER

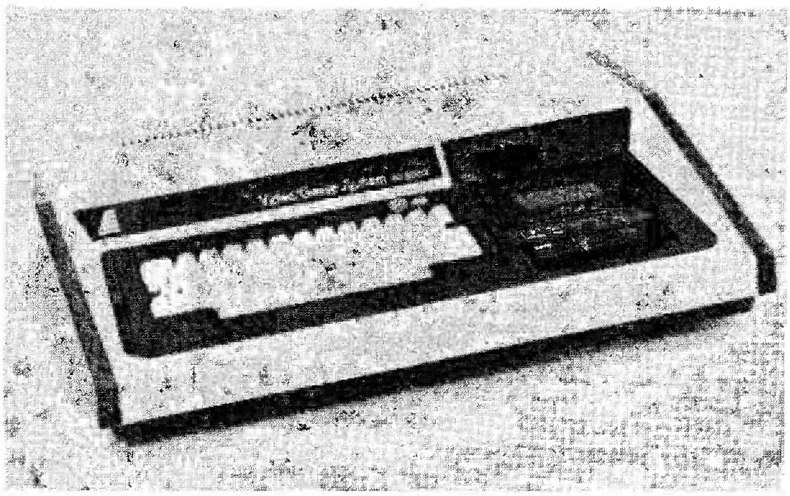
A low cost Z80-based microcomputer system, the Video Genie EG3000 Series, is now being offered by Cambridge Micro Computers Limited, Cambridge Science Park, Milton Road, Cambridge, CB4 4BN. The system hardware is shown in the second photograph and it is accompanied by software and support which make it ideally suited for industrial and educational applications. Designed to plug into a video monitor or u.h.f. television receiver, the Video Genie costs £330 (plus VAT), and Cambridge Micro Computers is also making available a Microsoft Z80 editor/assembler package on magnetic tape cassette, at a price of £24 (plus VAT).

The Video Genie EG3000 Series is a fully self-contained system with its own built-in power supply, u.h.f modulator and cassette tape unit. Software is based on the well established BASIC interpreter used on the TRS-80, and the standard system is supplied with a 16K random-access memory plus 12K of Microsoft BASIC in read-only memory. A 51-key typewriter-style keyboard with 10-key rollover facility is also included.

The system is ideally suited for education, particularly the teaching of BASIC software, as well as providing a low cost approach to Z80 microprocessor system development. In addition to the wide range of software available on cassette, the Video Genie's interface capability allows it to be expanded with the use of flexible-disc stores and printers into a comprehensive microprocessor system.

The Video Genie comes complete with a BASIC demonstration tape, a video lead and a second cassette lead, as well as a user's manual, BASIC manual and beginner's programming manual.

The Video Genie EG3000 Series, offered with industrial and eductional support by Cambridge Micro Computers Limited.



Active Tone Control Module

By A. P. Roberts

Very low distortion and noise

Treble boost and cut • Bass boost and cut

The tone control circuit to be described is primarily intended for those who are constructing their own amplifier systems, either from scratch or by using some of the excellent pre-amplifier and power amplifier modules which are currently available. The performance of the circuit is very good, the t.h.d. level being less than 0.05% over the audio frequency range provided the output is kept to about 1 volt r.m.s. or less, and this should be more than adequate to fully drive any normal power amplifier. The output has to reach about 5 volts r.m.s. before serious distortion occurs. The unweighted signal-to-noise ratio is better than – 80dB relative to an output of 1 volt r.m.s. The circuit has an input impedance of 500kΩ, so that there is minimal loading on the stage which drives the circuit. An emitter follower output stage gives the circuit a low output impedance, whereupon the output should not be significantly loaded by the following power amplifier.

BASS AND TREBLE

Both bass and treble controls are included, and these can each provide about 12dB of boost and cut (at 100Hz for the bass control and at 10kHz for the treble control) relative to 1kHz. The circuit contains resistors which "tame" the response at the highest and lowest audio frequencies, so that the levels of boost and cut at these frequencies are little more than the figures just quoted for 100Hz and 10kHz. In practice this gives good results, and reduces the risk of

The prototype tone control circuit, assembled on its printed board

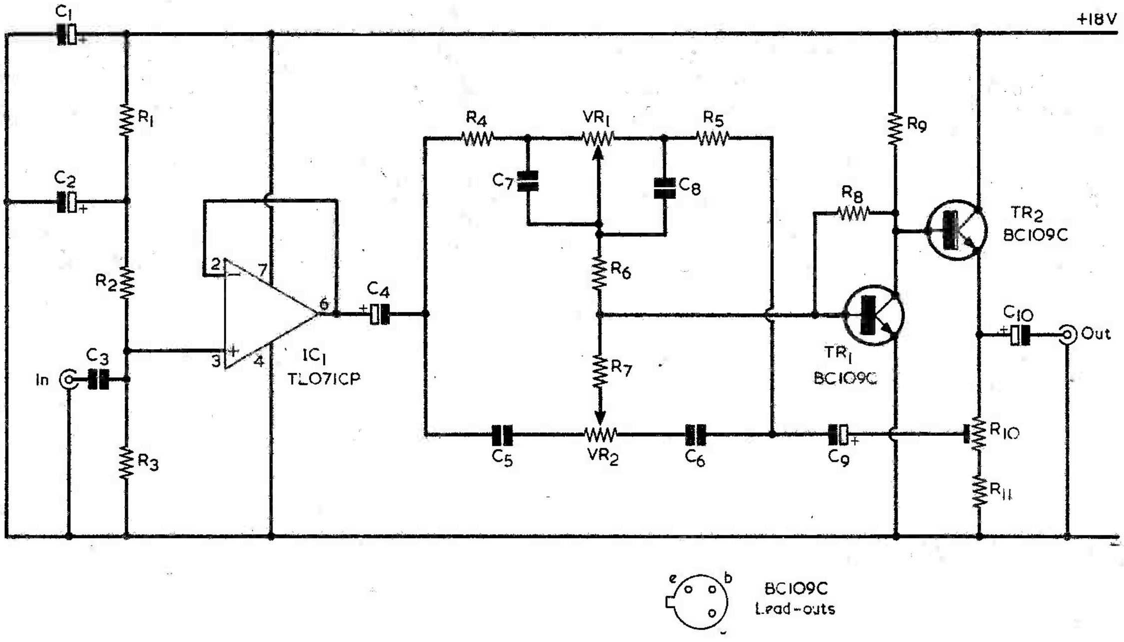


Fig. 1. The circuit of the active tone control module. VR1 provides base boost and cut, whilst VR2 gives treble boost and cut

the complete audio system becoming unstable due to excessive high or low frequency gain.

The circuit is designed for use with an 18 volt supply and has a current consumption of only about 5mA. However, it will work well with any supply voltage between 12 and 24 volts, the supply current varying from about 4 to 7mA over this range.

THE CIRCUIT

Fig. 1 shows the full tone control circuit. This is only for one channel, and two such circuits, with ganged potentiometers for the bass and treble controls, would of course be required for stereo operation.

The tone control circuitry proper should be fed from a low impedance source, and this is provided by the buffer amplifier IC1. This i.c. also allows the circuit to have its high input impedance. IC1 has 100% negative feedback from its output to its inverting input and therefore gives a voltage gain of unity. R2 and R3 bias the non-inverting input to about half the supply voltage, whilst R1 and C2 prevent hum and noise from the positive supply rail reaching this input. C3 is the input d.c. blocking capacitor.

IC1 is a low noise and distortion operational amplifier having a Jfet input stage, and it can be obtained from Watford Electronics, 33/35 Cardiff Road, Watford, Herts. However, similar devices, such as the TLO81CP, LF351 and even the standard 741C will all give a good performance in this design.

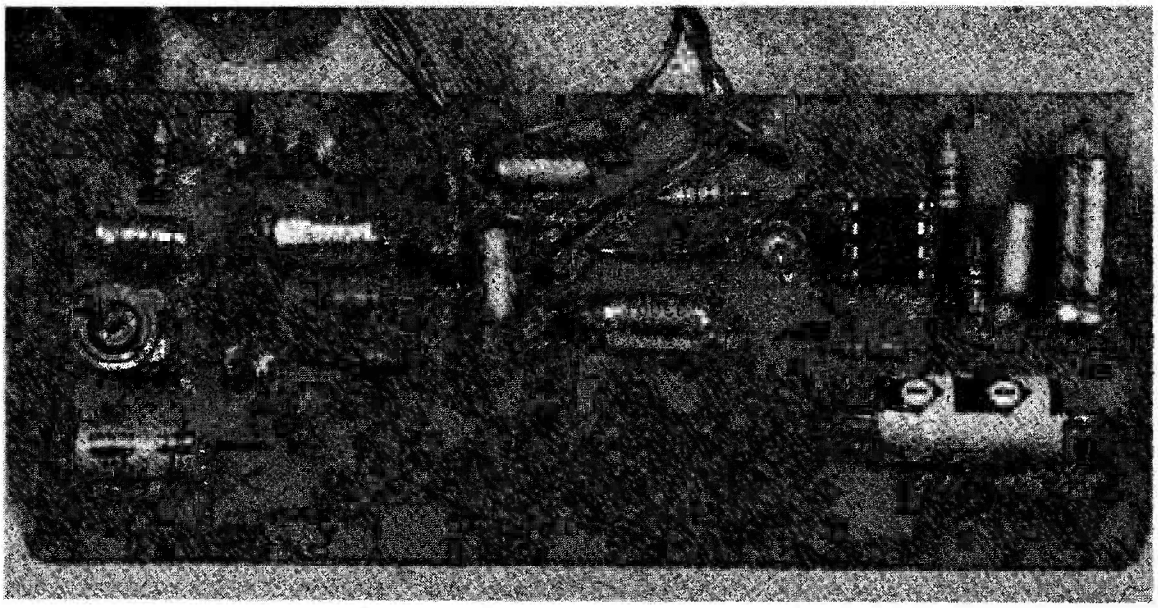
The tone control circuitry is based on the amplifier given by TR1 and TR2, and operates by simply increasing negative feedback at frequencies where cut is required, or by reducing feedback at frequencies where boost is needed. TR1 is a straightforward common emitter amplifier directly coupled to emitter follower TR2. TR2 merely serves to give a low impedance output.

TREBLE CONTROL

Detailed operation of the circuit is quite complex and it helps to look upon it in the light of an operational amplifier working in the inverting mode. If, with such an amplifier, a feedback resistor is connected from the output back to the inverting input, and a series resistor is connected between the signal source and the inverting input, the voltage gain of the amplifier is equal to the feedback resistance divided by the input series resistance. In Fig. 1 the output is at the slider of R10 and the inverting input is at the base of TR1. The voltage gain is then controlled by the feedback impedance given by the tone control components, and by the input series impedance which these components also give.

We can consider first the functioning of the treble section, which employs VR2, C5 and C6. The feedback impedance is through C6 and the right-hand section of VR2 track (i.e. right of the slider) and the input series impedance is given by C5 and the left-hand section of VR2 track. At low and middle frequencies, C5 and C6 have a reactance which is high in comparison with the track resistance of VR2. Therefore, adjustment of VR2 has little effect on the relative values of the feedback and input series impedances which, since C5 and C6 have equal values, remain virtually the same.

At higher frequencies the situation is very different because C5 and C6 start to have a reactance which is comparable with VR2 track resistance, and at the highest frequency this reactance is considerably lower than the track resistance of VR2. Thus, with the slider of VR2 towards the C6 end of its track the feedback impedance becomes much lower than the input series impedance, giving significantly reduced gain, or treble cut. When the slider of VR2 is moved to the C5 end of the track the feedback impedance is much larger than the series input impedance, producing



Looking down on the printed board. Input, output and supply leads were not fitted when these photographs were taken

COMPONENTS

Resistors
(All fixed values ¼ watt 5% unless otherwise stated)

R1 10kΩ
R2 1MΩ
R3 1MΩ
R4 10kΩ
R5 10kΩ
R6 12kΩ
R7 5.6kΩ
R8 3.9MΩ 10%
R9 10kΩ
R10 2.2kΩ pre-set potentiometer, 0.1 watt horizontal
R11 1kΩ
VR1 47kΩ potentiometer, linear
VR2 47kΩ potentiometer, linear

Capacitors

C1 100μF electrolytic, 25V. Wkg.
C2 100μF electrolytic, 25 V. Wkg.
C3 0.047μF polyester type C280
C4 4.7μF electrolytic, 25 V. Wkg.
C5 3,300pF polystyrene
C6 3,300pF polystyrene
C7 0.047μF polyester type C280
C8 0.047μF polyester type C280
C9 4.7μF electrolytic, 25 V. Wkg.
C10 10μF electrolytic, 25 V. Wkg.

Semiconductors

IC1 TL071CP
TR1 BC109C
TR2 BC109C

Miscellaneous

Printed circuit board
2 control knobs
Wire, solder, etc.

increased gain and treble boost. With VR2 slider at the centre of its track the two impedances are equal, a flat response is obtained and the high frequency amplifier gain becomes unity. In consequence, VR2 can provide a flat treble response, or any degree of treble cut or boost within its range which is required.

BASS CONTROL

The bass control, VR1, operates in a similar manner. At high and middle frequencies C7 and C8 have a low reactance and virtually short-circuit VR1. Since R5 and R4 have the same values, the feedback impedance at these frequencies is equal to the series input impedance, and adjustment of VR1 has no significant effect. At bass frequencies, the reactances of C7 and C8 are high in comparison with the track resistance of VR1, and they have little effect on the circuit. In this low frequency range, moving VR1 slider towards R5 makes the feedback impedance lower than the series input impedance, causing voltage gain to be reduced and giving bass cut. When VR1 slider is at the R4 end of its track the feedback impedance is greater than the series input impedance, resulting in bass boost. Since the bass control circuitry, like the treble circuitry, is symmetrical, unity gain and a flat bass response is achieved when VR1 slider is at the centre of its track.

VR1 can thus provide a flat response or the desired level of bass cut or boost, with R4 and R5 limiting the

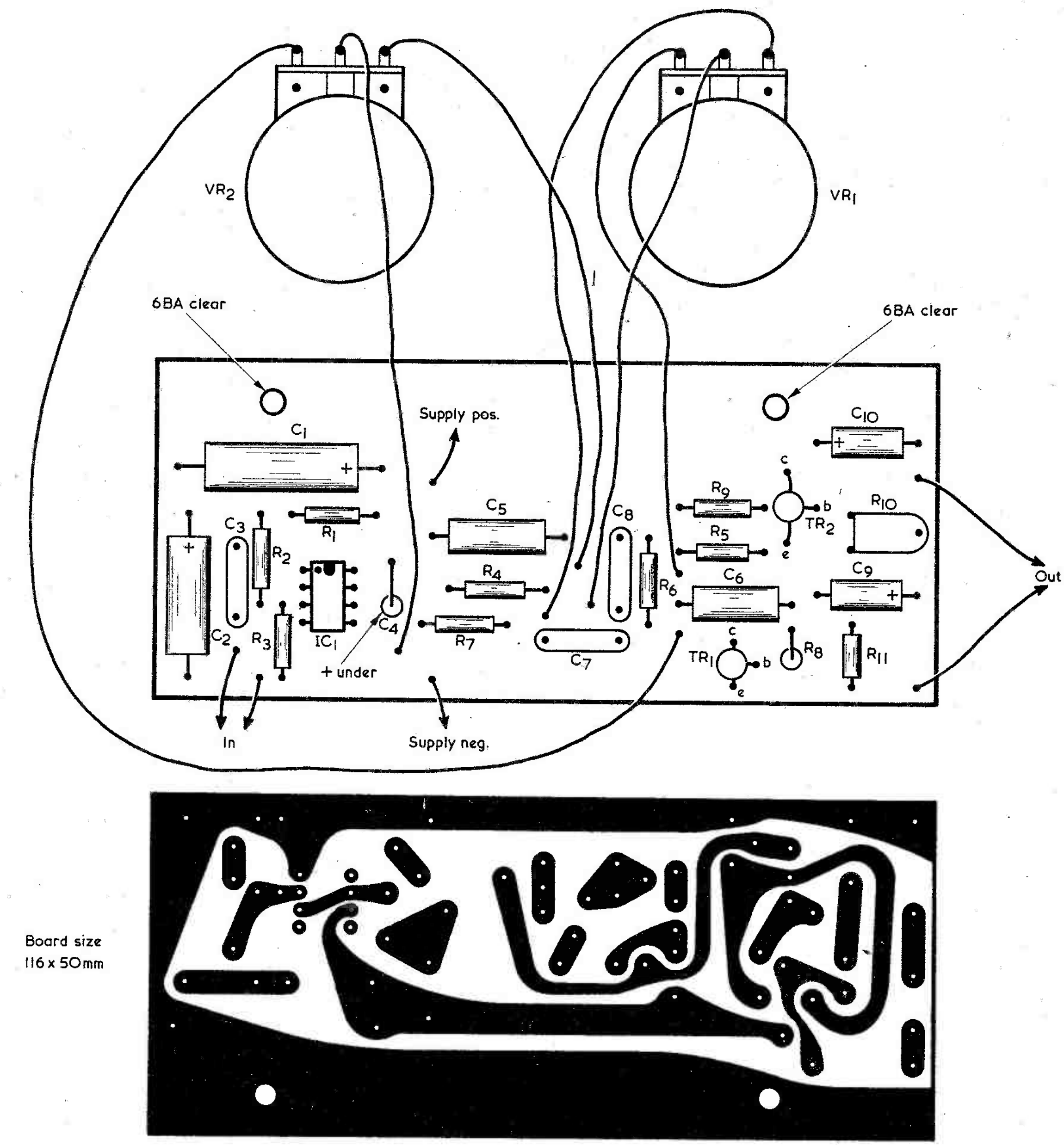


Fig. 2. The prototype circuit was assembled on a printed board which is reproduced here full size

maximum amounts of boost and cut respectively. R7 performs a similar limiting task in the treble control circuit and, together with R6, it also helps to minimise any interaction between the two controls.

When the slider of R10 is at the top of its track (and disregarding any cut or boost introduced by VR2 and VR1) the overall circuit has a nominal gain of unity. If required, the amplifier feedback can be reduced by adjusting the slider down the track, so that the circuit provides a small amount of voltage gain. The maximum gain available is a little over three times, or approximately 10dB. The gain could be boosted still further by reducing the value of R11 but, in the interests of obtaining good noise, distortion and overload performances, this is not recommended.

CONSTRUCTION

Any normal method of construction can be employed for this circuit; the prototype was built using the printed circuit design shown in Fig. 2. The layout is not particularly critical if some other method of construction is used, but the components should obviously be kept away from hum fields in order to minimise pick-up. The input connection should be made by way of screened cable. ■

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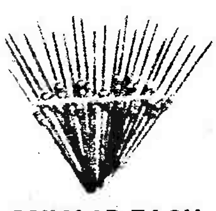

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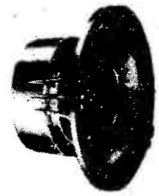

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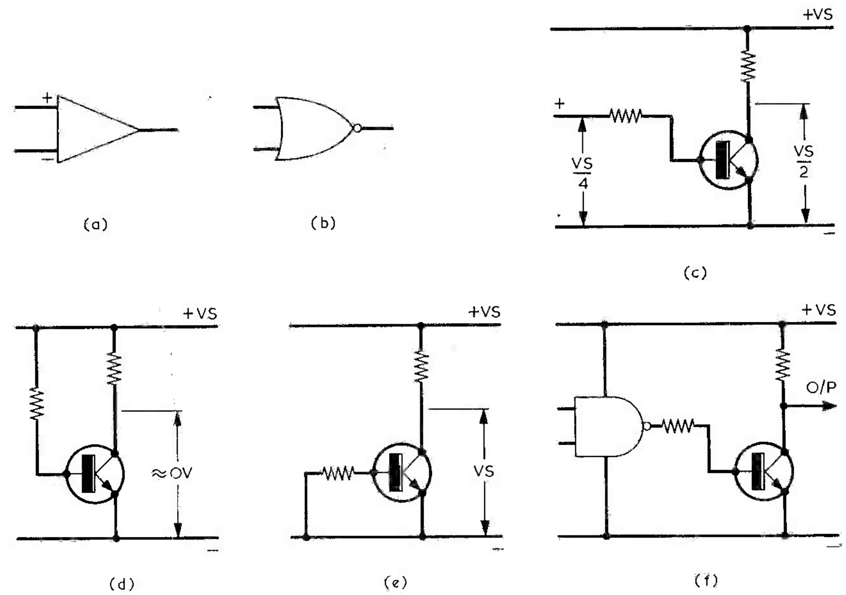
In practice, digital devices exhibit linear amplification whilst some linear devices can be employed in simple digital applications.

The transistor in (c) has its base bias resistor returned to an input voltage which is a fraction, say one-quarter, of the supply voltage. Resistor values are such that the transistor collector has a voltage half-way between the supply rails. In this state the transistor is capable of linear amplification: an increase in input voltage causes a fall in collector voltage and a decrease in input voltage causes a rise in collector voltage. In (d) the base bias resistor is returned to the positive rail and the transistor is turned fully on, producing a collector voltage which is virtually zero. The base resistor connects to the negative rail in (e), whereupon the transistor is turned off and the collector voltage is the same as that of the positive rail.

In (f) the transistor and base resistor follow a CMOS NAND gate. The transistor acts as a digital inverter, producing a low collector voltage when the gate output is high and a high collector voltage when the gate output is low. Since the output of the NAND gate does not change states instantaneously, there is a brief moment during a change of state when the transistor exhibits linear amplification. The same applies to all digital devices which are driven by other digital devices.



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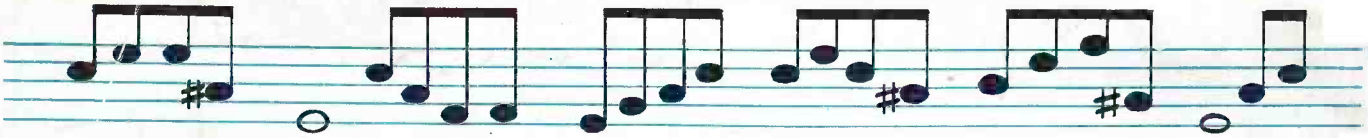

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