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AC176	20p	BB110	45p	BC184	10p	BD124	85p	BF182	30p	BFX88	25p	OA47	15p	TIP30B	65p	TIS90	25p	2N3055	60p
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ACY21	30p	BC108	10p	BC186	24p	BD132	39p	BF186	25p	BFY51	20p	OA91	6p	TIP31	55p	IN914	5p	2N3702	11p
AD149	60p	BC108C	15p	BC205	14p	BD133	45p	BF194	10p	BFY52	20p	OA202	8p	TIP31A	58p	IN3754	10p	2N3703	12p
AD161	40p	BC109	10p	BC212	11p	BD135	40p	BF195	10p	BFY90	125p	OC23	200p	TIP31B	65p	IN4001	5p	2N3704	11p
AD162	40p	BC109C	14p	BC212L	12p	BD136	40p	BF196	10p	BR101	35p	OC25	100p	TIP31C	70p	IN4002	5p	2N3705	12p
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AF116	22p	BC126	15p	BC258	13p	BD181	80p	BF200	30p	BSY40	25p	OC43	35p	TIP32C	90p	IN4006	6p	2N3772	175p
AF117	22p	BC146	12p	BC294	35p	BD182	80p	BF224	20p	BSY95	20p	OC45	35p	TIP33	100p	IN4007	7p	2N3819	25p
AF118	50p	BC147	10p	BC303	55p	BD207	70p	BF225	20p	BT100A	80p	OC71	25p	TIP33A	105p	IN4148	4p	2N3866	95p
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ASY26	40p	BC157	10p	BC338	12p	BDY62/01	90p	BF258	28p	BY100	20p	OC81D	25p	TIP34A	118p	2N929	20p	2N5061	35p
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5V6	10p
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10V	10p
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10/35	5p	3300/16	40p
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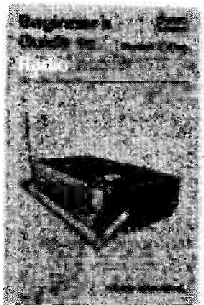

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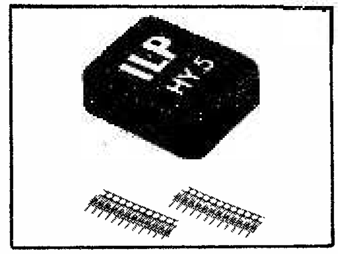
15—240 Watts!

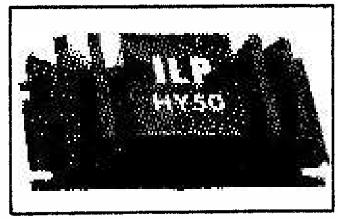
HY5
Preamplifier



The HY5 is a mono hybrid amplifier ideally suited for all applications. All common input functions (mag Cartridge, tuner, etc) are catered for internally. The desired function is achieved either by a multi-way switch or direct connection to the appropriate pins. The internal volume and tone circuits merely require connecting to external potentiometers (not included). The HY5 is compatible with all I.L.P. power amplifiers and power supplies. To ease construction and mounting a P.C. connector is supplied with each pre-amplifier.
FEATURES: Complete pre-amplifier in single pack—Multi-function equalization—Low noise —Low distortion—High overload—Two simply combined for stereo.
APPLICATIONS: Hi-Fi—Mixers—Disco—Guitar and Organ—Public address
SPECIFICATIONS:
INPUTS. Magnetic Pick-up 3mV; Ceramic Pick-up 30mV; Tuner 100mV; Microphone 10mV; Auxiliary 3-100mV; input impedance 4·7kΩ at 1kHz.
OUTPUTS. Tape 100mV; Main output 500mV R.M.S.
ACTIVE TONE CONTROLS. Treble ± 12dB at 10kHz; Bass ± at 100Hz.
DISTORTION. 0·1% at 1kHz. Signal/Noise Ratio 68dB.
OVERLOAD. 38dB on Magnetic Pick-up. SUPPLY VOLTAGE ± 16-50V.
Price £5·22 + 65p VAT P&P free.

HY30
15 Watts into 8Ω

The HY30 is an exciting New kit from I.L.P. It features a virtually indestructible I.C. with short circuit and thermal protection. The kit consists of I.C., heatsink, P.C. board, 4 resistors, 6 capacitors, mounting kit, together with easy to follow construction and operating instructions. This amplifier is ideally suited to the beginner in audio who wishes to use the most up-to-date technology available.
FEATURES: Complete Kit—Low Distortion—Short, Open and Thermal Protection—Easy to Build.
APPLICATIONS: Updating audio equipment—Guitar practice amplifier—Test amplifier—audio oscillator.
SPECIFICATIONS:
OUTPUT POWER 15W R.M.S. into 8Ω: DISTORTION 0·1% at 1·5W.
INPUT SENSITIVITY 500mV. FREQUENCY RESPONSE 10Hz-16kHz—3dB.
SUPPLY VOLTAGE ± 18V.
Price £5·22 + 65p VAT P&P free.

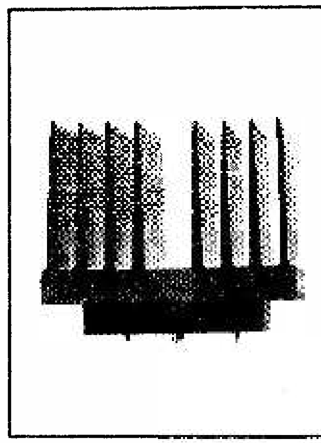


HY50
25 Watts into 8Ω

The HY50 leads I.L.P.'s total integration approach to power amplifier design. The amplifier features an integral heatsink together with the simplicity of no external components. During the past three years the amplifier has been refined to the extent that it must be one of the most reliable and robust High Fidelity modules in the World.
FEATURES: Low Distortion—Integral Heatsink—Only five connections—7 amp output transistors—No external components
APPLICATIONS: Medium Power Hi-Fi systems—Low power disco—Guitar amplifier
SPECIFICATIONS: INPUT SENSITIVITY 500mV
OUTPUT POWER 25W RMS into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·04% at 25W at 1kHz
SIGNAL/NOISE RATIO 75dB FREQUENCY RESPONSE 10Hz-45kHz—3dB.
SUPPLY VOLTAGE ± 25V SIZE 105 50 25mm
Price £6·82 + 85p VAT P&P free

HY120
60 Watts into 8Ω

The HY120 is the baby of I.L.P.'s new high power range. Designed to meet the most exacting requirements including load line and thermal protection this amplifier sets a new standard in modular design.
FEATURES: Very low distortion—Integral heatsink—Load line protection—Thermal protection—Five connections—No external components
APPLICATIONS: Hi-Fi—High quality disco—Public address—Monitor amplifier—Guitar and organ
SPECIFICATIONS
INPUT SENSITIVITY 500mV.
OUTPUT POWER 60W RMS into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·04% at 60W at 1kHz
SIGNAL/NOISE RATIO 90dB FREQUENCY RESPONSE 10Hz-45kHz – 3dB SUPPLY VOLTAGE ± 25V
SIZE 114 50 85mm
Price £15·84 + £1·27 VAT P&P free.

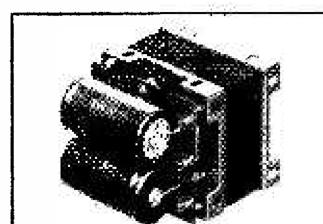


HY200
120 Watts into 8Ω

The HY200 now improved to give an output of 120 Watts has been designed to stand the most rugged conditions such as disco or group while still retaining true Hi-Fi performance.
FEATURES: Thermal shutdown—Very low distortion—Load line protection—Integral heatsink —No external components
APPLICATIONS: Hi-Fi—Disco—Monitor—Power slave—Industrial—Public Address
SPECIFICATIONS
INPUT SENSITIVITY 500mV
OUTPUT POWER 120W RMS into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·05% at 100W at 1kHz
SIGNAL/NOISE RATIO 96dB FREQUENCY RESPONSE 10Hz-45kHz – 3dB SUPPLY VOLTAGE ± 45V
SIZE 114 50 85mm
Price £23·32 + £1·87 VAT P&P free.

HY400
240 Watts into 4Ω

The HY400 is I.L.P.'s "Big Daddy" of the range producing 240W into 4Ω! It has been designed for high power disco address applications. If the amplifier is to be used at continuous high power levels a cooling fan is recommended. The amplifier includes all the qualities of the rest of the family to lead the market as a true high power hi-fidelity power module.
FEATURES: Thermal shutdown—Very low distortion—Load line protection—No external components.
APPLICATIONS: Public address—Disco—Power slave—Industrial
SPECIFICATIONS
OUTPUT POWER 240W RMS into 4Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·1% at 240W at 1kHz
SIGNAL NOISE RATIO 94dB FREQUENCY RESPONSE 10Hz-45kHz – 3dB SUPPLY VOLTAGE ± 45V
INPUT SENSITIVITY 500mV SIZE 114 100 85mm
Price £32·17 + £2·57 VAT P&P free.



POWER SUPPLIES

PSU36 suitable for two HY30's £5·22 plus 65p VAT. P/P free.
PSU50 suitable for two HY50's £6·82 plus 85p VAT. P/P free.
PSU70 suitable for two HY120's £13·75 plus £1·10 VAT. P/P free.
PSU90 suitable for one HY200 £12·65 plus £1·01 VAT. P/P free.
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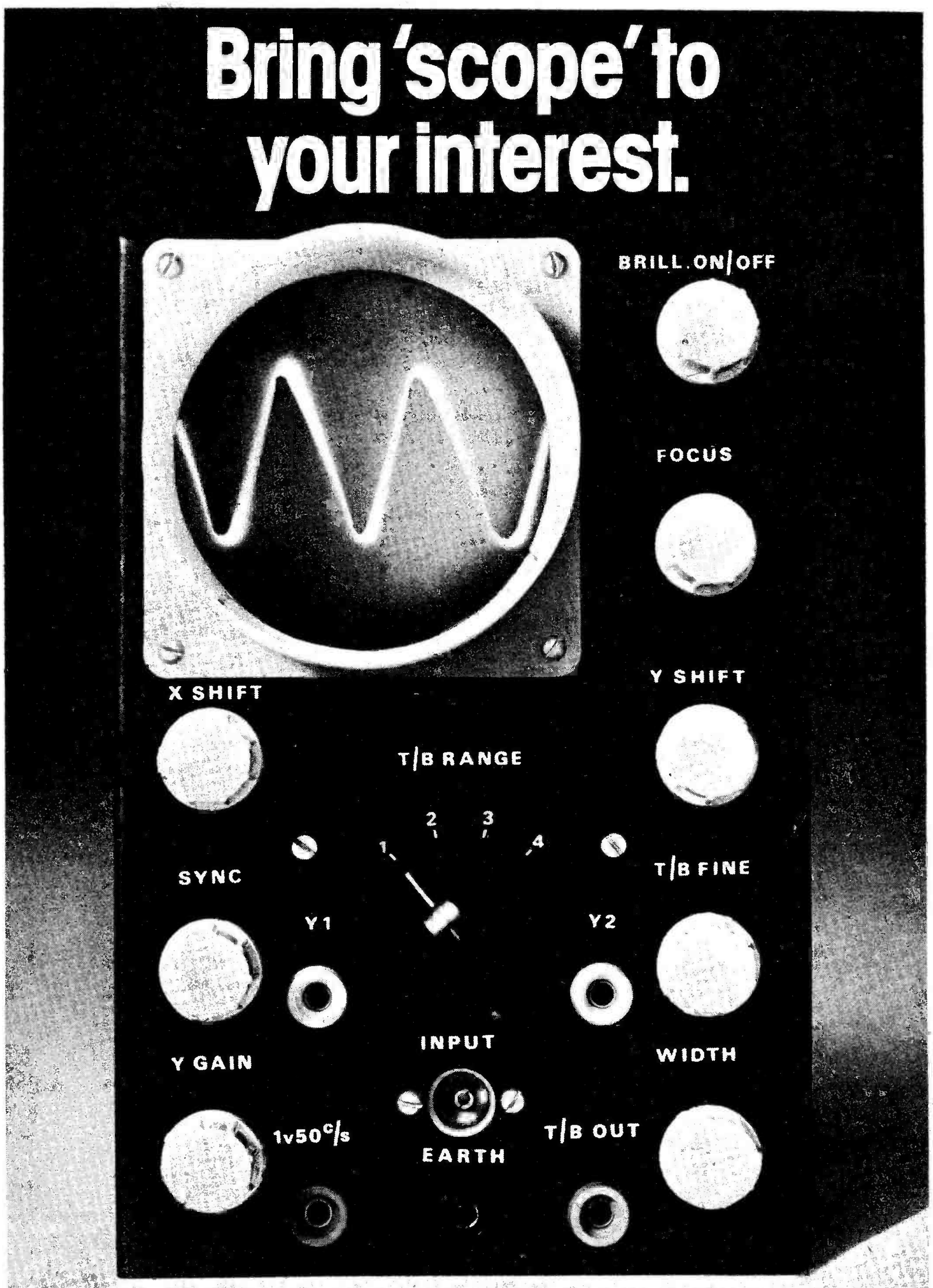
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T/B FINE
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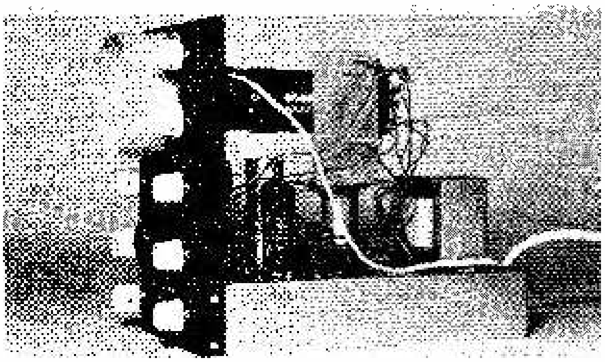
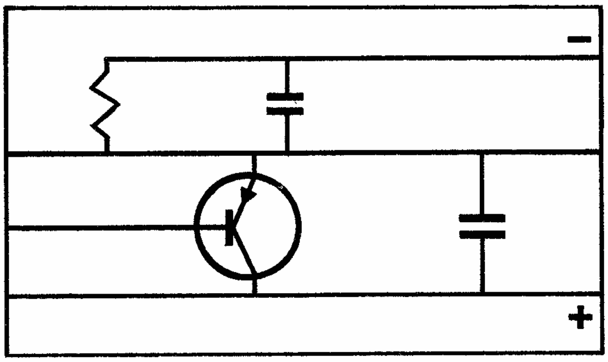
Y2
INPUT
Y GAIN
WIDTH
1v50c/s
T/B OUT
EARTH



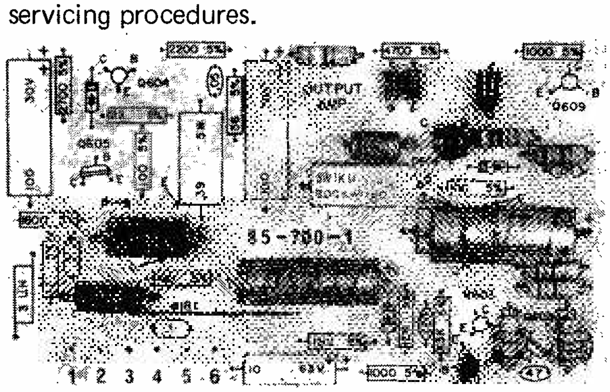
1 Build an oscilloscope.

As the first stage of your training, you actually build your own Cathode ray oscilloscope! This is no toy, but a test instrument that you will need not only for the course's practical experiments, but also later if you decide to develop your knowledge and enter the profession. It remains your property and represents a very large saving over buying a similar piece of essential equipment.



2 Read, draw and understand circuit diagrams.

In a short time you will be able to read and draw circuit diagrams, understand the very fundamentals of television, radio, computers and countless other electronic devices and their servicing procedures.



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INVERTORS

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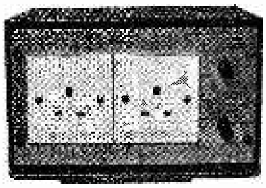

240v-50Hz from your 12v car battery.

O/P Powers available. 25W–40W–75W–150W–300W–400W–500W–1kW–1·5kW. Various battery I/P voltages available.

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These units have built-in battery charger which functions whilst mains are healthy. Upon mains failure unit automatically switches to invertor operation ensuring no interuption of supply. Send S.A.E. for price lists.

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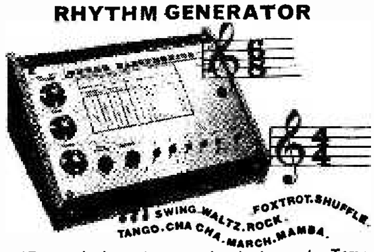


15 different rhythms, 9 percussion instruments. Tempo range 15 to 100 bars/min. Full kit of parts available at £39·50 + £1·20 P. & P. + VAT at 8%. Price assembled and tested add £12. Parts available separately, send S.A.E.

We reserve the right to alter published prices in the event of component or postal increases.

P.E. ORION STEREO AMPLIFIER & TUNER

May be mounted slim line or stacked as above. Parts available separately for both units.

20 + 20 Watts r.m.s. into 8 ohm load. Distortion less than 0·1% 100Hz–10kHz. Frequency response ± 1dB 20 Hz to 20kHz. Hum level virtually nil with volume full on. This is a power amplifier of superb quality incorporating the very latest design features. Professional hi-fi enthusiasts have classed it as fantastic and real value for money. The CCT incorporates a low flux transformer and inputs for disc, tape, tuner, etc.

TUNER UNIT

May be purchased separately in matching slim line case. As full kit or individual parts.

Send S.A.E. for price list and specification sheets.

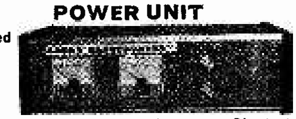
LOUDSPEAKERS

8 inch system

This system is designed for use with above amplifiers rated up to 25W r.m.s. per channel at 8Ω. May be incorporated in an enclosure 295 x 490 x 295mm (11·5 x 19·3 x 11·5in) approx. external, constructional details of which are given with each bass unit, to provide an overall frequency response of 50Hz to 22kHz. Four-element cross-over, ready constructed on p.c.b. Output leads have push-on receptacles to suit speaker tags. Cross-over frequency is 2·8kHz approx.

POWER UNIT

Regulated



Voltage adjustable from 1–35v at 2 amps. Short circuit protected. Voltage and current meters incorporated. Full Kit of parts £48 + 8% VAT or assembled and tested £58 + 8% VAT.

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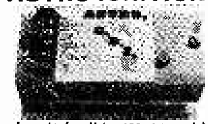

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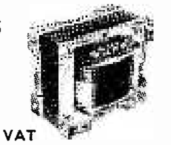

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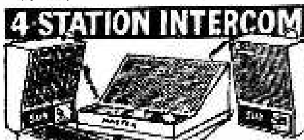

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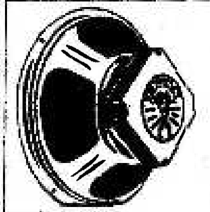

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AF115	0·20
AF116	0·20
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AF118	0·50
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AF126	0·25
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BC109B	0·12
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BC125	0·18*
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BC140	0·32
BC141	0·28
BC142	0·23
BC143	0·23
BC147	0·09*
BC148	0·09*
BC149	0·09*
BC157	0·09*
BC158	0·09*
BC159	0·09*
BC160	0·32
BC161	0·38
BC168	0·09*
BC169	0·12*
BC169C	0·14*
BC182	0·11*
BC182L	0·12*
BC183	0·10*
BC183L	0·10*
BC184	0·11*
BC184L	0·12*
BC186	0·20*
BC187	0·24*
BC207B	0·12*
BC212	0·11*
BC212L	0·12*
BC213	0·12*
BC213L	0·14*
BC214	0·14*
BC214L	0·15*
BC237	0·16*
BC238	0·16*
BC300	0·34
BC301	0·32
BC302	0·40
BC303	0·46
BCY30	0·55
BCY31	0·55
BCY32	0·60
BCY33	0·55
BCY34	0·55
BCY38	0·50
BCY39	1·15
BCY40	0·75
BCY42	0·30
BCY54	1·60
BCY70	0·12
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BF181	0·30
BF182	0·30
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BF184	0·20
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BFX30	0·30
BFX845	0·23
BFX8	0·25
BFX86	0·25
BFX87	0·20
BFX88	0·20
BFX89	0·90
BFY11	1·10
BFY18	0·50
BFY40	0·50
BFY41	0·60
BFY50	0·20
BFY51	0·18
BFY52	0·19
BFY53	0·25
BFY64	0·35
BFY90	0·90
BSX19	0·16
BSX20	0·18
BSX21	0·20
BSY52	0·28
BSY53	0·39
BSY54	0·33
BSY55	0·74
BSY65	0·30
BSY76	0·20
BSY78	0·75
BSY95A	0·16
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BU133	1·80*
BU204	1·60*
BU205	1·90*
BU206	2·40*
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MJ480	0·80
MJ481	1·05
MJ490	0·90
MJ491	1·15
MJE340	0·40*
MJE520	0·45
MJE521	0·65
OC43	0·95
OC44	0·32
OC45	0·32
OC46	0·20
OC70	0·30
DC71	0·35
OC72	0·22
OC84	0·40
OC139	1·30
OC140	1·30
OC170	0·23
TIP29A	0·44*
TIP30A	0·52*
TIP41A	0·54
TIP32A	0·64
TIP41A	0·68
TIP42A	0·72
2N404	0·40
2N696	0·20
2N697	0·20
2N706	0·15
2N1131	0·15
2N1132	0·16
2N1302	0·40
2N1303	0·40
2N1304	0·45
2N1305	0·45
2N1306	0·50
2N1307	0·50
2N1308	0·60
2N1309	0·60
2N1711	0·24
2N2102	0·44
2N2217	0·30
2N2369	0·14
2N2369A	0·14
2N2483	0·20
2N2484	0·16
2N2646	0·50
2N2711	0·20
2N2712	0·15
2N2904A	0·20
2N2905	0·18
2N2905A	0·22
2N2906	0·18
2N2925	0·14*
2N2926O	0·09*
2N2926R	0·10*
2N2926Y	0·09*
2N2926G	0·10*
2N3053	0·20
2N3055	0·50
2N3137	1·10
2N3440	0·56
2N3442	1·20
2N3570	3·60
2N3702	0·10*
2N3703	0·10*
2N3704	0·10*
2N3705	0·10*
2N3706	0·10*
2N3707	0·10*
2N3708	0·09*
2N3709	0·09*
2N3710	0·10*
2N3711	0·10*
2N3715	1·70
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2N3771	1·60
2N3772	1·90
2N3773	2·10
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4011BE	0·20
4012BE	0·20
4013BE	0·50
4014BE	1·00
4015BE	0·95
4016BE	0·54
4017BE	1·00
4018BE	1·10
4019BE	0·50
4020BE	1·12
4021BE	1·03
4022BE	0·95
4023BE	0·20
4024BE	0·86
4025BE	0·20
4026BE	1·55
4027BE	0·62
4028BE	0·91
4029BE	1·10
4030BE	0·55
4041BE	0·80
4042BE	0·83
4034BE	1·00
4044BE	0·94
4046BE	1·32
4049BE	0·54
4050BE	0·54
4069BE	0·30
4070BE	0·50
4071BE	0·26
4072BE	0·26
4081BE	0·20
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ORDER No. 16217 — *60p

R6—40 mixed ½W 1–8·2kΩ.
ORDER No. 16218 — *60p

R7—40 mixed ½W 10–82kΩ.
ORDER No. 16219 — *60p

R8—40 mixed ½W 100–820kΩ.
ORDER No. 16220 — *60p

R9—60 mixed ⅛W 1–10MΩ.
ORDER No. 16230 — *60p

R10—40 mixed ½W 1–10MΩ.
ORDER No. 16231 — *60p

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BACK NUMBERS

We are very glad to announce the re-establishment of a PW Back Numbers Service for our readers. In future back numbers dated from June 1977 only will be available from our Post Sales Department for 65p, which includes postage and packing. Cheques and Postal Orders should be made payable to IPC Magazines Ltd.
Send your orders to:- Post Sales Department, IPC Magazines Ltd., Lavington House, Lavington Street, London SE1 0PF.

I SPY!

From the correspondence that we have with our readers it is very evident that one of the principal reasons for the failure of a project to work the first time that it is switched on is the lack of attention to good and proper soldering and the avoidance of solder bridges. On stripboard, particularly that with 0·1in. matrix, and on some printed circuit boards, the copper rails can be pretty close together and a soldered joint can easily spread until it actually touches an adjacent rail.

When assembling a complicated circuit board it is usual to solder, say, half-a-dozen joints at a time and, in my own case, to inspect them with a watchmaker's magnifying glass. But this is not quite enough. A subsequent joint may lie very close to one made earlier and cause trouble. So it is imperative to check **all** the board **after** it is completely finished. This is the point where excitement runs high at the thought of switching on for the first time!

To help you in this checking operation, and indeed at many other points in the course of construction, we are presenting you this month with a magnifying "glass" that could save you from a lot of problems in the future. Keep it by your workplace, preferably in its case to protect it, and you will not regret having bought this issue of **Practical Wireless.**

Next month's **PW** will include yet another gift for our readers, in the form of a very comprehensive Component Source Directory, which we believe will prove of inestimable value to the constructor of electronic equipment . . . Indeed, we feel that its appeal may spread much further afield including, as it does, tools and hardware needed in other constructional endeavours. To give you some idea of the amount of effort that has gone into preparing the Directory some 210 copies of an 11-page questionnaire were sent out to a selection of advertisers from PW and other electronic magazines. Some did not bother to reply so the loss of a bit of free advertising is theirs!

Naturally many of the firms shown in the Directory carry a much wider range of goods than it is possible to indicate so do not hesitate to contact a likely supplier for further information. Incidentally, do send a stamped, self-addressed envelope of adequate size for the information you require. With the very high postal charges of today this little gesture is much appreciated by advertisers especially the smaller firms. It can also make quite a difference in the time you may have to wait for a reply!

So don't forget to order your copy of the November issue of **PW** with its Directory. Keep and treasure the Directory, consult it and use it to your advantage when you are forking out on your hobby! It could save you a lot of time and quite a bit of money in the long run.

Eric Dowdeswell *Assistant Editor*

PLEASE NOTE

We do not operate a Technical Query Service except on matters concerning constructional articles published in PW. We do not supply service sheets or information on commercial radios, TV's or electronic equipment.
All queries must be accompanied by a stamped self-addressed envelope otherwise a reply cannot be guaranteed.

NEWS... NEWS... NEWS...

R.A.E. Courses

Mid-Cornwall College of Further Education, Palace Road, St Austell, Cornwall.
Tuesday Evenings 7 to 9pm commencing 27th September. Enrolment on the 21st or 22nd September between 5pm and 7.30pm. Further information from G4DND. Tel: St Columb 479.

Boreham Wood College of Further Education, Elstree Way, Boreham Wood, Herts.
Tuesdays and Thursdays 7 to 9pm commencing 20th September. Enrolment on Wednesday or Thursday the 7th or 8th September between 4pm and 6pm. Further information from G. L. Benbow G3HB. Examination to be sat in December 1977.

Gosforth Adult Association Classes, Gosforth High School, Gosforth, Newcastle-upon-Tyne.
Tuesday evenings 7pm to 9pm with Morse classes on Thursdays at the same times. Further information from D. R. Loveday G3FPE. Tel: Newcastle-upon-Tyne 668439.

Bridgnorth College of Further Education, Stourbridge Road, Bridgnorth, Salop.
Wednesday evenings 7pm to 8.45pm commencing 14th September. Enrolment on Wednesday or Thursday 7th/8th September between 6.30 and 8.30pm. Cost for the three term course will be £10 or £5 for students under 18. The class tutor will be P. Edwards G3DKJ while the college call sign is G4COB. Further information from R. A. Buckley, Tel: 4431

College of Technology and Design, Feilden Street, Blackburn.
The course will be taken by Harry Leeming G3LLL, and any enquiries should be addressed to The Principal of the College.

North and West Farnborough Further Education Centre, Cove School, St John's Road, Farnborough, Hants.
Thursday evenings at 7.30pm commencing 22nd September. There will also be a Morse proficiency course beginning on Monday 19th September at 7.30. Further information from J. Brett Principal. Tel: Farnborough 42397.

Knottingley High School, Knottingley, West Yorks.
Tuesday evenings at 7pm. Enrolment on Monday 19th September. Course to be taken by G3HCW.

Newport Amateur Radio Society, Bryngla House, Bryngla Hill, Newport.
Monday evenings 6pm to 8pm commencing 19th September. Course fee will be in the region of £7·00, and course tutor will be L. A. Groucott GW3YTJ.

British Radio Technical Advisory Service

The object of this service is to provide a much-needed source to which professionals, transmitting amateurs and short wave listeners and others involved in radio communications may turn for advice. There is a panel of engineers, each a specialist in his field, both in radio communications and electronics in general, and a lifetime of experience to call upon. Questions and requests for advice will be referred to the engineer considered the most experienced in the particular field of the enquiry.

A quote in advance will give the fee for answering questions or requests for advice. This quotation will be offered in two ways, for a short answer or opinion, or for a detailed answer or opinion, based upon full consideration of all aspects of the enquiry and stating the reasons for their opinion.

The only initial outlay to obtain the quotation will be three stamped envelopes, two self-addressed and one left blank to send the enquiry to the appropriate engineer. A quotation for the necessary technical advice or opinion will then be sent. Upon receipt of the remittance the necessary technical advice or opinion will be sent together with a suggested source and, where possible, the cost of any equipment to comply with the needs.

G2DYM Aerials and Projects, Whiteball, Wellington, Somerset.

Wessex report

The Wessex AR Group had the good fortune to have two interesting lecturers recently. Ken Alford G2DX, holding an early TH500 valve, talked about the early days of Wireless and F.J.H. "Dud" Charman G6CJ, extreme right, gave his well-known lecture on Aerials. Between them is Frank Hicks-Arnold G6MB and Roy Scott G2CZH is at the left, President and Vice-chairman of the Group respectively.

Hon. Sec. G. Coles G4EMN, 6 St. Anthony's Road, Bournemouth.

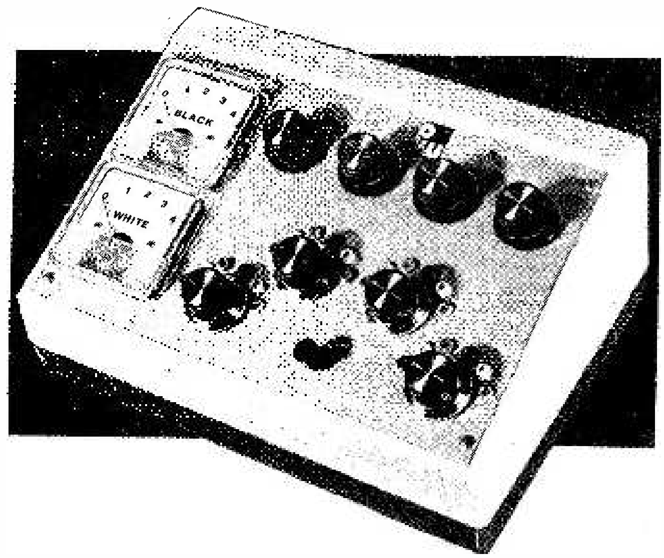
SOLO SUPERMIND

ALAN WILLCOX

The popular game of cunning and logic called "Mastermind" is intended for two players, named respectively, the "Codemaker" and "Codebreaker". Solo Supermind carries out all the necessary operations allowing the game to be played by one person. In Mastermind the Codemaker begins the game by placing four coloured pegs—the Code—in any order but hidden from the Codebreaker. There are six colours to choose from, giving 1,296 permutations. The object of the game is that the Codebreaker should duplicate the exact colours and positions of the secret Code.

For those not familiar with Mastermind the sequence is as follows:—the Code set by the Codemaker at the top of the board, shielded off, might be yellow, red and two blues. The Codebreaker begins his play by placing four coloured Code Pegs in Row 1—a pure guess at this stage. Suppose he has tried green, blue, yellow and red. The Codemaker must now give information by placing black and white "Key Pegs" in the Key Peg holes alongside the Code Pegs. A black Key Peg is placed in any of the Key Peg holes for every Code Peg which is of the same colour and in the same position as one of the Code Pegs in the hidden Code. A white Key Peg is awarded for each Code Peg of the right colour but in the wrong position. In this case three white Key Pegs are awarded by the Codemaker for the blue, yellow and red Pegs which are the correct colour but in the wrong positions.

On the basis of this information the Codebreaker tries another four Code Pegs in Row 2, hopefully bringing him nearer the solution. The three white Key Pegs give no indication as to which three Code Pegs are the correct colour, and so the Codebreaker in Row 2 tries retaining yellow, green and blue, and replaces the red with an orange. In the process he



has also shifted them about in order to try to achieve the correct position. The Codemaker replies by awarding two black Key Pegs, one each for yellow and blue, these being the correct colour in the correct position; but two Key Peg holes are now left vacant because orange and green do not appear at all in the Code. From this information the Codebreaker can deduce that red appears in the hidden Code and orange does not.

And so the game progresses, with the Codebreaker continually referring back to the results of previous tries in order to decide the best arrangement for the next move. When, in the illustrated case, the Codebreaker has reached Row 4 he can, by referring back, say with certainty what the hidden Code is, which he does in Row 5.

These logical thought processes can take a considerable time, and the Codemaker is apt to become impatient, all the more so as his role is rather a boring one! For this reason, as Mastermind players will confirm, it is often difficult to find an opponent willing to take on the role of Codemaker. Solo Supermind is designed to replace the Codemaker entirely, so allowing the game to be played by one person and at his own pace.

★ components

Resistors

R1 to R8 2·2kΩ 2% } $\frac{1}{4}$ or $\frac{1}{8}$W
R9 to R12 1·5MΩ }

Semiconductors

Tr1a to Tr4b	BCY 71 (8 off)
Tr5a to Tr8b	BC 109 (8 off)
D1 to D8	general purpose silicon e.g. 1N4148

Miscellaneous

S1 to S8	2-pole 6-way midget wafer. Doram code 327-254
S9	push-to-make switch
Case	plastic 216mm × 137mm ($8\frac{1}{2}$" × 5") Doram code 509-608

Meters, 1mA FSD (2 off). Control knobs, 4 plain, 4 pointer. Battery clip. 9V Battery PP3. 6 B.A. bolts, nuts and spacers (each 4 off). Veroboard 0·1" matrix— 79mm × 28mm ($3\frac{1}{4}$" × $1\frac{1}{4}$")

Using Solo Supermind

Switches S1 to S4 have their stops removed to allow them to rotate continuously, and at the commencement of the game these are turned at random to set the hidden Code, then left alone throughout the game. These four Codemaker switches are operated by control knobs which are unmarked, and in practice they have proved to be a simple and effective way of obtaining a random code.

The game then proceeds in the normal way with the first guess being entered in Row 1 on the Codemaker board. In order to find out how many and which Key Pegs are due for this attempt the calibrated Codebreaker switches are turned to indicate the same colours as the Code Pegs, the left hand switch corresponding to the left hand Code Peg, and so on. When the push switch is depressed the number of Key Pegs to be awarded is shown on the two meters, one showing the black and the other the white Pegs. The indicated Key Pegs are placed in position on the Mastermind board and the game continues, each attempt being duplicated on Solo Supermind to obtain the number of black and white Pegs due at each stage. The game is over when the black meter indicates "four", and of course the aim is to reach this with the least number of attempts.

Current is drawn by the circuit only when the push button is operated, and is then only 1mA max. so the battery, once installed, can virtually be forgotten. Keen Mastermind players will find their enjoyment of the game much enhanced with Solo Supermind for, freed from the disturbing presence of another person waiting, patiently or impatiently, for a move to be made, concentration and logical attack are much easier to maintain.

Circuit description

The key to the simplicity of the circuit, **Fig. 1**—other designs have used 40 or more IC's—is the constant current technique employed in the stages Tr1 to Tr8. Each of these stages will allow only one "unit" of current to flow, and these are counted by the meters. S1 to S4 are the "hidden" Codemaker switches, and S5 to S8 are the Codebreaker switches which duplicate the Code Pegs on the Mastermind board.

Maximum current through each stage is limited to 250μA, since, at this point, 0·5V is developed across each emitter resistor, turning on the complementary transistor and therefore removing bias. The advantage gained from this is that the circuit is not critical of transistor gains, and the meter pointer shows no variation of position for different switch combinations deserving the same value. Hence, the scale can be marked in points rather than areas, and remains compatible with 1mA FSD.

The bias resistors R9 to R12 are high in value so that the current via them to the white meter in the open collector situation, and to the black meter via D5 to D8 when it applies, is insignificant.

Switching sequence

The position of S1 corresponds to the colour of the left hand hidden Code Peg. Now if S5, a Codebreaker switch, in an attempt to duplicate the Code, is switched to the same position as S1 this would count as a black Peg, corresponding to the correct colour in the correct (left hand) position. One unit

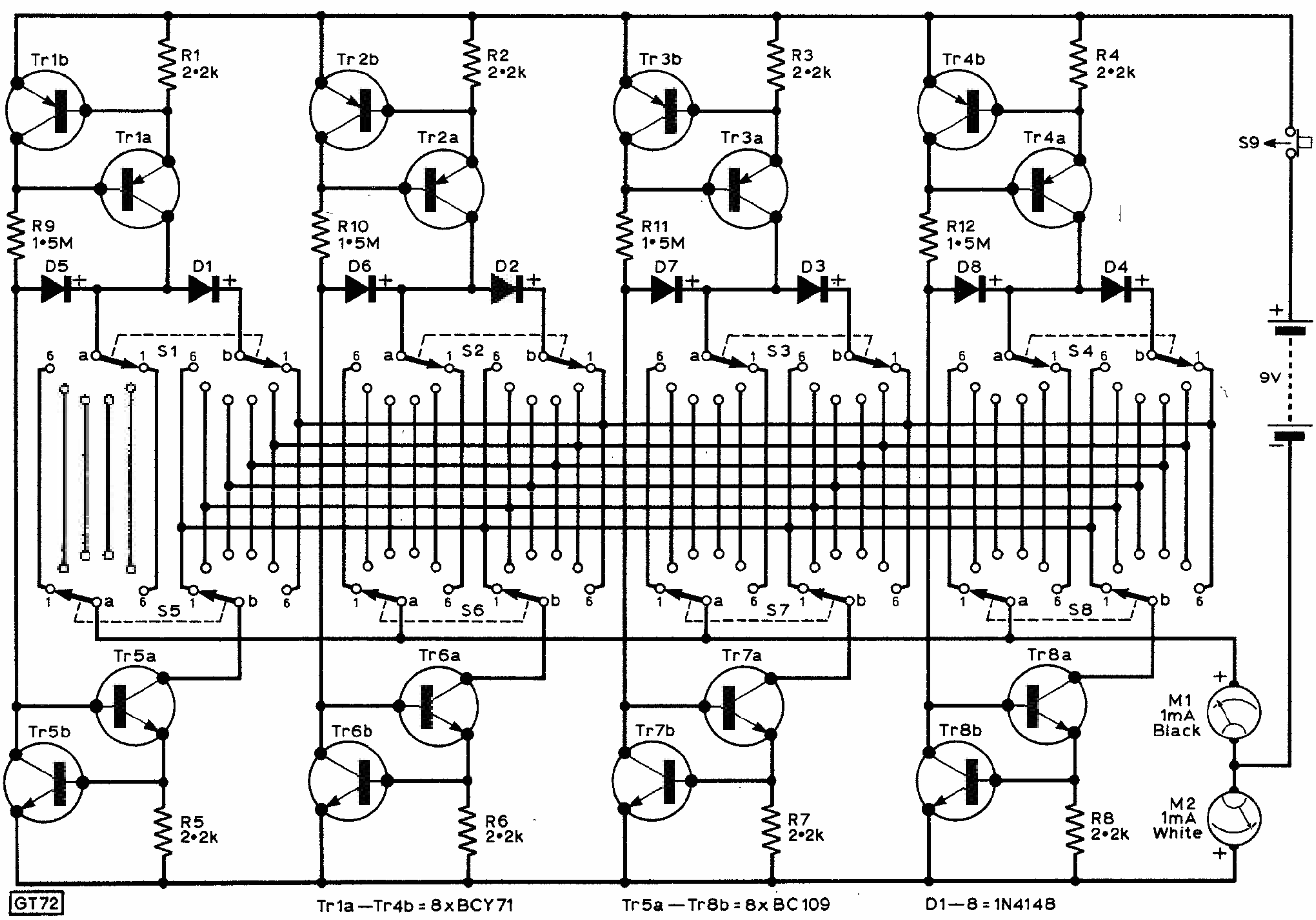


Fig. 1: The complete circuit diagram, showing the extensive use of constant current stages.

(¼mA) of current will flow through S1a and S5a to the black meter which, if the sensitivity is 1mA FSD will register a quarter FSD corresponding to one black Peg. Note that no current flows through D1 because the voltage developed across the meter is too small to allow it to conduct. So D1 serves to isolate Tr1's current and the path to M1 via S1a from the other switch banks.

Similarly, if any of the other switch pairs S2/S6, S3/S7 and S4/S8 are in the same position, current will flow through their 'a' sections to be counted by the black meter M1. Just as the 'a' sections are concerned solely with the allocation of black points, so the 'b' sections are concerned with the white. Say the Codebreaker switch S5 is positioned corresponding, not to S1 but to either S2, S3 or S4, then this would signify correct colour but wrong position and deserve a white Peg. In this case current is only available via the 'b' sections, which have all their similar positions (colours) linked together, so that the unit of current, whether supplied by Tr2, Tr3, or Tr4 is available on all the 'b' sections to pass, in this case via Tr5, to the 'white' meter M2.

Components

The meters used on the prototype were inexpensive units of the type commonly used as audio level indicators, with a sensitivity of approximately 250μA FSD; but almost any meter will do the job provided it is small enough to fit into the case and has sensitivity up to 1mA FSD. The circuit supplies 1mA for FSD, and so if more sensitive meters are used some of this current must be shunted around the meter. There is not much room to spare in a case of the kind used in the prototype, so if more conventional larger panel meters are used the unit will have to be housed in a roomier case.

Construction

The case specified is supplied with a metal front panel, although a plastic one may be preferred in that it tends to ease the hole cutting problem, reduces the risk of shorts, and provides a neater, more durable finish. The front panel size is 156 x 91 mm, and if the meters chosen are available a check should be made before the case is purchased that this area is sufficient to accommodate them and the switches. The area required for the switch bank is 125 x 70 mm.

The colour indicators for the Codebreaker switches were made on the prototype by using Code Pegs from a Mini-Mastermind. These were pushed into 3/32" diameter holes from the rear of the panel until just protruding, and then snipped off. The recommended switches have an adjustable stop **which is removed for the Codemaker switches S1 to S4.** Also there is a fixed stop consisting of an indentation in the switch body **which must be removed** by filing away or cutting to allow these four switches to rotate continuously. In the case of the Codebreaker switches the fixed and adjustable stops are retained to give six positions.

The switch wiring is quite straightforward as long as care is taken to position the switches exactly as

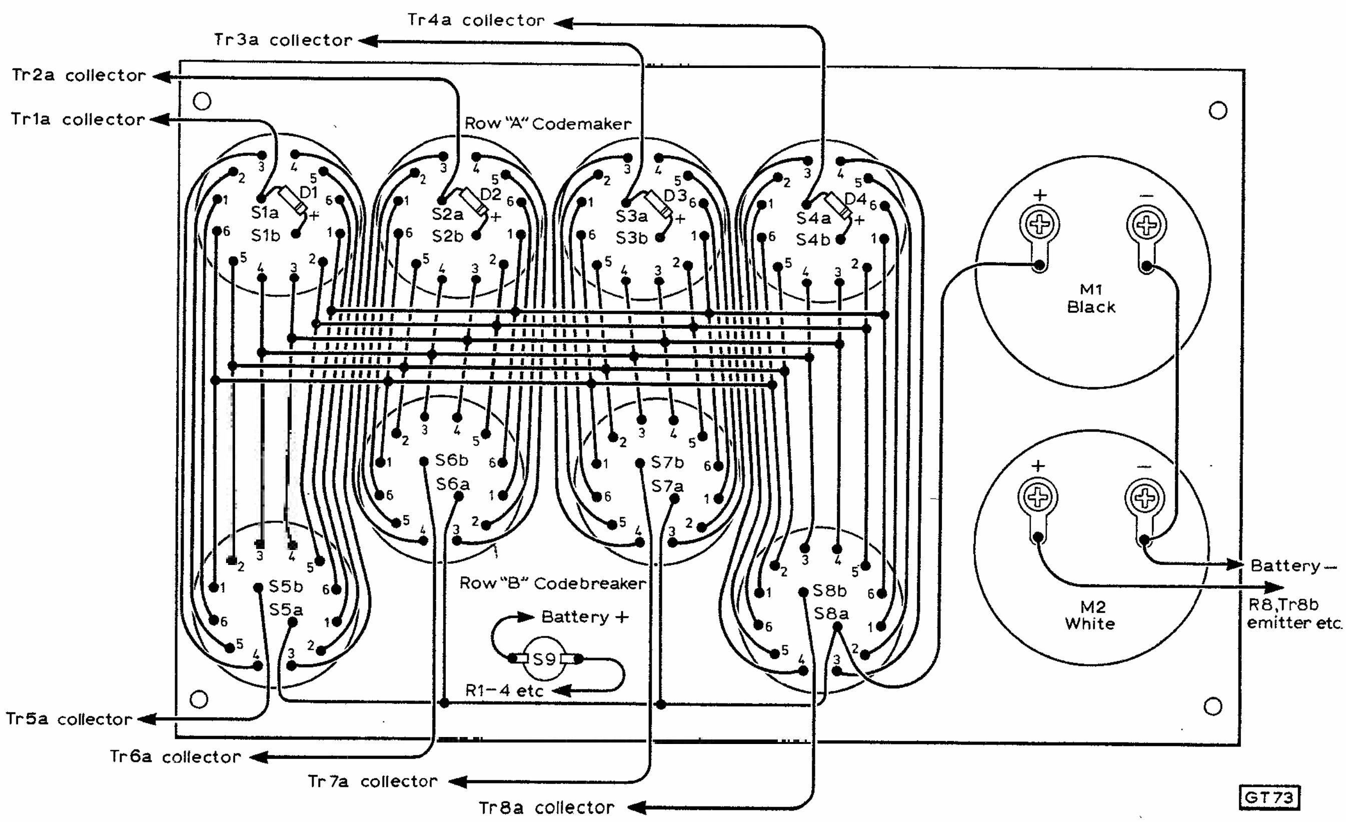
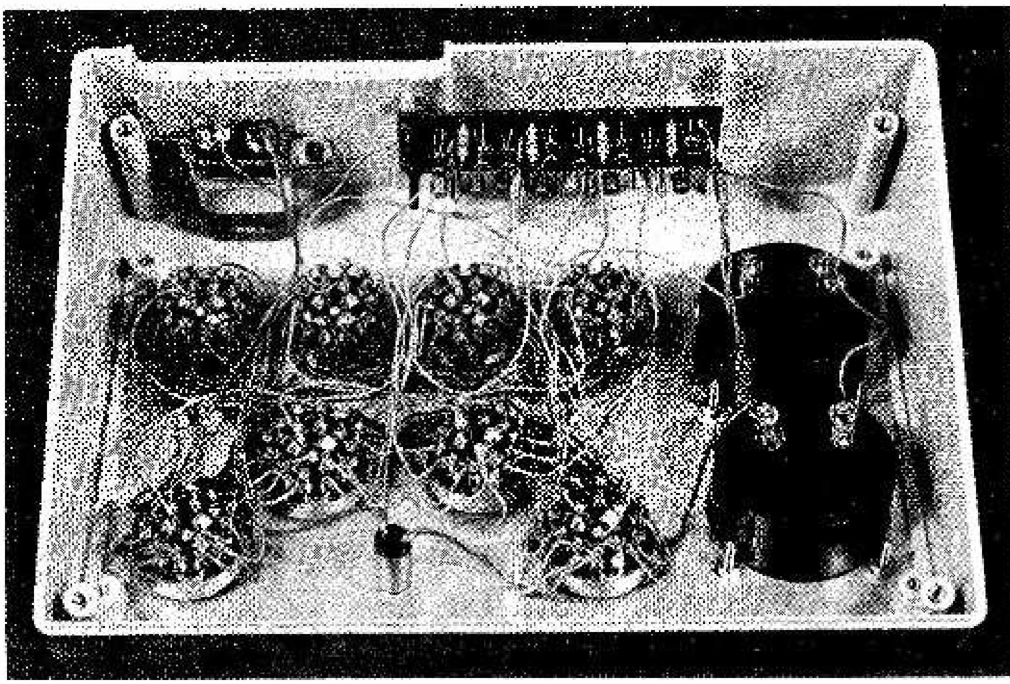


Fig. 2: The switch wiring, meter, and transistor connections.



Underside view of completed unit, showing positions of codemaker (upper) and codebreaker (lower) switches relative to meters.

shown in **Fig. 2.** Examination will show that it is as though the switch pairs were connected directly back to back, and so they have an opposite sense of rotation. That is, the sequence of colours which is clockwise for the Codebreaker switches is anticlockwise for the Codemaker switches. The second stage of the switch wiring is to connect together corresponding positions of the 'b' sections of the Codebreaker switches. The wiring of the switch poles and the interconnections are also shown in **Fig. 2.**

The remainder of the components are assembled on a small piece of veroboard as shown in **Fig. 3.** When mounting the components ensure that their height measured from the surface of the board does not exceed $\frac{1}{2}$″, otherwise it will be difficult to fit into the space provided. The battery is held in place by a clip, whilst the board is retained in the case by 6 BA bolts, nuts and spacers.

Playing the game

When starting a game the Codemaker switches, rather than just being turned at random, can be set by another person, to perhaps what he feels to be a difficult combination. If Solo-Supermind is played without a Mastermind board, using pen and paper to record the moves, it is more convenient to use a number code than a colour one. The Codebreaker switches would then be marked with the numbers 1 to 6 instead of the colours shown. ●

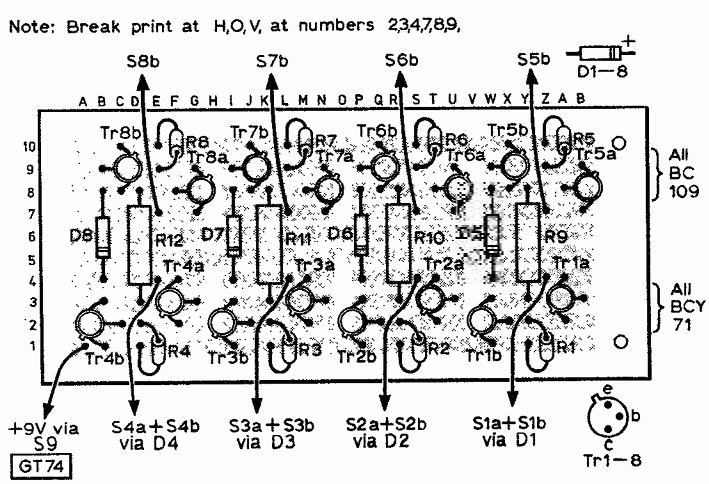


Fig. 3: Top view of veroboard showing overall component layout. Note matrix alphabetical and numerical references, and breaks in print.

LOW DISTORTION sine/square wave GENERATOR

MICHAEL TOOLEY BA/G8CKT

A variable frequency and variable voltage signal source is a most useful addition to the test equipment in an experimenter's workshop. This signal generator, suitable for general audio frequency work, provides both sine and square wave output covering the frequency range 15Hz to 25kHz. The output voltage is continuously variable from 0 to 3V peak-to-peak.

The attenuator output level calibration is adequate for testing high and medium impedance circuits. However, a voltage follower is also described for addition when the signal generator is to be used with low impedance circuits.

Circuit description

The circuit uses a Wien bridge network to determine the operating frequency. The basic circuit of a Wien bridge is shown in **Fig. 1**. The frequency determining components, C and R, are connected in series in one arm of the bridge and in parallel in the adjacent arm. If a sine wave alternating voltage is applied to the network at terminals A-B, the voltage appearing between terminals C-D will be out of phase by an amount determined by the values of C and R. If the frequency of the voltage is varied (whilst the values of C and R remain fixed) the resulting phase shift produced by the network will also vary. At a certain frequency the network will produce zero phase shift and the voltage between C-D will be in phase with the voltage A-B. This frequency is given by the relationship:

$$f=\frac{1}{2\pi CR}=\frac{0\cdot159}{CR}$$ Hz. (with C in farads and R in ohms).

The amplitude of the voltage appearing between C-D is determined by the resistive arms of the bridge, R2 and R3. The values of R2 and R3 may thus be adjusted to give a desired level of output.

The simplified circuit of the sine wave generator is shown in **Fig. 2**. An amplifier is used in conjunction with the Wien bridge network. The input of the amplfier is taken from C-D and the output is taken to A-B. Provided that the amplifier gives sufficient gain to overcome the loss in the bridge, and that the amplifier exhibits an overall phase shift of 0° or 360°, the feedback will be positive at the bridge frequency and oscillation will result.

The resistance R is varied continuously by the use of a dual-gang potentiometer, VR1A/B. The values of capacitance, C, may be conveniently switched in decades, C1, C2, C3 and C4, C5, C6 to give three frequency ranges while preserving the basic scale calibration. Two equal fixed resistors (**R2 and R3** in Fig. 2) restrict the frequency coverage obtained in any one range to a sensible amount while ensuring a reasonable overlap between the ranges.

Manual adjustment of the amplitude of oscillation is provided by the variable resistor, RV. If the amplitude of oscillation is allowed to be too large, appreciable distortion will result. Automatic amplitude control is also provded by the use of a thermistor,

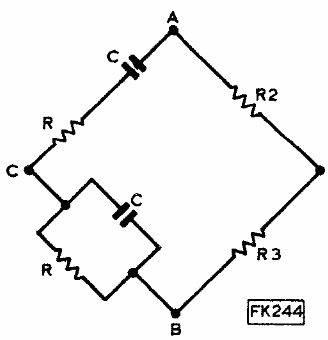
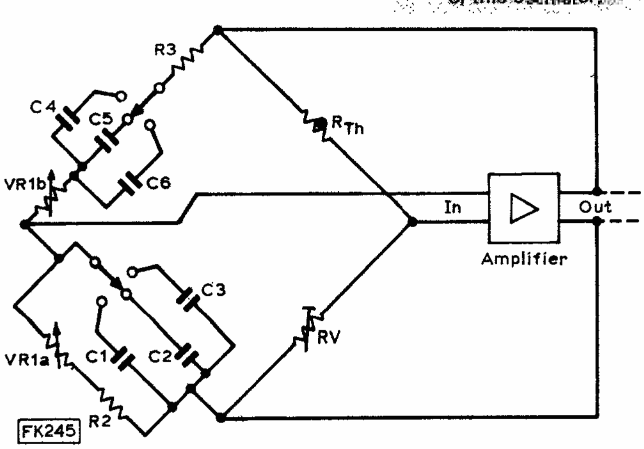


Fig. 1 (left): The basic arrangement of a Wheatstone bridge incorporates a balanced reactive element in one arm to form a Wein bridge network.

Fig. 2 (below): The Wein bridge network as used in the circuit of this oscillator.



★ specifications

Waveforms: sine, square

Frequency ranges: 15Hz to 250Hz
150Hz to 2·5kHz
1·5kHz to 25kHz

Output level: (measured into a [illegible] load)
variable in four ranges of
100mV peak-to-peak
300mV peak-to-peak
1V peak-to-peak
3V peak-to-peak

Rise time: (measured with square wave at 1 kHz) less than 10μs

Supply voltage: 240V A.C. or 16 to 20 V.D.C. external.

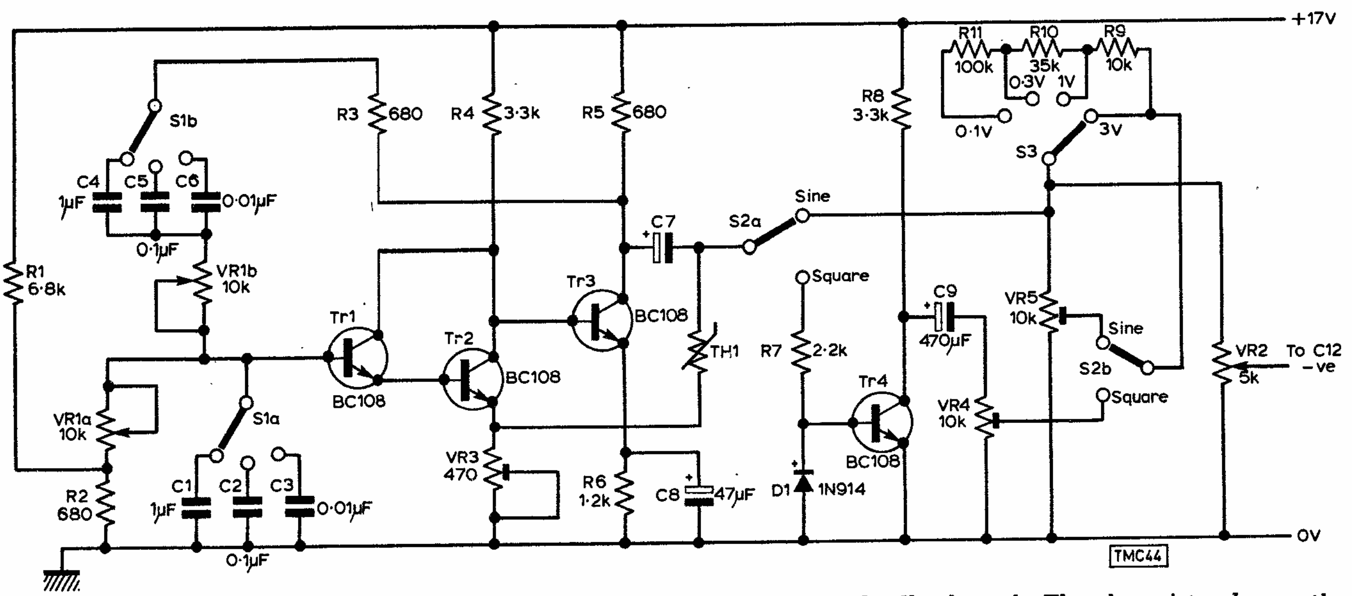


Fig. 3: Circuit diagram of the AF Signal Generator. The voltage follower circuitry surrounding IC1 may not be required (see text 'Construction').

★ components

Resistors
R1 6·8kΩ R8 3·3kΩ
R2 680Ω R9 10kΩ
R3 680Ω R10 35kΩ (33kΩ with lower attenuator accuracy)
R4 3·3kΩ
R5 680Ω R11 100kΩ
R6 1·2kΩ R12 47Ω All ¼W 5%
R7 2·2kΩ
VR1 10kΩ + 10kΩ tandem ganged log
VR2 5kΩ linear carbon VR4 10kΩ skeleton preset
VR3 470Ω skeleton preset VR5 10kΩ skeleton preset

Capacitors
C1 1μF C7 47μF
C2 100nF C8 47μF
C3 10nF C9 470μF
C4 1μF C10 1000μF
C5 100nF C11 2200μF
C6 10nF
Capacitors C1 to C6 inclusive are 160V polycarbonate.
Capacitors C7 to C11 are 25V electrolytic types.

Semiconductors
Tr1 to Tr4 BC108 D1 1N1418 or 1N914
D2 to D5 silicon bridge 200V 1A

Miscellaneous
4 insulated terminals. Mains transformer 12V 0·5A. Thermistor type R53 (subminiature encapsulated glass bead). Case about 250 × 120 × 120mm. Knobs. PCB from PW Readers PCB service. Mounting pillars for PCB. 20mm fuse holder with 0·5A fuse. S1, 2-P 3-W, S2, 2-P 2-W, S3, 1-P 4-W, S4, 1-P 3-W.

Additional components required for voltage follower (see text)

Resistors
R13 470kΩ R14 470kΩ R15 10Ω

Capacitors
C12 1μF 25V C13 470μF 25V

Semiconductors
IC1 741 mini-dip

RTH, in the feedback path. The thermistor keeps the amplitude of the output within close limits over the entire operating frequency range of the oscillator. It should be noted that, in the complete circuit of **Fig. 3**, only AC negative feedback is applied through the thermistor. The DC conditions are not stabilised by means of the thermistor since this can give rise to objectionable amplitude 'bounce' consequent on an adjustment of operating frequency.

Transistors Tr1, Tr2 and Tr3 form a three-stage amplifier with direct coupling between the stages. Switch S2 selects either sine or square wave output. In the square wave position an extra amplifier stage, Tr4, is introduced. This amplifier stage is substantially overdriven and effectively clips the sine wave. The clipping action is aided by D1 which also preserves the symmetry of the square wave. The output level on square and sine wave may be adjusted by means of VR4 and VR5, respectively. The sine or square wave output from S2b is fed to a simple switched resistive

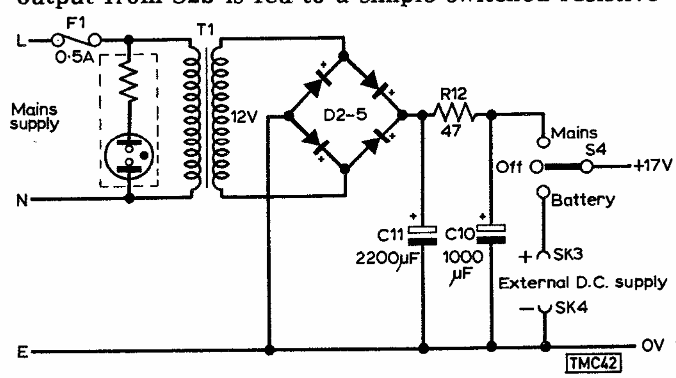
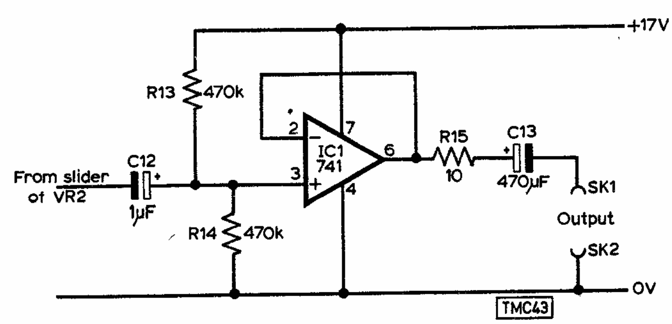
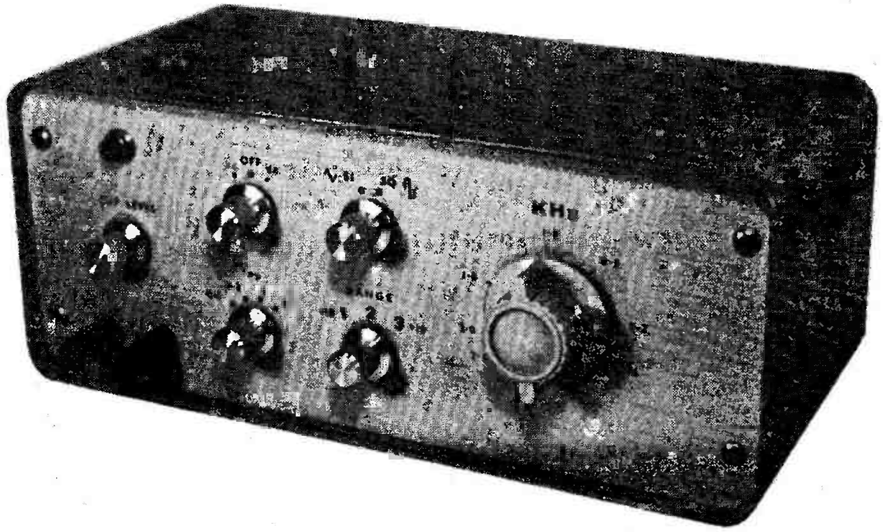


Fig. 4 (above): Power supply. C11 is mounted external to the PCB.
Fig. 5 (below): The optional voltage follower circuitry. Simply leave these components off the PCB if not required.

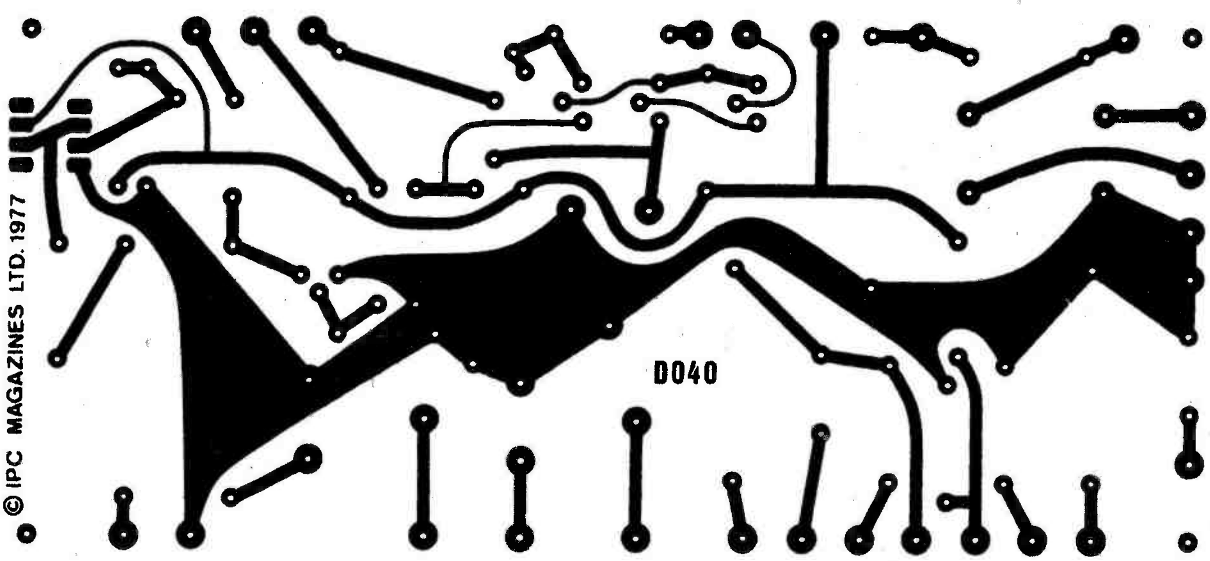


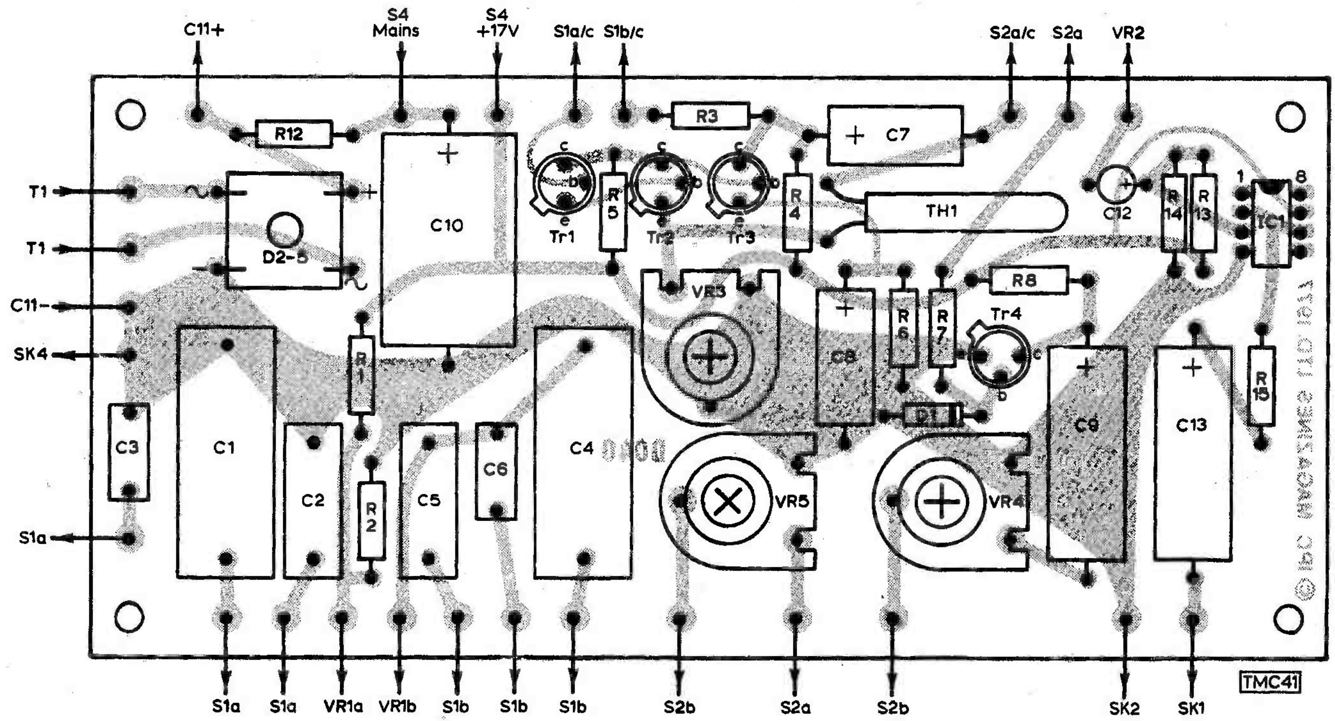


The photograph shows the prototype unit. The internals of this version were constructed on veroboard; the design was considered suitable for transference to PCB construction, artwork details of which are given below. As usual, a ready-made PCB will be available from our Readers PCB Service.

Fig. 6 (below): PCB shown copperside.

Fig. 7 (bottom): Component overlay and leadout information.





attenuator. The lower resistor of the potential divider network is made variable, thus providing a continuous adjustment of the output voltage level.

The power supply uses a conventional full-wave bridge rectifier arrangement. The current consumption of the signal generator is small and remains constant thus no provision for DC stabilisation is incorporated.

Construction

Although the prototype was constructed on veroboard, the design was considered eminently suitable for conversion to a printed circuit board. All three sections of the circuit (see oscillator, **Fig. 3**, power supply, **Fig. 4** and voltage follower, **Fig. 5**) are incorporated on a single board to facilitate easy construction. Some readers may not require the voltage follower circuitry in their application. In this case, it is recommended that the associated components are simply left off the board and the output taken directly from the slider of VR2.

Fig. 6 shows details of the copper side of the PCB while **Fig. 7** gives component identification and position. The ready-etched board may be obtained from the PW Readers PCB Service for those people who do not wish to make their own.

It is suggested that multiway ribbon cable is used to connect the front panel controls to the circuit board. This method of wiring allows much neater construction and minimises the risk of wiring errors at the same time.

Adjustments and calibration

Set VR1 to mid-position and S1 to the middle range, a frequency of approximately 1kHz. If an oscilloscope is available, adjust VR3 for a continuous sine wave oscillation with no noticeable distortion. Otherwise, connect the signal generator to an audio amplifier and adjust the volume control for a comfortable level of output. Set VR3 to maximum resistance and slowly rotate the control until oscillation begins. Note this position carefully. Continue rotating VR3 in the same direction until the oscillation just ceases and note this new position. Set VR3 mid-way between the two positions. Oscillation should then be continuous and undistorted. As a rough guide, the VR3 slider should be at about mid-travel, providing a resistance of between 220Ω and 300Ω.

Adjust VR2 for maximum output and switch S3 to the '3V' range. If an oscilloscope is available, adjust VR5 and VR4 for exactly 3V peak-to-peak output on sine wave and square wave, respectively. Alternatively, a high impedance AC voltmeter may be used. If the instrument is calibrated in RMS rather than peak-to-peak units, the corresponding outputs are approximately 1·1V sine wave and 1·5V square wave.

The output frequency may be checked either by using a digital frequency meter or by using an oscilloscope with a calibrated timebase. Another method, which is often described in text books on electrical measurements, involves the use of a signal at a known frequency to display Lissajous figures on the screen of an oscilloscope. It should only be necessary to calibrate the signal generator on the middle frequency range, 150Hz to 2·5kHz, the other ranges can make use of the same scale markings multiplied or divided by ten accordingly. ●

So you want to pass the R.A.E. [Radio Amateurs' Examination]? No. 2

John Thornton Lawrence GW3JGA & Ken McCoy GW8CMY

The passing of the Radio Amateurs' Examination, set by the City and Guilds, requires a certain level of theoretical technical knowledge. Whether one considers that this level is too high or too low is beside the point. The course that follows is intended, with the help of certain external aids, to prepare the reader to pass the examination. It will not teach him all about electronics!

Any questions?

Before we leave calculations and move into the next section, are there any queries? Yes! When finding the square root of indices, by halving the index number, what happens if the index number is not divisible by two? OK, in this case it is necessary to rearrange the values to obtain an index number which can be halved. For example, suppose we have $\sqrt{8 \cdot 1 \times 10^5}$ rearrange by reducing 10^5 by a factor of 10, to 10^4, and multiplying $8 \cdot 1$ by this factor, we get $\sqrt{8 \cdot 1 \times 10 \times 10^4} = \sqrt{81 \times 10^4}$. Square root the $81 = 9 \times \sqrt{10^4}$. Halve the index number $= 9 \times 10^2$ bring to normal notation $= 900$.

If the index number were negative, for example $\sqrt{8 \cdot 1 \times 10^{-5}}$ then rearrange by reducing 10^{-5} by a factor of 10, to 10^{-6}, and again multiplying $8 \cdot 1$ by this factor

$$= \sqrt{8 \cdot 1 \times 10 \times 10^{-6}}$$
$$= \sqrt{81 \times 10^{-6}}$$
$$= 9 \times \sqrt{10^{-6}}$$
$$= 9 \times 10^{-3}$$
$$= 0 \cdot 009$$

Attention please!

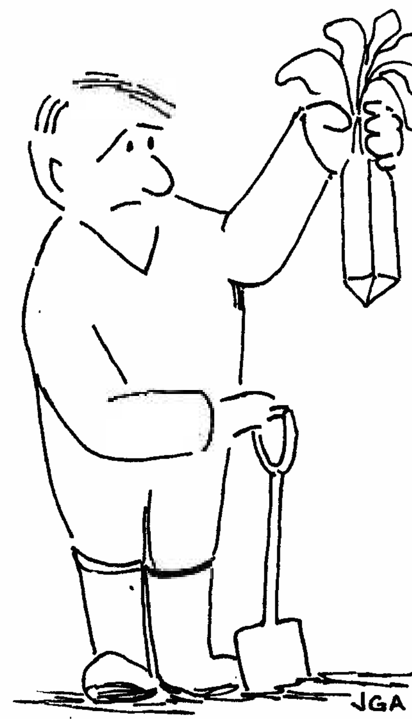
The most important single factor in preparing for the RAE is to get plenty of written practice and this includes working through calculations, drawing diagrams and writing explanations. It is so important that we will say it again! **Plenty of practice is the key to success.**

Got the message? Good! Then how about having a shot at answering the following by writing them out, stage by stage. The answers are given at the end of this part.

1. Express $0 \cdot 001$ microfarads (μF) in picofarads (pF).
2. Express $3 \cdot 6$ millihenrys (mH) in microhenrys (μH).
3. Express 33×10^2 ohms (Ω) in kilohms (kΩ).
4. Express 1296 megahertz (MHz) in gigahertz (GHz).
5. Solve $\sqrt{6 \cdot 4 \times 10^7}$.

Current

Before discussing resistance and resistors, let us remind ourselves about current flow. You know that all materials are made up of atoms, each having a



. . . still having trouble with square roots?

positively charged nucleus, and electrons with a balancing negative charge orbiting it. Current flow through a material is based on the movement of this negative charge from one atom to another and this depends on how loosely or tightly the electrons in each atom are bound to the nucleus and how much external attraction (applied voltage) there is to move them.

Conventional Current and Electron flow

Historically it had always been assumed that an electric current flowed from the positive terminal of the supply, through the external circuit and back to the negative terminal. However, with further knowledge of the structure of the atom it became obvious that current was due to the movement of a negative charge towards the positive (as in the radio valve). This apparent contradiction has caused much discussion over the years, but the accepted view and the one we will use is that, as stated previously, conventional current flows from the positive to the negative irrespective of the actual method or mechanism of the flow.

You may have noticed that it is also common practice to draw diagrams with the positive supply line at the top of the page and the zero or negative at the bottom. This convention makes it much easier to visualise the flow of current always coming vertically down the page through the various parts of the circuit. We will be discussing this in more detail later in the series.

Water Flow Analogy

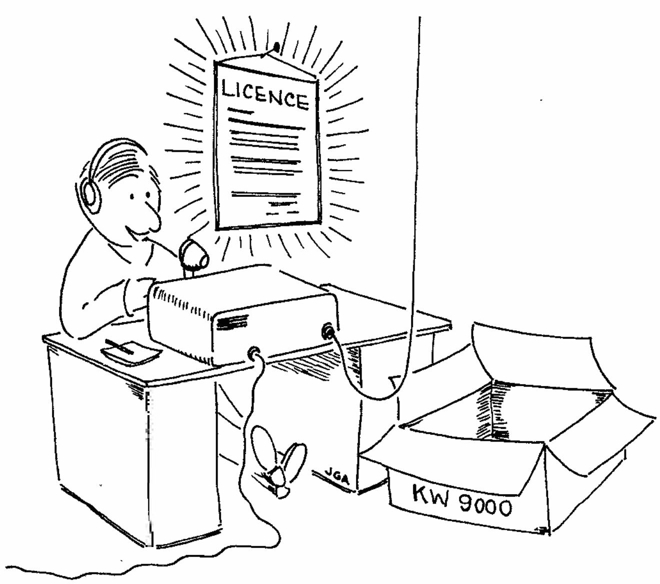
The usual analogy to electrical flow in a circuit is water flow through a pipe. The head of water or pressure represents the voltage, the flow of water through the pipe represents the current and the resistance to flow, caused by the smallness of the pipe, is equivalent to electrical resistance. The analogy also holds good in that, for example, when a tap, connected to a full hosepipe, is opened, water flows immediately out of the other end of the pipe and yet it is some time before a particular drop of water leaving the tap emerges from the far end. Similarly, an electric current entering a wire appears at the far end almost instantaneously but the actual 'bits' of charge forming the current take an appreciable time to make their way from atom to atom along the whole length of the wire.

Conductors and insulators

Those materials having atoms with loosely bound electrons, which can move easily from atom to atom, have a low resistance to current flow and are known as **conductors.** All metals are good conductors. Those materials having atoms with tightly bound electrons, which only move when under great electrical stress, have a very high resistance to current flow and are known as **insulators.** For example, an electric cable has a copper core to allow a free flow of current along its length and a plastic or rubber sleeve to insulate the core and to prevent current from leaking away to adjacent wires or to you, if you happen to be holding it!

Here is a list of typical conductors and insulators:—

Conductors	**Insulators**
Silver	Mica
Copper	Quartz
Aluminium	Glass
Brass	Ceramics
Iron	Plastics
Mercury	Rubber
Carbon	Oil
Some liquids	Air



. . . . you are my very first QSO OM

Ohm's Law and all that

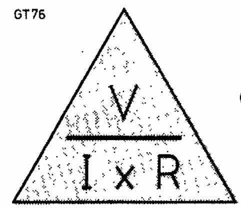
In radio and electronic circuits, besides needing good conductors and good insulators, we need a range of resistors which have a known, marked, value of resistance that does not change with temperature or time. The actual value of resistance is chosen to suit the requirement of the circuit in which it is to be used and this is calculated using Ohm's Law.

You may remember that Ohm's Law states that **for a particular resistor**, the ratio of the voltage across that resistor, to the current flowing through it, is constant. Thus, if we increase the voltage across the resistor, the current flowing through it will also increase, but the ratio between the two will remain constant. This ratio is known as the resistance and is stated in ohms (Ω), thus:—

$$\frac{\textbf{VOLTAGE}}{\textbf{CURRENT}} = \text{Constant} = \textbf{RESISTANCE}, \text{ ohms } (\Omega).$$

At this stage, a small memory aid is appropriate,

GT76



Code word VIR

By covering the unknown quantity, the appropriate formula is shown. From this you can write down the relationships between the three quantities, CURRENT (I) VOLTAGE (V) and RESISTANCE (R).

So you have

$$I = \frac{V}{R} \qquad \text{Current} = \frac{\text{Voltage}}{\text{Resistance}}$$

$$R = \frac{V}{I} \qquad \text{Resistance} = \frac{\text{Voltage}}{\text{Current}}$$

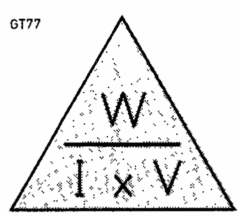
$$V = I \times R \qquad \text{Voltage} = \text{Current} \times \text{Resistance}.$$

Another quantity occurs here, **POWER.** This is the energy dissipated as heat when a voltage is applied across a resistance and causes a current to flow through it. The power is the product of the voltage and the current,

$$\text{Power (W)} = \text{Voltage} \times \text{Current} = V \times I.$$

Looking at this, you will no doubt spot the fact you can write another set of relationships and bring in another memory aid,

GT77



Code word WIV

It is then possible to combine them and produce a number of relationships or equations relating to Power, Voltage, Current and Resistance.

$$\text{Power (watts) } W = V \times I$$

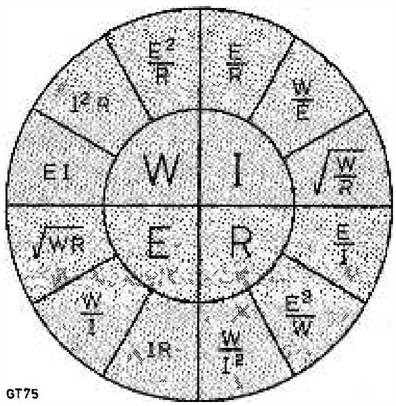
$$\text{but } I = \frac{V}{R}$$

$$\text{so that } W = \frac{V \times V}{R} = \frac{V^2}{R}$$

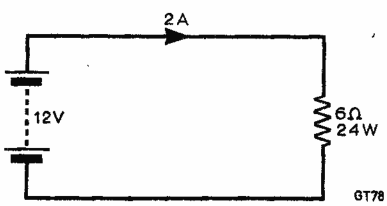
also $V = IR$
so that $W = IR \times I = I^2R$

summing up, you have $W = VI = I^2R = \frac{V^2}{R}$

The composite diagram or formulæ wheel given below, is rather too complex to be a memory aid but it is, nevertheless, very useful to refer to.



Here is an example of the memory aids in use.



Given the voltage, and the resistance, calculate the current.

$$I = \frac{V}{R} = \frac{12}{6} = 2 \text{ amperes.}$$

Given the voltage and the current, calculate the power.

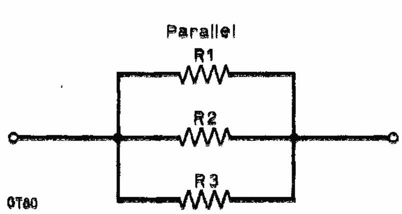
$$W = V \times I = 12 \times 2 = 24 \text{ watts.}$$

For your own reassurance, you may care to try out other formulæ with the values given.

Resistors in Series and Parallel

It will do no harm at this stage to have a brief reminder of how resistors behave in series and in parallel combinations.

Total Resistance (R_T) = R1 + R2 + R3.

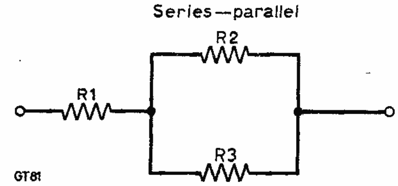


$$\frac{1}{R_T} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3}$$

or if there are only two resistors,

$$R_T = \frac{R1 \times R2}{R1 + R2}$$

Where both combinations occur it is known as the series-parallel case.

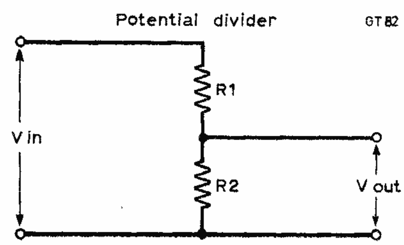


$$R_T = R1 + \frac{R2 \times R3}{R2 + R3}$$

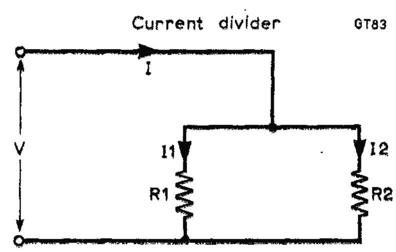
If you can remember the two memory aids given previously, you have all that is necessary to sew up the DC conditions in a circuit.

Potential and Current Dividers

There are two more useful cases which are variations of the basic DC circuit that are worth remembering, namely, the Potential Divider and the Current Divider. The potential divider is useful when setting up bias circuits for the base of a transistor, and the current divider when it is required to have currents flowing in two parts of a circuit.



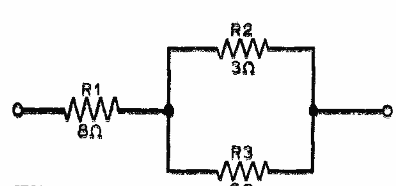
$$V_{in} = I \times (R1 + R2)$$
$$V_{out} = I \times R2. \text{ Also}$$
$$V_{out} = V_{in} \times \frac{R2}{R1 + R2}$$



$$I = I1 + I2$$
$$V = I1 \times R1 = I2 \times R2$$
$$I1 = I \times \frac{R2}{R1 + R2}$$
$$I2 = I \times \frac{R1}{R1 + R2}$$

Here are three more simple problems for you to do. Please write everything out in full. Answers at the end.

6. Find the total resistance of this series-parallel arrangement.



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70	6	3	5·35	0·96
108	8	4	6·98	1·14
72	10	5	7·67	1·14
116	12	6	8·99	1·32
17	16	8	10·39	1·32
115	20	10	13·18	2·08
187	30	15	17·05	2·08
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105	3·0	8·45	1·32
106	4·0	10·70	1·50
107	6·0	14·62	1·64
118	8·0	17·05	2·08
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152	250	12·79	1·84
153	350	16·28	2·15
154	500	19·15	2·15
155	750	29·06	OA
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157	1500	45·60	OA
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Ref	Amps	£	P & P
112	0·5	2·64	0·76
79	1·0	3·57	0·96
3	2·0	5·27	0·96
20	3·0	6·20	1·14
21	4·0	7·44	1·14
51	5·0	8·37	1·32
117	6·0	9·92	1·45
88	8·0	11·73	1·64
89	10·0	13·33	1·84

60 VOLT RANGE
Prim 220/240V Sec 0-24-30-40-48-60V
Voltages available 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60V or 24-0-24V or 30-0-30V

Ref	Amps	£	P & P
124	0·5	3·88	0·96
126	1·0	5·58	0·96
127	2·0	7·60	1·14
125	3·0	10·54	1·32
123	4·0	12·23	1·84
40	5·0	13·95	1·64
120	6·0	15·66	1·84
121	8·0	20·15	OA
122	10·0	24·03	OA
189	12·0	27·13	OA

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66	300	0-115-200-220-240	7·75	1·14
67	500	0-115-200-220-240	10·00	1·64
84	1000	0-115-200-220-240	18·76	2·08
93	1500	0-115-200-220-240	23·36	OA
96	2000	0-115-200-220-240	34·82	OA
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350	12·53	1·64	53W
500	15·73	1·64	67W
750	18·55	1·76	83W
1000	22·68	OA	84W
2000	37·65	OA	95W

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13	100	9-0-9	2·14	0·38
235	330, 330	0-9, 0-9	1·99	0·38
207	500, 500	0-8-9-, 0-8-9	2·50	0·71
208	1A, 1A	0-8-9, 0-8-9	3·53	0·78
236	200, 200	0-15, 0-15	1·90	0·38
214	300, 300	0-20, 0-20	2·56	0·78
221	700 (DC)	20-12-0-12-20	3·41	0·78
206	1A, 1A	0-15-20-0-15-20	4·63	0·96
203	500, 500	0-15-27-0-15-27	3·99	0·96
204	1A, 1A	0-15-27-0-15-27	5·39	0·96
S112	500	12-15-20-24-30	2·64	0·78

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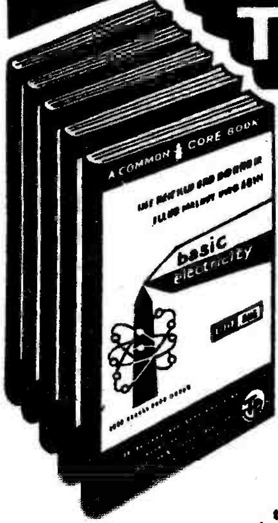

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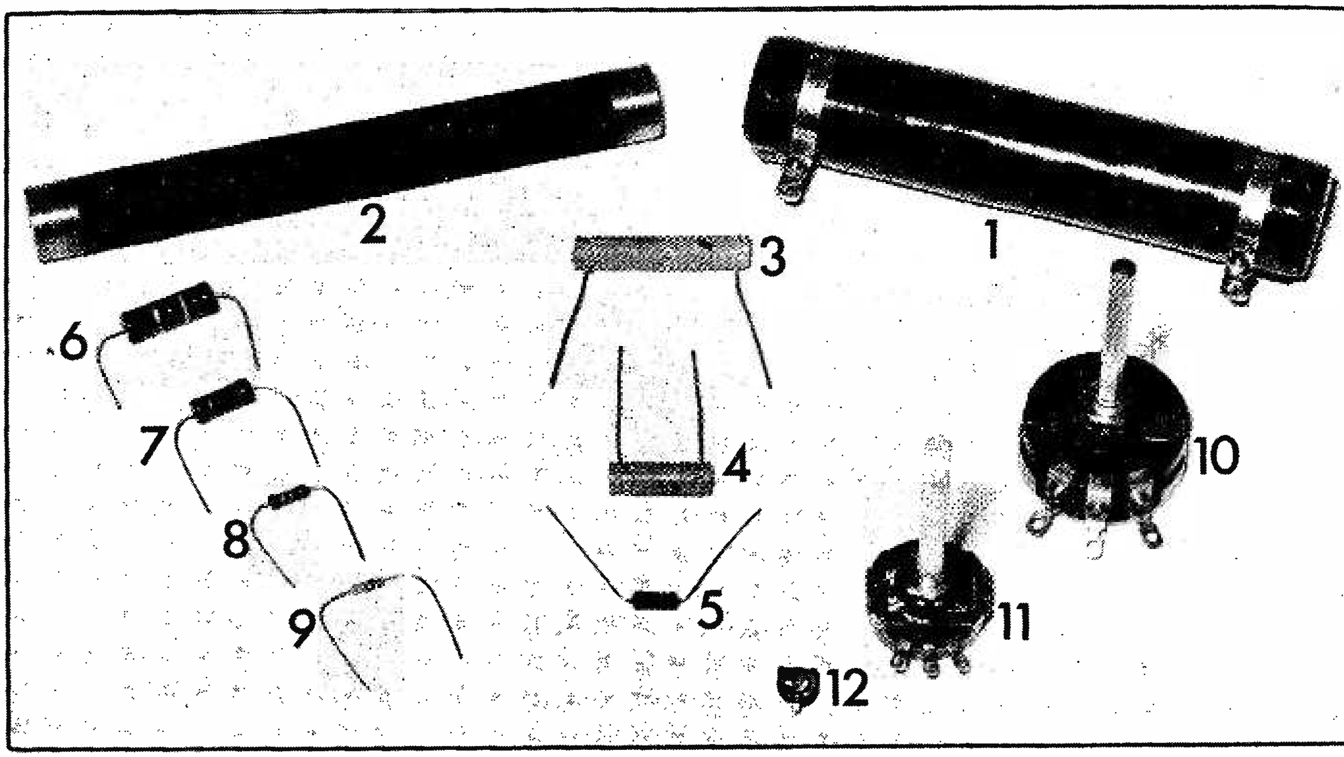


1. *Wirewound Resistor 50W.* **2.** *Carbon film resistor 30W.* **3.** *Wirewound resistor 10W.* **4.** *Wirewound resistor 5W* **5.** *Wirewound resistor 2W.* **6, 7, 8 and 9.** *Carbon film resistors, 2W, 1W, ½W and ¼W.* **10, 11 and 12.** *Potentiometers, 3W wirewound, 1W carbon and pre-set carbon.*

7. A mobile transmitter consumes 30 watts from a 12-volt battery, what current is being drawn? (Use memory aid No. 2 or the formulæ wheel).
8. What current is flowing in a 10 ohm resistor when 40 watts of power is being dissipated. (Use the formulæ wheel).

Resistors

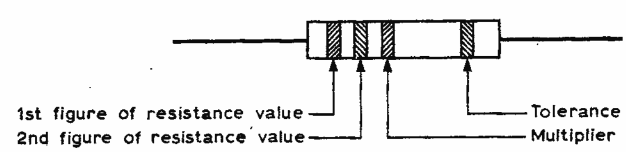
Resistors for use in practical circuits use either carbon or a metal to provide the required electrical resistance. In low-power circuits, where the power dissipation is less than 1 or 2 watts, carbon resistors are used, the most popular being the carbon film type. In this type the carbon is deposited as a film on a ceramic rod and trimmed, during manufacture, to the required value. Carbon film resistors are suitable for low and high frequency circuits.

In higher power applications, greater than 2 watts, wire-wound resistors are used. Here the resistance wire, usually nichrome or manganin alloy, is wound on a ceramic former and the whole is coated with cement (and sometimes vitreous enamel) to improve the heat dissipation. Some versions can be bolted down to improve the dissipation further. Due to their inherent and unspecified inductance, wire-wound resistors are not normally used at radio frequencies. They can of course be used in radio transmitters and receivers in voltage dropping or other power circuits providing that they are not actually carrying radio frequency currents.

Special resistors are made for higher power, high frequency use. For example, as a transmitter dummy load and these are usually giant versions of the carbon film type. The power dissipation of this type can usually be increased by fan cooling or by immersing in special oil.

The value and tolerance of a resistor is marked on it either in printing or by a colour code. A wire-

GT85 Resistor colour code



COLOUR	1st & 2nd BAND	MULTIPLYING FACTOR	TOLERANCE
BLACK	0	1	—
BROWN	1	10	±1%
RED	2	10^2	±2%
ORANGE	3	10^3	—
YELLOW	4	10^4	—
GREEN	5	10^5	—
BLUE	6	10^6	—
MAUVE	7	10^7	—
GREY	8	10^8	—
WHITE	9	10^9	—
SILVER	—	10^{-1}	± 5%
GOLD	—	10^{-2}	±10%

Resistor colour code table. Decode value of resistor as shown above. Note the third figure, the multiplier, is the number of noughts after the first two significant figures. Tolerance is usually indicated by an additional band, gold for 5% and silver for 10%.

wound resistor may be marked 100Ω ± 5%, which tells you that the actual value will be within 95 and 105Ω.

A new method of stating the resistance is given in the BS1852 resistance code, as shown below:—

0·56Ω would be R56	100Ω would be 100R
1·0Ω would be 1R0	1kΩ would be 1K0
5·6Ω would be 5R6	10kΩ would be 10K
56Ω would be 56R	10MΩ would be 10M

After the value, a further letter is added to indicate the tolerance, F=±1% G=±2% J=±5% K=±10% M=±20%. For example:—

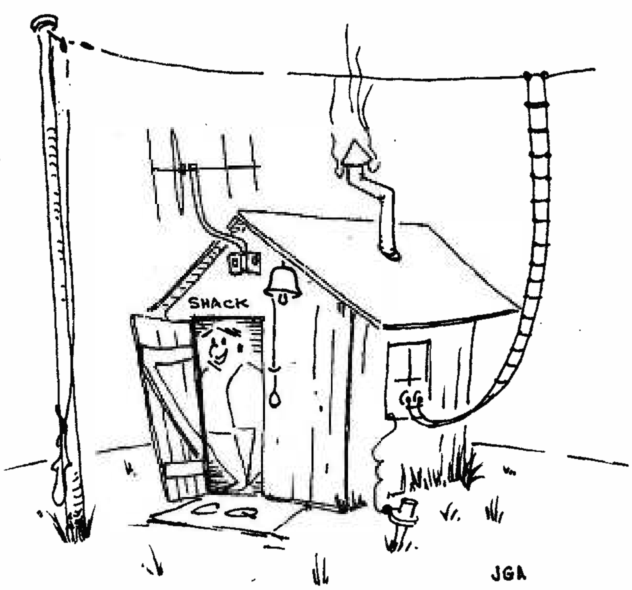
R56M=$0\cdot56\Omega\pm20\%$ 68KK=$68k\Omega\pm10\%$
390RJ=$390\Omega\pm5\%$ 1K2F=$1\cdot2k\Omega\pm1\%$

For the purposes of the R.A.E, either method would be equally acceptable, but it would be a good idea to stick to the method with which you are most familiar and use this exclusively.

All other resistors have their value and tolerance marked by coloured bands printed on the body of the resistor. The resistor colour code is given on the *Practical Wireless* INFO-CARD (March '77).*

Variable resistors are usually made in the form of a potentiometer with connections to both ends of the resistance element and to the sliding connection. Carbon is used as the resistance element in potentiometers up to about 1 watt rating and higher power versions are almost invariably wire-wound, 3 watts being a power size.

* Practical Wireless *INFO-CARD (March '77) is available free of charge. If you would like one please send a stamped, self-addressed envelope, at least 9 x 7in, to INFO-CARD, c/o* Practical Wireless, *Fleetway House, Farringdon Street, London EC4A 4AD. Do not enclose any correspondence.*



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7. $I = \frac{W}{V} = \frac{30}{12} = 2\cdot5A$
8. $I = \sqrt{\frac{W}{R}} = \sqrt{\frac{40}{10}} = \sqrt{4} = 2A$

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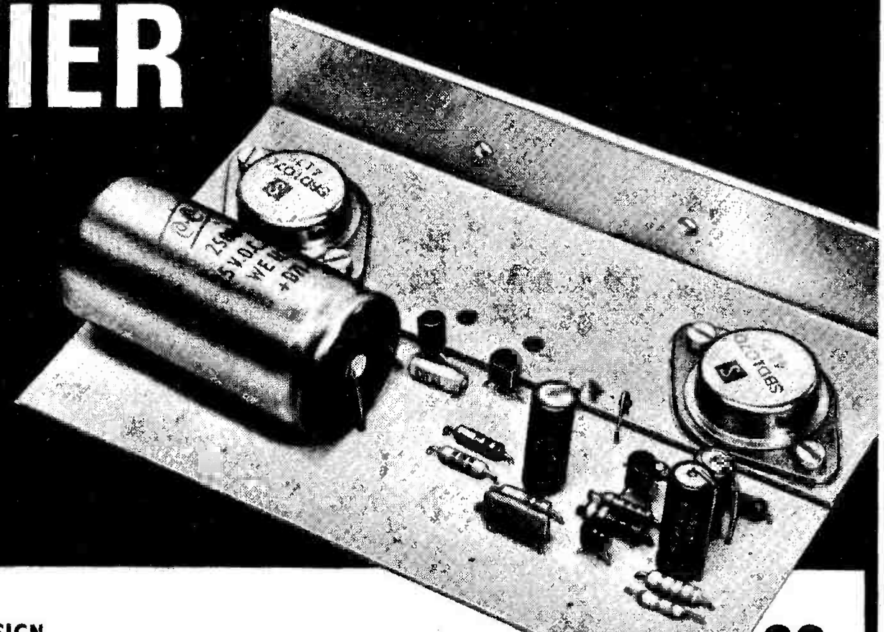

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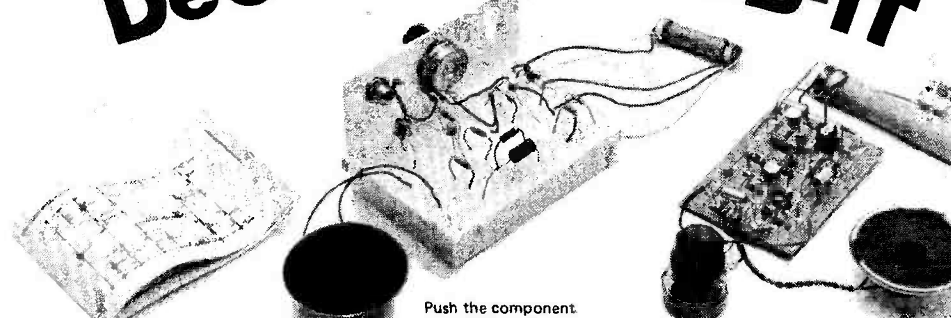
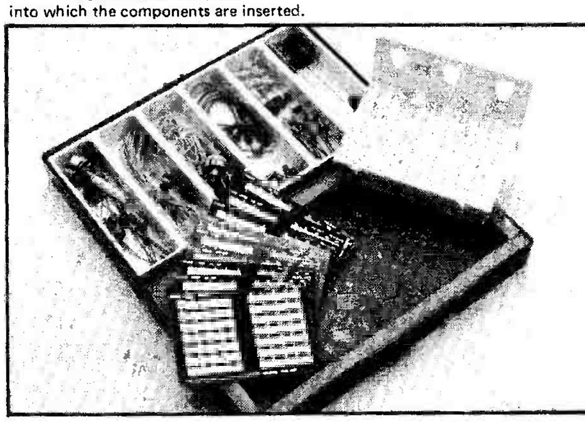


Each circuit diagram has the holes numbered into which the components are inserted.

Push the component into the S-Dec No soldering.

Plug components in and out. When circuit is proved working, transfer component by component to exactly same numbered position in Blob-Board.



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2N4920	·75	BC148	·12	BD138	·38	BU105	1·40	LM370N	2·50	SN7474	·43
2N4921	·50	BC149	·14	BD139	·40	BU126	1·90	LM371N	1·70	SN7490	·61
2N4922	·55	BC160	·35	BD140	·40	BU204	2·02	LM372N	1·70	SN7492	·61
2N4923	·70	BC161	·35	BD438	·50	BU205	2·20	LM373N	2·80	SN7493	·61
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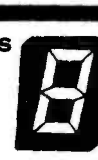

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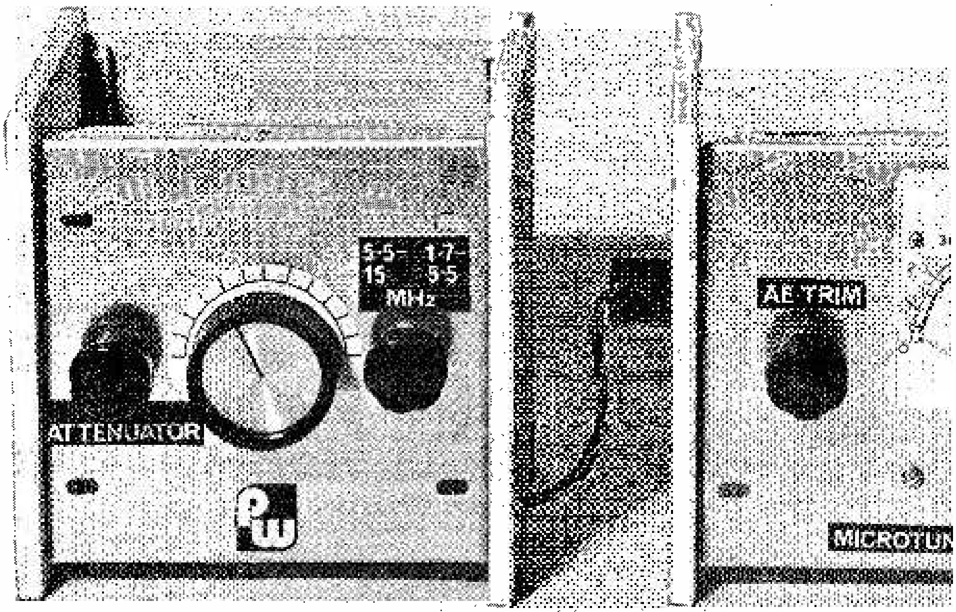
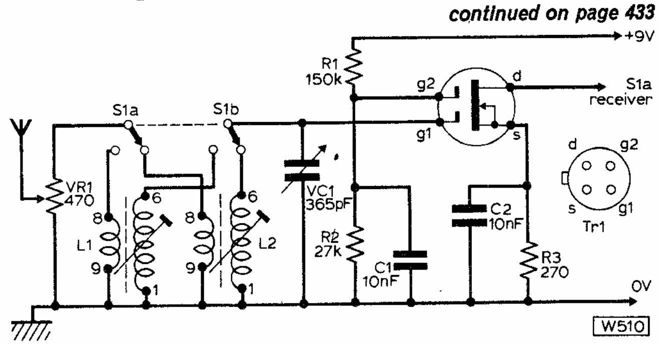


Preselector

Though this preselector is particularly intended for use with the 1·7-15MHz receiver described last month, it can be employed with other receivers, and can if necessary be adjusted to cover approximately 1·5MHz to 16MHz. It provides an increase in sensitivity and a substantial reduction in second channel interference.

Potentiometer VR1 in **Fig. 8** is an input attenuator which is essential to avoid overloading of the receiver with strong signals. It also allows the receiver input to be kept down, when necessary, for satisfactory reception of SSB and CW signals. The 2-pole switch S1a/b selects L1 or L2, and these are adjusted to provide a band coverage matching that of the receiver described. As this stage is individually tuned by VC1, no ganging problem arises. Output from the drain of the 40673 goes to the main receiver via the input switch which selects the appropriate receiver aerial coil primary. These windings are supplied from

continued on page 433



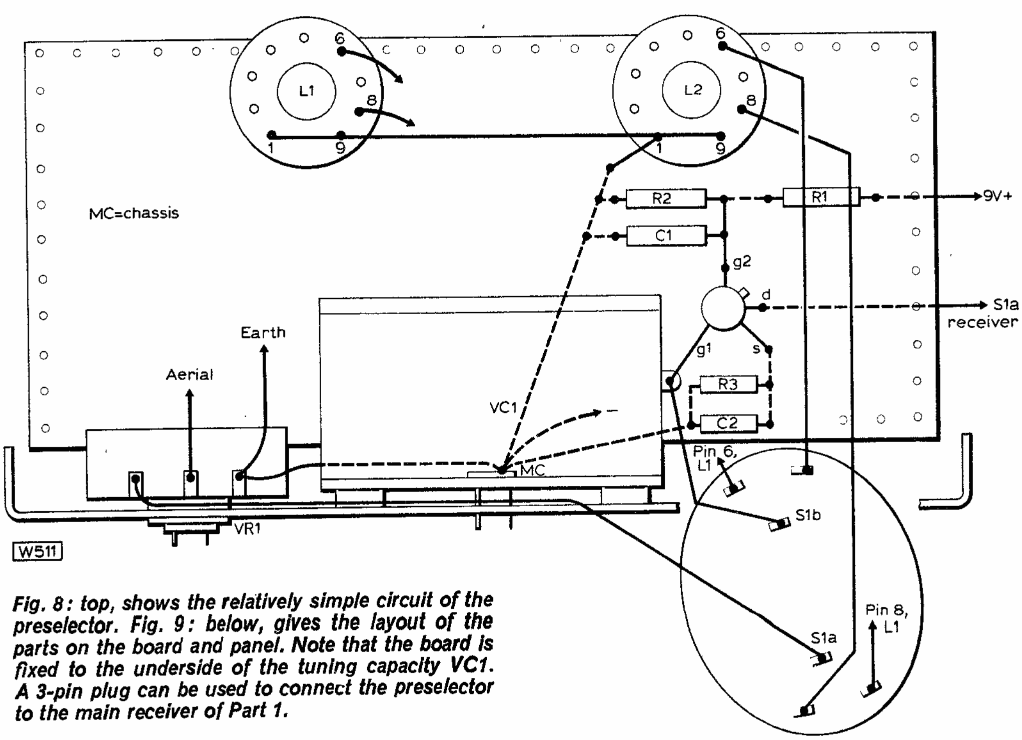


Fig. 8: top, shows the relatively simple circuit of the preselector. Fig. 9: below, gives the layout of the parts on the board and panel. Note that the board is fixed to the underside of the tuning capacity VC1. A 3-pin plug can be used to connect the preselector to the main receiver of Part 1.

THE PW 'jubilee' ELECTRONIC ORGAN

Part 2

M.J. HUGHES, MA, C.Eng., MIERE

Most of the construction takes place on a single printed circuit board, details of which are shown in **Fig. 1.** Because of its size, it cannot be shown full size in the magazine. Full size prints for PCB production purposes can be supplied from the editorial address at the front of the magazine, price 40p. Large (at least 13" x 8") stamped and addressed envelopes must accompany the cheque/money order. As usual, ready-made boards will be available from the *PW* Readers' PCB Service.

Keyboards

An early decision must be taken regarding choice of calculator key, or conventional keyboard. If you intend to make the former, start by cutting out the corner of the printed board along the guide lines. This is to allow room for the mains transformer in the final stages of assembly. Continuing with the same version, refer to the PCB overlay **Fig. 2** and insert the key switches. Make sure that they are pushed fully home and twist them slightly to get them into line. A smear of Evostick will hold the switches in place while soldering.

Insert and solder all the board pins—their positions are highlighted on **Fig. 2.** It is important that these are put in before other components are added to prevent the possibility of damage during insertion. For the conventional keyboard version, insert pins into the holes marked within the key switch areas of Fig. 2. These pins are used to take flying leads to the contacts under the keyboard.

The heading photograph shows a conventional keyboard version of the Jubilee organ. The PCB is shown in the lower picture. Note the replacement of calculator keys with PCB pins.

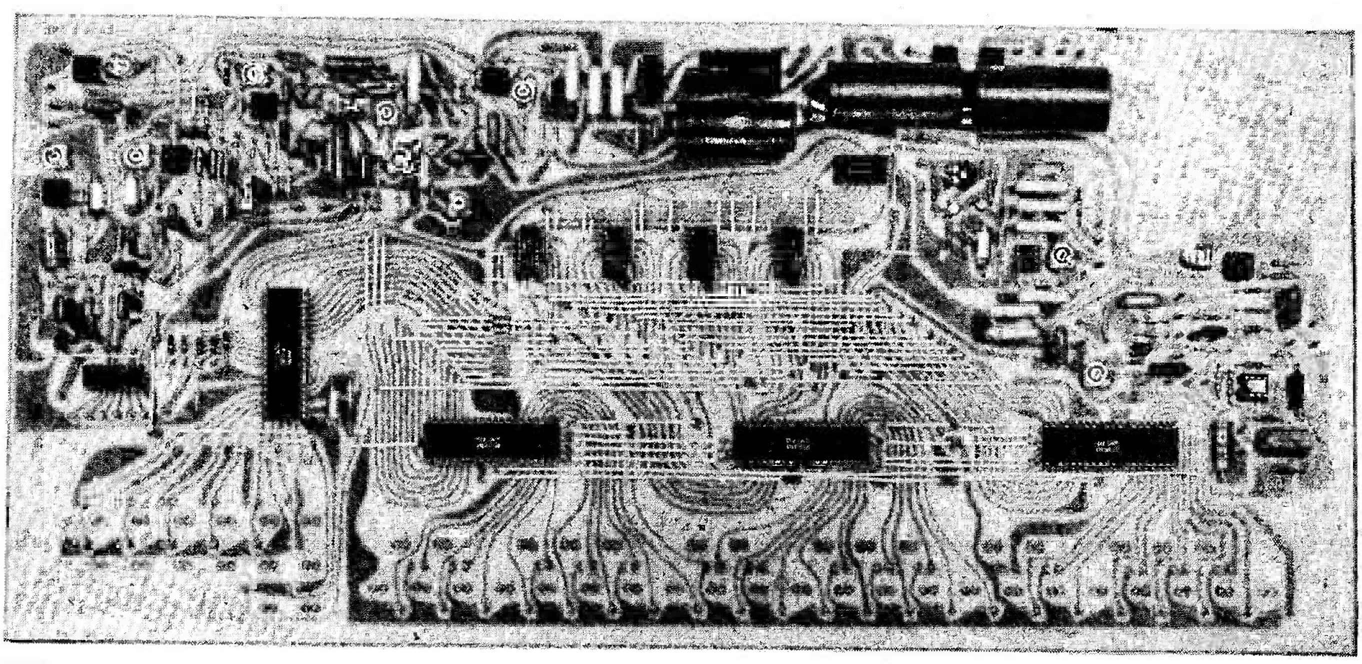
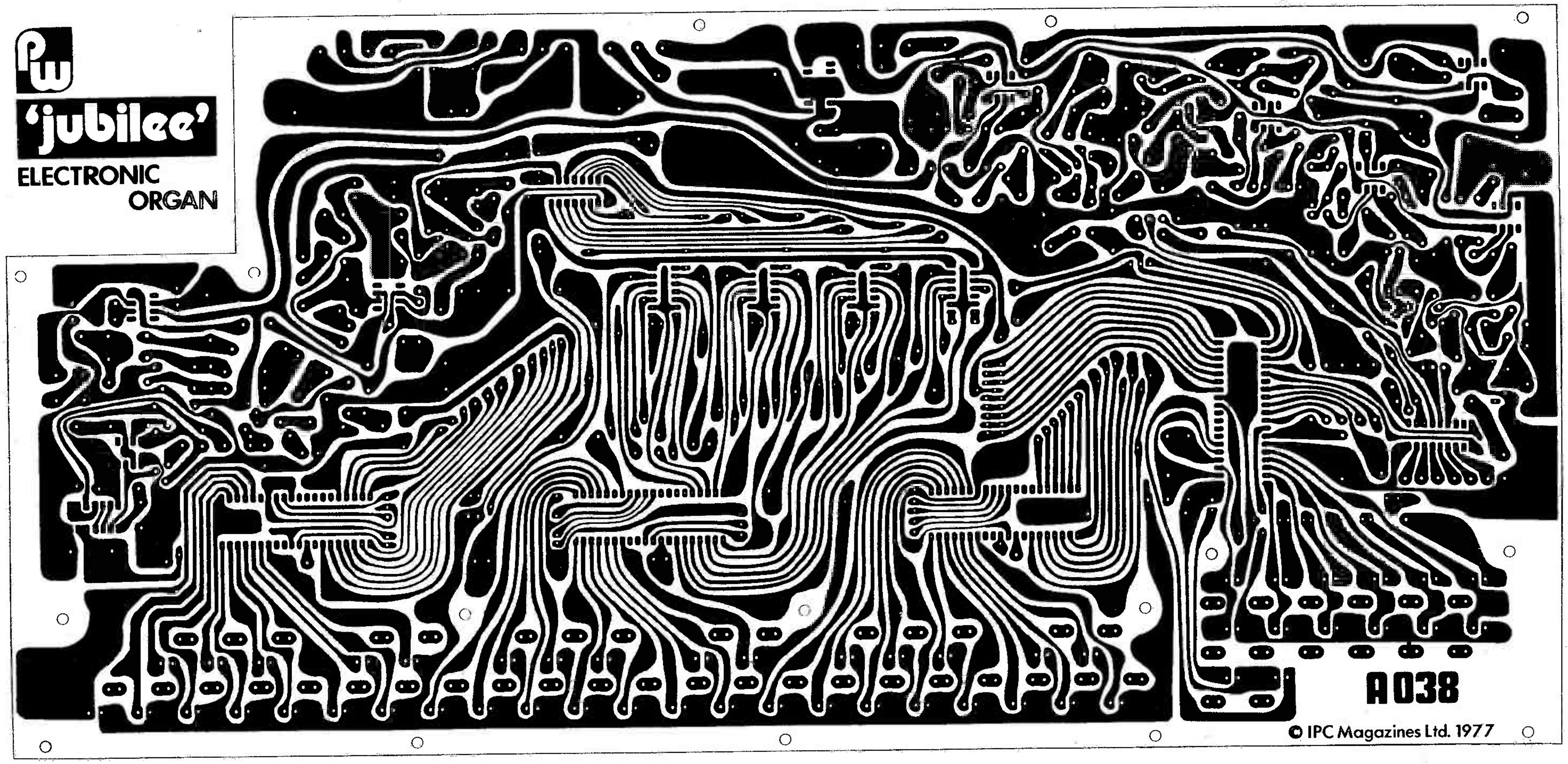


Fig. 1: The PCB shown copper side. This drawing has been reproduced at under half the original size to fit in with the page format of the magazine. The actual PCB size is 50·8 × 24·1 cm. Full size prints for PCB reproduction purposes can be supplied from the editorial address at the front of the magazine, price 40p. Be sure to include a large (at least 13" × 8") stamped and addressed envelope with the cheque/money order.



The board area incorporating the logo at the top left hand side is intended to be cut away to house the mains transformer in the calculator keyboard version where space is at a premium. In a creative moment we envisaged that the removed piece of board (which would have been thrown away) could usefully provide a silver front panel logo for the finished unit.

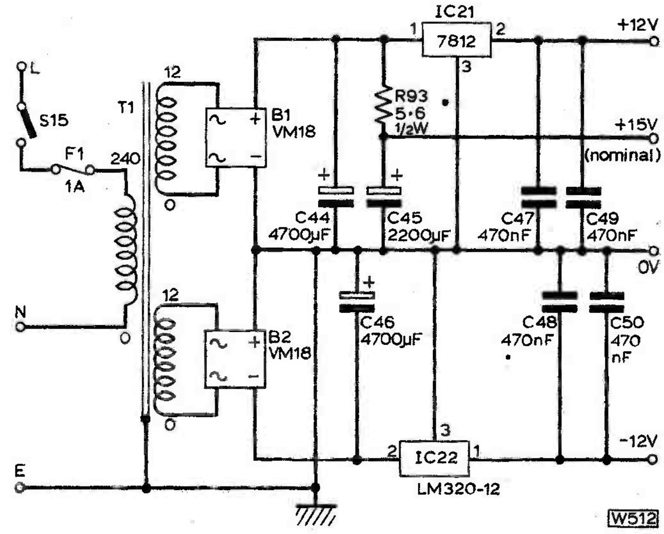
Links

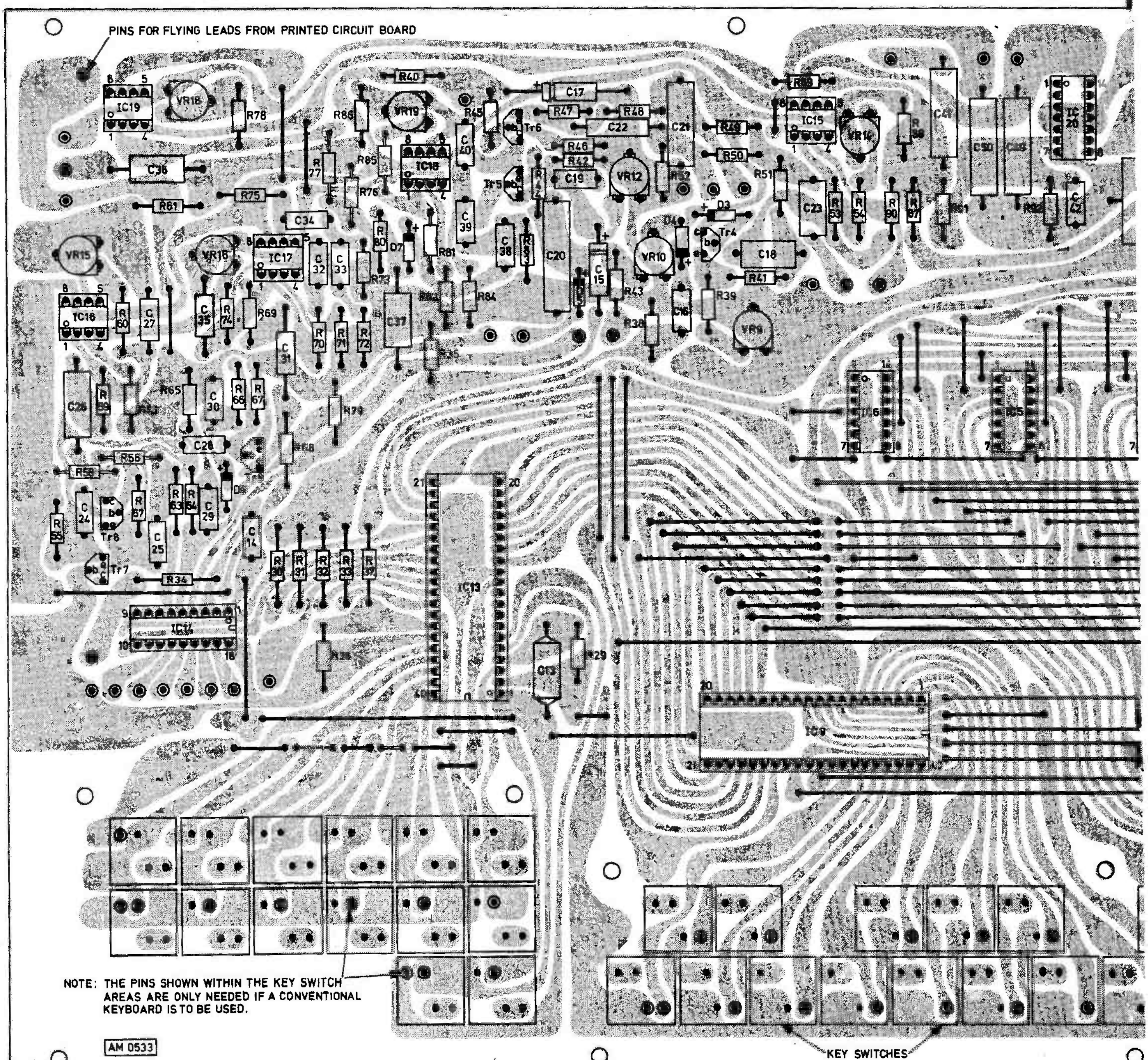
Next solder in all the top side links. It is easiest to use 22SWG tinned copper wire; make sure that there are no kinks, to minimise the possibility of shorts between adjacent links. To straighten, stretch the wire slightly before cutting to length. Fig. 2 highlights details of all links.

The circuits are described at each stage of construction. This should help in a logical approach to stage-by-stage testing. This will enable constructors to test the circuits as they are completed.

Power supply

The power supply schematic is shown in **Fig. 3.** Assembly details are shown in **Fig. 4.** Three power rails plus ground are required; +12V, −12V which





are regulated and +15V unregulated. These are obtained from a double-wound mains transformer (mounted off the board) and miniature DIL bridge rectifiers. When inserting these, check that they are the right way round. Likewise, check the polarity of C44, 45 and 46. Note that R93 is a ½W resistor. The regulators are mounted off the board on the back panel or on a separate heat sink; connections are made via board pins. Note that a mica insulator is required under IC22. The four 470 nF capacitors (C47 to C50) are there to prevent parasitic oscillations in the regulators.

Cross check component insertions against sectional component lists.

Test the supply before progressing further. This requires flying leads to the transformer and regulators (at this stage they need not be on a heat sink). Connect the regulator pins '3' back to the pin labelled 'Chassis Tag' adjacent to B1. Refer to Fig. 4. Flying leads should also be connected between the regulators and pins labelled +12V and −12V immediately above C49 and C50 and to the right of IC2; also wire between all other connections marked 'chassis tag' in Fig. 4. Connect the mains to T1 and check voltages in respect of Fig. 3.

Power amplifier

Assemble the power amplifier stage shown in **Fig. 5.** This uses the LM380 which, in this application, will deliver about 1W into an 8Ω loudspeaker. Resistors R87, 88 and 89 together with R90 mix the signals from the Drums, Melody and Accompaniment circuits. This is all done at low impedance to avoid undue pick-up of the chorus from the tone generators. It also provides an output via C41 for an external power amplifier. The signal level is approximately 150mV—ideal for feeding the crystal cartridge or phono input of a

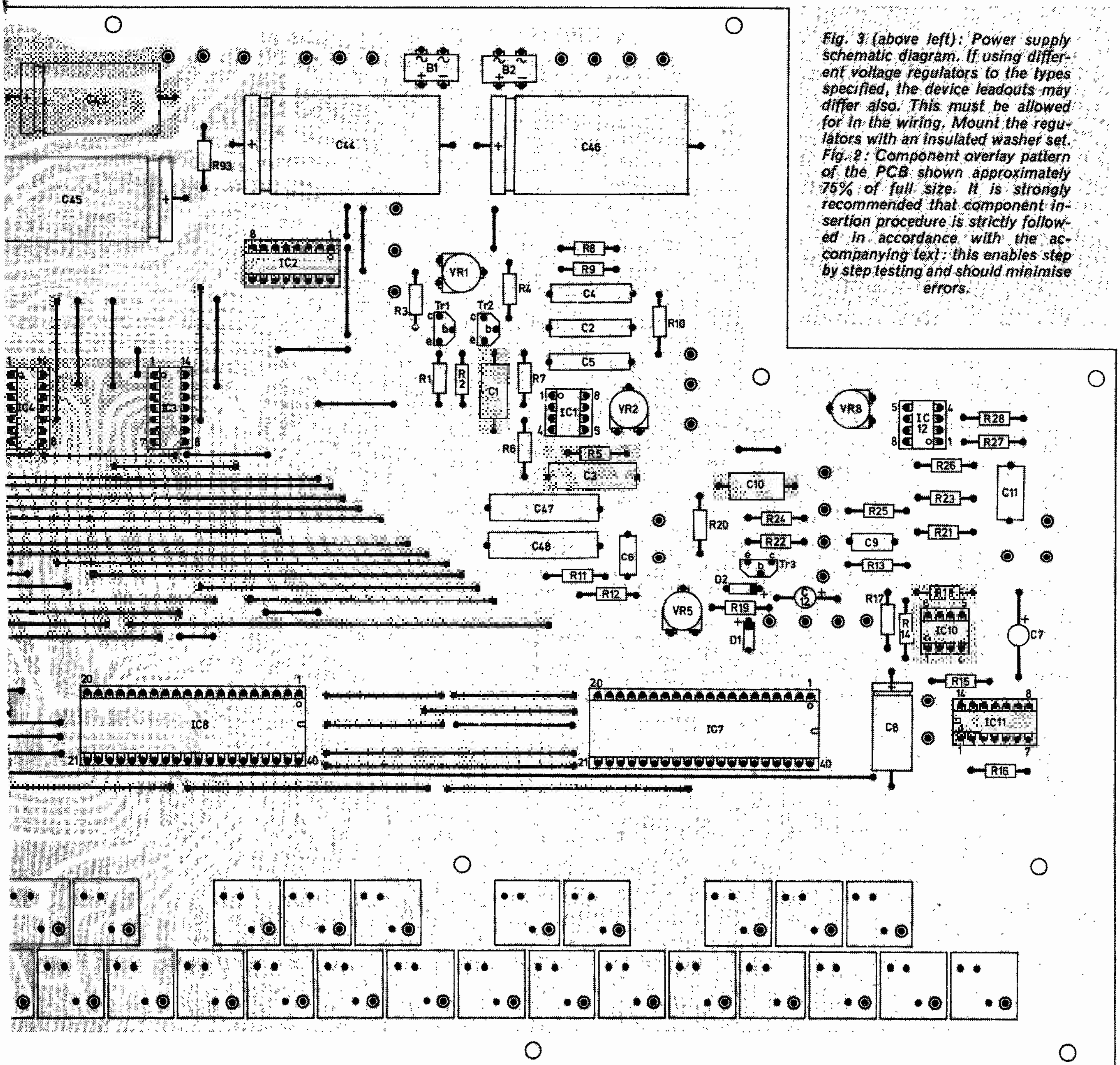


Fig. 3 (above left): Power supply schematic diagram. If using different voltage regulators to the types specified, the device leadouts may differ also. This must be allowed for in the wiring. Mount the regulators with an insulated washer set.
Fig. 2: Component overlay pattern of the PCB shown approximately 75% of full size. It is strongly recommended that component insertion procedure is strictly followed in accordance with the accompanying text: this enables step by step testing and should minimise errors.

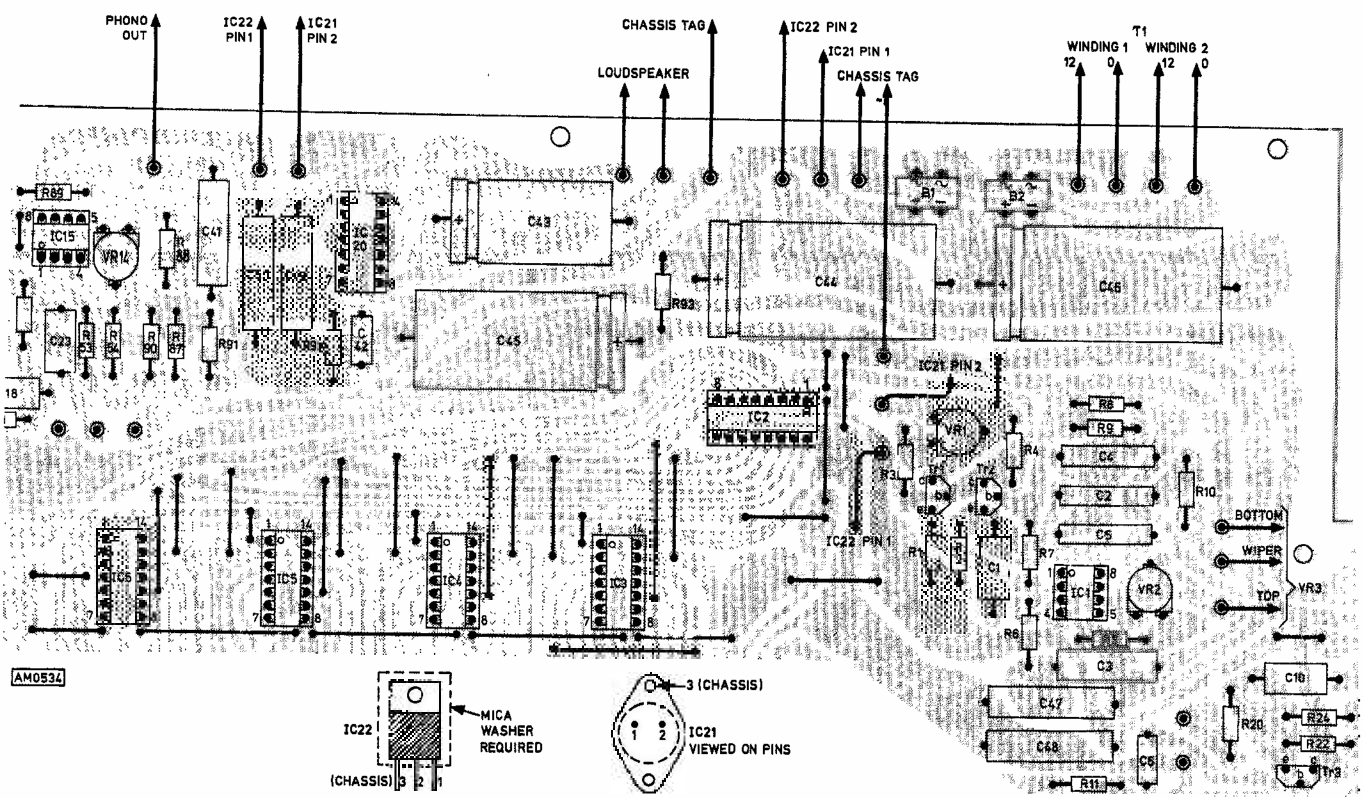


Fig. 4: Blown up sector of the PCB overlay showing the power supply, audio amplifier and tone generator sections.

domestic hi-fi system. R91 and 92 attenuate the signal slightly prior to feeding the power amplifier IC20. Ensure that C43 is inserted with the correct polarity sense.

A check may be made to ensure that the power stage is working. Re-connect the flying leads for the power supply and add a couple of leads for the loudspeaker (see Fig. 4). Touching the top end of R92 should produce 50Hz hum pick-up in the loudspeaker. Apart from this there should be no other noise from the power stage. A correctly functioning power amplifier will allow checks on other signals.

Generators and dividers

Fig. 6 shows the Master Oscillator, Vibrato and Divider circuits. Tr1 and Tr2 form an emitter-coupled multivibrator the frequency of which is controlled by C1 and VR1 in association with R3 and R4. VR1 is used to provide fine tuning and should initially be set in the middle of its track. Its frequency can be shifted slightly by varying the voltage at the emitter of Tr2.

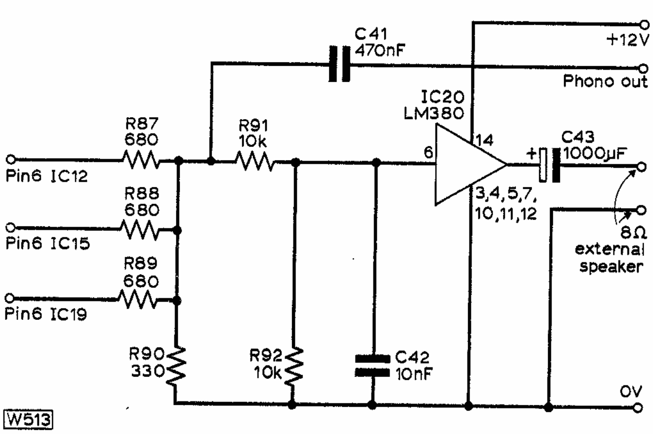


Fig. 5: Power amplifier schematic.

A low frequency sinusoidal signal fed to this point provides vibrato. IC1 is connected as a low frequency phase shift oscillator to give vibrato. Its frequency is controlled by C3, 4 and 5 in association with R6, 8 and 9. If the value of VR2 is too low, oscillation will not occur; if too high the vibrato output will distort. VR3 controls vibrato depth.

When assembling the PCB, the use of sockets for all the ICs except IC20 is strongly recommended. Temporarily connect VR3 to the three pins to the right of IC1—their separation allows the potentiometer to fasten directly to the pins. If you own an oscilloscope, check that the oscillator and vibrato stages are working by monitoring the collector of Tr2. Initially set VR3 to the OV end of its track to produce a well defined square wave (frequency 250kHz) adjustable over a small range by VR1. Centre this frequency on 250kHz. Turning VR3 up to maximum should cause no change to the signal; slowly increase the value of VR2 to start the vibrato oscillator. At a certain setting, the signal at VR2 should change frequency at a regular rate.

Switch the power off and re-apply it, several times, to make sure that the vibrato oscillator has sufficiently high gain to permit self-starting. Do not increase the value of VR2 more than absolutely necessary. Check that the depth of vibrato control works by varying VR3 up and down while monitoring the degree of frequency shifts at Tr2. If you do not own an oscilloscope there is no need to worry. An alternative method of testing will be given.

To complete assembly of this stage, insert DIL sockets for ICs 2 to 6 and double check that all the highlighted top side links are in position. Tick them off on the drawing as you check them! Before inserting these integrated circuits, connect up the power supply and loudspeaker but do not apply power yet. Taking great care to avoid static electricity (do not wear nylon or synthetic soled shoes. Touch your

★ components

Power Supply

C44	4700μF 25V
C45	2200μF 25V
C46	4700μF 25V
C47	470nF
C48	470nF
C49	470nF
C50	470nF
R93	5·6Ω ½W
B1	1A DIL bridge VM18
B2	1A DIL bridge VM18
IC21	7812
IC22	LM320-12

T1 Mains transformer. F1 1A mains fuse. S15 Mains rated slide switch.

Power Amplifier

R87	680Ω ¼W	R90	330Ω
R88	680Ω	R91	10kΩ
R89	680Ω	R92	10kΩ

C41	470nF	C43	1000μF 25V
C42	10nF	IC20	LM380

14-pin DIL socket. 6·25mm Jack socket for external loudspeaker. 5-pin 180° DIN socket for phono output.

Tone Generators

R1	3·3kΩ	C1	1nF
R2	3·3kΩ	C2	470nF Polyester
R3	3·3kΩ	C3	470nF Polyester
R4	2·2kΩ	C4	470nF Polyester
R5	470kΩ	C5	470nF Polyester
R6	22kΩ	Tr1	BC148
R7	10kΩ	Tr2	BC148
R8	22kΩ	IC1	741
R9	22kΩ	IC2	AY-1-0212
R10	10kΩ	IC3	AY-1-5050
VR1	10kΩ preset	IC4	AY-1-5050
VR2	500kΩ preset	IC5	AY-1-5050
VR3	5kΩ potentiometer	IC6	AY-1-5050

finger on something that is earthed while touching one of the chassis tag pins of the board with the other hand) insert ICs 2 to 6 the right way round. Switch on and proceed to test for the presence of all the tones.

Testing without instruments

Use the power amplifier as a test unit by injecting signals into it via the 'Phono Out' pin through C41. Cut a length of insulated wire and connect a crocodile clip to one end. This clip should be connected to the phono out pin using the lose end as a test probe.

First, hold this end on pin 8 of IC2 where the tone of top C should be present. With VR3 set to minimum try adjusting VR1 when the frequency of this note should change. Leave VR1 in the middle of its range and then increase VR3 to maximum. Probably, the vibrato oscillator is not oscillating so you will hear no change. Increase the value of VR2 until the onset of vibrato occurs. Set VR2 just high enough so that the vibrato always starts at switch on. Check that VR3 controls the depth of the vibrator.

Move the test probe to pin 3 of IC3 to monitor C, an octave lower. If not, check that the longer link to

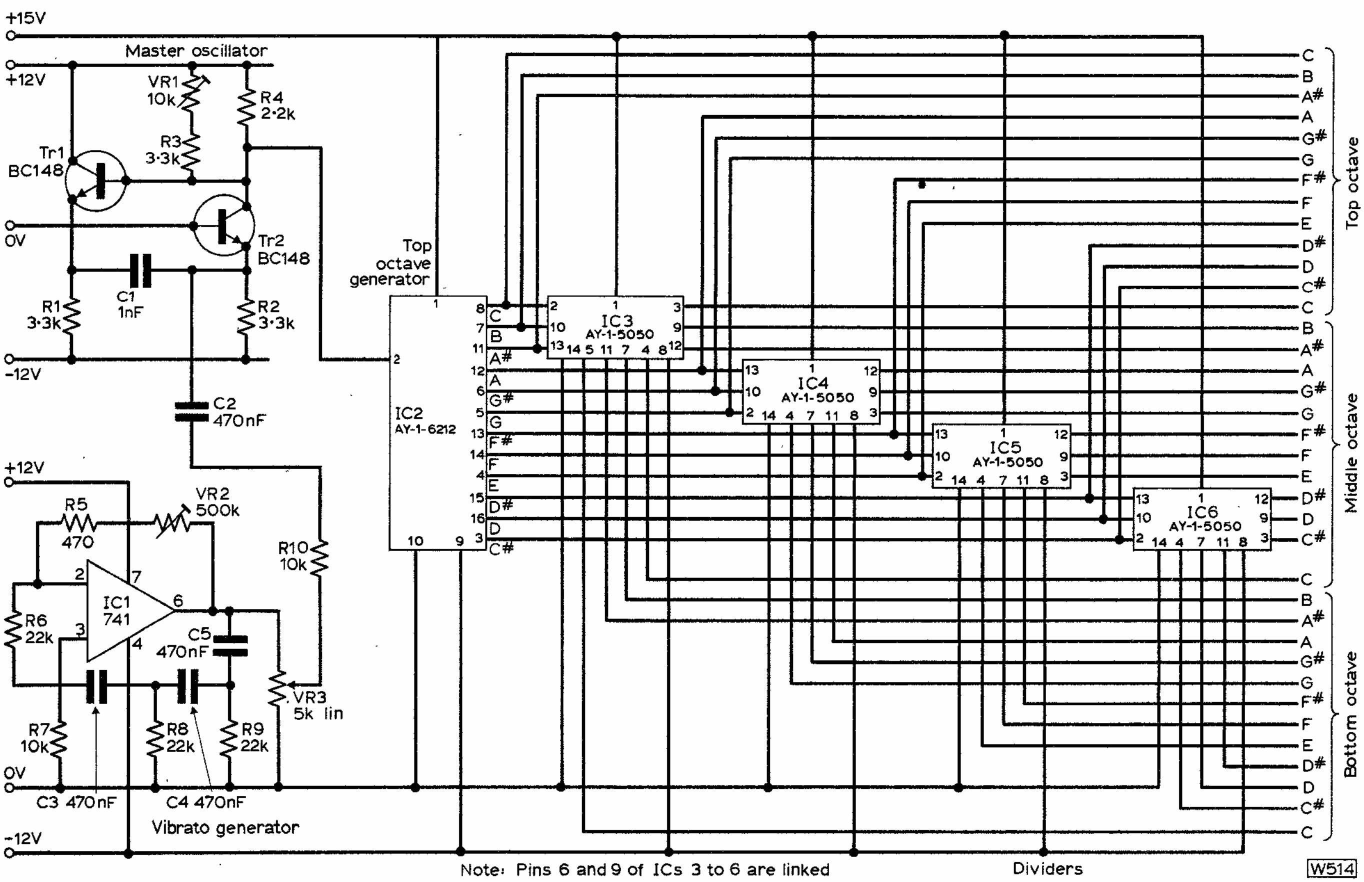


Fig. 6: Tone generator and divider circuits. When testing this section, take special notice of instructions in the penultimate paragraph (over page).

NEW BOOKS

THE RADIO, TV AND AUDIO TECHNICAL REFERENCE BOOK
S. W. Amos
Published by Newnes-Butterworths
1172 pages £24

This is an unusual reference book, to say the least; to my knowledge, this is the first time that so many electronic and related disciplines have been gathered together within one volume. There are no fewer than 35 separate sections written by 31 authors covering everything from acceptance tests to zinc-silver oxide batteries.

The book weighs heavily towards technicians and all those who deal in the practicalities of a whole wealth of electronic hardware. To this end mathematics, although evident, take an intentional second place to photographs and drawings (there are over 1200 of them). Curiously, circuit diagrams do not feature as prominently as one would expect; where included, they are mostly notional although there is no real shortage of production equipment examples.

Taken generally, the contents indicates a slight degree of bias towards consumer electronics. For instance the sections on colour TV, taken together, are as specific and detailed as more single minded books dealing purely with that area. This book quotes the theory of the three systems (PAL, NTSC and SECAM) and enlarges on the practical aspects of the PAL system (as would be expected of a UK publication). It offers a very creditable description of tube types and convergence problems associated with the various gun arrangements. It details decoder operation and generally provides enough information for CTV line-up and test. As a slight contrast, the section on professional sound recording is a good deal thinner and generally fails to do this important topic justice; however most people who read this review won't be unduly perturbed.

The *Technical Reference Book* offers easy explanations of the simplest of circuits wnile wading in to far more difficult concepts in others. For instance, it seems reasonable to suppose that most people who will use this book would be perfectly familiar with all the common amplifying configurations of a bipolar transistor. However, chapter 8 provides all the notional diagrams which will be instantly recognisable to all those who got past their first term at college. They don't need to be told about 'common base stage of amplification with stabilisation by potential divider and emitter resistor'. Similarly, the chapter on digital techniques was so facile that its author should have stuck to sucking eggs. . . . If a subject cannot be tackled at a reasonable level within the limited space allotment, then it should not be tackled at all. However, such criticisms are local and shouldn't disguise the value of other chapters and sections.

There are many chapters of interest to radio amateurs of which much material comes from personnel within the professional broadcasting organisations. For example, there are carefully explained descriptions and operating principles of all kinds of antennae including the slot variety; this topic has an adjunct of beam steering by phased array which should hold much interest for G8's and the like.

Transmitters of all forms are dealt with at length; although broadcast installations are given more space (as they should be in a book of this type) there are specific sections on both amateur sound and television transmitters. Since amateur and professional areas require the same techniques and technicalities, all parts of the book are of interest, if not directly applicable.

It is quite impossible to do the *Radio, TV and Audio Technical Reference Book* justice in the space of one short review. It is much to the credit of editor S. W. Amos to have organised so many contributors to cover so many topics under one edition. Even more noteworthy is the uniformity with which he has done so. There are wrinkles; several subjects overlap quite noticeably in places while others could do with greater coverage. However, the overall balance leaves little room for criticism. Although the price is high at £24, it seems worth the money, particularly if your technical library only extends to *The Foundations of Wireless*. The *Technical Reference Book* should only be purchased by those with a reasonable grasp of electronics and will be of greatest value to technicians and engineers.

Frank Ogden

JUBILEE Part 2 *continued from previous page.*

the left of IC3 is properly soldered in. Check at pin 4 of IC3 to hear the same note, yet another octave lower. Pin 5 of the same IC produces Bottom C. Carry out the same checks for the other notes of the scale referring to the pin numbers shown on the schematic of Fig. 6. You should end up with all 37 notes sounding clearly.

If all the notes are present at the outputs of IC2 but fail to appear in lower octaves, the fault almost certainly lies in the links; you may have bridged a couple of conductors with a solder blob. Do not forget that it is easy to leave out a soldered connection on the pins of the DIL sockets.

You are likely to experience some irregularity in tone generation at this stage. This is because the master oscillator operates from the +12V stabilised supply (to ensure frequency stability) but the top octave generator and subsequent dividers operate from the unregulated +15V rail. The latter power rail is not fully loaded at this stage of construction (ICs 7, 8, 9, 13 and 14 are not yet inserted) so its voltage will be higher than its design level. This temporarily reduces the input logic swing to the noise threshold. Some of the notes may 'burble' or sound irregular as a result.

If this situation occurs, you can compensate for the lack of loading from the omitted ICs by temporarily connecting a 270 ohm 1 watt resistor across the +15V rail and ground (ie between the positive end of C45 and one of the pins which are designed to go to the chassis tag). This resistor will draw approximately the same current as the missing ICs and reduce the nominal +15V rail to its design level.

Do not forget to remove this resistor when you come to insert the missing integrated circuits.

Before progressing with next month's instructions, it is wise to remove ICs 2 to 6 and put them back into their protective packing. To avoid damaging their pins, use a small screwdriver to lever them out of their sockets—a little bit at a time at each end.

Next month: Construction of the melody, rhythm and accompaniment sections.

★ components

Resistors

R1	150kΩ	R3	270Ω
R2	27kΩ	VR1	470Ω (or 500Ω) linear pot

Resistors ¼ or ½W 5%

Capacitors

C1	10nF	VC1	365pF (Jackson type 00)
C2	10nF		

Miscellaneous

L1, Denco Range 3 'Blue' valve type. L2, Denco Range 4 'Blue' valve type. Tr1, 40673. S1, 2-pole 2-way rotary switch. Knob for VC1. 'Universal Chassis' (Home Radio). Aerial and earth sockets. Perforated board 0·15in. matrix 3½ × 2in.

the positive line in the receiver and thus the drain voltage, without the need for other coupling circuits.

The 9V positive line is taken from the receiver positive line, so the preselector needs no separate on/off switching.

Layout

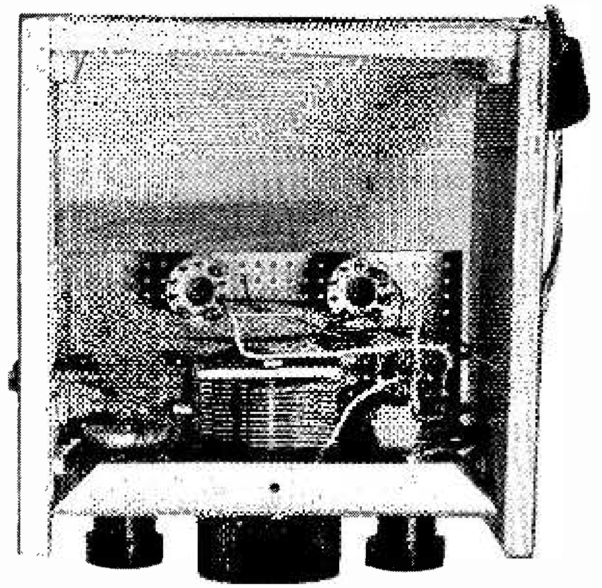
The panel is a flanged 4 x 4in "universal chassis" member, and the variable capacitor VC1 is mounted centrally, as in **Fig. 9.** Three **short** 4BA bolts are used here to avoid damage to the capacitor plates. The 2-pole 2-way switch S1 is shown out of place, to clarify the wiring to it.

Other components are mounted on perforated board (0·15in matrix) about 3½ x 2in. This is fixed to the bottom of VC1 by running a 4BA bolt into the threaded hole. Washers are necessary between board and capacitor, and again ensure that the bolt does not project into the component and **touch the** internal plates. The few connections above and below the board will be seen from **Fig. 9**.

Using the Preselector

The lead from 40673 drain to the aerial input circuit of the receiver should not be longer than necessary, and the aerial lead to the preselector is kept away from it. To simplify tuning, set the coil cores so that movement of VC1 approximately matches that of the ganged tuning capacitor in the receiver. VC1 is rotated to peak up wanted signals, but **not** those which constitute second channel interference. The latter signals will be at a point 3·2MHz higher in frequency than the wanted transmissions, with the receiver having an IF of 1·6MHz. For a receiver with 470kHz IF, offending second channel signals will be 940kHz higher in frequency than wanted signals.

If neither the preselector nor the receiver have a metal case to provide screening, they need to be kept slightly apart, so that instability is not caused by coupling between the preselector and aerial coils. If trouble of this kind arises it is readily identified as whistles, and oscillation will be heard when the preselector is tuned to the same frequency as the receiver. Some screening between the units can be provided by sticking a piece of aluminium foil to the side of one of the cabinets, as mentioned **in Part 1** and shown in the photograph on page 339 of Part 1. This foil must be connected to the chassis with a short lead.



The finished preselector. If it is used with a different receiver an internal 9V battery can be incorporated, with an on-off switch on VR1.

Remember that the capacitor C1 in series with the aerial, Fig. 1 in Part 1, **must be removed** from circuit when using the preselector otherwise the 9V supply to the preselector will be interrupted. Even with a short aerial, strong signals can cause overloading, unless it is remembered to turn VR1 back as necessary.

The cabinet shown used 6mm plywood sides, approximately 4½ x 4½in in size, secured to the flanges present on the panel by means of nuts and bolts. The back is 4 x 4in fitted with woodworking adhesive. Small screws hold the top in place. ●

Frank Hennig G3GSW.

The sudden death of Frank Hennig G3GSW on July 21st has deprived the amateur radio movement of a distinguished member. In addition to his frequent operating on the HF bands, Frank's voice was heard by millions of people every week when he presented the BBC World Service programme, World Radio Club. Throughout his broadcasting life, Frank interviewed thousands of people for both radio and television and each item carried his own special brand of humour, and that obvious personal care which was the hallmark of all his efforts. It was great to work at the side of Frank, because, whatever the subject, whether he was serious or sporting that characteristic smile, he simply oozed confidence which was only dominated by his sincerity.

Our June issue (p. 107) carried a picture of Frank interviewing Lord Wallace of Coslany, President of the RSGB, at the 500th edition of World Radio Club, and, although his multitude of friends will miss him, Frank Hennig will always be remembered as the 'one off' jovial individual portrayed in that picture.

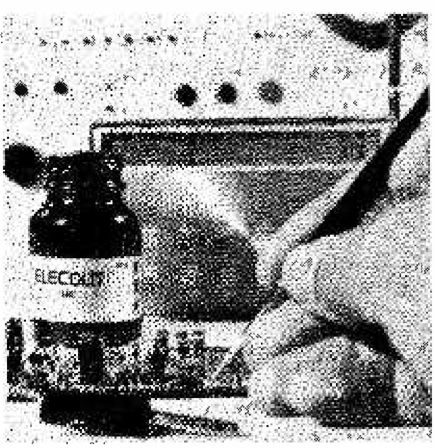
Ron Ham BRS15744

PRODUCTION LINES

bill tull

Redundant soldering iron

Broken track on a PCB? If only I could get that piece of glass to conduct. Two problems amongst many that can now be overcome with the careful use of a paintbrush. It sounds strange I know, but after five years successful use in industry a conductive paint is being made available to the general public. Called Elecolit 340 it is a pure, silver filled, electrically conductive acrylic paint which forms a tough film with



good adhesion to ceramics, glass, rubber, plastics, and most plastic films.

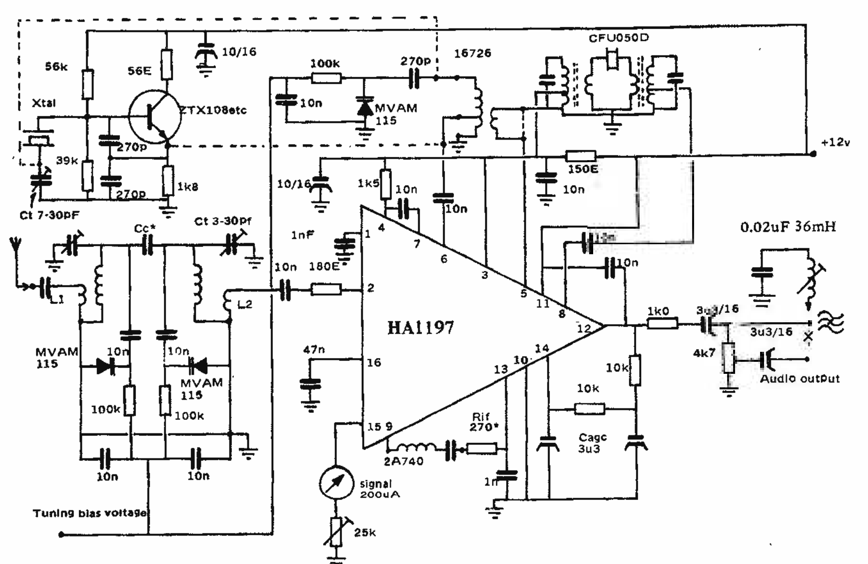
Typical applications include RF shielding, component lead termination, prototype PCB manufacture, PCB repair and a novel, but very useful idea, to repair the rear window demister of a car if a track gets broken. Elecolit 340 can be applied by dipping, brushing, silk screen or roller and will dry tack free in free air in 15min. For the DIY reader the smallest quantity available is in 3g bottles which sell for £2·70, while for the person who thinks he can use 500g he will have to part with £161·60!

Industrial Science Ltd., Leader House, 117-120 Snargate Street, Dover, Kent. Tel: 0304 202656.

Single board AM tuner

Recently introduced by Ambit International, the 7122 AM tuner Module is suitable for three stage varicap tuning or for crystal controlled operation in the range 175kHz to 30MHz. Featuring the HA1197 IC as the heart of the package, input sensitivity is claimed to be 4-6μV @ 1·6MHz, and 8-10μV @ 21MHz for a weighted S/N ratio of 26dB.

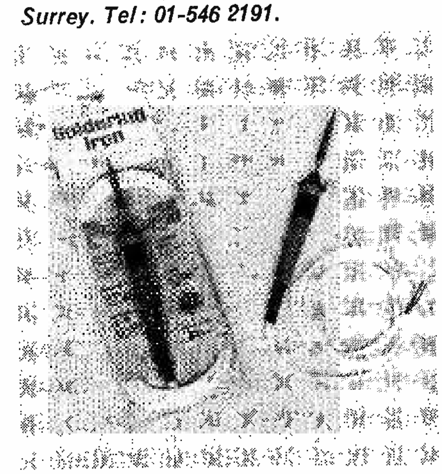
Referring to the circuit, Cc value will vary with selected frequency range although 8·2pF will suit most applications. Rif is nominally 270 ohms, although IF gain can be increased by reducing this value and the AGC reaction time constant capacitors, Cagc are 3·3μF, although smaller values will speed up reaction time. The entire circuit is housed on a single PCB measuring approx. 90 × 65mm and will operate from a minimum supply of 12V if the MVAM115 diodes are used. However in strong signal applications, and to minimise the effects of tuning voltage drift, the MVAM125 diodes may be used with a corresponding increase in voltage to 25V. Priced at £9·00 for the kit and £11·75 for a built and tested model, units can be obtained from *Ambit International, 37 High Street, Brentwood, Essex. Tel: 0277 227050.*



Iron plug

Contrary to another heading on this page, there really is no substitute for a good soldering iron for the man who dabbles in electronics. A new one recently launched on the UK market is made by that "unlikeliest" of electronic firms—The Rawlplug Co. Ltd. Conforming to BS3456, this new 25W iron comprises a solid copper bit that is iron coated, and a double shaft consisting of a ceramic inner shaft and a stainless steel outer shaft for strength. The former has a breakdown voltage of 1,500V AC.

Priced at £3·80 + VAT it can be obtained from the usual outlets or from *The Rawlplug Co. Ltd., Rawlplug House, London Road, Kingston upon Thames, Surrey. Tel: 01-546 2191.*



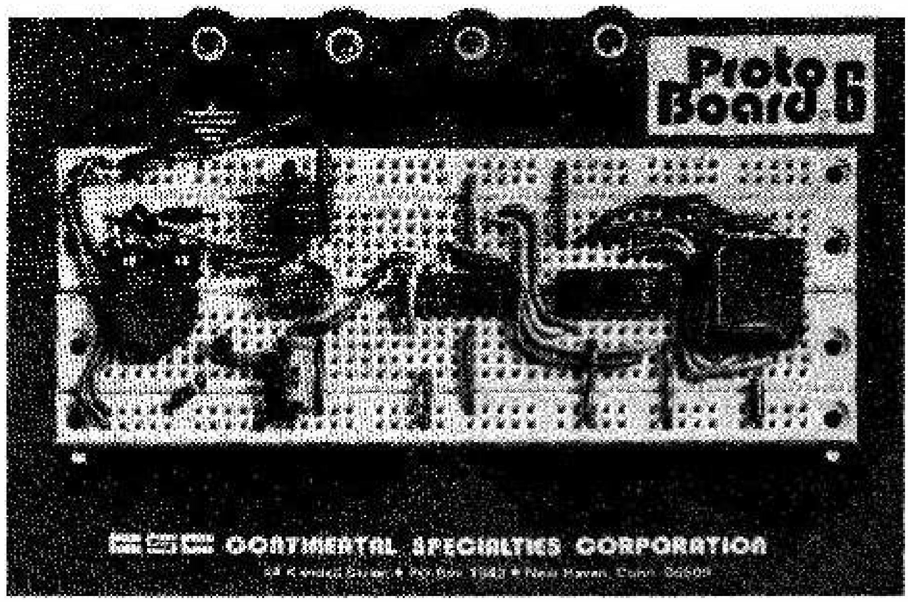
Boarded up

Trust the Yanks to come up with something just that little bit better, a little bit more sophisticated, and a little bit more expensive! Modules that accept components without the need for any soldering have been with us for some time now, and as a form for "breadboarding" they are invaluable. Now from America, but hopefully soon to be distributed in the UK comes the QT System which comprises sockets and bus strips which can be easily locked together in any pattern to form breadboards of any shape or size.

The sockets and bus strips will accept DIL IC's (6 to 40 pins), TO5s, diodes, resistors, capacitors, transistors, and just about any other discrete component with lead diameters between 0·015 and 0·032 inches. The contacts are solid silver-nickel alloy with a contact resistance of 0·4 milliohms and spaced 0·1in apart. Each socket is made up of rows of 5 contacts, connected transversely at the back, while each bus strip has two rows of contacts connected lengthways. Connections between components are made with standard solid 23 SWG wire.

Called the Protoboard 6 the basic kit contains one QT-47S socket (5 × 94 contacts), two QT-47B bus strips (2 × 40 contacts), four 5-way terminal posts, a metal earth and base plate with rubber feet and all the necessary assembly hardware. In all, one unit measures 6 × 4 inches. Other sockets available range between 5 × 118 contacts and 2 × 30 contacts. Price for one PB-6 is £10·45.

Further information including catalogue and UK price list available from Continental Specialities, 44 Kendall Street, PO Box 1942, New Haven, Connecticut 06509, USA.



A case for sawing

In the construction of a project, there comes a time when you just have to put down that soldering iron, and get on with a bit of cabinet construction. It's a bit of a chore, but if the finished article is to look as well as it performs, then considerable care must be taken when measuring, drilling and cutting. To this end, Abrasive Tools Ltd., are marketing five packs of different size tension files (to the laymen—sawing wires) that will fit most all-metal 6in junior and 10/12in Senior hacksaws. Prices range from 50p for a pack of five 6in files to 70p for a pack of three 12in files. All are plus VAT.

Abrasive Tools Ltd., Abrium Works, Colne Road, Twickenham, Middx. Tel: 01-894 1273.

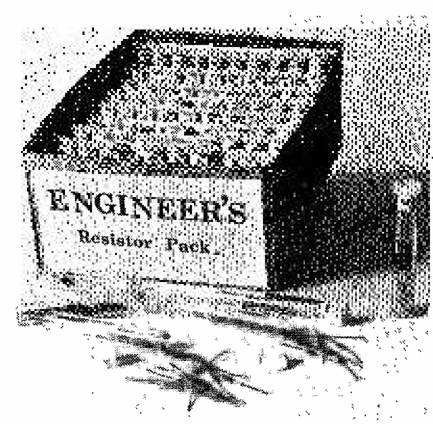
60 pages of data

The instrument Division of Gould Advance Ltd., has produced a new 60 page data book for 1977-78. The book gives full details of the entire range of oscilloscopes, digital voltmeters, timer-counters, pulse generators, signal generators and recorders and digital multimeters.

Gould Advance Ltd., Roebuck Road, Hainault, Essex.

You can't resist this

The prolific home constructor or service engineer can now buy his resistors in quantity from Home Radio in the form of an Engineers Resistor Pack. Values from 4·7Ω to 1·5MΩ are separately packed in individual clear plastic tubes and there are additional resistors of the more popular values making a grand total of 1600 in all. The resistors are all 5% tolerance and $\frac{1}{8}$ or $\frac{1}{4}$W rating. Each tube is clearly marked and the backing cards retaining the tubes can be left in the original box



supplied to give quick access to any value of resistor required. The Pack costs £17·50 plus 12½% VAT plus 85p post, packing and insurance.

Home Radio, 234 London Road. Mitcham, Surrey CR4 6HD.

DESIGN YOUR OWN PROJECTS

No. 2

CASSETTE RECORDER POWER SUPPLY

TOBY BAILEY & BOB WHITAKER

This series describes how to design experimental projects for yourself. Each month we hope to set ourselves a reasonably simple problem, produce a set of specifications to which we want our circuit to conform, and design an appropriate circuit. We will give an account of the possibilities we explored and the thought processes we used to arrive at the final circuit, together with details of how we calculated (or guessed!) component values and why we chose particular component types. Last, but not least, we will provide an honest report of what happened when we built our circuit.

Toby's cassette tape recorder is normally run from the mains but he wanted to use it in his car without having to provide vast quantities of U2 batteries! The manufacturer had kindly provided a socket on the back marked "6V-DC." Hence this month's design example will be a power supply to convert the voltage available from the car battery to a 6V supply for the cassette recorder.

Specification

A plate stuck to the back of the recorder has "3W" printed on it, and whilst this seems quite a lot we had better allow for 0·75A of current to be drawn as a maximum. Now the voltage of a car battery can vary quite a bit especially if the apparatus which controls the charging is somewhat dodgy! So, to be on the safe side, perhaps we had better cater for a car battery range of 11 to 18V. As regards regulation of the output we shall specify that the voltage should remain between 5·5 and 6·5V for output currents of 0 to 0·75A. We shall have achieved our aim if we can produce a circuit which will perform to these criteria, so let us now turn to the design of the circuit.

Design

We are going to require some component with which to stabilise the output voltage and a zener diode is the obvious choice. The simplest circuit using such a component is shown in **Fig. 1.** 6·2V is the nearest standard value of zener we can get to 6·0V, although there is generally a ±5% spread from the nominal value, anyway. Resistor R must take 0·75A when the input voltage is 11V so its maximum value is $\frac{11-6 \cdot 2}{0 \cdot 75} = 6 \cdot 4\Omega$. At an input of 18V it will be forced to take a current of $\frac{18-6 \cdot 2}{6 \cdot 4} = 1 \cdot 84$A. This means that R will have to have a power rating of V x I = (18−6·2) x 1·84 = 22 watts and the zener will need a rating of 6·2 x 1·84 = 12W (when $I_{OUT}=0$). Well, 20W zeners are available but they are pretty expensive and the available values seem to start at above 6·2V, but 22W resistors are a bit excessive.

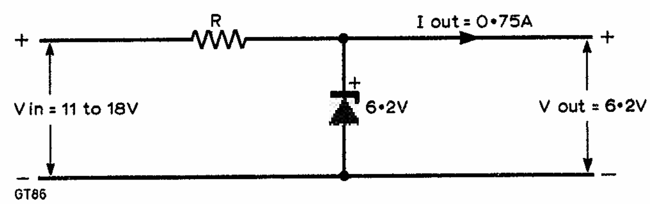
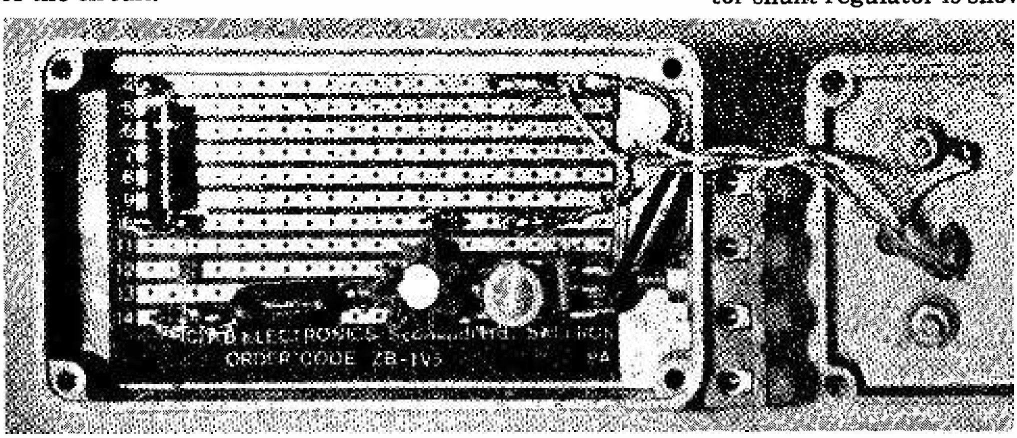


Fig. 1

No, this is getting out of hand, so we are going to have to use at least one active component, so let us look at the possible ways of doing this.

The easiest way is to use a shunt regulator. Note that the zener diode by itself is effectively a regulator as well, it works by shunting excess current away from the load to keep the output voltage down to the required level. The basic circuit of the single transistor shunt regulator is shown in **Fig. 2.**



The completed board is stuck to the bottom of the aluminium box. The lid accommodates the 2N3055 transistor which must be properly insulated from the lid.

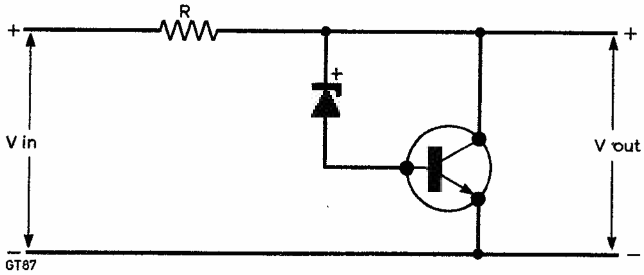


Fig. 2: Use of a shunt regulator transistor to relieve the load on the zener diode.

This has taken a lot of pressure off the zener and shifted it to the transistor but the poor resistor is going to have to dissipate the same power as before. This is usually the problem with shunt regulators, inasmuch as excessive amounts of power are dissipated in the shunting element and associated components.

The other principal type of regulator is the series regulator whose circuit is shown in **Fig. 3.**

We have now used the simple shunt regulator (R1 and the zener) to control the base current of Tr1. The resistor no longer has to pass the output current, which is handled solely by the transistor. This now has to pass only 0·75A as opposed to the maximum of 1·84A to which it was subjected before. This means that we have managed to reduce the dissipation from 22W to 9W which is more reasonable.

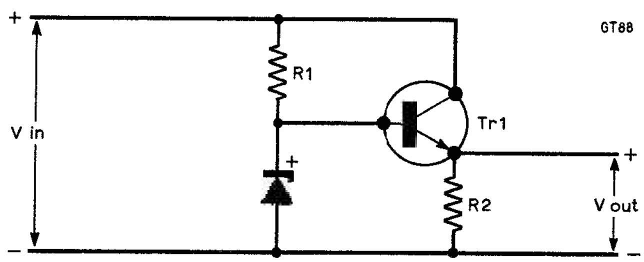


Fig. 3: The alternative series regulator circuit.

Nonetheless, 9W is quite a lot and we are going to need a pretty hefty transistor here. One of the commonest NPN types is the 2N3055, but is this going to be OK in this circuit? The catalogue happily tells us that the maximum allowable power dissipation is 115W at 25°C but do not be mislead by this. The figure quoted is for a case temperature of 25°C and if you start to dissipate 9W in the transistor without some means of conducting all this heat away the case temperature is going to rise very quickly! For example, a 2in square finned heatsink is quoted in the catalogue as having a thermal resistance of 6°C/Watt from the transistor to the temperature of the surrounding air. This means that if we are dissipating 9W the case will be at least 6 x 9=54°C above ambient temperature. All in all you will almost be able to fry a small egg on the heatsink and as the temperature of the lump of silicon inside the transistor case will be even higher there is not all that much to spare.

We can actually let the junction temperature creep up to 200°C, so we should be OK as long as we heatsink the transistor adequately. The simplest solution seems to be to make the unit in a diecast aluminium box and to bolt the transistor to the outside, plus silicone grease and an insulating kit if necessary. The box will help to make the unit nice and robust which is a decided advantage in this case.

Resistor R2 is included just to draw a small current when the load is not connected. By doing this we do not have to worry about the various esoteric effects which are prone to occur at very low currents and high junction temperatures, and which might conceivably cause loss of regulation of the output voltage. We could easily do without R2 but it is good practice to put it in. A value of 2·2kΩ which gives a minimum load current of 2mA should be quite adequate. The zener value will now have to be 6·8V to allow for the 0·6V base-emitter voltage drop in Tr1. The circuit so far is shown in **Fig. 4.**

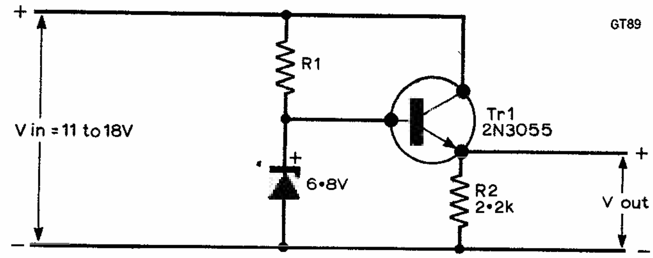


Fig. 4: The practical circuit so far with component values.

What about the value of R1? This depends on the value of base current needed to drive Tr1. The minimum gain of a 2N3055 for a collector current of 4A is given as 20. This figure should do for our purposes as the gain should be substantially the same at 0·75A. Hence we are going to have a maximum base current of $\frac{0\cdot 75}{20}=38\text{mA}$. What about leakage current which may be quite large in a hot power transistor? Well, this is going to flow in the opposite direction to the rest of the base current and so tends to reduce it so we are OK here. To supply 38mA at the minimum input voltage we need R1 to be at most $\frac{11-6\cdot 8}{38}=110\Omega$, so 100Ω should supply enough extra current for the zener as well.

When the input voltage is 18V R1 will be passing $\frac{18-6\cdot 8}{100}=112\text{mA}$ and, if we take the worst case of all, this current going through the zener so then the maximum dissipation in this component will be $6\cdot 8 \times 0\cdot 112=0\cdot 76\text{W}$. The dissipation in R1 will be $I^2R=(0\cdot 112)^2 \times 100=1\cdot 25\text{W}$, hence a 1·5W resistor for R1 and a 1W zener should be quite adequate.

★ components

R1	100Ω 5W	R2	2·2kΩ ¼W	R3	0·68Ω 1W
C1	25µF 25V	D1	6·8V 1W zener diode		
Tr1	2N3055	Tr2	BFY51		

Miscellaneous

Diecast box 4½ × 2½ × 1in. or similar. Terminal block. Stripboard about 3¼ × 1¾in. Insulating kit for 2N3055. Heatsink for BFY51.

At this juncture it was suggested that we might add another transistor to end up with either of the circuits in **Fig. 5**, circuit (b) being the more sophisticated. We would like to avoid having to use high wattage resistors and zeners but to do this the services of

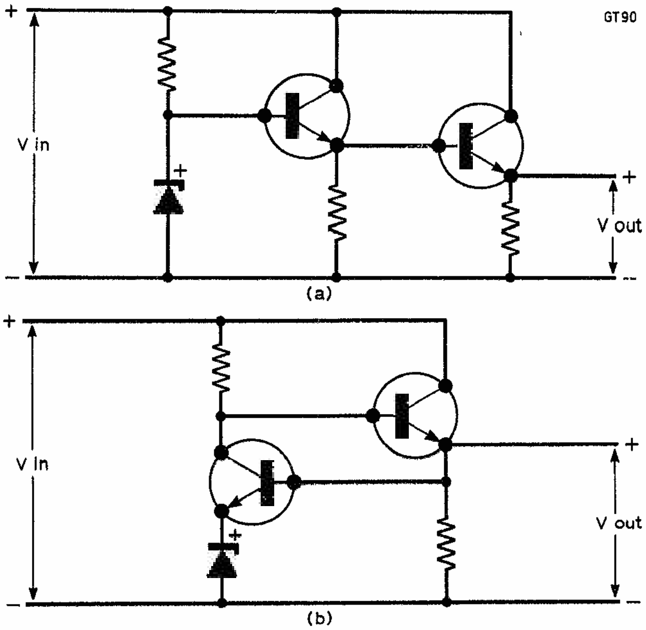
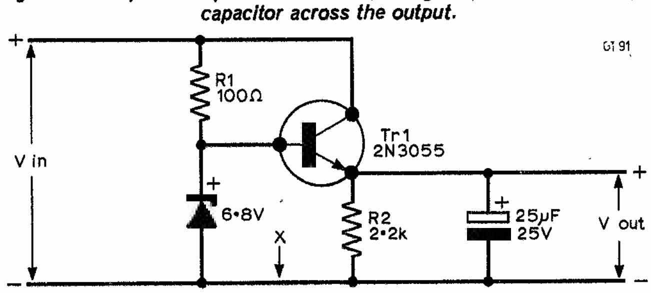


Fig. 5: above, a second transistor can be used in either of these circuits. Circuit (a) was chosen.
Fig. 6: below, shows practical values for Fig. 5 plus a smoothing capacitor across the output.



another transistor are required. In the end the virtues of simplicity won the day and we pushed onwards with our original design which was now at the stage shown in **Fig. 6**. We have added the capacitor across the output to get rid of any ripple or anything else lurking on the car electrics.

Protection

Now, what can go wrong? Well, if one of us contrives to short-circuit the output terminals (by a well known law of nature this is virtually certain to happen sooner or later) then the power transistor is not going to survive for more than a second or so. Since our supply of 2N3055s is strictly limited we would like to incorporate some form of short-circuit protection.

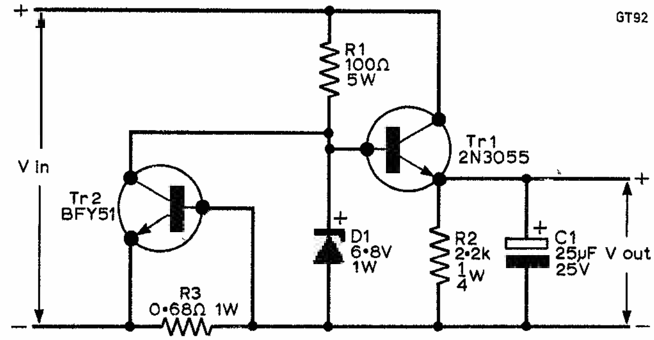


Fig. 7: The final circuit which includes an overload sensing transistor Tr2.

The principle of simple protection is that you sense the current being supplied with a low value resistor and turn on a transistor when the voltage drop across the resistor reaches about 0·6V. Of course, you do not drop the output voltage by fighting with the emitter of the power transistor. A rather easier way is to drag the base of Tr1 down to earth by shorting out the zener and passing a rather higher current through R1. This can be achieved by an NPN transistor with the current sensing resistor connected between its base and emitter and its collector connected to the base of the 2N3055.

Where does the current sensing resistor go? One of us, exhibiting a rare and temporary aberration, drew in the resistor at the point marked X in **Fig. 6**, but Bob does not want us to say who it was. The point is that the zener is controlling the voltage between the emitter of Tr1 and the earth line and sticking a resistor between the zener and the negative output will increase the output voltage by up to half a volt at the maximum current. No, the resistor will have to go right back at the input, the fact that the

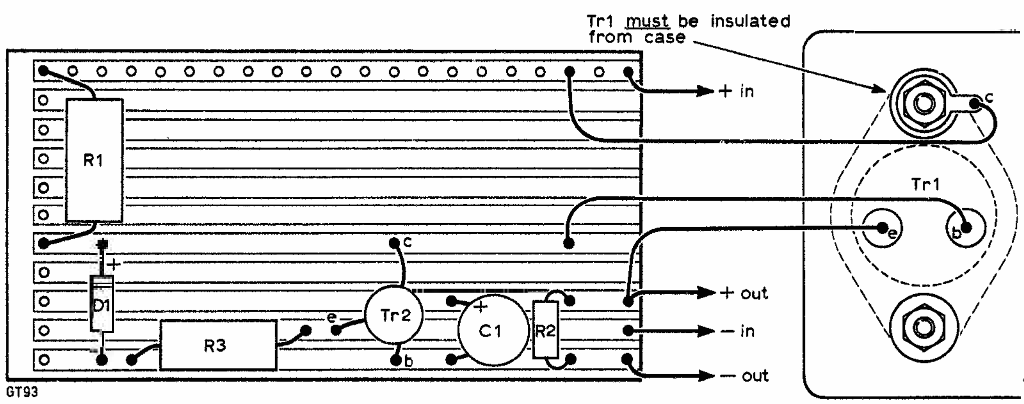


Fig. 8: A practical layout as used by the authors, on a piece of stripboard.

current being sensed now includes that being supplied to the zener does not matter much, since this extra current is a lot smaller than the current being supplied when limiting is taking place. We now have the circuit in **Fig. 7**. A suggested layout is shown in **Fig. 8**.

We require the base-emitter voltage of Tr2 to reach 0·6V for currents of about 0·85A, thus giving R3 a value of 0·7Ω but 0·68Ω 1W will have to suffice. The power dissipated in Tr2 will be highest when it is fully on and V_{CE} is around 6·8V. I_C will then be 112mA (for an input supply of 18V, as before) and the power dissipated, given by $V_{CE} \times I_C$, comes to 0·76W. The maximum dissipation of a BFY51 is given as 0·8W so if we use one of these with a clip-on finned heatsink or something similar we should just

continued on page 454

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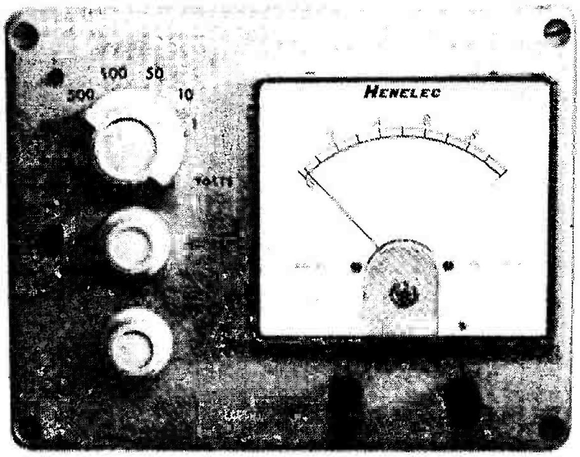

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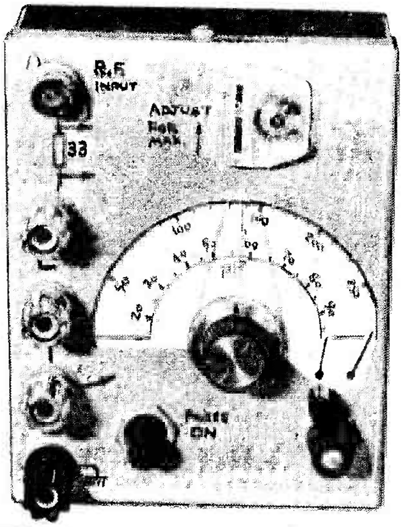

HOTLINES

A REVIEW OF RECENT DEVELOPMENTS
In general, the author does not have any more information on products than appears in the article.

The CB Saga!

Citizens Band arguments still smoulder, but while potential users and opposers debate the finer points, the manufacturers are steaming full speed ahead. One possible advantage in the UK is that when CB does come, it will bring with it some very sophisticated pieces of equipment.

One manufacturer has launched a CB system, transmitter and receiver which uses microcomputers in both! The microphone looks rather like a small pocket calculator. The mike is housed in the uppermost portion of the hand held unit. Directly beneath this is a 5-LED readout and underneath these are all the small push buttons. Channels are selected by simply pressing the buttons and the readouts confirm the channel.

It is interesting that the internal microcomputer is used to electronically control a CCD (charge-coupled device) filter. It does this in such a way that there is never any need to touch anything to "resolve" SSB signals. Bandwidth, bandpass and automatic frequency locking are all achieved by the microcomputer.

No cheap gimmicks either. The receivers are triple-conversion types with a few very mouth-watering advantages. Things like fully automatic scanning of all channels, automatic and continuous measurement of the VSWR and, if the VSWR gets too high, the set will automatically shut down. Automatic level and gain are other convenient features.

Power for these transceivers is 12W pep with the option of 4W of AM. In the SSB mode, upper and lower sidebands are selectable.

In the USA, the launch price of the mobile station is around the £200 mark.

10 min. a day

I was interested to hear about a Japanese company in the watch making game. They launched an electronic watch with a conventional face (i.e. hands plus day and date) but with great cunning this company also designed the face of the watch to take in eight silicon solar cells. It is reckoned that a battery will last at least three years and that only ten minutes of light on the cells every 24 hours is sufficient to keep the battery charged. One of the solar cells is connected in reverse to prevent reverse current from flowing when the other "working" cells are not receiving any light. The approach seems to be a success; over 50,000 of these watches have been sold in only eight months.

Hang a TV on your wall!

Flat screen televisions took a step nearer commercial use recently when a Japanese company released details of some work being carried out with liquid crystal TV screens. This one is a six-inch screen with 8,938 elements on it. The device does work and has been demonstrated in a television receiver application.

The liquid crystal screen is driven by CMOS, and drivers plus screen take only 10mW. The remainder of the set consumes only 5W and this includes the audio stages. While some work still remains to perfect this approach, the company is already talking about a pocket television receiver which will be no larger than a small pocket calculator. This is envisaged within the next three years.

Sad isn't it?

Be kind to tin! Did you know that metals "cry" when stressed? Well they do, due to molecular dislocations, micro-cracking and molecular deformations. With special equipment you can hear these noises. German workers are now using sound emission analysis to obtain advance warning in things like nuclear reactor vessels. The characteristics of a particular "cry" tells the workers just what's happening inside the structure of the metal; whether its just a small stress, or if there is some more serious damage or weakness, such as a crack starting.

I must confess that banging the Ginsberg begging bowl brought no sobs of distress from the metal—only from my bank manager!

This takes the biscuit!

Just what you've always wanted—an electronic biscuit checker! Not for the housewife, perhaps, but the biscuit manufacturers have to be a bit careful. After all, they can't send out one fat biscuit and three skinny ones, can they? It's all done with mirrors, plus some electronics, of course. The system projects a slit of light onto the surfaces of the passing biscuit. The scattered light is scanned by a photomatrix and the resultant information is used to adjust the temperature of the oven. The system can measure to within 0·1mm accuracy, but the designers claim than an improved version will allow accuracies down to 0·01mm.

Soon—mass X-ray in space

I shudder to imagine the enormous complexity of the latest space shot planned by the USA. Apparently they are to launch a half-ton X-ray detector. The earth's atmosphere prevents this type of detection efficiently from the ground.

Called Laxray, it will be able to pinpoint X-ray sources to within 0·1° and will do this for sources as far afield as a billion light years. The scientists expect Laxray to find many thousands of X-Ray sources with names like quasars and black holes. Makes that S-DeC project you just built seem a bit tame, doesn't it?

Even cheaper by Xmas

A late news flash for games chip addicts. A very big chip manufacturer in the USA is to launch a chip which should put games systems in the "less than ten dollars" market by this Christmas. Further, the manufacturer reckons to add to this chip family and next year the aim is to bring the total system cost down to a miserly five dollars. As the electronic canary said, "Cheap cheap".

Ginsberg

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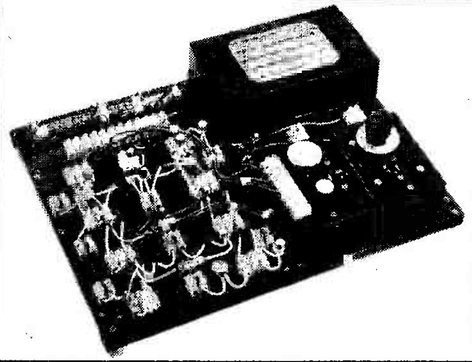

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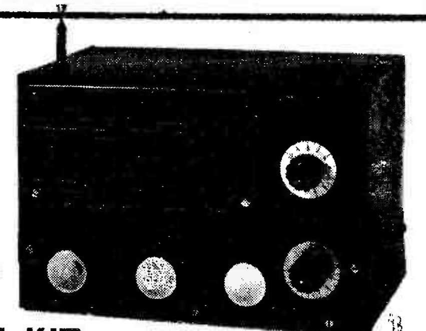

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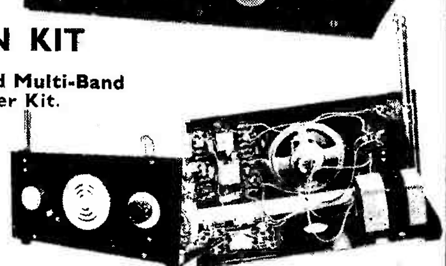

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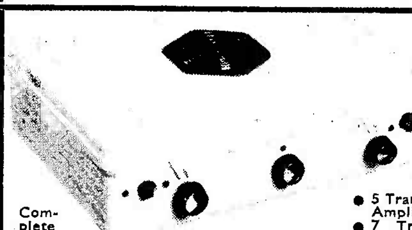

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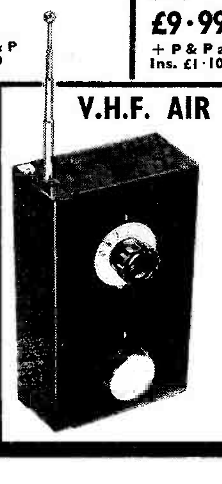

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AUDIO LEVEL INDICATOR

PEAK PROGRAMME RESPONSE WITH LED DISPLAY

William Pleass

This peak reading audio level indicator may be incorporated into a tape recorder or the modulating system of a transmitter, or used to give visual indication of the output of an audio amplifier. The indication is by means of four light-emitting diodes which light in sequence as the input increases. These save the high cost of a moving-coil meter, while still giving an easily assimilated display. A more complex circuit is necessary but the components are inexpensive.

The design responds to the peak-to-peak value of the signal. Thus, both positive and negative peaks are taken into account, which is a slight advantage with asymmetric waveforms such as male voices.

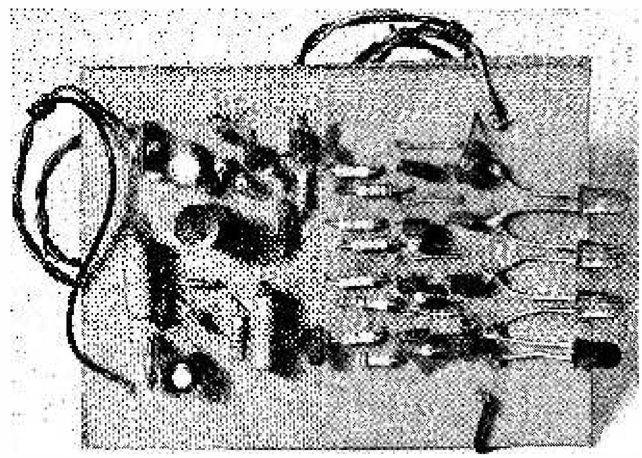
Circuit description

The circuit is shown in **Fig. 1** and **2** where VR1 is used to set the sensitivity. Tr1 and Tr2 form an amplifier with a voltage gain to audio signals of about 50 times (R4/R3). The function of C2 is to prevent the amplifier from oscillating at a supersonic frequency because of stray capacitive feedback. The amplified signal is applied via R6 to a peak-to-peak detector comprising C5, C6, D1 and D2. R6 gives a charging time constant of a few milliseconds, the accepted charging time constant for a peak programme meter being 2·5ms. This period may be shortened by reducing the value of R6, or omitting it completely. The discharge time constant is about one second (0·22μF x 5·6MΩ).

Tr3 and Tr4 are connected as a Darlington emitter-follower so as to prevent a very high resistance to the rectifier and preserve the full time-constant. R7 and VR2 apply a forward bias to overcome the cut-in voltages of diodes D1 and D2 and of the base-emitter junctions of Tr3 and Tr4. C4 is an audio bypass.

The full peak-to-peak voltage thus appears at Tr4 emitter. In the absence of any signal, this voltage is zero and Tr5, Tr7, Tr9 and Tr11 are all non conducting. Tr6, Tr8, Tr10 and Tr12 are all in saturation bypassing the current supplied by R20 from any of the light-emitting diodes. If the input voltage is gradually increased, Tr5 will begin to conduct when the rectifier output reaches approximately 0·5V. Shortly afterwards, it will conduct sufficiently to shunt the current provided by R10 away from the base-emitter junction of Tr6. Tr6 will cease to conduct and LED1 will light.

When the rectifier output exceeds approximately ((R12+R11)/R11 x 0·5V, or approximately 5V, Tr7 will conduct and LED2 will come on. Similarly, LED3 will light at 10V and LED4 will light at 15V. With VR1 set for maximum sensitivity, the signal voltages at which the LEDs conduct are roughly 15mV, 100mV, 200mV and 300mV p-p. The sensitivity increases with increasing temperature, but only by about 3% for a rise of 10°C.



Components

The prototype used selected transistors from untested ones which were bought for 50p per 50 (80% good). They are similar to ZTX108(NPN) and ZTX500(PNP). The eight transistors in the switching section may have an HFE as low as 50 and also low breakdown voltages. However, Tr1 and Tr3 should have high gains and low leakages.

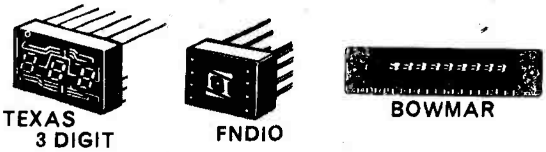
When used with a tape recorder, it is a good idea to use green LEDs for the first three and a red one for LED4, as an overload indicator. VR1 is then adjusted so that the third LED lights at the optimum peak recording level. LED1 will be found to light almost continuously with normal programme input.

Construction

Fig. 3 and **4** show the printed circuit layout. Single-sided Vero-pins were used for the power and signal inputs and for the LEDs. Soldering the LEDs directly to the pins is a convenient method of mounting them in a straight line. Alternatively, they may be situated away from the board and connected by cable.

Setting-up

VR1 should be adjusted temporarily for zero sensitivity to avoid picking up hum and other noises. A sensitive test meter (50μA FSD) should be connected across the base-emitter junction of Tr5. VR2 should be advanced from zero until the meter begins to register and then reduced slightly. Alternatively, VR2 may be advanced until LED1 just lights, and is then turned back a little.



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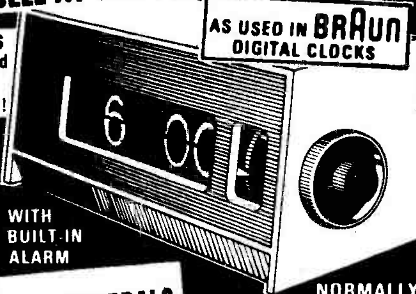

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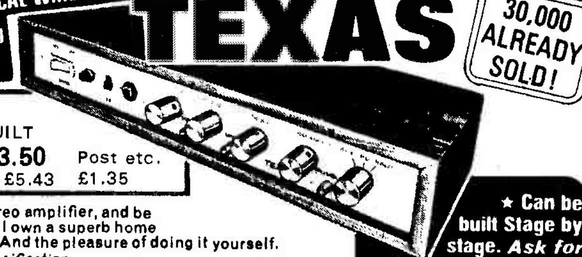

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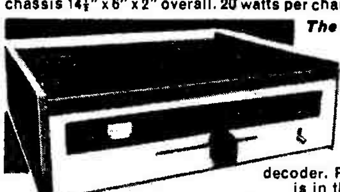

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7433	43p	74162	130p
7437	37p	74163	130p
7438	37p	74164	140p
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AC176	20p	TIP31C	68p
AC187	20p	TIP32A	63p
AC188	20p	TIP32C	85p
AD149	60p	TIP33A	97p
AD161	45p	TIP33C	120p
AD162	48p	TIP34A	124p
AF114	22p	TIP34C	160p
AF115	22p	TIP35A	243p
AF116	22p	TIP35C	290p
AF117	22p	TIP36A	297p
AF127	40p	TIP36C	360p
AF139	40p	TIP41A	70p
AF239	48p	TIP41C	84p
BC107/B	10p	TIP42A	76p
BC108/B	10p	TIP42C	96p
BC109	10p	TIP2955	76p
BC109C	11p	TIP3055	60p
BC147	9p	TIS43	40p
BC148	8p	TIS93	28p
BC149	10p	2N697	25p
BC157	11p	2N698	43p
BC158	13p	2N706	22p
BC159	13p	2N708	22p
BC169C	15p	2N918	43p
BC171	12p	2N930	19p
BC172	11p	2N1131	25p
BC177	20p	2N1132	25p
BC178	17p	2N1304	75p
BC179	20p	2N1305	75p
BC182	12p	2N1306	75p
BC183	12p	2N1307	75p
BC184	14p	2N1613	22p
BC187	32p	2N1711	22p
BC212	14p	2N1893	32p
BC213	12p	2N2102	60p
BC214	17p	2N2160	120p
BC461	40p	2N2219	22p
BC478	32p	2N2222	22p
BCY70	20p	2N2369	15p
BCY71	24p	2N2484	32p
BD124	140p	2N2646	52p
BD131	63p	2N2904/A	22p
BD132	67p	2N2905/A	22p
BD135	54p	2N2906/A	22p
BD136	55p	2N2907A	25p
BD139	56p	2N2926RB	9p
BD140	60p	2N2926OG	11p
BDY56	225p	2N3053	22p
BF115	24p	2N3054	65p
BF167	25p	2N3055	65p
BF170	25p	2N3439	72p
BF173	27p	2N3442	151p
BF177	28p	2N3565	34p
BF178	30p	2N3643	48p
BF179	35p	2N3644	48p
BF180	35p	2N3702	14p
BF181	35p	2N3703	14p
BF184	24p	2N3704	14p
BF185	24p	2N3705	14p
BF194	13p	2N3706	14p
BF195	11p	2N3708	14p
BF196	17p	2N3709	14p
BF197	19p	2N3707	14p
BF200	40p	2N3711	14p
BF244B	40p	2N3773	320p
BF256B	80p	2N3819	27p
BF257	34p	2N3820	50p
BF258	39p	2N3823	70p
BF259	48p	2N3866	97p
BF337	32p	2N3903	18p
BFR39	34p	2N3904	22p
BFR40	34p	2N3905	22p
BFR41	34p	2N3906	22p
BFR79	34p	2N4058	19p
BFR80	34p	2N4060	19p
BFR81	34p	2N4123/4	22p
BFR88	37p	ZN4125/6	22p
BFW10	90p	2N4289	24p
BFX30	34p	2N4401	34p
BFX84	30p	2N4403	34p
BFX85	30p	2N4427	97p
BFX86	30p	2N4871	60p
BFX87	30p	2N5089	34p
BFX88	30p	2N5179	75p
BFY50	22p	2N5245	40p
BFY51	22p	2N5296	58p
BFY52	22p	2N5401	62p
BFY90	90p	2N5457	40p
BRY39	48p	2N5458	40p
BSX19	20p	2N5459	40p
BSX20	20p	2N5485	45p
BU105	200p	2N6107	70p
BU108	312p	2N6027	60p
MJE340	70p	2N6247	200p
MJ481	175p	2N6254	140p
MJ491	216p	2N6292	70p
MJ2501	250p	3N128	90p
MJ2955	130p	3N140	97p
MJE2955	130p	3N141	80p
MJ3001	250p	3N187	209p
MJE3055	90p	40360	43p
MPF102	45p	40361	43p
MPF103	40p	40362	[illegible]
MPF104	40p	40409	[illegible]
MPF105	40p	40410	[illegible]
MPSA06	37p	40411	[illegible]
MPSA12	62p	40594	[illegible]
MPSA56	40p	40595	[illegible]
MPSH05	40p	40635	[illegible]
MPSU05	72p	40636	[illegible]
MPSU06	78p	40673	58p
MPSU55	90p	40871	35p
MPSU56	98p	40872	50p
OC28	90p		
OC35	90p		
OC42	25p		
OC45	25p		
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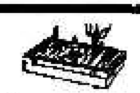

S-DeC **£1·94.** T-DeC **£3·61.**
u-DeCA **£3·97.** u-DeCB **£6·67.**
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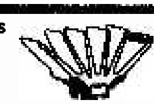

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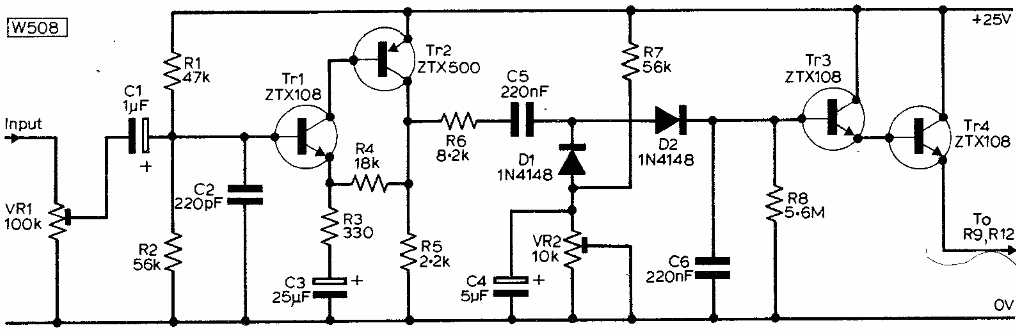


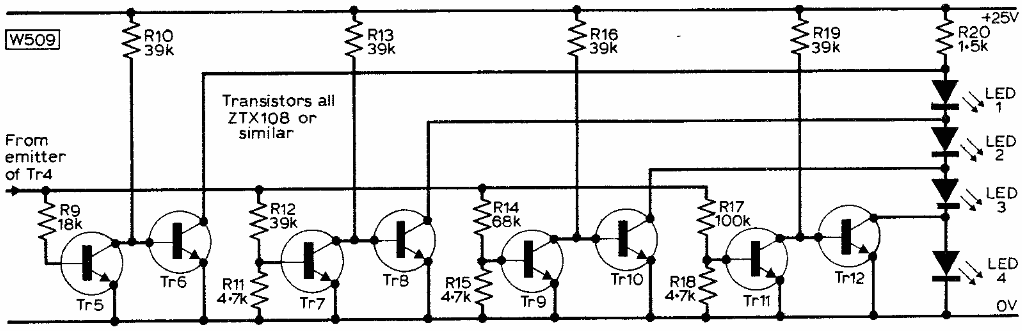


Fig. 1 (top): The circuit diagram of the buffer amplifier and rectifier. The rectified peak to peak voltage appears at the emitter of Tr4.

Fig. 2 (middle): The voltmeter section. Tr5, 7, 9 and 11 turn on successively with a rising voltage on the common line from Tr4 emitter. For satisfactory operation, the supply voltage must not be less than +22V or more than +30V.

Fig. 3 (below): The PCB shown copper side, actual size. A ready made board may be obtained from the PW Readers PCB service if required.

Fig. 4 (bottom): The component overlay for the PCB.

★ components

Resistors

R1	47kΩ	R11	4·7kΩ
R2	56kΩ	R12	39kΩ
R3	330Ω	R13	39kΩ
R4	18kΩ	R14	68kΩ
R5	2·2kΩ	R15	4·7kΩ
R6	8·2kΩ	R16	39kΩ
R7	56kΩ	R17	100kΩ
R8	5·6MΩ	R18	4·7kΩ
R9	18kΩ	R19	39kΩ
R10	39kΩ	R20	1·5kΩ ½W

All resistors except R20 ¼W 5%

Capacitors

C1	1μF 25V	C4	5μF 6V
C2	220pF	C5	220nF
C3	25μF 25V	C6	220nF

Potentiometers

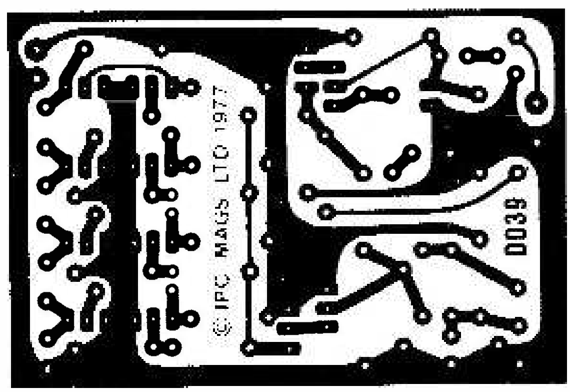
VR1 100kΩ miniature skeleton preset
VR2 10kΩ miniature skeleton preset

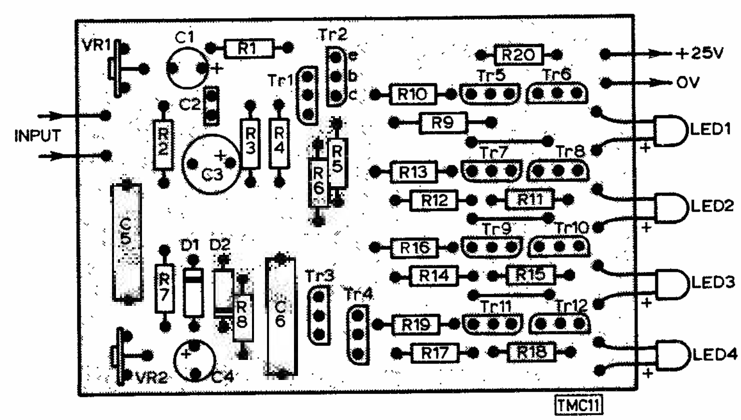
Semiconductors

Tr1, 3 to Tr12 ZTX108 or equivalent
Tr2 ZTX500 or equivalent
D1, 2 1N4148
LED1 to 4 TIL207 red and green (see text)

Miscellaneous

PCB from PW Readers PCB Service





VR1 should now be adjusted so that LED4, or LED3 if LED4 is to indicate overloads, lights at the desired maximum level. In a tape recorder, the unit must, of course, be connected after the recording-level control. For a stereo system, the best method is to have two separate indicators, but a single one can be switched manually between channels. The signal should be taken from points of low impedance relative to the input impedance of the indicator. This lies between 20kΩ and 100kΩ, depending on the setting of VR1.

The current consumption of the circuit is approximately 25mA from a 25V supply. The display is bright enough to be clear in fairly strong daylight. ●

ON THE AIR

AMATEUR BANDS

by Eric Dowdeswell G4AR

There seems to be little doubt now that we are starting to climb out of the doldrums of the last sunspot cycle. Activity on the 10m band is increasing rapidly and it behoves all of us to get those 10m beams dusted off ready for the fray. Many readers of this column will not have experienced 10m in full cry and they are in for a very exciting time. Those with transmitting licences will find themselves working all over the world with the simplest of equipment and low power. However, because of the small physical size of 10m beams a multi-element job is not a massive engineering undertaking. Not to get the gain necessarily but to provide some discrimination against the QRM!

The performance of a receiver at these frequencies should not be taken for granted. The older sets may be fine on 80m but abysmal on 10m. It is not a bad idea to make up a crystal-controlled converter for this band and tune the station receiver over a convenient part of the dial such as 4 to 6MHz thus taking advantage of the facilities of the set. It is a fact that much of the reported lack of activity on the higher frequency bands is due not to conditions but to poor receivers!

Paul Bradbeer runs from one problem to another! In Braunton, Devon, he has got his exams over but now finds his summer job interfering with his listening activities! However, he seems to be putting enough aside to buy a decent receiver and a trap vertical aerial in the not too distant future. Can't be too bad! Although not a VHF man Paul was sorely tempted when he joined in the VHF NFD fun with his local radio club. In Holyhead **John Higginbotham** BRS36901 is determined to use his holiday to up his DX figures. In anticipation of the RAE result John has acquired an FR100B and FL200B. I do hope that you have been successful OM or you will have to put that TX into mothballs for a while!

"As you may know, we schoolchildren have five weeks off now for summer holidays, so I'll have a chance to do some 'night owling'," so says **Michael Walker** BRS38836 up in Leeds. He frequents the White Rose club there and expects to start an RAE course later in the year. **Paul Pasquet** and **Iain Christie** jointly looked over the 15 and 20m bands in Farnham, Surrey, and found fairly scarce ones like HH2, VP1 and KG4 but don't seem to have ventured to the 10m band. In London W4 **Denis Sullivan** admits to finding the amateur bands a bit more interesting than the aircraft bands on HF. As ex-G2FCJ he couldn't resist the temptation to get back and has acquired a Trio QR666 used with "a bit of wire in the loft". He gave up his ticket in the '60s which seems rather a pity as he too comments on finding the 10m band producing signals at 2230.

An interesting letter from **Louis Meulstee** PA0PCR who was in EI land on holiday as EI2VLB/M with his Heathkit SB104 and whip aerial on 10, 15 and 20m. In Hastings 10m was scanned by **Brian Harrison** producing C31, FM7, HI8 while 20m turned up JW7 (Bear Is.), KG6 and VK9 (Christmas Is.). The neighbours of **Dave Peck** BRS37621 in Cambridge can now rest easy as he has cured the QRM he was causing them, by sprinkling around his RTTY gear an assortment of capacitors and chokes. Not much to report says Dave but he did copy a DM on RTTY via Oscar 7 on 2m. Writing from Walsall, **M. F. Wilson** says he has been very active in DX-TV using the sporadic-E mode, "but now wishes to move into the world of amateur TV". If there are any enthusiasts in this field in the Walsall area he would like a note to 406 Sutton Road.

Brian Alderwick's letter was his first to this column but not the last, I hope. He has replaced his 9R59DS with a Yaesu FRG7, the former being relegated to MW DXing with a PW look aerial! At which it performs very well indeed, as I can personally testify! His brief log covers 20m SSB only so I hope that you will not be averse to using the bandswitch now and again OM! Like 10m? Don't worry Brian you won't revert to the BC bands now that you have tasted our bands!

The log from **D. W. Waddell** in Herne Bay covered 10 to 80m with a mixture of CW and SSB which is as it should be. That is the only way in which to get a good picture of what conditions are up to, enabling one to select the appropriate band that is active, without wasting time. Even if you do not have a couple of hours to sit down with the receiver a few minutes switching from band to band will put you in the picture.

CLUB NEWS. The Newport ARS meets every Monday at 1900 at the Community Centre, Brynglas, during the school term. New aerials being installed now include a TH2 for the HF bands with a 4-over-4 slot for 2m plus a 19ft colinear for the same band. Forthcoming programmes include: September 12th, "Linear Amplifiers"; October 10th, "Oscilloscopes", both by GW3NWS. Interested? Then contact **M. L.**

Busson GW8MER at Brynglas House, Brynglas Hill, Newport.

The Wessex AR Group will be pleased to see you at 1930 in the Club room at the Dolphin Hotel, Holdenhurst Road, Bournemouth, for the following: September 16th, "Working Maritime Mobile" by Bill Sykes G2HCG and Dick Weston G3RGJ. The AGM is on October 7th, but for more info contact **Geoff Cole** G4EMN, 6 St. Anthonys Road, Bournemouth. Tel: 20027.

Log extracts

D. Waddell:— **80m** 9G1JX **20m** HH2MC **KH6HC KL7AM SU1M1 VP8PL** 5T5CJ **15m** AP2P **ST2SA** TL8LE **ZD8EW** 8R1J **10m** TU2FM ZP5SD

B. Alderwick:— **20m** CO2WK CX5BT HS1ALG JY25DI VP2LCT 6Y5LB

B. Harrison:— **20m** JW7BK (Bear Is.) KG6BZ TJ1BB VK9XI (Christmas Is.) 3B8BZ 8R1Q **15m** VP2MBB 9Y4R **10m** C31NX FM7WE HI8EJH 9Y4AL

P. Pasquet and I. Christie:— **20m** C31NX KJ6BD TR8BA ZF1SV 5W1BF **15m** CJ1EJ (Prince Edward Is.) FG7AS HH2MC KG4AN VP1WCS VP2MVP

A. Butler:— **20m** CO2HZ JY25MB KP6BD

J. Higginbotham:— **20m** CR9AJ HK0QA (San Andres) KG400 KJ6BZ KX6DC TJ1BB TT8SM VS6DO 8R1W **15m** CE3FI CX7BF PJ2FR VP2MVP

P. Bradbeer:— **15m** JY9CR VP2MBB (QSL cards to VE3ECP) 9Y4R

BROADCAST BANDS

MEDIUM WAVE DX

by Charles Molloy G8BUS

South East Europe is an area neglected by the medium wave DXer. Signals are not conspicuous, channels are often shared with western Europe, and the best time for DXing is in the early morning before broadcasting from the west starts up for the day, a time when the majority of DXers are in bed!

Greece is one of these neglected countries. It's time zone is two hours ahead of GMT and its main channel is on 728kHz which is shared with East Germany, Austria, Spain and Portugal. It is possible though, to pick up a few signals in the late evening. Corfu is at reasonable strength on 1007kHz after Hilversum signs-off at 2300 (2200GMT in the summer) while Zakinthos is on 926kHz at the same hour with a weaker signal, after the Belgian station on that channel has closed down. Athens on 1385kHz has a night programme and a loop will reduce the QRM on this channel.

YENED is the Hellenic Armed Forces Network which operates a chain of low-power outlets that sign-off at 2100. Those logged by the writer are Kavala with 1kW on 1355 and Serrae with 1kW on 1301. The Pyrgos Broadcasting Station also run by YENED, has a night programme with announcements in English which is on 1349kHz with 4kW from 2300 until 0300. QRM is usually troublesome on this frequency. Two out-of-band transmissions can be heard during the winter. Radio Ierapetra on the island of Crete is on 1614 with a power of 250 watts and according to a letter from the station it is located at Ierapetra on the south of Crete, and signs-off at 2200. The other is Amphissa on 1622 which closes down at 2100. Kalamata is listed as being on 1620 but has not been heard by the writer.

Mark Brighton writes from Benfleet in Essex. "A couple of months ago I began DXing on the medium waves, mainly because I have no radio with short waves". Shame on you Mark, medium wave DXers prefer their band to the short waves! Mark says his receiver in an ancient 5-valve domestic superhet connected to 100ft of wire strung between his bedroom window and the apple tree up the garden. He tried for CJON at 0200 but thinks he might have heard AFN Berlin on 935kHz. AFN is on a 24-hour schedule and could easily be mistaken for a North American. The majority of North Americans identify frequently by their callsigns and all are compelled by law to announce their identity on the hour and the half hour. Good luck with your DXing Mark, and stick to the medium waves!

Leslie Dewhurst writes from Leamington Spa to say that he has been a regular but silent reader of this column for the last twelve months. He had some small successes with North America last winter and he now has a Realistic DX160 receiver. He is preparing for the darker nights and is putting up a 100ft long wire aerial with a screened downlead in order to get rid of local electrical interference. He purchased a notch filter kit and has collected the "bits" and pieces" to make a loop.

Leslie raises an interesting point when he asks if readers would give the times when reporting DX. He says "it would be a great help to beginners like myself, to avoid the frustration of searching when there is in fact no chance of success". Well, readers, please help others by giving details of your gear, aerials and the date and time (GMT) of your loggings.

Loops are in the news again with a letter from Exeter where **Richard Harding** logged WINS on 1010 and WCBS on 880 both in New York and CHER in Sydney, Nova Scotia. Reception was in July between 0130 and 0430! The receiver is an Astrad VEf 17 with a loop measuring 60in high and 47in wide coupled to the receiver via a differential amplifier and an Aerial Tuning Unit. Richard asks; Do you know of anyone else who uses a rectangular loop and is there any limit to the size a loop may be.

A loop may be any shape that is symmetrical; square, rectangular, circular, diamond shaped or even triangular will do. Some DXers in the United States use a delta loop which is shaped like an isosceles triangle with the apex at the top and the opposite short side being the base. Yes, there is a maximum size and this would be a single turn loop which, if square, would have each side about 25ft in length! This estimate is based on the rule-of-thumb measurement that holds in practice with smaller sizes; that it takes about 100ft of wire to wind a medium wave loop.

The pick-up of a loop is proportional to the area enclosed by the windings and to the number of turns. If those two are multiplied together a figure will be obtained that will be a measure of the pick-up of the loop. For example, the figure for a 40in loop with 7 turns is 77, for a 6ft loop with 4 turns it is 144 and for an 8ft loop with 3 turns it is 192. Clearly the larger loops pick up more signal but unless they are well made and rigid then the null may not be too good. The standard loop which is an optimum size between pick up, convenience in use and sharpness of null is the square loop of 40in side with 7 turns.

Does anyone use a Trio QR666 receiver for medium wave DXing? **Richard Harding** would like to know how this receiver handles on the medium waves and what stations have been logged with it. Can anyone help?

Following up a request last month from **Derek Taylor** for information about low power stations in the United States. "Broadcasting Year Book" obtainable from Broadcasting, Telecasting Building, De Salles St, Washington DC 20036, USA, gives the addresses, transmission times and names of the owners of all medium wave stations in the United States. The total number of stations, including a large number of 250 watt daytimers only, is in excess of 4000 and the cost of the Year Book is 20 dollars. In a subsequent letter Derek mentions the National Radio Club Domestic Log, which covers USA and Canadian stations. Stations are listed in frequency order and also by callsign. Details of addresses, transmission times, power used and other data are included in the log which is obtainable from N.R.C. Publications Centre, PO Box 401, Gales Ferry, CT 06335, USA at a price of 8 dollars to non members.

SHORT WAVE BROADCASTS

by Charles Molloy G8BUS

The short waves are used for domestic broadcasting in tropical countries and in other parts of the world where the high level of static caused by thunderstorm activity makes broadcasting on the medium waves impracticable. The Tropical Bands, mainly 60 metres and 90 metres, are used during the hours of darkness, a time when propagation is by means of the F layer, to provide a service for several hundred miles around the transmitter.

During the day, when the sky wave is absorbed in the D and E layers, a change to higher frequencies is required to maintain the service. Consequently, many broadcasters operate on a split schedule. They are on the tropical bands from sign-on until sunrise, then they move to the 49m, 41m or 31m bands during the daytime and return to the tropical bands from sunset until sign-off. The night time signals travel considerable distances and if the DXer wishes to pick them up he should listen at a time when there is a path of darkness between the transmitter and his location (QTH).

60 metres (4750kHz to 5060kHz)

This is the main tropical band and worldwide reception is possible. At this time of year listen for:

4756kHz	Brazzaville, Congo. French. Close down 2300
4770	Radio ELWA, Liberia. English. C.d. 2300
4780	Radio Bissau, Guinea. Portuguese. C.d. midnight
4815	Radio Ougadougo, Upper Volta. French. C.d. midnight
4870	Cotonou, Benin. French. C.d. 2300
4890	Port Moresby, New Guinea. Sign-on 2000
4904·5	Radio N'Djamena, Chad. French. C.d. 2200
4920	ABC, Brisbane. Sign-on 1900 (1930 Sundays)
4940	Radio Abidjan, Ivory Coast. French. C.d. midnight
4947	Radio Yaounde, Cameroon. French. C.d. 2300

90 metres (3200kHz to 3400kHz)

3222kHz	Radio Lawa Kara, Togo. French. C.d. 2230
3227	Radio ELWA. Local languages. C.d. 2230
3232	Brazzaville. C.d. 2300
3330	Radio Rwanda. French. C.d. 2100
3380	Blantyre, Malawi. English. C.d. 2210

Programmes for DXers are a feature of many of the international broadcasts on the short waves. News items of interest to DXers, latest schedules, information about new stations, frequency changes, answers to technical questions from listeners, are the meat of these programmes and one station, Radio Nederland in Holland, even runs courses on various aspects of DXing.

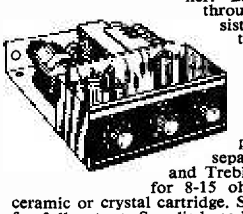
'Sweden Calling DXers' has been on the air for many years. The English version, which is on Tuesdays, can be heard in Europe on 6065kHz in the 49m band at 1615, 1845 and 2115. Reception in parts of the UK can be difficult after dark but the programme is repeated on the medium waves on 1178kHz at 2300. The items broadcast are supplied by listeners who receive in return a copy of the script of the programme in the form of a weekly news sheet.

'DX Juke Box' is the title of the programme from Radio Nederland. It is on the air on Thursdays on two frequencies in the 49m band. On 6045kHz at 1415 and on 6030kHz at 1845. A 'Communications Systems' course is currently included in this programme. The Swiss 'Short Wave Merry-go-round' appears on the second and fourth Saturdays of the month on 3985kHz in the 75m band, on 6165kHz in the 49m band and 9535kHz in the 31m band. Listen at 0705, 1105, 1320, 1535 or 2105.

Although DX is generally accepted as an abbreviation for Distance, the suggestion put forward by Eric Dowdeswell in the August issue that 'Distance Xtra' would be better, touches the heart of the matter. There is a lot more to DXing than listening to distant stations. At the risk of trying to improve on this novel suggestion from the Assistant Editor the writer would suggest that by far the best definition of DX is the one put forward many years ago by the late G6QB who suggested simply that DX stands for Difficulty!

The DXer who owns an efficient communications receiver, lives in a country district free from electrical noise, and has an aerial farm, will have a different idea of difficulty than the owner of less pretentious gear who is surrounded by high-rise flats and has to use an indoor aerial! The feeling of achievement however will be the same when some difficult DX has been winkled out and that, really, is what the hobby is all about.

SUPERSOUND 13 HI-FI MONO AMPLIFIER



A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohms. Frequency response 12Hz 30KHz ± 3db. Fully integrated pre-amplifier stage with separate Volume. Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3" high × 6" wide × 7½" deep. AC 200/250V. PRICE £13·75. P. & P. £1·20.

HARVERSONIC MODEL P.A. TWO ZERO

An advanced solid state general purpose mono amplifier suitable for Public Address system. Disco, Guitar, Gram., etc. Features 3 individually controlled inputs (each input has a separate 2 stage pre-amp.). Input 1 5mv into 47k. Input 2 5mv into 47k. (suitable for use with mic. or guitar etc.). Input 3 100mv into 1 meg. suitable for gram. tuner, or tape etc. Full mixing facilities with full range bass & treble controls. All inputs plug into standard jack sockets on front panel. Output socket on rear of chassis for an 8 ohm or 16 ohm speaker. Output in excess of 20 watts R.M.S. Very attractively finished purpose built cabinet made from black vynil covered steel, with a brushed anodised aluminium front escutcheon. For ac mains operation 200/240 volts. Size approx. 12½" w. × 5" h. × 7½" d.

Special introductory Price £28·00 + £2·50 carriage & packing.

HARVERSONIC STEREO 44

A solid state stereo amplifier chassis, with an output of 3-4 watts per channel into 8 ohm speakers. Using the latest high technology integrated circuit amplifiers with built in short term thermal overload protection. All components including rectifier smoothing capacitor, fuse, tone control, volume controls, 2 pin din speaker sockets & 5 pin din tape rec./play socket are mounted on the printed circuit panel, size approx. 9¼" × 2¼" × 1" max. depth. Supplied brand new & tested, with knobs, brushed anodised aluminium 2 way escutcheon (to allow the amplifier to be mounted horizontally or vertically) at only £9·00 plus 50p P & P. Mains transformer with an output of 17v a/c at 500m/a can be supplied at £1·50 + 40p P & P if required. Full connection details supplied.

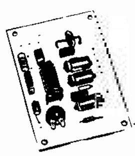
VYNAIR & REXINE SPEAKERS & CABINET FABRICS app. 54 in. wide. Our price £1·50 yd. length. P. & P. 50p per yd. (min. 1 yd.). S.A.E. for samples.

BRAND NEW MULTI-RATIO MAINS TRANSFORMERS. Giving 13 alternatives. Primary: 0–210–240v. Secondary combinations 0–5–10–15–20–25–30–35–40–60v. half wave at 1 amp. or 10–0–10, 20–0–20, 30–0–30v. at 2 amps full wave. Size 3in. long × 3½in. wide × 3 in. deep. Price £2·90 P. & P. £1·00.

MAINS TRANSFORMER. For power supplies.
Pri. 200/240v. Sec. 9–0–9 at 500 mA. £1·50. P. & P. 65p.
Pri. 200/240v. Sec. 12–0–12 at 1 amp. £1·65. P. & P. 65p.
Pri. 200/240v. Sec. 10–0–10 at 2 amp. £2·35. P. & P. 95p.
Pri. 200/240V Sec. 23V at 1·5 amp, 6V at ·6 amp. 8V at 50mA. £2·00 + 65p P. & P.

ALL-PURPOSE POWER SUPPLY UNIT 200/240v. A.C. input. Four switched fully smoothed D.C. outputs giving 6v. and 7½v. and 9v. and 12v. at 1 amp on load.
Fitted insulated output terminals and pilot lamp indicator. Hammer finish metal case overall size 6" × 3½" × 2¾". Ready built and tested. Price £6·75 P. & P. 95p.

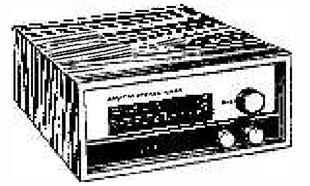
STEREO-DECODER



SIZE 2" × 3" × ½" ready built. Pre-aligned and tested. Sens. 20-560 mV for 9-16V neg. earth operation. Can be fitted to almost any FM VHF radio or tuner. Stereo beacon light can be fitted if required. Full details and instructions (inclusive of hints and tips) supplied. £5·62 plus 20p. P. & P. Stereo beacon light if required 40p extra.

QUALITY RECORD PLAYER AMPLIFIER MK. II A top quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. wide × 3in. deep × 6in. high. Ready built and tested. PRICE £7·00. P. & P. £1·25. ALSO AVAILABLE mounted on board with output transformer and speaker. PRICE £8·00, P. & P. £1·30.

MAINS OPERATED SOLID STATE AM/FM STEREO TUNER

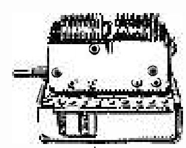


200/240V Mains operated Solid State F/M A/M Stereo Tuner. Covering M.W. A.M. 540-1605KHz VHF/FM 88-108MHz.
Built-in Ferrite rod aerial for M.W. Full AFC and AGC on AM and FM. Stereo Beacon Lamp Indicator. Built in Pre-amps with variable output voltage adjustable by pre-set control. Max o/p Voltage 600m/v RMS into 20K. Simulated Teak finish cabinet. Will match almost any amplifier. Size 8¼"w × 4"h × 9½"d approx.

LIMITED NUMBER ONLY at **£28.00** + £1·50 P. & P.

SPECIAL OFFERS

Mullard LP1159 R.F.–I.F. Double Tuned Amplifier Module for nominal 470 KHz. Size approx. 2¼" × 1¼" × ¾" 7·6 Volt + earth. Brand new pre-aligned. Full specification and connection details supplied. £2·25. P. & P. 20p.



Pye VHF/FM Tuner Head covering 88-108 M/Hz. 10·7 M/Hz I.F. output. 7·8 Volt + earth. Supplied pre-aligned, with full circuit diagram. Connection details supplied. Beautifully made with precision-geared FM gang and 323Pf + 323Pf A.M. Tuning gang only £3·15 + P. & P. 35p.

PRECISION MADE
Push Button Switch bank. 8 Buttons giving 16 S/P C/O interlocked switches plus 1 Cancel Button Plus 3 d/p c/o. Overall size 5" × 2½" × 1". Supplied complete with chrome finished switch buttons. 2 for £1·50 + 20p P & P.

HI-FI LOUDSPEAKER SYSTEM MK II

Beautifully made, simulated teak finish enclosure with attractive slatted front. Size 16½" high × 10½" wide × 9" deep (approx.). Fitted with E.M.I. Ceramic Magnet 13" × 8" bass unit, H.F. tweeter unit and crossover. AVAILABLE IN NOMINAL 4 Ohm, 8 Ohm or 16 Ohm impedance (state which). Handling power 10 watts R.M.S.

OUR PRICE £12·80 each. Carr. £2·20 ea.
Cabinet Available Separately £7·60, Carr. £1·60 each. Also available in 8 ohms with EMI 13" × 8" bass speaker with parasitic tweeter £11·10, Carr. £2·20 each.

LOUDSPEAKER BARGAINS
5in. 3 ohm £2·00, P. & P. 35p. 7 × 4in. 3 ohm £2·35, P. & P. 48p. 10 × 6in. 3 or 15 ohm £3·20, P. & P. 75p. 8 × 5in. 3 ohm with high flux magnet £3·00, P. & P. 60p. Tweeter. Approx. 3½". Available 3 or 8 or 15 ohms, £2·00 + 30p, P. & P. 2" Plastic Cone HF Tweeter 4 ohm £3·50 per matched pair + 50p P. & P.

HIGH POWER HI-FI 8 OHM DOME TWEETER. 1" voice coil, magnet size 3" dia. suitable for use in up to 50 watt systems £4·50 ea + 60p P. & P.

SPECIAL OFFER. 6½" long throw, roll surround, ceramic magnet 8 ohm 10 watt speaker chassis. Specially suitable for HiFi £3·95 + 75p P. & P.

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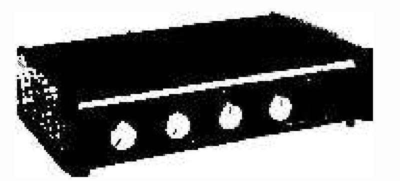
Size 11¾" × 14$\frac{5}{16}$" × 1$\frac{3}{16}$" deep. Weight 19oz. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40Hz-20kHz. Can be mounted on ceilings, walls, doors, under tables, etc., and used with or without baffle. Send S.A.E. for full details. Only £8·40 each + p. & p. (one 90p, two £1·10). Now available in either 8" round version or 4½" × 8½" rectangular. 10 watts RMS 60Hz-20KHZ £5·25 + P. & P. one (65p, two 75p).

SPECIAL LINES OFFERED SUBJECT TO STOCK AVAILABILITY
Limited number of British manufacturer's surplus professional 100 watt RMS slave amplifiers. Special features, 2 separate power modules, 1 for Bass response and 1 for mid-range/tweeter. 5 stage LED display for power o/p indication. A/C mains i/p switchable for 110 or 240v. Can easily be converted to Stereo. AVAILABLE TO PERSONAL CALLERS ONLY. PLEASE PHONE TO CONFIRM AVAILABILITY. Brand new & tested only £33·75.

Prices include VAT at Current Rate

HARVERSONIC SUPERSOUND 10 + 10 STEREO AMPLIFIER KIT



A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integral pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridge—instructions included. Output stage for any speakers from 8 to 15 ohms. Compact design, all parts supplied including drilled metalwork, high quality ready drilled printed circuit board with component identification clearly marked, smart brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification; Power output: 14 watts r.m.s. per channel into 5 ohms. Frequency response ±3dB 12–30,000 Hz Sensitivity: better than 80mV into 1M Ω: Full power bandwidth: ±3dB 12–15,000 Hz. Bass boost approx. to ±12dB. Treble cut approx. to −16dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1·0 amp.
Overall Size 12"w. × 8"d. × 2¾"h.

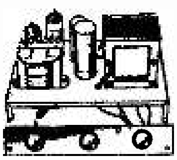
Fully detailed 7 page construction manual and parts list free with kit or send 25p plus large S.A.E.

AMPLIFIER KIT .. .. £13·50 P. & P. 80p
(Magnetic input components 33p extra)
POWER PACK KIT .. £5·50 P. & P. 95p
CABINET .. .. .. £5·50 P. & P. 95p

SPECIAL OFFER—only £23·75 if all 3 items ordered at one time plus £1·25 p. & p.

Full after sales service
Also available ready built and tested £31·25. P. & P. £1·50

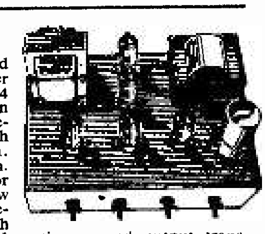
3-VALVE AUDIO AMPLIFIER HA34 MK II



Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½"w. × 4"d. × 4½"h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only £8·20. P. & P. £1·40.

HSL "FOUR" AMPLIFIER KIT. Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc. £7·60 P. & P. £1·40.

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3–15 Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 25p + SAE (Free with parts).
All parts sold separately. ONLY £12·00 P. & P. £1·40. Also available ready built and tested £16·50 P. & P. £1·40.

GENERAL PURPOSE HIGH STABILITY TRANSISTOR PRE-AMPLIFIER

For P.U. Tape, Mike, Guitar, etc. and suitable for use with valve or transistor equipment. 9-18v. battery or from H.T. line 200/300v. Frequency response 15Hz—25KHz. Gain 26dB. Solid encapsulation size 1¾" × 1¼" × ¾". Brand new complete with instructions. Price £1·80 P. & P. 15p.

Open 9.30–5.30 Monday to Friday. 9.30–5 Saturday Closed Wednesday.

All prices and specifications correct at time of press and subject to alteration without notice.

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A few minutes from South Wimbledon Tube Station.
For personal callers only we can now offer a full repair service on all Hi-Fi Equipment, Disco, Cassettes, Car Radio etc. SEND S.A.E. WITH ALL ENQUIRIES

(Please write clearly)

PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY. P. & P. ON OVERSEAS ORDERS CHARGED EXTRA.

An attenuator is a device, usually made of resistors, which will absorb electrical energy. If one is placed between the aerial and the aerial socket on a receiver it will cause a reduction in signal strength. This would seem a strange thing to do as usually the object is to collect as much signal as possible and then amplify it within the receiver so that weak signals can be heard. There is an exception though. Overloading inside the receiver can occur when a long outdoor aerial is connected to a receiver that is designed to operate from a short aerial, such as a whip or a car aerial. Signals will spread out on the dial, spurious responses will occur along with whistles which will make it very difficult to listen to any but the strongest stations. When this occurs it will be an advantage to switch in an attenuator which will reduce the strength of the stronger signals, reduce overloading and make the weaker signals audible.

A simple yet effective attenuator is a 500Ω or 1kΩ carbon potentiometer connected between the aerial and earth terminals of the receiver with the aerial going to the rotor. (See the article in this issue on a SW bands pre-selector.)

A variable capacitor in series with the aerial will also act as an attenuator. The capacitor should be mounted in a small box with an input socket for the aerial plug and an output lead with a plug on the end which is inserted in the receiver aerial socket. The variable capacitor is normally left with the vanes fully meshed, i.e. at maximum value, when it will have little effect on receiver sensitivity. When overloading occurs, the capacitor is adjusted until weaker but clearer signals are obtained.

Paradoxically, a capacitor in series with the aerial will, under some circumstances, peak up a signal. It has the effect of electrically shortening the aerial and can be used as a simple matching device. It is worth trying one in series with a long outdoor aerial especially when listening to the higher frequencies.

Radio Australia broadcasts to Europe in English daily between 0700 and 0900. It can be heard on the 25m band on 11740kHz and on the 31m band where it has moved back from 9510kHz to 9570. It has also been reported on 21570kHz on 13m though it is not clear whether this frequency is beamed on Europe. 'DXers Calling' is on the air on Sundays at 0840.

According to Deutsche Welle they are now using 6000, 15320, 15405 and 17875kHz from their relay in Malta, and 5960, 5995, 6145, 9545, 9590, 9625, 9690, 11865 and 11970kHz from the relay in Montserrat.

VHF BANDS

by Ron Ham BRS15744

Although sporadic-E is an annual mid-summer phenomenon its sudden and varying effect on radio signals still fascinates the seasoned enthusiast and excites the newcomer to VHF, and Saturday June 25 was a good example. For most of the day both the 4 and 6m bands were in chaos. My frequent checks revealed strong vision pulses on Ch.R1 (49·75MHz) and very strong signals from some 40 east-European broadcast stations between 65 and 73MHz, with only dipole aerials feeding my 770R and R216 receivers.

> Reports on the various bands are welcome and should be sent direct, by the 15th of the month, to:-
>
> **AMATEUR BANDS** Eric Dowdeswell G4AR, Silver Firs, Leatherhead Road, Ashtead, Surrey KT21 2TW. Logs by bands, each in alphabetical order.
>
> **MEDIUM and SW BANDS** Charles Molloy G8BUS, 132 Segars Lane, Southport, PR8 3JG. Reports for both bands **must** be kept separate.
>
> **VHF BANDS** Ron Ham BRS15744, Faraday, Greyfriars, Storrington, Sussex RH20 4HE.

Frank Luman, Glasgow, reports that Band II was disturbed throughout the afternoon, "They came thick and fast" says Frank and while he was counting the Italian and Spanish broadcast stations he noticed that the BBC transmissions from Holme Moss on 91·5MHz were often obliterated by the Italian Programme 2 station at M.Sambuco.

Alan Baker G8LGQ Newhaven, reports that around 1600 HG5AIR, on 2m SSB, was heard in Haywards Heath and about the same time IT9 was received in GM. OE and SP were worked from G and G8HVD along with other stations in G, GW and GU successfully contacted 9H1. Further sporadic-E disturbances affecting the 4 and 6m bands occurred during the early mornings of July 1, 3, 8, 9, 11 and 16, at midday on the 8th, and the late afternoons of the 5th and 12th. The most intense of these took place at midday on the 8th when I counted 63 strong signals from east-European stations between 65 and 73MHz, in addition to a variety of continental radio-telephone signals between 40 and 46MHz. On the other disturbed days an average of 14 broadcast stations were heard in the 4m band.

Frank Luman has recently purchased a Hallicrafters S36A receiver to extend his DX listening into Band I and has already heard TV sound carriers from both French and Spanish stations. **John Branegan**, Saline, Fife, has recently retired from the Navy and is in the process of building up his station to study propagation and DX. At present he has a FRG7 fed by a pair of home-brew 10m crossed dipoles and is constructing a receiver for 2m plus a general purpose VHF/UHF receiver using varicap tuners into an IF strip. During the early mornings of July 1st and 3rd John received 539 signals from the Cyprus beacon 5B4CY and at 1300 on June 25th (that day again) GB3SX suddenly came up from a quiet 10m band giving a 599 signal in Scotland. Like myself, and **Nigel Golds** BRS 36910, West-Chiltington, Sx, John has kept an ear open for the German beacon DL0IGI (28·195MHz) and often receives it at good strength. On 16 of the 27 days between June 21 and July 18 I received DL0IGI at different times and at signal strengths varying between 539 and 599.

At 1940 on July 5 Nigel heard ZP5 calling EA on 10m and around the same time on the 18th he heard UP2 and SM working among other European stations during one of those short skip openings which are becoming a regular feature on 10m. **John Branegan** also sent an Oscar report. He is delighted to find that on some days he can hear 10 consecutive orbits of Oscar-7 and his log for July 2nd shows that he has heard signals from EA, DB, F, G, GM, OE, OZ, PA, I3, W1 and W3 coming from the satellite. At 1604 on June 27, **Ian Jones** G8LWI Old Heathfield, Sussex, heard a strong burst of signal on 2m SSB from EA, but later that day there was more excitement when he had a solid copy contact with G8LGQ, 15 miles away, while running **15 milliwatts** to a 4 element quad!

Around 0600 on July 9th the atmospheric pressure started to rise rapidly and continued to do so through the 10th and then began to fall at midday on the 11th and, as usual, **Alan Baker**, recognising the ingredients for a tropo-opening, kept at his rig from 1900 on the 10th until 0448 on the 11th, during which time he worked ON, PA, F, SM and DJ. The first surprise of this opening came for Alan, and maybe others, at 2014 when he worked GM3JNW, 59, via the Belgian repeater on R4, ON0OV. Then at 2105 he worked G8JNJ Manchester via another Belgian repeater on R8, ON0HT. His best DX was at 0120 when he contacted SM6GUS on 2m SSB at 1035km.

At 2207 on the 10th I received a 53 signal from GM3OLK/P Peterhead, and for most of the 10th and 11th I could hear the 70cm beacon GB3SUT from Sutton Coldfield with only a dipole feeding the receiver. That same dipole proved that 70cms was well used during the VHF NFD on July 2/3 because, between two separate one-hour sessions I heard 30 stations from Dover to Dorchester, and Arundel to Ipswich. Many of these stations were also arranging for contest skeds on 23cm, which leads us into microwaves and another interesting report from **Peter Kerry** G8ARO Farnham, who has worked from virtually all the "high spots" on the South Downs, in co-operation with G8BDJ, G8GKV and G3JHM. Using 0·9W ERP, a small klystron to a 14dB horn, some paths, 35 to 60km, have been worked many times. "However," says Peter, "one of the biggest events for me was the 10GHz cumulative on June 19th", I can imagine the excitement, when he worked G3KSU/P on St Catherines Hill, IOW, a distance of 85km from a good site 11km SW of Newbury at 59+, and later he received a 58 report from GW4BRS/P on Mynydd Maen, near Pontypool, over a distance of 116km on a path obstructed in three places.

Both G8ARO and G8BCO took their microwave gear to the Farnborough and District Radio Society NFD site at Farnham Heights and at 0330 on July 3rd G8ARO detected the signal from the London 3cm beacon GB3LBH near Romford, using a hand portable receiver consisting of an intruder alarm into a pocket FM radio at 108MHz and a horn aerial with approximately 6dB gain! This prompted G8BCO to drive home and collect a larger rig and they both monitored this signal, the first over a 75km path, often at 59+ until it faded out around 0700. Summing up in his letter, Peter said, "Must have been one of the best all-time land ducts". Well done, both of you, and we look forward to hearing more in the future.

On June 24th Cmdr Henry Hatfield, Sevenoaks, observed a plage and a solar flare with his spectrohelioscope and recorded several bursts of noise on his 136MHz radio telescope. This was the beginning of a period of solar activity which lasted until July 4. Both Henry and myself recorded many individual bursts and some longer periods of solar noise at 136MHz throughout the period. This event was confirmed by **John Smith**, Cranleigh, with his 142MHz telescope and by **Cliff Ranft** using his cosmic noise equipment at 30MHz.

Once again we have covered amateur activity from 10m through to 3cm and natural disturbances occurring on the sun 93 million miles away and in our atmosphere, relatively a few miles above us. Thank you all for your reports and letters and for the interest you are taking in my column.

DESIGN YOUR OWN PROJECTS-2—*continued from page 438*

about be OK. This is running the BFY51 pretty close to its limits but even Toby should find it difficult to achieve this rather exceptional "half shorted out" condition.

With a complete short circuit the power dissipated in Tr2 will be much lower since V_{CE} will only be about half a volt. An unfortunate side effect in this state is that R1 will now be dissipating over 3W so we are going to have to replace this with a 5W type. The dissipation in Tr1 when shorted is going to be around 18W which is pushing things a bit! However, it should be pointed out that the protection circuit is meant to handle safely the occasional accident and should not be subjected to studied abuse.

Well, the unit worked as built and is still helping to entertain Toby on long journeys.

Postscript

We would consider this circuit rather dubious if it were to be used as a test-bench supply for general experimenting. In this type of environment a supply ought to be able to cope safely with all forms of overload conditions for quite long periods. At least the supplies we use have to possess these characteristics if they are to survive! However, we feel that the simple short-circuit protection we have used is all that is required in this application.

Next month our authors will deal with another little problem found around a car. The courtesy light that goes out just at the wrong moment!

KINDLY NOTE!

ATOMIC TIME RECEIVER

August 1977

Readers have requested more detailed information on the Mullard RM6 coil assembly used for T1 in this project. Reference numbers are:—Bobbin DT2517 Cores (2 off) LA4145: Clip (2 off) DT2398: Adjuster LA1501. The wire used is 30SWG enamelled copper.

SO YOU WANT TO PASS THE RAE?—1

September 1977

The RSGB has informed us that since the above article went to press the prices of their publications mentioned in the article have been increased. The "A Guide to Amateur Radio" is now £1·38, "The Radio Amateurs' Examination Manual is £1·60 and the "Radio Amateurs' Examination Revision Notes" is 86p. These prices are inclusive of postage.

PP3/PP9 REPLACEMENT MAINS UNIT

Japanese made in plastic container with leads size 2" × 1½" × 1½", this is ideal to power a calculator or radio, it has a full wave rectified and smoothed output of 9 volts suitable for a loading of up to 100mA. £2·53.

SWITCH TRIGGER MATS

Wiring dig supplied for complete house protection—'Keep Those Robbers Away'.

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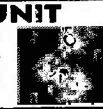
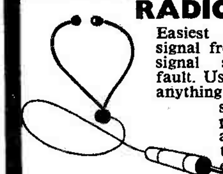
Electronically changes speed from approximately 10 revs to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. £3·45 including post & VAT. Made up model £1·00 extra.

SOUND TO LIGHT UNIT



Add colour or white light to your amplifier. Will operate 1, 2 or 3 lamps (maximum 450W). Unit in box all ready to work. £7·95 plus 95p VAT & Postage.

RADIO STETHOSCOPE



Easiest way to fault find, traces, signal from aerial to speaker, when signal stops you've found the fault. Use it on Radio, TV, amplifier, anything. Complete kit comprises two special transistors and all parts including probe tube and crystal earpiece, £2·95, twin stetho-set instead of earpiece. £1·00 VAT and postage incl.

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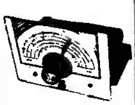
SHORTWAVE CRYSTAL SET



Although this uses no battery it gives really amazing results. You will receive an amazing assortment of stations over the 19, 25, 29, 31 metre bands. Kit contains chassis front panel and all the parts £1·90—crystal earphone 55p including VAT and postage.

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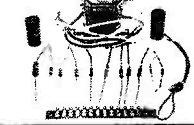

Designed to operate transistor sets, and amplifiers full wave and half wave working—output adjustable from 45v to 15v up to 300mA—Kit with full constructional data £2·06

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AMPLIFIER PANEL

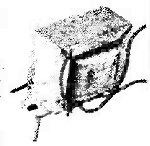
6 photo sockets and d.p. changeover slide switch all mounted on insulating board. Glossy black finish size 2" × 8¼" approx.—silly price 35p, or £1 for six.

—THIS MONTH'S SNIP—

BREAKDOWN PARCEL—

four unused made for computer units containing most useful components, and these components unlike those from most computer panels, have wire ends of easily usable length. The transistors for instance have leads over 1" long, the diodes have approx. ½" leads. List of the major components is as follows: 17 assorted transistors, 38 assorted diodes, 60 assorted resistors and condensers, 4 gold plated plugs in units which can serve as multipin plugs or as hook up boards for experimental or quickly changed circuits (note we can supply the socket boards which were made to receive these units). The price of this four units parcel is £1 including VAT and post (considerably less than value of the transistor or diodes alone). Don't miss this splendid offer.

MAINS TRANSFORMER BARGAINS



20v ½ amp	£1·25
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100 watt Auto 115v	£1·75

REVOLUTION COUNTER

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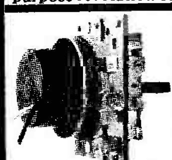

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IT'S FREE

Our monthly Advance Advertising Bargains List gives details of bargains arriving or just arrived—often bargains which sell out before our advertisement can appear—it's an interesting list and it's free—just send S.A.E. Below are a few of the Bargains still available from previous lines.

SPECIAL NOTES: The "+" sign after the amount shows the amount of VAT. The postage item shown is based upon the amount an article costs to send if this same article formed a part of a larger parcel. Where one or only a few items are ordered however you must send the minimum parcel postal charge of 50p+VAT and the VAT rate would be 8% or 12½% depending upon whether the article ordered was rated at 8% or 12½% (that is the Customs and Excise rule).

Nearly Sold out. Car Starter Charger kits—we have been able to get a few more of the rectifiers which made this kit possible at a very low price but had to pay more for these and with the increased postal charges, price of this is now £7·95. It is still a bargain, however, and it is interesting to note the various uses to which our customers have put this kit. One wrote in to say that he started his old Bentley with it, apparently it was almost impossible to turn over by hand but started quite quickly with our car starter. Another customer writes to say that fitted on to his electric lawn mower, the battery of which had worn out, he now uses the car starter to drive the mower instead of the battery. We like to hear about the uses found for our various kits and welcome hints and suggestions from customers.

Automatic Telephone Exchange, this takes standard GPO instruments which can dial each other, up to 75 telephones can be interconnected. Believed to be in good working order in fact it was working until removed recently from a Bank by the builders doing alterations. The exchange which is floor standing is full of relays and uniselector switches and has a separate power units supply for the 50v AC bells and the DC for speech. Price of this exchange is £250, carriage at cost, telephones are not included in this price but are available. Prices £3 + 24p or new style £5 + 40p.

Tubes for Rigonda 6" TV's. Limited quantity of these are available, used but tested and guaranteed o.k. Price £7·50 + 94p. Post £1·50 + 18p.

Power Units for Rigonda 6" T.V. Again not new but tested and guaranteed. Price £3·50 + 44p. Post 40p + 4p.

Fan Motor, mains operated, this is totally enclosed and therefore suitable for extracting dusty or corrosive vapours, good maker, specifications as follows: 1300 rpm, 240v, 50hz, 7w. Spindle is threaded to take the fan blade, no doubt could be adapted. £1·50 + 12p. Post 60p + 5p.

12v Battery Motor. Delco, as used for blower heaters, fans etc. This is very powerful but quite compact, size 3" long × 2½" dia. with central fixing flange and ¼" spindle. this is a series wound motor so it will also work off AC and can be made reversible by bringing out the internal brush connections to a d.p. changeover switch. Price £2·00 + 16p. Post 50p + 4p.

"C" Core Transformer, primary tapped 115v, 200v, 240v, primary screen to separate tag and 4 secondaries. (1) is 50-0-50v @ ·9A (2) 17volts ·7A (3) 17volts ·7A (4) 20volts @ ½A. It will be seen that by interconnecting it could be made to give 50v-0-50v at 900mA, a useful transformer for high power amplifiers etc. Ex equipment but guaranteed perfect £3·75 + 28p. Post £1·00 + 8p. The makers price of this is over £10.

Professional Scotch Tape on 10½" spool (these having the normal ½" spindle). We understand that this spool is standard for most popular professional reel to reel tape recorders. This is first class tape normally priced at over £9 per reel. We have limited number, brand new and unused. Price £4·50 + 36p. Post 50p + 5p.

Ex G.P.O. Telephones. We have recently had to replace our stocks of these and like everything else the prices are up so we take this opportunity of revising our prices. Three types are available—standard desk model, this is the one with internal bell and dial, price £3·00 + 24p. Post £1·20p + 9p. Model 2 has the dial but no internal bell, price £2·00 + 16p. Post 80p + 7p. Model 3 has no dial but internal bell price £2·00 + 16p. Post £1·20p + 9p.

Sundries available. 50v transformer for ringing GPO type bells, price £2·00 + 16p. Post 40p + 3p. Twin connecting wire for telephones 100 metre coil, price £5·00 + 40p. Post 80p + 7p. Bakelite cased bells, so you can hear telephone when you are not in same room, price £2·50 + 20p. Post 50p + 4p.

Kymograph Brodie Starling, motor gear box type. This is a mains operated unit very solidly constructed in heavy cast iron case. It seems to be basically a motor with a variable speed gear box. The ouput speeds are quoted in mm per minute, on 9" diameter cylinder but the drive which is fitted to the device is normal ½" spindle and the speeds are selected by a knob on the front dial through which the knob rotates, is calibrated as follows: 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024. We are not at all sure to what purpose these machines were normally put and would welcome any information about them from readers. We have only a few, price £17·50 + £1·40p. Post £1·60 + 14p.

Interrupted Beam Switch Kit. This has been recently re-arranged and is suitable for operation by a normal light beam or an infra red beam. The kit consists photo electric cell, 2 transistors, relay and all the necessary resistors and condensors together with mounting board and tag strip. This is both useful and educational, price £2·00 + 16p. Post 50p + 4p.

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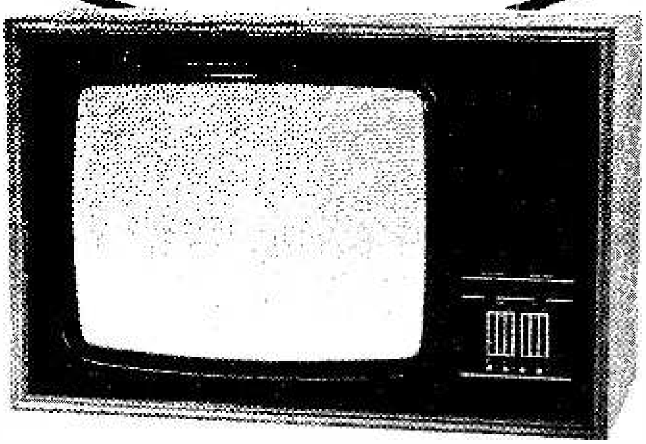

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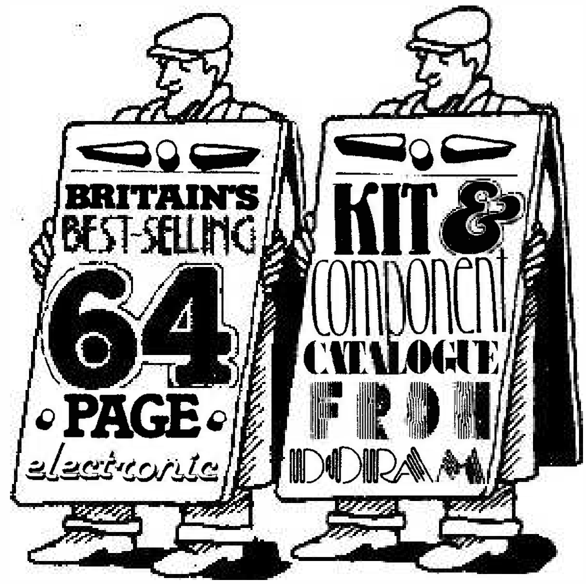

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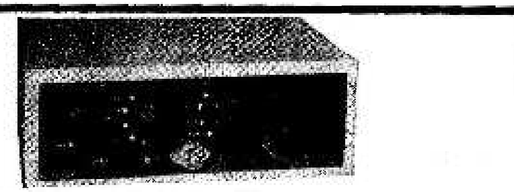

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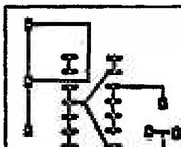

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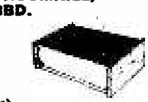

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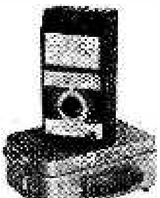

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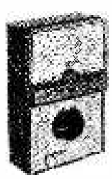

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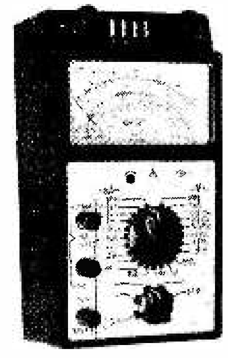

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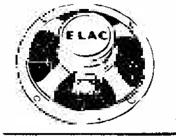

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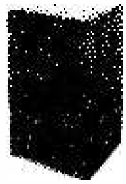

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Post £1
90-14,500 c/s, 12in. double cone, woofer and tweeter cone together with a BAKER ceramic magnet assembly having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 40 c/s rated 25 watts. NOTE: 4 or 8 or 16 ohms must be stated.

Module kit, 30-17,000 c/s with tweeter, crossover, baffle 19 × 12½in.
Please state 4 or 8 or 16 ohms. Post £1·60 **£19·00**

BAKER SPEAKERS "BIG SOUND"

Robustly constructed to stand up to long periods of electronic power. As used by leading groups.
Useful response 30-13,000 cps.
Bass resonance 55 cps.

GROUP "25" 12in. 30 watt 4, 8 or 16 ohms. **£12·00** Post £1
GROUP "35" 12in. 40 watt 4, 8 or 16 ohms. **£14·00** Post £1
GROUP "50/12" 12in. 60 watt professional model. 8 ohms or 16 ohms. **£21·00** Post £1·60
With aluminium presence dome.
GROUP "50/15" 15in. 75 watt 8 or 16 ohms. **£26·00** Post £1·60

Send for leaflets on Disco, P.A. and Group Gear.

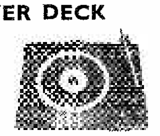
BAKER 150 WATT QUALITY TRANSISTOR MIXER/AMPLIFIER

Professional amplifier using advanced circuit design. Ideal for disco, groups, P.A. or musical instruments. 4 inputs 4 way mixing. Master treble, bass and volume controls. 3 speaker output sockets to suit various combinations of speakers. 4-8-16 ohm. Slave output. A/C mains. Guaranteed. Details S.A.E. 150w SLAVE VERSION £60.
£72 Carr. £1·00

100 WATT DISCO AMPLIFIER

MADE BY JENNINGS MUSICAL INSTRUMENTS **£59**
4 Speaker outputs volume, treble, bass, controls
CAN BE USED AS 100 WATT SLAVE Carr. £1

B.S.R. SINGLE PLAYER DECK



3 speed. Plays all size records. Stereo Cartridge. Cueing device. Ideal Disco Deck.
£13·50 Post 75p

DRILL SPEED CONTROLLER/LIGHT DIMMER KIT. Easy to build kit. Will control up to 500 watts AC mains. Post 35p **£3·25**

STEREO PRE-AMP KIT. All parts to build this pre-amp. 3 inputs for high medium or low gain per channel, with volume control and P.C. Board. Can be ganged to make multi-way stereo mixers. Post 35p **£2·95**

P.W. SOUND TO LIGHT DISPLAY

Complete kit of parts with R.C.S. printed circuit. Three channels. 800 to 1,000 watts each.
As featured in Practical Wireless.
Cabinet extra £3. Price **£14·00**

200 Watt Rear Reflecting White Light Bulbs. Ideal for Disco Lights. Edison Screw Fitting 75p. Each.

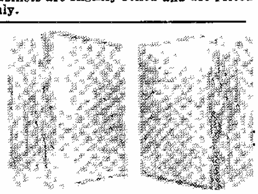
MAINS TRANSFORMERS Post 50p

6 VOLT ½ AMP. £1·00 3 AMP. £1·40
12 VOLT 300 MA. £1·00 750 MA. £1·30
30 VOLT 5 AMP. AND 34 VOLT 2 AMP. C.T. £3·45
20 VOLT 1 AMP. £2·00 3 AMP. £2·20 20-0-20 VOLT 1 AMP. £2·95
30 VOLT 1½ AMP. £2·50 40 VOLT 2 AMP. £2·95
0-20-40-80 VOLT 1 AMP. £3·50 2 × 18 VOLT 6 AMP. £1.

PERIOD LOUDSPEAKER CABINETS

Two styles available. Regency and Queen Anne. Size approximately 34 × 19 × 16in. Then cabinets are slightly soiled and are priced from £10 each. Callers only.

R.C.S. BOOKSHELF SPEAKERS



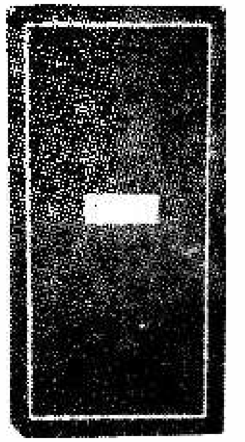
13 × 10 × 6in.
50 to 14,000 cps.
8 watts rms. 8 ohms
£16 pair Post £1·30

BAKER DISCO SPEAKERS

HIGH QUALITY—BRITISH MADE

2 x 12" CABINETS

For Disco or PA all fitted with carrying handles and corners. Black vynide covered. Other cabinets in stock SAE for leaflet



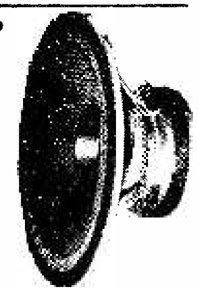
50 WATT R.M.S. £52 Carr. £3

70 WATT R.M.S. £56 Carr. £3

100 WATT R.M.S. £69 Carr. £4

1 x 15" + 1 x 12" 100 WATT CABINET
Size 36" x 24" x 15" £75·00. Carr. £5
Ideal for Disco, Organ or PA work.
High quality. Full range.

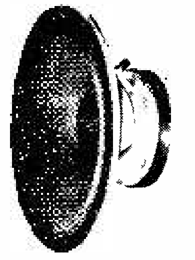
"SUPERB HI-FI"



12in 25 watts

A high quality loudspeaker, its remarkable low cone resonance ensures clear reproduction of the deepest bass. Fitted with a special copper drive and concentric tweeter cone resulting in full range reproduction with remarkable efficiency in the upper register.
Bass Resonance 25cps
Flux Density 16,500 gauss
Useful response 20-17,000cps
8 or 16 ohms models.
£22·00 Post £1·60

"AUDITORIUM"



12in. 35 watts

A full range reproducer for high power. Ideal for Hi-Fi and Discotheques. Electric Guitars, public address, multi-speaker systems, electric organs.
Bass Resonance 35cps
Flux Density 15,000 gauss
Useful response 25-16,000cps
8 or 16 ohms models.
£21·00 Post £1·60

"AUDITORIUM"

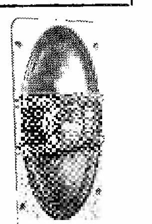
15in. 45 watts

A high wattage loudspeaker of exceptional quality with a level response to above 8,000 cps. Ideal for Public Address, Discotheques, Electronic instruments and the home Hi-Fi.
Bass Resonance 35cps
Flux Density 15,000 gauss
Useful response 20-14,000cps
8 or 16 ohms models.
£26·00 Post £1·60

Loudspeaker Cabinet Wadding 18in wide, 20p per ft.

Hi-Fi Enclosure Manual containing plans, designs, crossover data and cubic tables, 68p.

E.M.I. 13½ × 8in SPEAKER SALE!



With tweeter. And crossover. 10W. State 3 or 8 ohm. As illustrated. **£7.95** Post 45p
15W model 8 ohms. **£10·50** Post 65p
20W model 4 or 8 or 15 ohms. **£11.50** Post 65p

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