JUNE 1978

practical WIRELESS

45p

Australia 85c
New Zealand 85c
South Africa 80c
Malaysia $2·25

The PW 'BOVINGTON' TANK BATTLE GAME

ALSO:- SIMPLE DARKROOM TIMER
STATESIDE CALLING

ISSUE 856

practical WIRELESS

JUNE 1978 · VOLUME 54 · NUMBER 2

BRITAIN'S LEADING JOURNAL FOR THE RADIO & ELECTRONIC CONSTRUCTOR

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News and Views

For our Constructors

General Interest

Extra

THERMOSTATS

Refrigeration as illustrated with 36" capillary **£1·62.**

Limpet Stat must be mounted in close calibrated 90°–190°F 15 amp contact **£1·62.**

Appliance Stat fix like a volume control—15 amp contact 30°–80°F **85p.**

ditto but for high temps **£1·25.**

Oven Stat—with sensor and capillary **85p.**

MAINS OPERATED SOLENOIDS

Model TT2—small but powerful 1in. pull—approx. size 1½ × 1½ × 1½in. **£2·00.**

Model 4001/—¾in. pull. Size 2¾ × 2 × 1½in. **£2·50.**

Model TT10—1½in. pull. Size 3 × 2½ × 2in. **£4·50.**

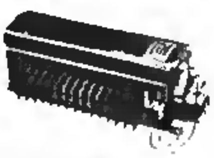
Prices include VAT & postage.

DELAY SWITCH

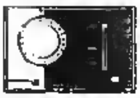
Mains operated—delay can be accurately set with pointers knob for periods of up to 2½ hrs. 2 contacts suitable to switch 10 amps—second contact opens few minutes after 1st contact **95p.**

MOTORISED DISCO SWITCH

With 10 amp change-over switches. Multi adjustable switches are rated at 10 amps. This would provide a magnificent display. For mains operating. 8 switch model £5·25. 10 switch model £5·75. 12 switch model £6 75.



SMITHS CENTRAL HEATING CONTROLLER



Push button gives 10 variations as follows. (1) continuous hot water and continuous central heating (2) continuous hot water but central heating off at night (3) continuous hot water but central heating on only for 2 periods during the day (4) hot water and central heating both on but day time only (5) hot water all day but central heating only for 2 periods during the day (6) hot water and central heating on for 2 periods during the day time only—then for summer time use with central heating off (7) hot water continuous (8) hot water day time only (9) hot water twice daily (10) everything off. A handsome looking unit with 24 hour movement and the switches and other parts necessary to select the desired programme of heating. Supplied complete with wiring diagram. Originally sold we believe at over **£15.** We offer these while stocks last at £6·95 each INCLUDING VAT and Postage.

LOW R.P.M. MOTORS

Made by Crouzet—Smiths—SAIWA—Venner and similar famous companies—all supplied ready for 230/240v 50hz mains working at £2·75 each. Following speeds in stock when preparing this advert.

1 rev per day — 6 rev per day
1 rev per hour — 12 revs per hour
1 rev per min
2 rpm — 1½ rpm
4 rpm — 15 rpm — 16 rpm — 25 rpm — 30 rpm

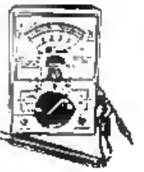
EXTRACTOR FAN

Ex computers—made by Woods of Colchester, ideal for fixing through panel—reasonably quiet running—very powerful 2500 rpm. Choice of two sizes 5" or 6½" dia. £5 and £6.

FLUORESCENT TUBE INVERTOR

For camping – car repairing – emergency lighting from a 12v battery you can't beat fluorescent lighting. It will offer plenty of well distributed light and is economical. We offer invertor for 21" and 13 watt miniature tube for only £3·75 with tube and tube holders as well.

MINI-MULTI TESTER



Amazing, deluxe pocket size precision moving coil instrument—jewelled bearings—10000opv—11 instant ranges measure:—

DC volts 10, 50, 250, 10000.

AC volts 10, 50, 150, 1000.

DC amps 0–1 mA and 0–100 mA Continuity and resistance 0–150K ohms.

Complete with insulated probes, leads, battery, circuit diagram and instructions.

Unbelievable value only **£6·90**

FREE

Amps ranges kit enable you to read DC current from 0–10 amps directly on the 0–10 scale. It's free if you purchase quickly but if you already own a mini tester and would like one send £1·50.

MULLARD UNILEX

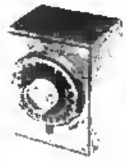
A mains operated 4+4 stereo system. Rated one of the finest performers in the stereo field this would make a wonderful gift for almost anyone in easy-to-assemble modular form and complete with a pair of Plessey speakers this should sell at about £30—but due to a special bulk buy and as an incentive for you to buy this month we offer the system complete at only **£15** including VAT and postage.

UNISELECTORS

These are pulse operated switches as used in automatic telephone switchboards etc. The pulse moves the switch arm through one position. Except where indicated the selectors are 25 position types and 50v Coil is standard. 24v or 12v operation extra at £2 per switch.

3 pole	£4·80	4 pole	£5·84
6 pole	£7·62	8 pole	£8·72
10 pole	£10·80	12 pole	£12·96
3 pole 50 way	£16·50	4 pole 50 way	£12·74

24 HOUR TIMERS



The one illustrated is 'E' controls this uses the Smiths mechanism as in their autoset. 2 On/off's per 24 hours 13 amp contacts. override switch **£8·50.** Smiths 100 amp model one on/off per 24 hours **£16·56,** extra contracts **£1·08** per set. AEG 60 amp model with clockwork standby, one on/off per 24 hours **£9·50,** extra contacts **£1·08** per set

INDUCTION MOTORS

One illustrated is our reference MM11 made for ITT ¾" stack 1½" spindle £2·25. ¾" stack model £1 75. 1" stack £2·75. 1½" stack £3 25.

MAINS TRANSFORMERS

6v 1 amp £1·00. 12v ½ amp £1·00. 20v ½ amp 20w auto 230v £1·50. 18v ½ amp £1 75. 6·3v 2 amp £1·75. 25v 1½" amp £2·25. 24v 2 amp £2·50. 50v 2 amp £4 50. 9v 1 amp £1·50. 8·5v–0–8 5v ½ amp £1·50. 100w auto 230–115v £2·00. 5·5kv £9·50.

Many more, send for list.

MULLARD AUDIO AMPLIFIERS

All in module form, each ready built complete with heat sinks and connection tags, data supplied. Model 1153 500mW power output £1·50 including Post & VAT.

Model 1172 1W, power output £1 85 including Post & VAT.

Model EP9000 4 watt power output £2·90 including Post & VAT. EP 9001 twin channel or stereo pre-amp £2 90 including Post & VAT.

THIS MONTH'S SNIP

Japanese made FM tuner and matching decoder. Two items for less than average price of the tuner only **£11·20** the two. Don't miss this, stocks will not last long. Wooden case with glass dial **£15·50.**

RELAYS

12 volts two 10 amp changeover plug in **85p.** 12v three 10 amp changeover plug in **£1·20.** 12v two changeover miniature wire ended **95p.** 12 volt open single screw fixing two 10 amp changeovers **65p.** 12 volt open three 10 amp changeovers £1·25. Latching relay mains operated 2 c/o contacts **£2·11.** Mains operated three 10 amp changeovers open type one screw fixing **£1·25.** Many other types with different coil voltages and contact arrangements are in stock, enquiries invited.

MICRO SWITCH BARGAINS

Rated at 5 amps 250 volts. Ideal to make a switch panel for a calculator and for dozens of other applications.

Parcel of 10 for £1·00. VAT and post paid.

25A ELECTRIC PROGRAMMER

Learn in your sleep. Have radio playing and kettle boiling as you wake—switch on lights to ward of instruders—have a warm house to come home to. All these and many other things you can do if you invest in an electrical programmer. Clock by famous maker, with 15 amp on/off switch. Switch-on time can be set anywhere to stay on up to 6 hours. Independent 60 minute memory jogger. A beautiful unit. Price **£2·95.** VAT and postage 50p, or with glass front, chrome bezel £1·50 extra.

Terms. Prices include Post & VAT. But orders under £6·00 please add 50p to offset packing. Bulk enquiries – Please Phone for Generous Discounts 688 1833.

J. BULL (ELECTRICAL) LTD

(Dept. P.W.), 103 TAMWORTH RD. CROYDON CR9 1SG

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 lists.

MAINS TRANSFORMERS

All these have 230/240v 50Hz Primary

VOLTAGE	CURRENT	REF.	PRICE
1v	2 amp	TM 1	£1·84
2 4v	5 amp	TM 2	£1·62
4v	7 amp	TM 32	£2·78
6v	½ amp	TM 3	85
6·5v	½ amp	TM 37	85
6·5v	200 ma	TM 21	£1·62
6·5v–0–6 5v	100mA	TM 21	£1·82
6·5v–0–6·5v	750mA	TM 7	£2·16
6·3v–0–6·3v	100mA	TM 33	£1·82
6·3v	2 amp	TM 4	£1·89
8·5v	1 amp	TM 12	£1·62
8·5v + 8·5v sep winding	½ amp	TM 12	£1·62
9v	½ amp	TM 5	£1·62
9v	1 amp 'c' core	TM 6	£1·59
9v	3½ amp	TM 11	£2·78
9v	5 amp	TM 38	£3·24
10v	25 amp	TM 15	£4·86
10v–0–10v	12½ amp	TM 15	£4·86
12v–0–12v	4 amp	TM 27	£4·32
12v	½ amp	TM 9	£1·85
13v	½ amp	TM 7	£2·16
12v	1 amp	TM 10	£1·89
12v–0–12v	50mA	TM 19	£1·62
14v–0–12v	1 amp	TM 41	£3·24
18v tapped 9v	2 amp	TM 11	£2·78
15v	7 amp	TM 27	£4·32
15v–0–15v	3½ amp	TM 27	£4·32
15v–0–15v	3½ amp	TM 35	£4·86
17v	½ amp	TM 12	£1 62
18v	½ amp	TM 13	£1 99
20v	½ amp	TM 14	£1·62
20v	5 amp	TM 27	£4 32
20v	12½ amp	TM 15	£4 86
20v–0–20v	8 amp	TM 15	£4 86
13v	100mA	TM 21	£1·62
24v	1½ amp	TM 16	£2·12
24v	2 amp	TM 17	£2 78
24v + 2v 7 amp	2 amp	TM 39	£2 97
24v	4 amp	TM 40	£3·78
25v	1½ amp	TM 18	£2 43
26v	2 amp	TM 39	£2·86
30v tapped 24, 20, 15 & 12	3½ amp	TM 27	£4·32
30v	5 amp	TM 15	£4·86
37v	37 amp	TM 34	£21 50
40v tapped at 30v, 20v & 10v	8 amp	TM 15	£4·86
50v–2 amp with 6·3v shrouded		TM 22	£4·88
50v	8 amp	TM 29	£11 85
60v	5 amp	TM 24	£7 82
75v–3 amp with 6·3v shrouded		TM 23	£8 10
75v	4½ amp	TM 24	£7 82
80v tapped 60v & 75v	4 amp	TM 24	£7·82
100v	1 amp	TM 25	£7·62
100v–0–100v	½ amp	TM 25	£7·62
130v tapped 120v	½ amp	TM 28	£3·78
200v	½ amp	TM 25	£7 62
250v–0–250v with 6·3v 2A	50 mA	TM 36	£3 78
250v	100 mA	TM 36	£3 78
500v	50mA	TM 36	£3·78

330mA 6 Volt Mains Unit. Ideal for power 6 volt equipment, cassettes, tape recorder or amplifier or other appliances requiring more than the average amount of current. This is a really well made unit in plastic case made for Crown Radio intended originally to clip into position, this has external battery type contacts but it is a simple matter to solder leads straight onto these contacts and this unit employs full wave rectification and is recommended in every way. Price £4·30

Calculators. By famous makers like Texas, intended originally to be sold at quite high prices new and unused. **Type 1.** Basic functions—add, subtract, multiply, divide etc. Price £5·15. **Type 2.**—again basic functions but with rechargeable nicad batteries. Price **£7·92. Battery Chargers** for same **£2·78. Type 3.**—basic functions but with memory **£9·18. Type 4**—basic functions, memory and rechargeable batteries, Price £11·34 + 84p.

AM/FM Radio. Complete chassis, has tuning scale with pointer, volume control, on/off etc. Controls have edgewise knobs. These radios can be mounted on or just inside extension speaker, then you have a first class "music while you work" receiver. Reception on both AM-FM is better than average and even in areas where FM is notoriously bad, good results have been obtained. The output also is above average, the speaker power is probably around 1½—2 watts. They can be powered by 6v batteries or 6v power supply, in fact the Crown Radio one mentioned above is ideal, would no doubt function as an AM/FM Tuner—real bargain at **£5·50** + 59p.

UV Tubes (Philips Atinic). Useful for bringing out water marks in stamps and special colours in rocks, similar specimens. We have these in two sizes 9" 6w price **£1·50** + 12p. Post 50p + 4p. 2ft 20 watt **£2·90** + 16p. Post 75p + 6p.

1 Pole 10 Way Switch. For digital displays the 10 positions being evenly spaced through the 360 turn, and there is no stop. Silver plated contacts are rated at 5 amps, normally an expensive switch but offered at **55p** each.

Morse Key. This is well designed, fully adjustable key, suitable for beginners. Our Ref. MK1. Price **£1·19.**

Professional Morse Key. Heavy cast base of metal construction, this is high speed key with fine adjustments. Price £3·35. Our Ref. MK2.

Terminals. Very good quality, British made, screw down type, top accepts a 4mm plug. The screw down section also has a hole through which solid wire may be passed, with insulators for metal panel mounting, 5 popular colours. Price **15p** each, Ref. TS1, or 10 in bag for **£1·30.** Ref. TS1/10.

Spring Trigger Terminals. Red and black terminals mounted on insulated panel approximate size 2½" × 1". These terminals grip like a vice but connection in the first place is quick and simple. Hold back the trigger—push in wire—let go of trigger, definitely a time saver. Price **54p** the pair.

Skeleton Pre-Set. Miniature size 2·2k, 10 for **£1·00** + 12½p. **Relay Base.** 14 pin standard for many plug-in relays **50p** + 4p.

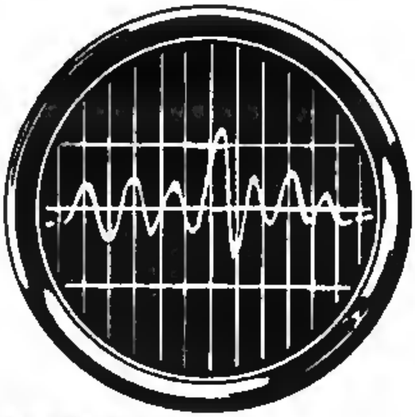
AC Mains Relay. Plug in to standard base, three 10 amp changeover contacts. Price **£1·06** + 14p. but 2 × 10 amp c/o contacts **£1·26,** bases **35p** extra.

Heavy Duty 12v Relay. This has 3 pairs of changeover contacts which are rather bigger than usual and look capable of dealing with 15 amp loads.

Ditto but 6 Volt Coil. Price **£2·16** + 16p.

LOOK! Here's how you master electronics.

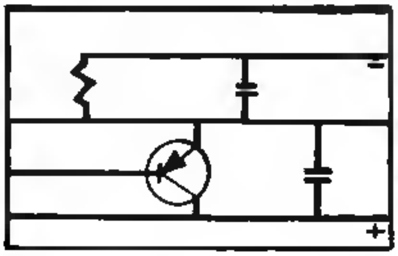
....the practical way.

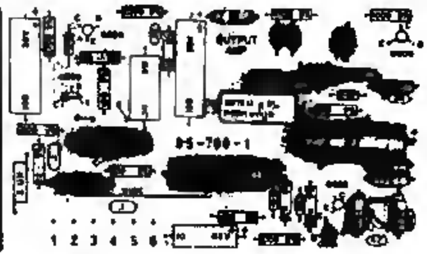


This new style course will enable anyone to have a real understanding of electronics by a modern, practical and visual method. No previous knowledge is required, no maths, and an absolute minimum of theory.

You learn the practical way in easy steps mastering all the essentials of your hobby or to further your career in electronics or as a self-employed electronics engineer.

All the training can be carried out in the comfort of your own home and at your own pace. A tutor is available to whom you can write, at any time, for advice or help during your work. A Certificate is given at the end of every course.





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, computors and countless other electronic devices and their servicing procedures.

3 Carry out over 40 experiments on basic circuits.

We show you how to conduct experiments on a wide variety of different circuits and turn the information gained into a working knowledge of testing, servicing and maintaining all types of electronic equipment, radio, t.v etc.

All students enrolling in our courses receive a free circuit board originating from a computer and containing many different components that can be used in experiments and provide an excellent example of current electronic practice.

Free!

To find out more about how to learn electronics in a new, exciting and absorbing way, just clip the coupon for a free colour brochure and full details of enrolment.

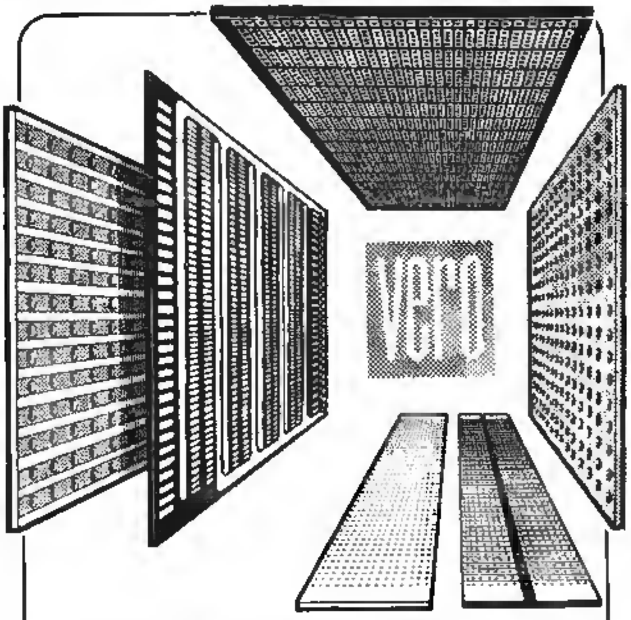
British National Radio & Electronic School

P.O. Box 156, Jersey, Channel Islands.

NAME ____________________

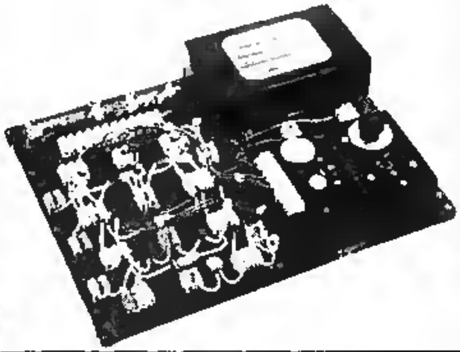
WB 6 ADDRESS ____________________

____________________ Block caps please



VERO

RADIO EXCHANGE LTD.



NEW ELECTRONIC MASTER KIT

WITH SPECIAL V.H.F. TUNER MODULE TO CONSTRUCT. A completely Solderless Electronic Construction Kit, with ready drilled Bakelite Panels, Nuts, Bolts, Wood Screws etc. Also in the kit: Transistors, Capacitors, Resistors, Pots, Switches, Wire, Sleeving, Knobs, Dials, 5" × 3" Loudspeaker and Speaker Case, Crystal Earpiece, etc. Also ready wound Coils and Ferrite Rod Aerial. These are the Projects you can build with the components supplied with the kit, together with comprehensive Instruction Manual Pictorial and Circuit Diagrams.

PROJECTS: V.H.F. Tuner Module ★ A.M. Tuner Module ★ M.W. L.W. Diode Radio ★ Six Transistor V.H.F. Earpiece Radio ★ One Transistor M.W. L.W. Radio ★ Two Transistor Metronome with variable beat control ★ Three Transistor and Diode Radio M.W. L.W. ★ Four Transistor Push Pull Amplifier ★ Eight Transistor V.H.F. Loudspeaker Receiver ★ Variable A.F. Oscillator ★ Jiffy MultiTester ★ Four Transistor and Diode M.W. L.W. Radio ★ A.F. R.F. Signal Injector ★ Five Transistor Push Pull Amplifier ★ Sensitive Hearing Aid Amplifier ★ Three Transistor and Diode Short Wave Radio ★ Signal Tracer ★ Three Transistor Push Pull Amplifier ★ One Transistor Class A Output Stage to drive Loudspeaker ★ Sensitive Transistor Pre-Amp ★ Transistor Tester ★ Sensitive Three Transistor Regenerative Radio ★ Four Transistor M.W. L.W. and Diode Tuner ★ Five Transistor M.W. L.W. Trawler Band Regenerative Radio ★ Five Transistor V.H.F. Tuner ★ Three Transistor Code Practice Oscillator ★ Five Transistor Regenerative Short Wave Radio ★ Four Transistor and two Diodes M.W. L.W. Loudspeaker Radio ★ Seven Transistor M.W. L.W. Radio with Loudspeaker Push Pull output ★ One Transistor Home Broadcaster.

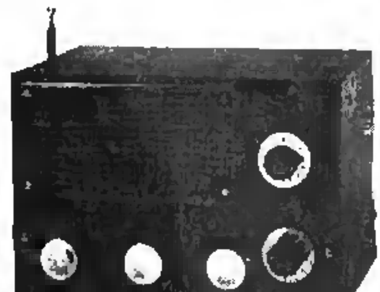
£14·99 + P & P £1·10

NEW ROAMER TEN MODEL R.K.3

MULTIBAND V.H.F. AND A.M. RECEIVER.
13 TRANSISTORS AND SIX DIODES. QUALITY 4" ROUND LOUDSPEAKER.

WITH Multiband V.H.F. section covering Mobiles, Aircraft, T.V. Sound, Public Service Band, Local V.H.F. Stations, etc. and Multiband A.M. section with Airspaced Tuning Capacitor for easier and accurate tuning, covering M.W.1, M.W.2, L.W. Three Short Wave Bands S.W.1, S.W.2, S.W.3 and Trawler Band. Built-in Ferrite Rod Aerial for Medium Wave, Long Wave and Trawler Band, etc., Chrome Plated 7 section Telescopic Aerial, angled and rotatable for peak Short Wave and V.H.F. reception. Push-Pull output using 600mW Transistors. Gain, Wave-Change and Tone Controls. Plus two Slider Switches. Powered by P.P.9—9 volt Battery.

Complete kit of parts including carrying strap. Building Instructions and operating Manuals. **£14·79** + P & P £1·10



NEW MODEL R.K.1

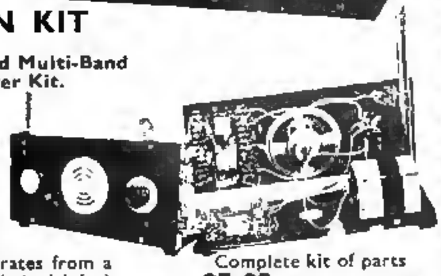
MultiBand A.M. Receiver. M. W. L. W. Trawler Band and Three Short Wave Bands Seven Transistors and Four Diodes. Push Pull Output stage. 5" × 3" Loudspeaker. Internal Ferrite Rod Aerial. Kit includes all parts to build it up including Carrying Strap, Rubber Feet and ready-drilled Panels. Comprehensive Instruction Manual for stage by stage construction. Uses P.P.9 Nine Volt Battery.

£8·99 + P & P 90p

ELECTRONIC CONSTRUCTION KIT

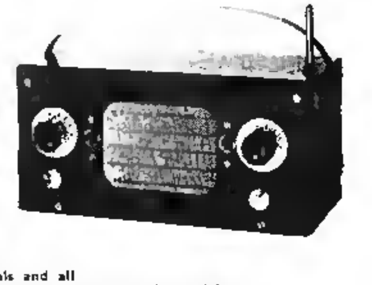
E.C.K. 2 **Self Contained Multi-Band V.H.F. Receiver Kit.**

8 transistors and 3 diodes. Push pull output. 3in. loudspeaker, gain control, 7 section chrome plated telescopic aerial V.H.F. tuning capacitor, resistors, capacitors, transistors, etc. Will receive T.V. sound, public service band, aircraft, V.H.F. local stations, etc. Operates from a 9 volt P.P. 7 battery (not supplied with kit)



Complete kit of parts
£7·95 + P & P and Ins. 90p

NEW MODEL R.K.2



MW, LW and Air Band Receiver. Eight Transistors and Four Diodes. 3" Loudspeaker, Telescopic Aerial, Internal Ferrite Rod Aerial. Complete with Carrying Strap, and ready-drilled Panels and all components necessary for construction. A sensitive Receiver with the additional luxury of an Air Band section to pick up Aircraft from many miles away. Full Instruction Manual enables stage by stage construction. Uses P.P.9 and P.P.3 Nine Volt Batteries.

£9·99 + P & P £1 10

EDU-KIT MAJOR

COMPLETELY SOLDERLESS ELECTRONIC CONSTRUCTION KIT
BUILD THESE PROJECTS WITHOUT SOLDERING IRON OR SOLDER

Complete kit of parts including construction plans
Total building costs
£9·99
+ P & P and Ins. £1 10

- 4 Transistor Earpiece Radio
- Signal Tracer
- Signal Injector
- Transistor Tester NPN—PNP
- 4 Transistor Push Pull Amplifier
- 5 Transistor Push Pull Amplifier
- 7 Transistor Loudspeaker. Radio MW/LW.
- 5 Transistor Short Wave Radio
- Electronic Metronome
- Electronic Noise Generator
- Batteryless Crystal Radio
- One Transistor Radio
- 2 Transistor Regenerative Radio
- 3 Transistor Regenerative Radio
- Audible Continuity Tester
- Sensitive Pre-Amplifier

● 24 Resistors ● 21 Capacitors ● 10 Transistors ● 5" × 3" Loudspeaker ● Earpiece ● Mica Baseboard ● 3 12-way Connectors ● 2 Volume Controls ● 2 Slider Switches ● 1 Tuning Condenser ● 3 Knobs ● Ready Wound MW/LW/SW Coils ● Ferrite Rod ● 6½ yards of wire ● 1 yard of sleeving, etc.

E.V.6. PLUS ONE

Build this exciting new design. Now with 7 Transistors and 4 diodes. MW/LW. Powered by 9V battery. Ferrite rod aerial, tuning condenser, volume control, and now with 3in. loudspeaker. Attractive case with red speaker grille. Size 9in. × 5¼in. × 2¾in. approx. All parts including Case and Plans.

Total Building Costs **£6·95** + P & P and Ins. 90p

ALL PRICES INCLUDE VAT

V.H.F. AIR CONVERTER KIT

Build this converter kit and receive the aircraft band by placing it by the side of a radio tuned to medium wave or the VHF band and operating as shown in the instructions supplied free with all parts.

Uses a retractable chrome plated telescopic aerial, gain control, V.H.F. tuning capacitor, transistor, etc.

All parts including case and plans

£4·95 + P & P and Ins. 60p

To: RADIO EXCHANGE LTD
61A High Street, Bedford MK40 1SA
Tel.: 0234 52367 **REG NO. 788372**

- Callers side entrance "Lavells" Shop.
- Open 10-1, 2.30-4.30 Mon.-Fri. 9-12 Sat.

I enclose £................for.......

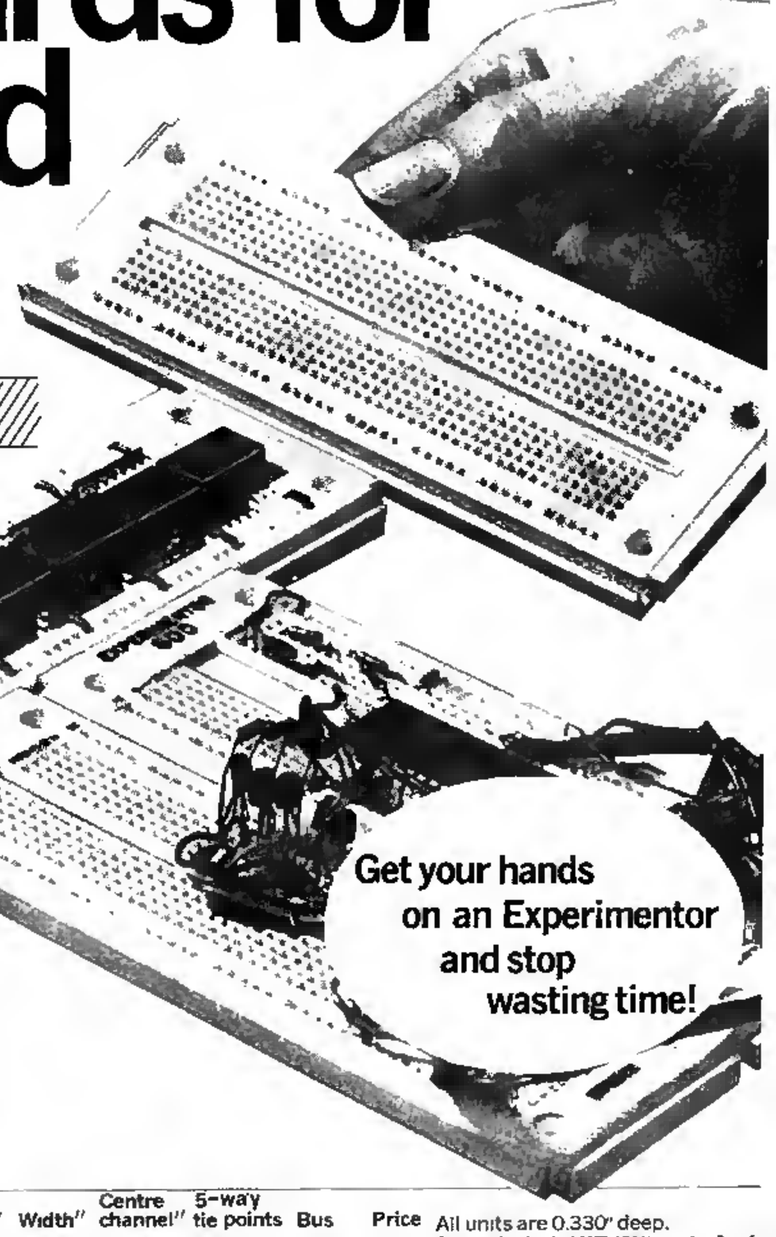
Name ....

Address ....

....

.... PW578

Mini-priced breadboards for maxi-sized projects.

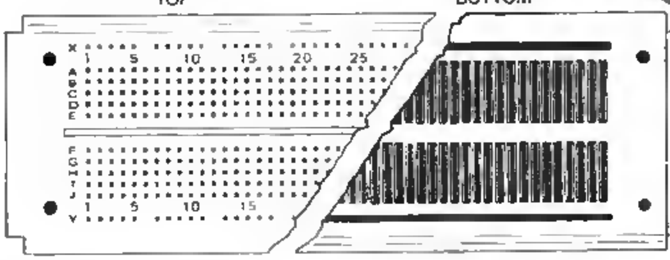


Experimentor* low-cost solderless breadboards are the first in the world specially designed for 0.3" and 0.6" pitch DIP's.


EXCLUSIVE INTERLOCKING SYSTEM.

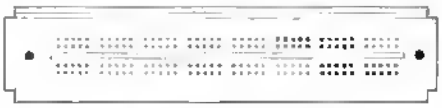
They clip together by an exclusive interlocking system in any configuration, (just like dominoes), so you arrange the breadboards to suit your circuit, not vice-versa.

They are precision moulded from durable, flame-retardant plastic, and feature alphanumeric coding for easy circuit building, and non-corrosive, pre-stressed nickel-silver alloy contacts—reliable for well over 10,000 insertions.



Contact resistance is a mere 0.4 mΩ and interterminal capacitance is typically less than 5 pF. The **Experimentor** is usable to over 100 MHz.

Experimentor 600 and 650 models are ideal for RAM's ROM's and PROM's (0.6" centre IC's) while the 300 and 350 models are for smaller DIP's (0.3" centres). All four models, of course, also take all standard components, the 0.1" grid being compatible with transistors, diodes, LED's, capacitors, resistors, pots—in fact any component with lead sizes between 0.015" and 0.032".



A useful quad bus strip (EXP4B) further expands the versatility of the system for the MPU user.

Model	Length"	Width"	Centre channel"	5-way tie points	Bus	Price
EXP300	6.0	2.1	0.3	94(470)	2(80)	£7·29
EXP350	3.6	2.1	0.3	46(230)	2(40)	£4·21
EXP600	6.0	2.4	0.6	94(470)	2(80)	£7·88
EXP650	3.6	2.4	0.6	46(230)	2(40)	£4·69
EXP4B	6.0	1.0	N/A	N/A	4(160)	£3·29

All units are 0.330" deep.
Prices include VAT (8%) and p & p fo
UK Orders.
Add 5% to all orders outside UK.
All prices and specifications correc
at the time of going to press.

Experimentor breadboards can be used alone or mounted on any convenient flat surface, thanks to moulded-in mounting holes and vinyl insulation backing that prevents short circuits. Mount them from the front with 4-40 flathead screws or from the rear with 6-32 self tapping screws.

But however you use them, **Experimentor** breadboards are the quickest and easiest way to build and test circuits.

If you're working on IC's, MPU's, memories, displays or any other circuits, buy the breadboards that are designed for you.

Ring us (01-890 0782) with your Access, Barclaycard or American Express numbe and your order will be in the post that ni

Alternatively, send a cheque, or postal order (don't send credit cards!) and it still only takes a few days.
Otherwise ask for our complete catalogu

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High quality audio modules for Stereo and mono

S450

STEREO FM TUNER
Fitted with phase lock-loop

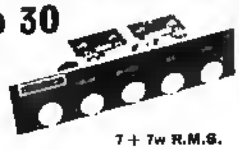
£22·30
+ 40p p&p
+ 12½% VAT

FREQUENCY RANGE	88–108 Mhz
SENSITIVITY	3·0 μV
BANDWIDTH	250 kHz
SPURIOUS REJECTION	50 dB
SELECTIVITY ± 400 kHz	55 dB
AUDIO OUTPUT (22·5 kHz deviation)	100 mV
STEREO SEPARATION	30 dB
SUPPLY REQUIREMENTS	20 to 30V (90mA max)
AERIAL IMPEDANCE	75 ohms
DIMENSIONS	240mm × 110mm × 32mm

The 450 Tuner provides instant programme selection at the touch of a button ensuring accurate tuning of 4 pre-selected stations, any of which may be altered as often as you choose, simply by changing the settings of the pre-set controls. Features include FET input stage. Vari-Cap diode tuning. Switched AFC LED Stereo Indicator.

Stereo 30

COMPLETE AUDIO CHASSIS



£18·95
+ 40 p&p
+ 12½% VAT

7 + 7w R.M.S.

OUTPUT POWER	7 Watts RMS
LOAD IMPEDANCE	8 ohms
TOTAL HARMONIC DISTORTION	Less than ·5% (Typically ·3%)
FREQUENCY RESPONSE	50 Hz to 20 kHz ± 3dBs
TONE CONTROL RANGE	± 12 dBs at 100Hz and 10kHz
SENSITIVITY	100 mV for full output
INPUT IMPEDANCE	1 M ohms
TRANSFORMER REQUIREMENTS	22 V.A.C. rated at 1A
DIMENSIONS (Less controls and panel)	200mm × 130mm × 33mm

The Stereo 30 comprises a complete stereo pre-amplifier, power amplifiers and power supply. This, with only the addition of a transformer or overwind will produce a high quality audio unit suitable for use with a wide range of inputs i.e. high quality ceramic pick-up, stereo tuner, stereo tape deck etc. Simple to install, capable of producing really first class results, this unit is supplied with full instructions, black front panel, knobs, main switch, fuse and fuse holder and universal mounting brackets.

AL60

25w R.M.S.

AUDIO AMPLIFIER MODULE 25 Watts RMS

£4·55 + 25p p&p
+ 12½% VAT

OUTPUT POWER	25 Watts RMS
SUPPLY	30–50 V
LOAD IMPEDANCE	8–16 ohms
TOTAL HARMONIC DISTORTION	Less than ·1% (Typically ·05%)
FREQUENCY RESPONSE	20 Hz to 30 kHz × 2 dBs
SENSITIVITY	250 mV for full output
MAX. HEAT SINK TEMPERATURE	90°C
DIMENSIONS	103mm × 64mm × 15mm

This high quality audio amplifier module is for use in audio equipment and stereo amplifiers and provides output powers up to 25 RMS with distortion levels below 0·1%.

AL80

35w R.M.S.

AUDIO AMPLIFIER MODULE

£7·15*
+ 25p p&p
+ 8% VAT

OUTPUT POWER	35 Watts RMS
SUPPLY	40–60 V
LOAD IMPEDANCE	8–16 ohms
TOTAL HARMONIC DISTORTION	Less than ·1% (Typically ·06%)
FREQUENCY RESPONSE	20 Hz to 30 kHz × 2 dBs
SENSITIVITY	260 mV for full output
MAX. HEAT SINK TEMPERATURE	90°C
DIMENSIONS	103mm × 64mm × 15mm

The AL80 is similar in design to the AL60 above and is of the same high quality but provides output powers up to 35W with distortion levels below 0·1%

AL250

125w R.M.S.

POWER AMPLIFIER

OUTPUT POWER	125 Watts RMS continuous
OPERATING VOLTAGE	50–80 V
LOADS	4–16 ohms
FREQUENCY RESPONSE	25 Hz 20 kHz measured at 100 Watts
SENSITIVITY FOR 100 WATTS O/P AT 1 kHz	450 mV
INPUT IMPEDANCE	33 K ohms
TOTAL HARMONIC DISTORTION	
50 WATTS into 4 ohms	0·1%
50 WATTS into 8 ohms	0·06%

£17·25* + 40p p&p + 8% VAT

This unit, designated AL250, is a power amplifier providing an output of up to 125W RMS, into a 4 ohm load.

AL30A

10w R.M.S.

AUDIO AMPLIFIER MODULES

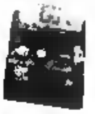
£3·75 + 25p p&p
+ 12½% VAT

MAXIMUM SUPPLY VOLTAGE	30 V
POWER OUTPUT for 2% THD	10 Watts RMS
TOTAL HARMONIC DISTORTION	Less than ·25%
LOAD IMPEDANCE	8–16 ohms
INPUT IMPEDANCE	100 K ohms
FREQUENCY RESPONSE	50 Hz–25 kHz ± 3 dBs
SENSITIVITY	75 mV for full output
DIMENSIONS	74mm × 63mm × 28mm

These low cost 8 and 10 watt modules offer the utmost in reliability and performance, whilst being compact in size.

SPM80

STABILISED POWER SUPPLY



£4·25 + 12½% VAT
+ 12½% VAT

INPUT A.C. VOLTAGE	33–40V
OUTPUT D.C. VOLTAGE	33 V nominal
OUTPUT CURRENT	10 mA–1·5 amps
OVERLOAD CURRENT	1·7 amps approx.
DIMENSIONS	105mm × 63mm 30mm

Designed to power two AL60s at 15 Watts per channel simultaneously. Circuit Techniques include full short circuit protection.

PA100

STEREO PRE-AMPLIFIER

£15·80
+ 40p p&p
+ 12½% VAT

FREQUENCY RESPONSE	20 Hz to 20 kHz × 1 dB	
TOTAL HARMONIC DISTORTION	Less than ·1% (Typically ·07%)	
SENSITIVITY INPUTS 1. TAPE	100 mV/100 K ohms	For an output 250 mV
2. RADIO TUNER	100 mV/100 K ohms	
3. MAGNETIC P.U.	3·5 mV/50 K ohms	
EQUALISATION	Within ± 1 dB from 20 Hz to 20 kHz	
BASS CONTROL RANGE	± 15 dBs at 75 Hz	
TREBLE CONTROL RANGE	+ 10–20 dBs at 15 kHz	
SIGNAL/NOISE RATIO	Better than 65 dBs (All inputs)	
INPUT OVERLOAD	Better than 26 dBs (All inputs)	
SUPPLY	20 to 40 V	
DIMENSIONS	300 × 90 × 33mm (less controls)	

A top quality stereo pre-amplifier and tone control unit, the PA100 provides a comprehensive solution to the front end requirements of stereo amplifiers or audio units. The six push button selector switch gives a choice of inputs together with two filters for high and low frequencies.

MPA30

MAGNETIC CARTRIDGE PRE-AMPLIFIER

£2·95
+ 25p p&p
+ 12½% VAT

Enjoy the quality of a magnetic cartridge with your existing ceramic equipment using the MPA 30 which is a high quality pre-amplifier enabling magnetic cartridges to be used where facilities exist for the use of ceramic cartridges only.

SENSITIVITY	3·5 mV for 100 mV output
EQUALISATION	Within ± 1 dB from 20 Hz to 20 kHz
INPUT IMPEDANCE	50 K ohms
SUPPLY	18 to 30 V—ve earth
DIMENSIONS	110 × 50 × 25mm (inc DIN socket)

PA12

STEREO PRE-AMPLIFIER

£7·10
+ 30p p&p
+ 12½% VAT

The PA12 Stereo Pre-Amplifier chassis is designed and recommended for use with the AL 20/30 Audio Amplifier Modules, the PS12 power supply and the T538 Transformer. Features include on/off volume, Balance, Bass and Treble controls. Complete with tape output.

FREQUENCY RESPONSE	20 Hz–20 kHz (—3dB)
BASS CONTROL	± 12 dB at 60 Hz
TREBLE CONTROL	± 14 dB at 10 kHz
INPUT IMPEDANCE	1 Meg. ohm
INPUT SENSITIVITY	300 mV
CROSSTALK	—60 dB
SIGNAL/NOISE RATIO	—65 dB
OVERLOAD FACTOR	± 20 dB
TAPE OUTPUT IMPEDANCE	25 K ohms
DIMENSIONS	152mm × 84mm × 25mm

PS12 POWER SUPPLY

Designed for use with the AL30A S.450 and MPA30 in conjunction with transformer T538.

INPUT VOLTAGE	17–20v AC
OUTPUT VOLTAGE	27–30v DC
OUTPUT CURRENT	800mA
SIZE	60mm 43mm × 26mm

£1·30
+ 25p p&p
+ 12½% VAT

GE 100 NINE CHANNEL MONO-GRAPHIC EQUALIZER

The GE100 has nine 1 octave adjustments using integrated circuit active filters. Boost and Cut limits are ± 12dB. Max Voltage handling 2 V RMS, T.H.D., 0·05%, input impedance 100K Output impedance less than 10 K. Frequency response 20 Hz–20 KHz (3dB). The nine gain controls are centred at 50, 100, 200, 400, 800, 1,600, 3,200, 6,400 and 12,800 Hz. The suggested gain controls are 10 K LIN sliders (not supplied with the module) See Paks S31 and 16192.

£22·00
+ 25p p&p
+ 12½% VAT

SG30 POWER SUPPLY BOARD for GE100 15-0-15 VOLT £5·50 + 12½% VAT + 25p p&p

SIREN ALARM MODULE

American Police screamer powered from any 12 volt supply into 4 or 8 ohm speaker. Ideal for car burglar alarm, freezer breakdown and other security purposes. Order No. S15. No. BP124.
Only £3·50 + 8% VAT + 25p p&p

MA60 HI-FI AMPLIFIER KIT

Build you own top quality amplifier, save yourself pounds. The MA60 kit comprises the following Bi-kits modules, 2 × AL60 amps, 1 × PA100 pre-amp, 1 × SPM80 stab. power supply, 1 × BMT80 transf. giving 17 watts RMS per channel STEREO. All modules covered by the BI-PAK satisfaction or money back guarantee. Details of the above modules are in this ad.
Price £32·60 + 12½% VAT + 68p p&p.

TC60 KIT

A beautifully designed genuine TEAK WOOD veneered cabinet to put the professional touches to your home built amplifier. Full set of parts incl. Front & Back Panels, Knobs, Chassis, Fuses, Sockets, Neon, etc. Ideal for the MA60, Size. 425mm × 290mm × 95mm
Price £19·95 + 12½% VAT + 86p p&p

TRANSFORMERS

T538 For use with S.450 AL30A MPA30
Order No 2031 Price: £3·30 + 68p p&p + 12½% VAT
T2050 For use with Stereo 30
Order No. 2030 Price: £3·28 + 68p p&p + 12½% VAT
BMT80 For use with AL60 SPM80
Order No 2034 Price: £5·40 + 68p p&p + 12½% VAT
BMT250 For use with AL250
Order No. 2035 Price: £8·35 + £1·10 p&p + 12½% VAT

BI-PAK

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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.

Crystal Gazing

IN a recent lecture entitled "Tomorrow's Broadcasting—The Technical Possibilities", Dr. Boris Townsend, head of the Engineering Information Service of the Independent Broadcasting Authority, highlighted some examples of the pitfalls in trying to forecast future developments in engineering. In 1924 for example, Campbell Swinton, talking to the RSGB, dismissed the topic of television (or as he called it then, seeing at a distance) as " . . . probably scarcely worth anybody's while to pursue". In more recent times, a well-known television engineer swore an affidavit to the FCC in America, that the shadow-mask colour display tube could not be mass-produced!

In making his forecasts, Dr. Townsend saw the biggest advances in broadcasting coming from the ever-widening use of sophisticated microcircuits. Their use in signal-processing circuitry would allow good quality TV pictures to be produced from scenes with low lighting levels, and reproduced from small, cheap videotape recorders. The adoption of microprocessor-based control systems has already allowed the IBA to operate and maintain 400 transmitters with the same number of staff as were needed for only 40 transmitters some dozen years ago. The introduction of similar systems into studios is also having far-reaching effects.

Sticking my own neck out, I foresee that the domestic TV receiver itself is likely to undergo a change of use over the coming years. The growing popularity of TV games, such as the Tank Battle which we feature in this issue, is the first step in this process. The broadcast Teletext services, Oracle from the IBA and Ceefax from the BBC, are already established and hopefully we will soon see a reduction in the price of receivers fitted with the necessary decoders. Also on the data front, the Post Office has recently announced that their Viewdata service is to be made available to the public from January 1979. All this will mean that the TV set will be used less as a source of broadcast entertainment and more as a source of information and participative entertainment. The adoption of microcircuits should also allow the domestic videotape recorder to be reduced in mechanical complexity and hence in cost, so that we may be able to view our favourite TV programmes when it suits us, rather than when the planners deem that we should.

Geoffrey C. Arnold

PLEASE NOTE—CORRESPONDENCE

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...

Rally date

'The Northern Mobile Rally 1978', organised by the Otley Radio & Electronics Society (G8JTD, G3XNO) is to be held at The Victoria Park Hall, Keighley on Sunday 21 May between 11.30 and 17.30.

Talk in stations on 2m f.m. S22 and 70cm f.m. SU8. There will be trade stands, films for the children, bar, refreshments and many other attractions. Further details from:

J. E. Annakin, G8DFZ, Rally Manager, 25 Ashfield Place, Otley, W. Yorks LS21 3JN.

Revival '78

The Martlesham and Ipswich Radio Club and The Ipswich Area Civil Service Sports Association (I.A.C.-S.S.A.) are again organising an outdoor event for the Radio Amateur and his family, to be held on Sunday, 14 May 1978, at the I.A.C.S.S.A. Sports Ground, Straight Road, Bucklesham (NGR TM 222 421). Special attractions include; A v.h f./u.h.f./s.h.f. aerial gain competition and demonstration, measurement of transmitter and receiver performance, bring and buy stands, Ad-hoc trading tables at £1 per hour for visitors and home-brew equipment competition.

The South Anglian Repeater Group, West Suffolk f.m. Group and Raynet will be well represented and a 2m (R3 S22, 70cm) (RB4 SU8) and h.f. bands talk-in station will be in operation, probably using the call sign GB3 SWR. Further attractions include; Big name traders, demonstrations of Viewdata tv and microprocessor games, vintage wireless displays, raffle, pistol and archery ranges, flying display of radio controlled aircraft, plus many other family entertainments.

The event will start at 11.00am, admission 40p (accompanied children free). A licensed bar will be open from midday and there will be snacks, teas etc., throughout the day.

Further information can be obtained by sending a SAE to: C.P. Ransom G8LBS, 79 Camden Road, Ipswich, Suffolk IP3 8JN.

First show

The Dept. of Electrical Engineering Science at the University of Essex is organising the 1st Essex Electronics Exhibition on 18/19 April 1978.

Admission is by free ticket issued by either the companies exhibiting or by the Department. Further details from:

E. P. Strudwick, Dept. Electrical Engineering Science, University of Essex, Wivenhoe Park, Colchester, Essex. Tel: 0206 44144 Ext. 2248.

Hi-Fi Seminar

Latest developments in turntables and pickups, amplifiers, loudspeakers, tuners and tape recorders will be reviewed in a one day seminar being organised by the Society of Electronic and Radio Technicians. Speakers include such famous names from the audio field as James Moir, James Linsley Hood, John Borwick, Angus McKenzie and Basil Lane. The lectures will be followed by demonstrations.

The seminar will be held at the Institute of Marine Engineers, Mark Lane, London EC3 on Wednesday, 7 June 1978, commencing at 10.00 am. Fees are £15 (£10 to SERT members) and this includes a copy of the papers, coffee, lunch and afternoon tea.

Further details from: *SERT, 8-10 Charing Cross Road, London WC2H 0HP.*

Can I help you!

Are you the secretary, organiser or general dog's body of your local radio club or any other group whose functions may interest readers of *PW*. If so, let me know and I will endeavour to publicise your rally, get-together, whatever, through this column. Remember though, we compile the magazine some time ahead of publication day (e.g. this note was written in mid-March), so, the earlier I can have details, the better. *Alan Martin*

KINDLY NOTE!

Radio 2 Tuner, July 1977
On p 213, C7 is incorrectly shown as 3·3pF. This should be 3·3μF as shown in the components list.

"Shoot", August 1977
Certain errors in the circuit diagram on p.283 have been noted. The PCB is correct, however. VR4 should be 22k preset, and not 2·2k. Pin 14 of IC3A should be connected to +8V line as should pin 14 of IC4A and pin 3 of IC2B. Pins 1, 2, 5, 6 and 7 of IC3C should be connected to 0V line, as should pin 7 of IC4B. Under the heading "Connection" on p.282, it is claimed that the sync. output is taken from pin 16 of IC1 of "Tele-Games" unit. This should read "pin 15".

IC of the Month, Sprague ULN-3006T Hall Effect Switch, March 1978 PW the second paragraph following the heading "The Hall Effect", p. 845, and commencing "The current carriers . . ." is somewhat ambiguous, and should read "The current carriers in the silicon (which may be electrons or "holes") are both deflected to one side of the material, depending upon direction of current flow and magnetic field, in accordance with Fleming's Left Hand Rule."

"Multi-Range Test Meters," March 1978
Page 839, the paragraph commencing "The minimum measurable . . ." should read:

The minimum total circuit resistance necessary, if full-scale deflection is not to be exceeded, is therefore 1500 ohms. This will be made up of the meter movement resistance plus a series current-limiting resistor, both of which are internal to the instrument. External readings are from zero upwards.

Experimenter's Corner, p. 910 April 1978. In the circuit diagram and text for "LED Light Display", the *pnp* transistors are incorrectly shown as AC176 (*npn*). These should of course be AC128 in every case.

AUDIO DISTORTION METER

E. A. RULE

PART 2

Construction

In general the construction is not critical and the prototype built by the author used plain Vero matrix board as shown in the photographs. However a complete set of p.c.bs is available and the various drawings show these and the associated component placements.

Leads from the front panel controls to the boards should be of screened wire, and the millivoltmeter circuit board should have a tinplate screen fitted around it as detailed in **Fig. 8.** It can be made from tinplate cut from a cocoa tin and is held in position by two paper clips soldered to it as shown. The better the screening of boards and components, the lower the final distortion measurement limit will be.

Initial Setting Up of the Meter

Set all pre-sets to halfway. After carefully checking that no mistakes have been made in the construction, switch on. At first the meter will swing about for a few moments and then settle down.

Allow about one minute before setting up the distortion meter as follows:—

Disconnect the bridge output lead to the millivolt meter attenuator and then connect an audio generator directly to the millivolt meter attenuator. (The point originally connected to the bridge.)

Set the output of the generator at 1kHz to give full scale deflection of the meter with the millivolt meter range switch on the 1V range. Switch to the 10V range, meter should fall to 10% of full scale. If not, adjust the pre-set 3 for more feedback and repeat test. Only the minimum amount of feedback required to obtain a linear scale should be used. When the reading drops to 10% of full scale, pre-set 2 should be adjusted so that a 5V input gives full scale on the 10V range, and 0·5V input gives full scale on the 1V range, etc.

Switch millivolt meter attenuator back to 10V range and transfer generator to the input socket. Reconnect output lead of bridge. Set/Read switch to Set. Adjust generator output for 10V and distortion meter input attenuator to maximum. Adjust VR7 in bridge circuit for full scale on meter. (If your generator does not have 10V output, use 1V and switch millivolt meter attenuator to 1V range.)

Turn input attenuator to minimum. The residual reading on meter should be less than 0·4mV on the 1mV range with all screens etc., in place. The authors instrument has a residual noise 0·24mV on the 1mV range. This represents a 93dB measuring range for signals above 10V, i.e., down to 0·003%. Set generator to 1V output at 1kHz. Set distortion meter to 1V range and adjust input attenuator for a convenient reading about two thirds of full scale. Switch generator to 1V output at 100kHz. Adjust trimmer TC1 for the same reading on meter as before. This adjusts the frequency response of the meter for a flat response to 100kHz.

Switch generator back to 1kHz and set its output to 10V (or 1V if the higher output is not available).

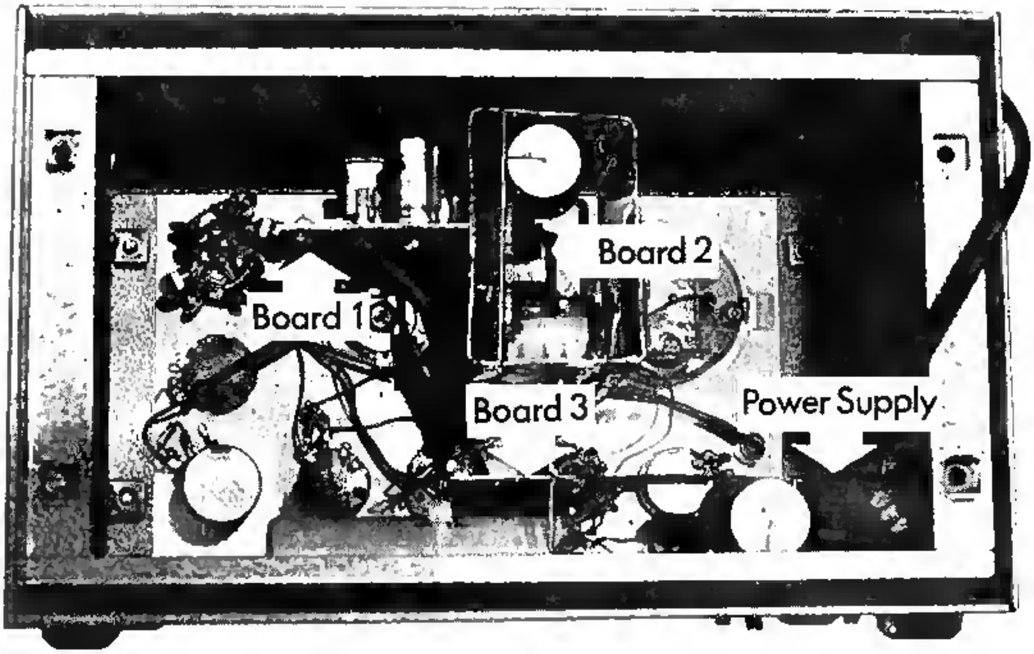
After adjusting the input attenuator for full scale deflection, switch Read/Set switch to Read. Adjust bridge frequency and balance controls to obtain lowest possible reading on meter, reducing the voltage range switch as the meter readings reduce. The final lowest reading obtained is the Total Harmonic content of the Test Signal.

Operation

A typical set up is shown in **Fig. 13.** When measuring very low values of distortion, it is very important to avoid multiple earth connections. Only the amplifier under test should be earthed. The other test equipment must have its normal mains earth removed and connected only via its connecting lead to the earth of the amplifier. Care should be taken that all test equipment is safe and fitted with mains isolation transformers or battery operated. Multiple earths can cause very high distortion readings and could be very misleading.

Before commencing a measurement, connect your generator directly to the distortion meter and measure its distortion. The figure you get from this test will set the minimum distortion you can measure. This minimum should be restricted to at least twice the direct reading obtained if reasonable accuracy is to be maintained.

To make a measurement, adjust the input signal of the amplifier under test to provide the required



Inside view of the completed instrument showing the layout of the p.c.bs and the controls mounted on the front panel. The power supply is fitted to the cabinet base and is the only board not mounted onto the front panel

output into a dummy load. Set the distortion meter millivolt switch to a suitable voltage range. Adjust the input attenuator for full scale reading (100%). Switch to "Read" and null out the fundamental signal. As the optimum bridge balance is obtained, the millivolt meter range will have to be switched to the next lower range. Read off the distortion direct from the meter when no further reduction in level is possible. Note that the frequency and balance controls are interdependent.

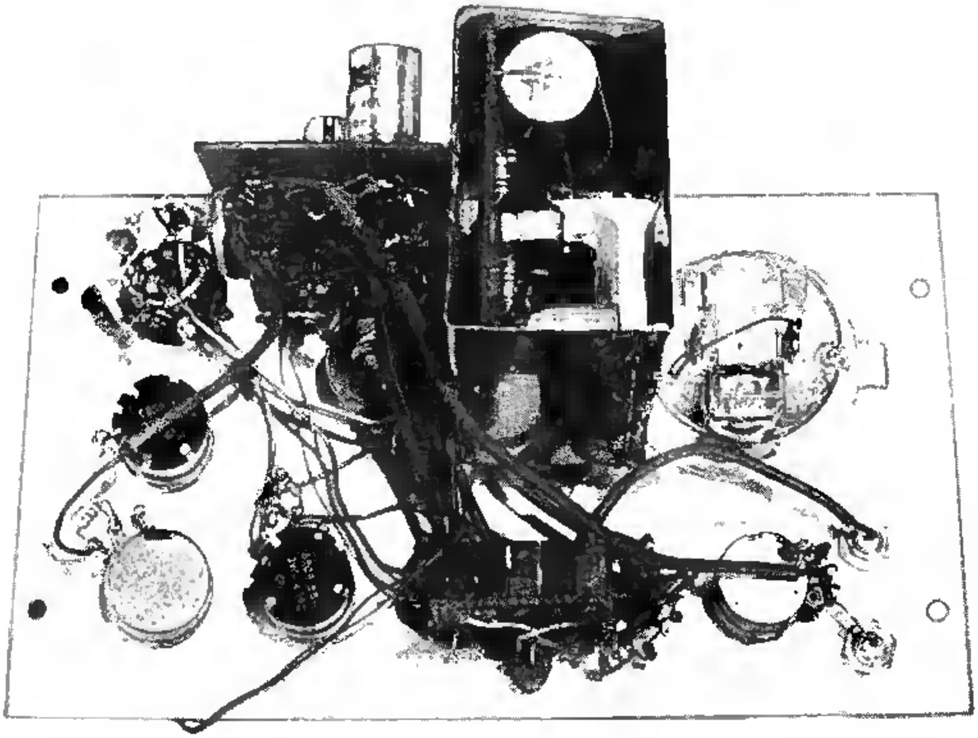
With an oscilloscope connected to the socket provided on the distortion meter the harmonic content of the signal can be examined. A scope sensitivity of approximately 10mV/cm is required. With inputs below 10V the minimum distortion readable will be reduced.

(Note: For inputs of less than 10V set the millivolt meter voltage switch to the range which will allow full scale deflection to be obtained. This range then becomes [for purpose of measurement] the 100% range and all other ranges move down by the same factor. For example, with 1V input, switch meter to 1V range, this is then 100% distortion full scale, the 0·1V range becomes 10% full scale etc.)

For accurate measurements the limits are shown in Table 1. However measurements of distortion to lower levels can be made, but with decreasing accuracy.

Nearly all pre-amplifier and tape recorders have

This view shows the components and boards mounted onto the back of the front panel. This is the prototype unit using matrix boards instead of p.c.bs



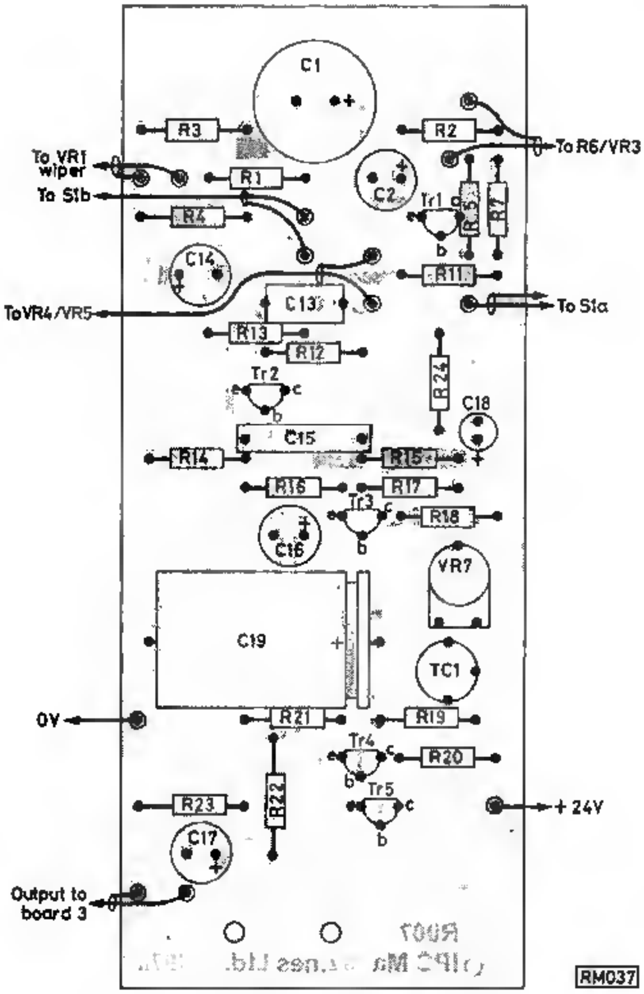


Fig. 5: Component placement drawing for the Bridge Circuit p.c.b. (Board 1)

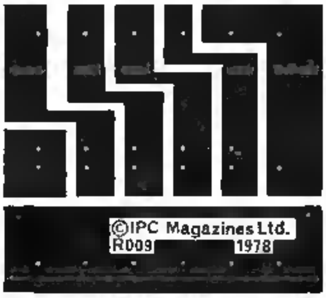
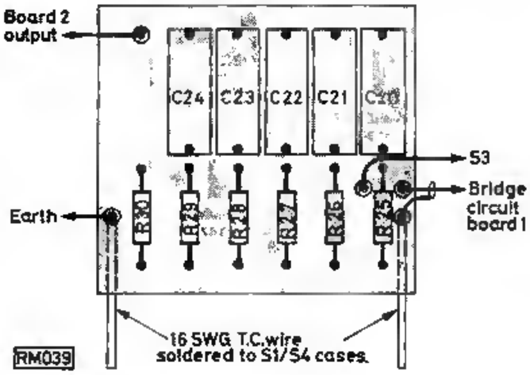


Fig. 7: Copper track layout for Board 3. Fig. 8: (Below) Component placement drawing for Board 3



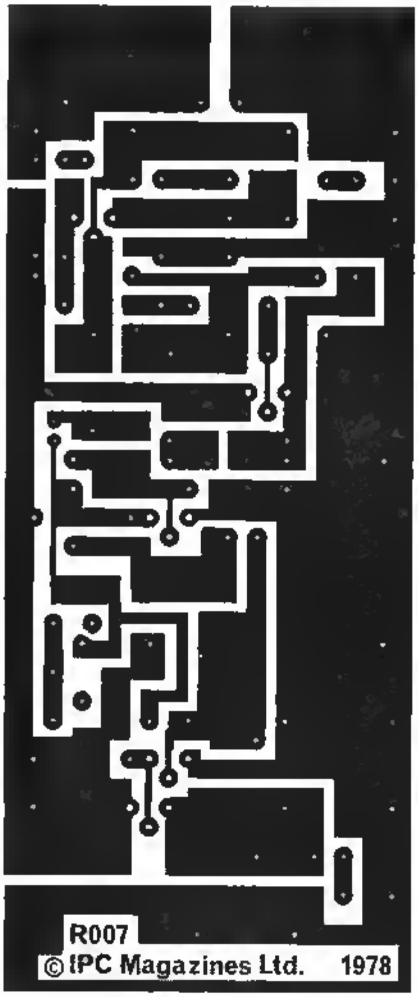


Fig. 6: Copper track layout for Board 1. Ready drilled boards for this instrument are available from Reader's PCB Services (See page 68)

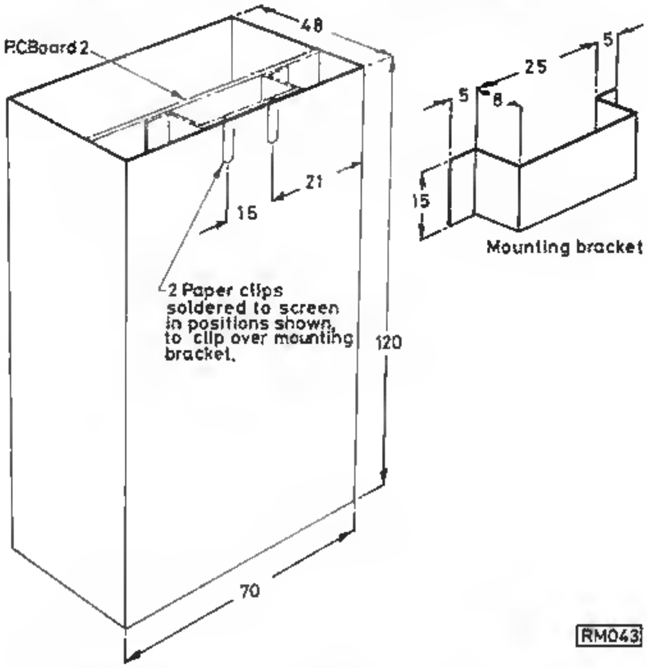


Fig. 8: Details of the tinplate screen for Board 2. The small bracket is soldered to the copper earth tracks at the top of Board 2

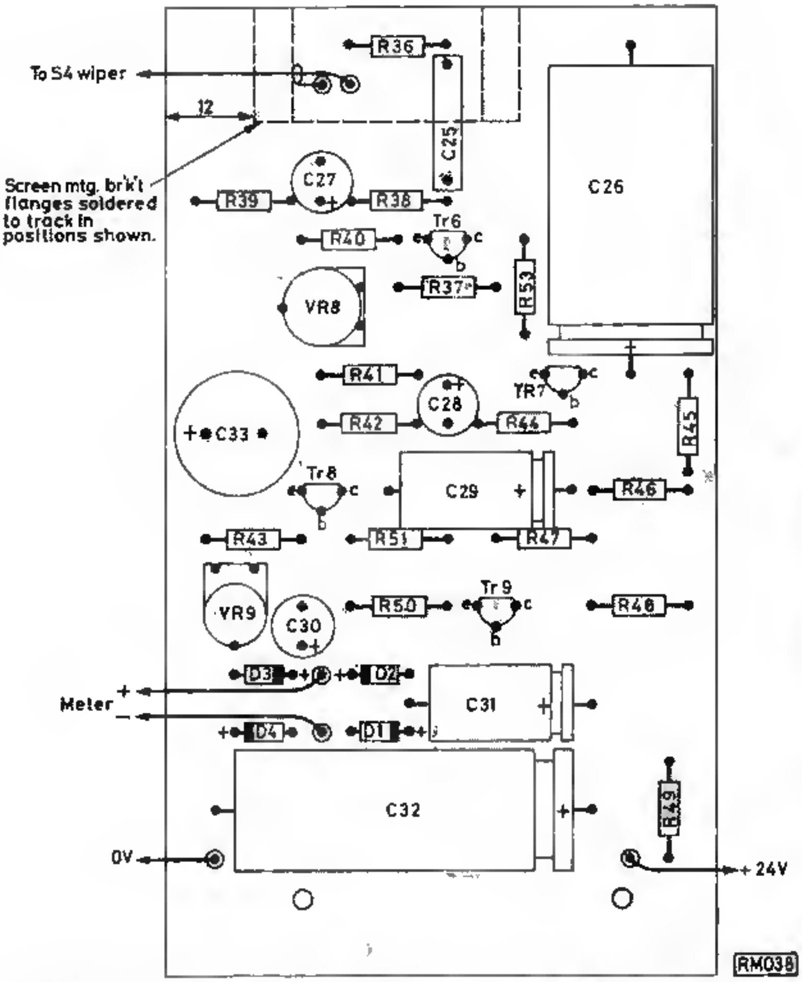


Fig. 9: Component placement drawing for the Meter Circuit p.c.b. (Board 2). Note the small tinplate bracket soldered to the earth track

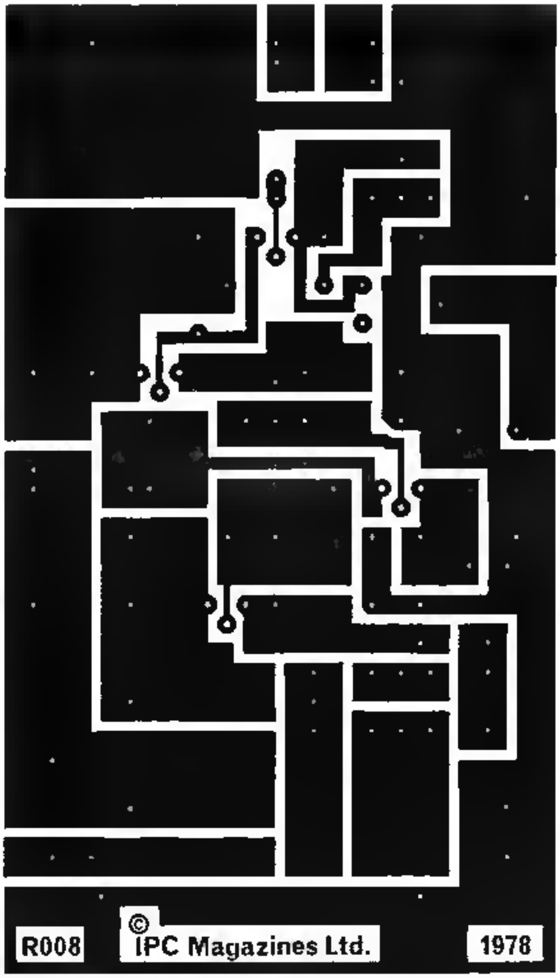
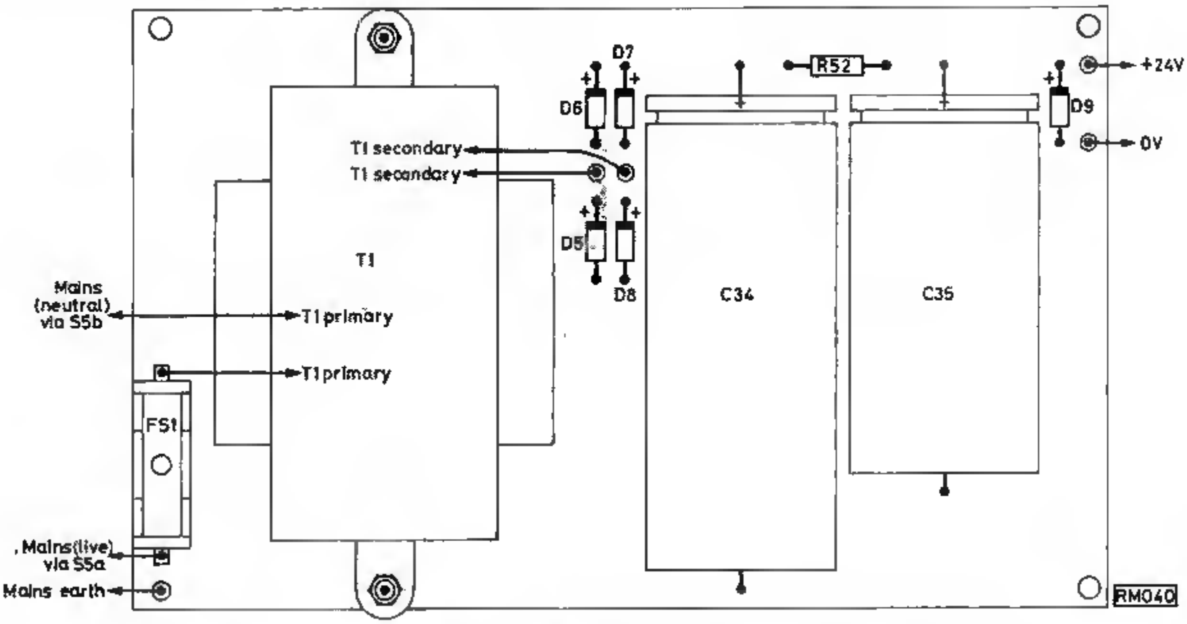


Fig. 10: Copper track layout for Board 2



Component placement drawing for the Power Supply p.c.b. (Board 4)

outputs in excess of 1V and power amplifiers of the hi-fi type will have more than 10V output. So the t.h.d. meter should enable the hi-fi amplifiers to be checked down to below 0·01% with reasonable accuracy. Do not be surprised if your amplifier does not reach the lowest figures at the extremes of the audio band and do not maintain the highest frequency for longer than it takes to make a measurement.

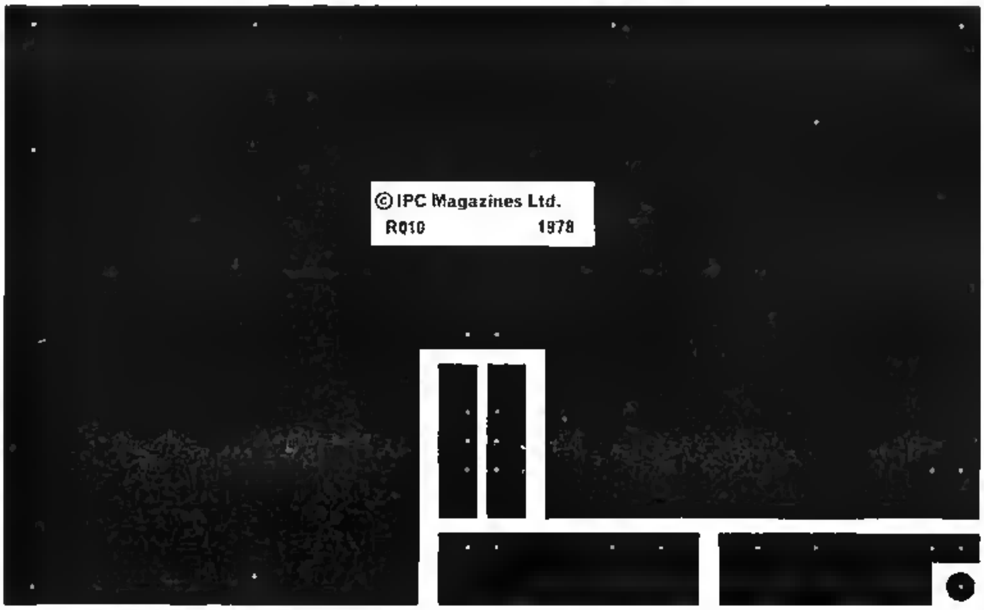


Fig. 11: Copper track layout for Board 4. A ready drilled set of boards for this instrument is available from Reader's PCB Service (see page 88)

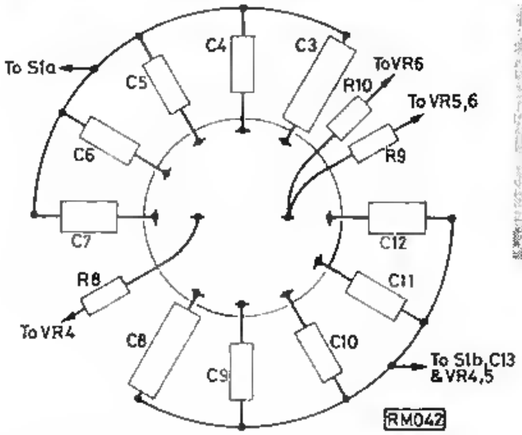
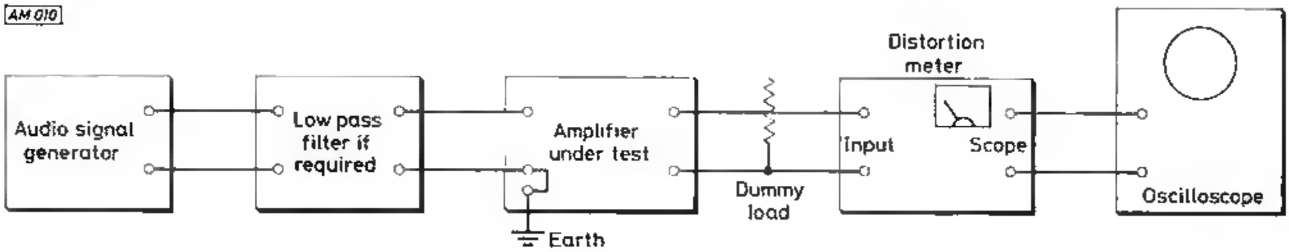


Fig. 12: Details of the components mounted directly onto S2 wafer tags. The drawing shows the components opened out for clarity, they should be arranged along the axis of the switch mechanism in a cylindrical fashion

Fig. 13: A typical set up for testing an audio amplifier using the Audio Distortion Meter



The following procedure is to assist the operator when using the distortion measuring meter for the first time. It is confined to measuring the distortion of a 1kHz signal, and should help the operator to become familiar with the basic operation.

Minimum Input	Accurate Measurement
10V	0·01%
1V	0·1%
100mV	1%
10mV	10%
1mV	—

Table 1.

The controls should be set as follows:—

Meter Range Switch on 1V range.
Frequency Range Switch on range 3.

Filter	Out
Set/Read switch on	Set
Input Attenuator at	Zero
All other controls	Midway

Connect a sine wave signal of 1kHz, 1V RMS to the input socket. Advance the input attenuator until meter reads 1V, i.e., full scale. Switch the set/read switch to the read position and rotate the frequency dial for minimum reading on meter. Adjust balance control to reduce meter reading further. Switch the volt meter range switch to next lower range as the signal is reduced by adjustment of the frequency and balance controls.

When no further improvement (reductions) can be obtained the distortion can be read directly from the

★ components

Resistors

¼ W 5% metal oxide

33Ω	1	R43
100Ω	3	R7, 49, 52
560Ω	1	R6
1kΩ	1	R50
1·2kΩ	1	R4
2·2kΩ	3	R5, 8, 23
2·7kΩ	1	R9
4·7kΩ	2	R10, 45
10kΩ	9	R14, 15, 16, 18, 20, 21, 36, 46, 48
12kΩ	3	R3, 42, 51
22kΩ	2	R40, 53
27kΩ	1	R41
33kΩ	5	R26, 27, 28, 29, 30
39kΩ	1	R2
47kΩ	3	R1, 19, 24
100kΩ	5	R11, 12, 13, 25, 47
150kΩ	1	R38
180kΩ	1	R17
220kΩ	1	R22
270kΩ	1	R39
330kΩ	1	R44
470kΩ	1	R37

¼ W 2% metal oxide

1Ω	1	R35
10Ω	1	R34
100Ω	1	R33
1kΩ	1	R32
10kΩ	1	R31

Potentiometers

¼ inch diameter spindles

100Ω	1	VR9
1kΩ lin.	2	VR2, 6
10kΩ lin.	1	VR8
10kΩ + 10kΩ lin.	1	VR4, 5
20kΩ lin.	1	VR3
100kΩ log.	1	VR1

Miniature horiz. skeleton preset

100kΩ	1	VR7

Semiconductors

Diodes

OA202	4	D1, 2, 3, 4
IN4001	4	D5, 6, 7, 8
BZY88C24	1	D9

Transistors

BC413B	9	TR1, 2, 3, 4, 5, 6, 7, 8, 9

Capacitors

Polyester

2·2nF	2	C7, 12
0·01µF	2	C6, 11
0·047µF	2	C5, 10
0·1µF	1	C25
0·22µF	8	C4, 9, 13, 20, 21, 22, 23, 24
0·68µF	1	C15
1µF	2	C3, 8

Electrolytic Printed circuit board mounting

2·2µF	63V	3	C14, 18, 27
10µF	63V	6	C2, 16, 17, 28, 29, 31
100µF	63V	1	C30
220µF	63V	1	C1
470µF	63V	1	C33

Electrolytic Axial leads

470µF	63V	2	C19, 32
1000µF	63V	2	C26, 34
4700µF	25V	1	C35

Ceramic trimmer

3–35pF	1	TC1

Switches

Min. toggle s.p.d.t.	1	S3
2p. 6w. midget wafer	2	S1, 4
2p. 6w. miniature rotary switch	1	S2
Mains switch assy to fit S2 mech.	1	S5

Miscellaneous

Transformer 24V 20VA Miniature
Case RS 509-888
Printed circuit boards (Four in set) Readers PCB Service.
24V indicator lamp
Knobs Sifam collet fixing type 15mm diameter
W151 wing knob (3)
K150 plain knob (3)
K151 plain knob with line pointer (2)
N150 nut covers (6)
C150 caps (8)
Figure dial for 15mm knobs with pointer (1)
numbered 1–10 (1)
Meter 1mA f.s.d. 90 × 74mm approx.
BNC 50Ω sockets (2)
Tinplate sheet for screen (cut from used cocoa tin or similar)
PW Front panel overlay (Obtainable from PW Editorial Office)

meter and voltage switch.

That is, if initial full scale (100%) was 1V and final reading was (say) 6mV, then distortion is 0·6%. The low frequency filter can be switched in for measuring frequencies above 1kHz if hum is affecting the measurement.

Other uses of the Meter

With the input attenuator at maximum, the meter can be used as a normal AC millivoltmeter with full scale range of 10 and 1V, 100, 10 and 1mV. This would make it possible for example to measure the output of a magnetic pick-up directly.

It can also be used for measuring Hum and Noise in an amplifier. By adjusting the input attenuator for full scale on a test signal from an amplifier and then removing the test signal and shorting the test amplifier input to earth. The meter will then indicate the residue Hum and Noise of the test amplifier, for example: if full scale was obtained on 10V range with the test signal and then after removing it the reading was (say) 6mV, this represents a ratio of 1666:1, approximately 64dB.

Many other uses can be found and a few hours spent using the meter will be very rewarding. ●

HOTLINES

A REVIEW OF RECENT DEVELOPMENTS

In general, the author does not have any more information on products than appears in the article

I spy Strangers

Some kind soul sent me a whole heap of papers from the recent International Solid State Circuits Conference and there seems to be some real goodies on the way (not available yet). One which took my eye is a single 14-pin dual-in-line package which houses a complete motion detector. It is intended for application in electronic toys. This little beasty can be made to keep an eye on a 2ft. diameter area at 8ft. The photodiode itself is actually integrated as part of the chip. An external loudspeaker is required and when connected up, the unit will emit a whooping noise whenever it senses motion within its "sight" area. It carries on making this din for a set period of time, then it goes back to sleep and waits for the next "something" to move within its sighting area. It would seem to offer great possibilities as a burglar alarm, etc.

A further nice feature of this little i.c. is that it has another mode of operation. To change it to this you need only add a single connection.

In its new mode it will "search". It does this by flashing an external bulb at some 3Hz. At the same time, it croaks out a random series of squeaks and grunts (the paper offers the more sophisticated description, "emits audible notes"). When the "thing" detects its own reflection it immediately sounds an alarm and simultaneously increases the bulb flashing rate to 25-30Hz. The chip uses two technologies; linear bipolar, and I^2L.

Hi-digi-fi

A recent report from Japan details feverish activity among audio equipment manufacturers—in the digital field. It is now virtually certain that the hi-fi systems of the future will be digital.

To date it seems that the only "standard" to emerge is a wide acceptance of a 30cm disc as the norm. Interestingly, though, the early professional systems will use tape before moving over to disc, and it is expected that the consumer scene will also follow this pattern.

But don't get too enthusiastic about digital audio. The world concensus of opinion is that it will be some four years before professional digital audio systems really catch on, and a further six years after that the consumer market will blossom. It could therefore be some ten years before you see these systems advertised. The main hold up will be price. Initially, systems will be expensive and the first few years will be needed to gradually bring the prices down.

Why go digital anyway? It seems that analogue hi-fi has now gone about as far as it can, whereas digital is in its infancy. In terms of improvements digital technology has much to offer the audio buffs. To start with, frequency response and dynamic range are both independent of the characteristics of the tapes or discs used. It is also claimed that there is no crosstalk problem between channels. From all the specifications on systems that I've read, the responses are flat (very, very flat) right up to 20kHz, and dynamic range, even at this early stage is well over 80dB—some 20dB better that most analogue systems I read about these days.

Another advantage of the digital approach is wow and flutter—there isn't any! This is because all the signals are retimed so accurately during playback.

Various individual technologies are to be employed initially, including a laser/disc system. But the comforting thing is that despite the very different techniques, the final product, be it tape or disc is compatible in that one can convert material from tape to disc and vice versa.

Perhaps we'll all end up with a home computer to play our gramophone records on. Wonder what that dog, squinting down that trumpet/horn thinks about it all?

Useful Chips

Another chip which could be very useful for the home constructor (when it becomes available) is a new level detector i.c. Onto the chip the manufacturers have managed (somehow) to cram five comparators, a voltage regulator, five output driver transistors, five scaling resistors and an input buffer stage with a high input impedance. By connecting five l.e.d.s (plus usual limiting resistors), each l.e.d. can be made to light as the input voltage increases in steps of 200mV, i.e. for each 200mV input, the next l.e.d. illuminates. The open-collector outputs on the chip can handle currents up to 80mA and voltages up to 18V. In practical terms this means versatility because the ratings allow not only l.e.d.s to be used as indicators, but also filament lamps. By using suitable circuitry, the device can be made to flash the first lamp or l.e.d. continuously when the input level falls below the 200mV threshold level.

Charge!

Charge those c.c.d. (charge-coupled devices) are in the news again—well worth keeping an eye on. This time it's a Japanese company that is using c.c.d.s in an experimental colour television camera. Each of the three c.c.d. chips (one for each primary colour has an array of 111,192 separate little sensing elements in an area 10·3mm × 9·1mm. If small is beautiful, then these devices must be fantastic.

The colour television camera, when it comes on the market (probably late next year if all goes well) will come complete with zoom lens, built-in camera control circuitry, and electronic viewfinder. Price is set at around the £500—£600 mark. Weight will be less than 2kg.

Programmer

Microprocessors are here to stay and many are available to home constructors. One of the problems is learning how to programme these clever little electronic beasties. An answer is offered by a German manufacturer. He's marketing a little "black box" which can be used in conjunction with a black and white TV receiver. The black box has a light pen and the TV receiver is used as both input and output terminal. The box comes with a 230-page manual and costs around £280. For a further £140 (approximately) the purchaser can add a cassette control interface for writing (and reading) memory data on standard, commercially available tape. The reading/writing rate is some 1 kilobyte in 90 seconds.

Ginsberg

PW 'purbeck'

Part 3

OSCILLOSCOPE

IAN HICKMAN

Having made up the Stabilisers board, check it over and mount it in the mainframe. Set all preset pots. to mid travel. The Raw Supplies have no current limit protection of course, so unless you feel 100% sure that everything is going to be all right, the following procedure is suggested.

Either run up the voltage between pins 9 and 5 to +17V using a current limited lab. bench power supply or if one of these is not available, connect up the 0V line between Boards 1 and 2, but connect the +17V Raw supply from C19 to Board 2 pin 9 via a 330Ω resistor. Check that +5V appears at pin 8 and that the voltage at pin 10 responds to varying VR202.

If so, all is well, though it may not be possible to set the output at pin 10 to +12V until the 330Ω resistor is removed. The +17V raw may now be wired in permanently and VR202 set to give +12V at pin 10. Similarly, check out the −6V and −12V stabilised outputs at pins 3 and 2 with the −17V raw from C20 supplied to pin 1 via a 330Ω resistor, then wiring up and setting VR203 for −12V at pin 2. Finally, connect the +300V raw supply from Board 1 to pin 6 of Board 2 and check that +150V appears at pin 7. Note that due to the absence of load current drawn from the +150V stabilised supply the "+300V Raw" will be nearer +360V.

This completes the checking out of the instruments supplies and at this stage it is worth completing the mainframe and front panel wiring. Wiring confined to the front panel should be completed before offering it up to the mainframe and likewise, wiring of S1 and S2 should be completed before offering them up to the front panel. Note that the probe power socket SKT10 is also used as a distribution point for the stabilised supplies to various controls on the front panel.

A ten way colour coded ribbon cable brings the supplies from the rear of the instrument, five of the leads terminating on SKT10 as detailed in Fig. 2 Front Panel Wiring. Further lengths of ribbon cable, stripped down to the same five coloured leads distribute the stabilised supplies from SKT10 to the edge connector of Board 4 and thence to that of Board 3. (Note that the pins of both edge connectors are numbered 1 to 36 working from the bottom upwards. As both Boards have the components facing outwards when plugged in, the edge contacts on the component face of the Board read from right to left for Board 3 and left to right for Board 4.) The remaining five wires in the 10-way ribbon cable are used as follows:

Black. 0V from Board 1 pin 6 to common earth point at Board 3 edge connector.

Brown. Pins 1 and 2 of c.r.t. (cathode) to clockwise end of VR5 track.

Violet. Pin 5 of c.r.t. (anode 1) to wiper of VR6 (focus).

Grey. R18 and D1 (mounted on c.r.t. base) to wiper of VR5 (brilliance).

White. −800V Stabilised from Board 1 pin 7 to anticlockwise end VR5 track.

The earthed pins on the edge connectors of Boards 3 and 4 are each individually wired direct to a 16 s.w.g. tinned copper wire running the length of the edge connector, at each end of which it is supported on a

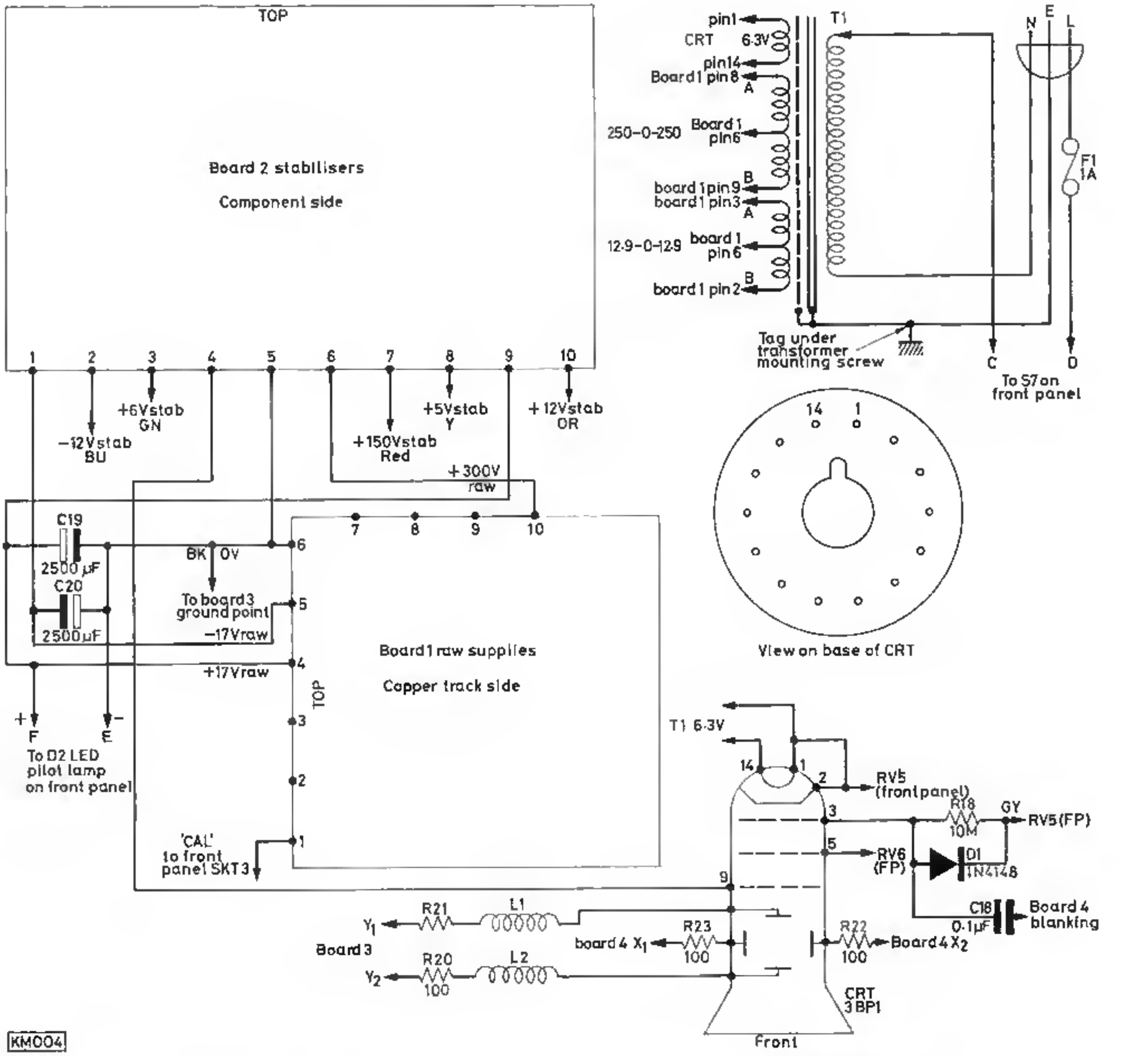


Fig. 1: Power supply interwiring diagram and c.r.t. base connections. This drawing should be read in conjunction with Fig. 2 Front Panel wiring diagram. Please note that RV5 and RV6 should be read as VR5 and VR6

WARNING

Extra care must be taken when working on any part of this instrument while power is switched on. 1100 volts can kill. When delving into the insides of the scope for any reason with power on keep one hand in your pocket

solder tag under the edge connector mounting screws.

Thus Board 4 ground plane, when plugged in, is earthed to the base of the mainframe via the edge connector mounting bracket and to the front panel via the 4BA pillar. Board 3, whilst similarly earthed, picks up the Black wire from the ribbon cable, at a point on the 16 s.w.g. earthwire adjacent to the Input Low contact and from the same point an earth-wire runs to the earth point on S3 and thence to a solder tag under SKT 1 mounting screw.

This earthing arrangement is essential to avoid instability, ensure a flat Y amplifier frequency response and avoid ringing on square waves.

When making the connections between the front panel and mainframe, lay the panel down in front of the mainframe as though it were hinged at its lower edge. (This is why Fig. 2 Front Panel Wiring has been drawn the way it has.) Dress the wires from the front panel along towards the "hinge" and thence off to their destinations. This will ensure that when the front panel is offered up and secured in position, there is adequate but not excessive lead length.

Having rechecked the wiring and removed the temporary link from Board 1 pin 6 to chassis, plug in briefly and check straight away that all the stabilised voltages are correct, indicating no shorts anywhere. Check that the slider of VR5 covers the range −750V to −800V approximately and that of VR6 −350V to −600V approximately. The c.r.t. base wiring can now be completed, except for C18 and the deflection plates.

In fact, the c.r.t. and mu-metal screen can now be fitted and a simple check carried out if desired. To do this, temporarily connect one end of a 47kΩ resistor to +150V stabilised and the other end via a 100kΩ resistor to chassis.

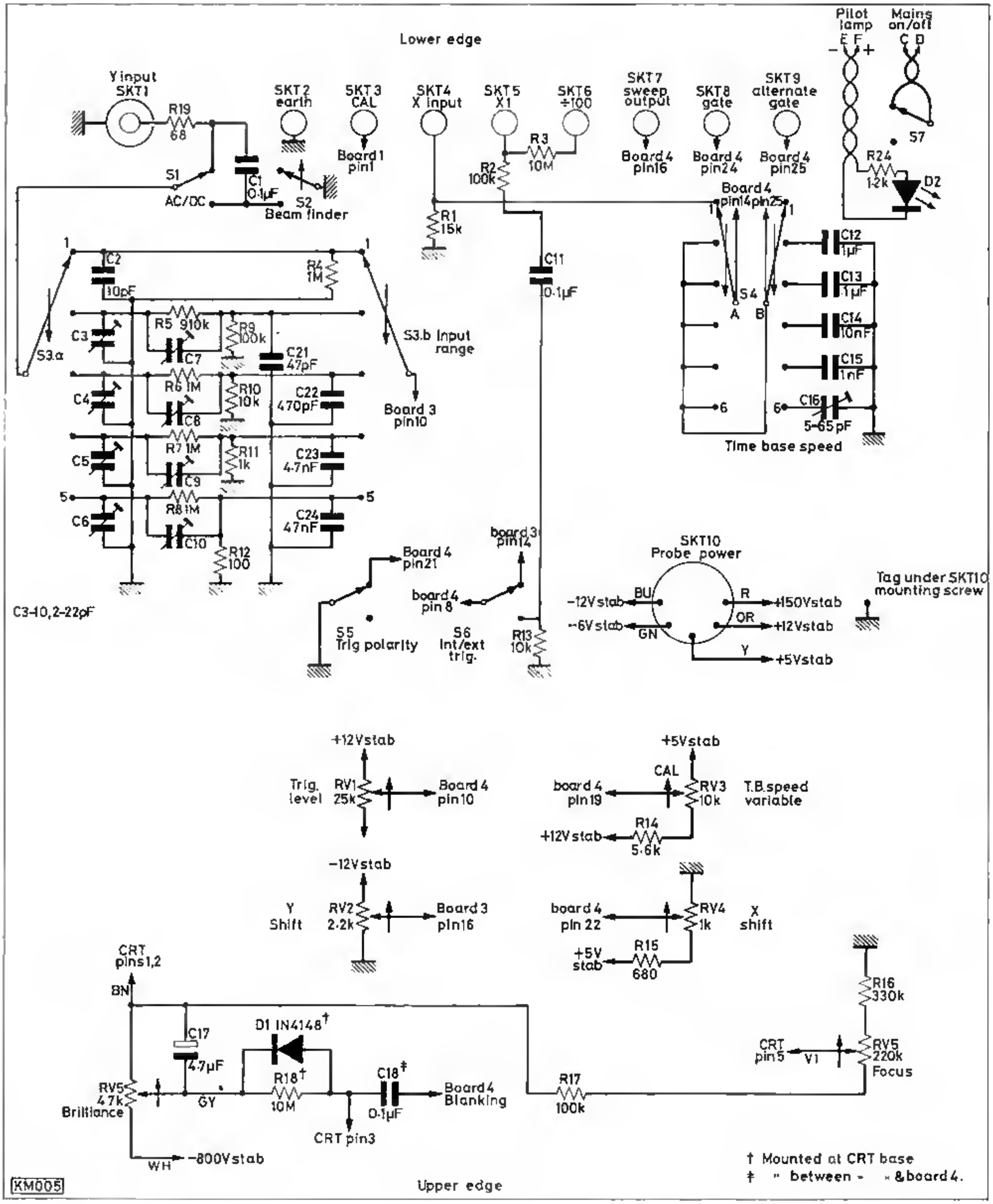


Fig. 2: Front panel back wiring. This diagram has been drawn with the top edge of the front panel at the bottom so as to correspond with its orientation when placed on the bench for the purpose of wiring. Connecting wires from the front panel to other parts of the instrument should be long enough to allow the panel to be lowered to the bench in front of the mainframe. This makes for easier working conditions. Please note that potentiometers labelled RV1 to 5 should be read as VR1 to 5 and also that the 220kΩ Focus potentiometer at the bottom righthand corner of the diagram labelled RV5 should be VR6. This drawing should be used with Fig. 1 the power supplies interwiring diagram

★ components

FRONT PANEL AND MAIN FRAME

Resistors

(Unless otherwise specified 5% ¼W carbon film)

R1 15kΩ	R13 10kΩ
R2 100kΩ	R14 5·6kΩ
R3 10MΩ 10%	R15 680Ω
R4 1MΩ 1%	R16 330kΩ
R5 910 kΩ 1%	R17 100kΩ
R6 1MΩ 1%	R18 10MΩ 10%
R7 1MΩ 1%	R19 68Ω
R8 1MΩ 1%	R20 100Ω
R9 100kΩ 1%	R21 100Ω
R10 10kΩ 1%	R22 100Ω
R11 1kΩ 1%	R23 100Ω
R12 100Ω 1%	R24 1·2kΩ

Capacitors

C1 0·1μF 350V	C13 0·1μF 1% 63V
C2 10pF Ceramic	C14 10nF 1% 63V
C3 2-22pF	C15 1nF 1% 63V
C4 2-22pF	C16 5-65pF
C5 2-22pF	C17 4·7μF 100V
C6 2-22pF	C18 0·1μF 1000V
C7 2-22pF	C19 2500μF 25V
C8 2-22pF	C20 2500μF 25V
C9 2-22pF	C21 47pF Ceramic
C10 2-22pF	C22 470pF Ceramic
C11 0·1μF 350V	C23 4·7nF met. film
C12 1μF 1% 63V	C24 47nF met. film

Potentiometers

20% lin. ¼W ¼inch shafts

VR1 25kΩ	VR4 1kΩ
VR2 2·2kΩ	VR5 47kΩ
VR3 10kΩ	VR6 220kΩ

Inductors

L1 See Text — L2 See Text

Diodes

D1 1N4148 — D2 Hi brightness l.e.d.

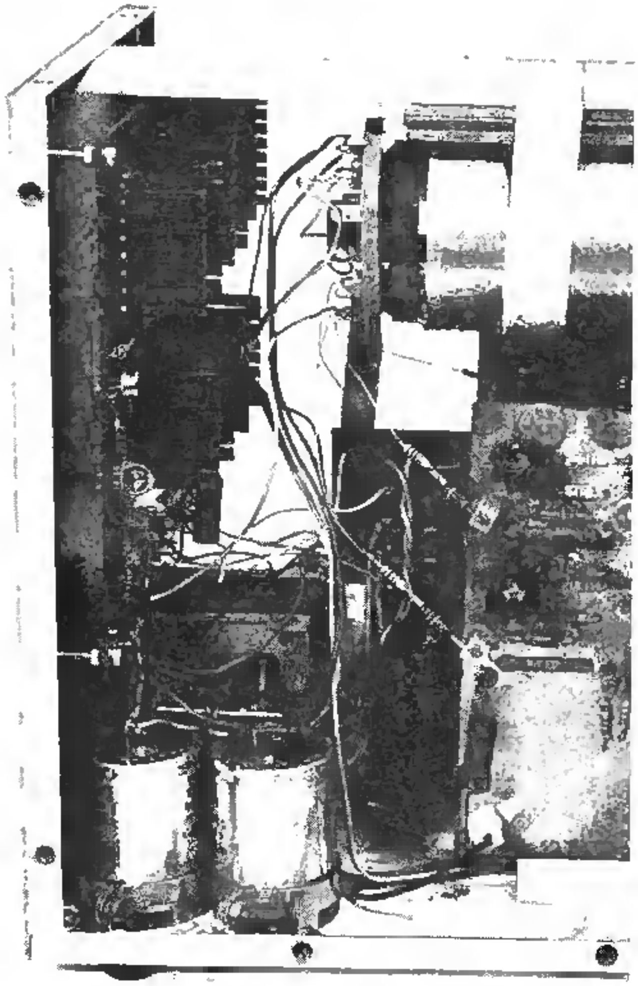
Transformer

T1 250-0-250V, 6·3V, 12·9-0-12·9V, Transformer Type 7559 (Barrie Electronics)

Miscellaneous

F1 1¼inch × ¼inch, 1A fuse and holder
S1 Miniature s.p.c.o. toggle switch
S2 Miniature push button n.o.
S3 2p 5w 2 wafer (Maka-switch)
S4 2p 6w 1 wafer
S5 Miniature s.p.c.o. toggle switch
S6, 7 Miniature s.p.c.o. toggle switch
SKT1 BNC socket, round 50Ω (UG1094/U)
SKT2 4mm socket, black
SKT3 4mm socket, blue
SKT4 4mm socket, white
SKT5, 6 4mm socket, green
SKT7 4mm socket, yellow
SKT8, 9 4mm socket, red
SKT10 5 pin DIN 180° (A)
CRT 3BP1 plus base
Case mounting clips (vert) for C19, 20
Edge connector 0·1 inch pitch 36 way 2 off
Knobs Sifam 15mm collet fixing with nut covers and caps.

K150 plain	2 off
K151 line pointer	4 off
W151 wing and line pointer	6 off



Connect all four deflection plates to the junction of the two resistors, i.e. approximately +100V. With VR5, VR6 and VR201 all set to midtravel, switch on and allow a few seconds for the tube heater to warm up.

Adjusting VR5 should produce a spot on the end of the tube and VR6 should enable it to be focused to a small diameter. If at either side of this setting it looks elliptical, wider or taller as VR6 is adjusted, VR201 (astigmatism) should enable this to be corrected. Mind where you put your hand when adjusting VR201, it's not far from the e.h.t. on Board 1! It should be possible to focus the spot down to a pin-point, provided the brilliance control is not advanced too far, though of course VR201 will need resetting when Boards 3 and 4 are fitted.

In fact Board 3, the Y amplifier is the next step and full details of this will be published in next month's instalment.

Several readers have enquired about the possibilities of using alternative tubes for Purbeck. We cannot advise anyone as to the suitability of components other than those specified. Not only will the mechanical construction need alteration, but revised amplifiers and e.h.t. supplies will also be required.

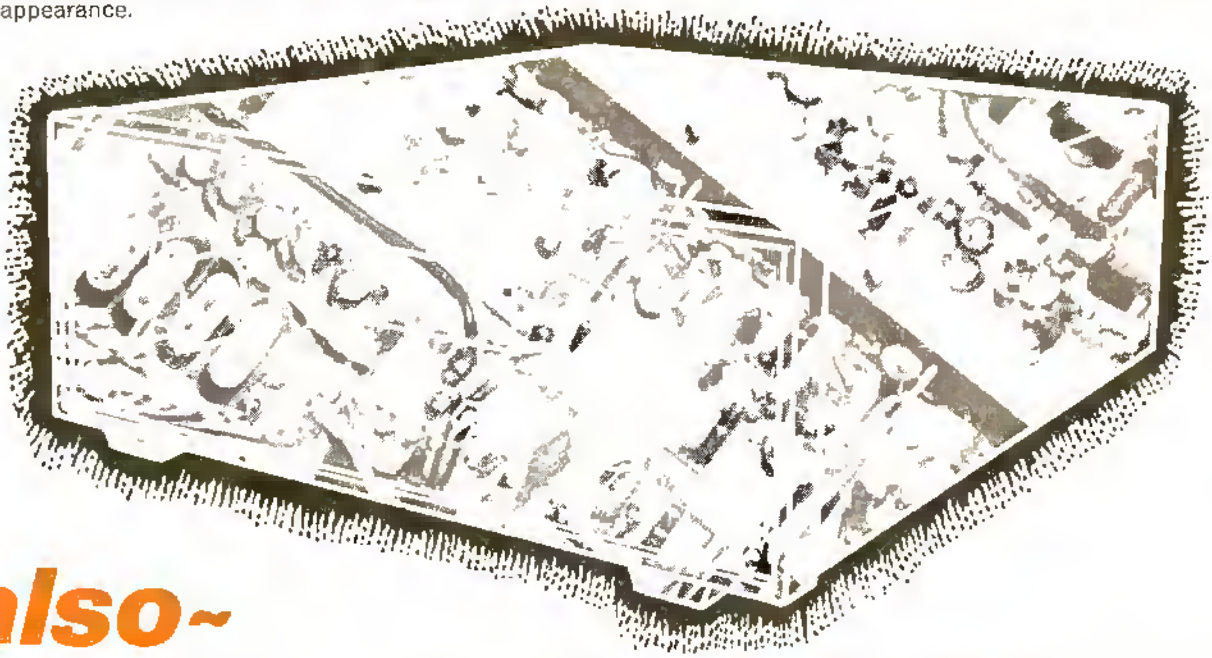
NEXT MONTH IN...

practical WIRELESS

ON SALE 2ND. JUNE

Get on the Air WITH THE PW 'AVON' 2m FM Transmitter

A 2m f.m. transmitter of nominal 10 watts output, having six crystal-controlled frequencies and provision for an external v.f.o.
Easily constructed on four simple printed circuit boards, the transmitter is housed in a quality instrument case and provided with a novel frequency readout.
The completed unit is both modern and professional in appearance.



also~

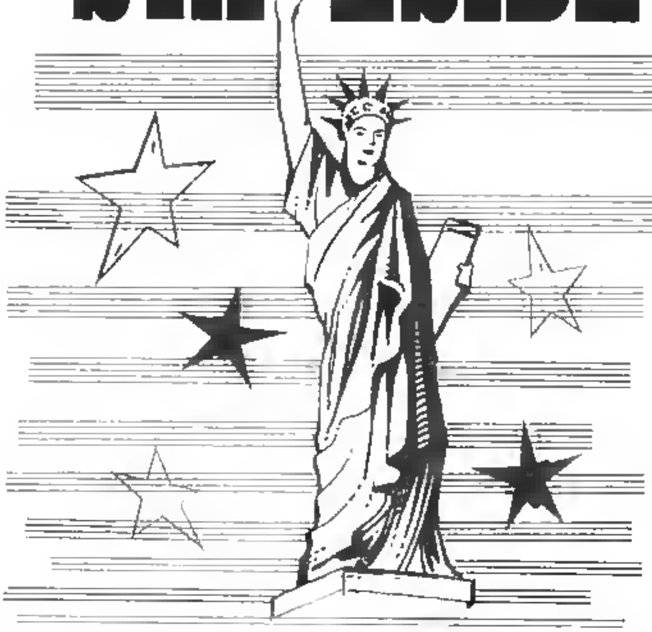
Introducing DIGITAL LOGIC

Beginning a primer in logic, which will cover gates, flip-flops and counters, characteristics of TTL and CMOS and design techniques.

Phase~Locked Calibrator

A simple circuit design which provides an accurate 200kHz output signal, phase-locked to the BBC's Droitwich transmitter, useful for calibration of receivers and digital frequency meters.

STATESIDE CALLING



JOE KASSER G3ZCZ/W3

When one thinks of people in another part of the world, one usually imagines that their life style is almost identical to one's own. The fallacy of this concept is only obvious when one travels and is exposed to another way of life. Contrary to popular belief, radio amateurs are no different to other people and although the hobby is international, it takes on different forms in different countries. This article is an introduction to amateur radio in the United States of America.

The Transmitting Licence

It is much easier to become a radio amateur in the USA than in the UK. There are several classes of Licence, each having different examination standards and frequency privileges, as shown in the table. In general, Novices have to pass an examination in elementary theory and a 5 w.p.m. Morse test. The examination is administered by a radio amateur volunteer on behalf of the licensing authority (which in the USA, is the Federal Communications Commission).

The Novice licence is valid for two years and until recently was distinguished by the WN prefix. It allows its owner c.w. only privileges in the 10, 15, 40 and 80 metre bands with a maximum power input of up to 250 watts.

The Technician class of licence requires slightly more technical knowledge than a Novice, and allows operating privileges similar to our Class B licence on segments of the 6 metre band and higher frequencies. The General, Advanced and Extra class licences are all allowed all-band, all-mode operation, but each class of licence (except Extra) is limited to segments of the band. The test for the General requires 13 w.p.m. c.w. and the test for the Extra requires 20 w.p.m. Increasing levels of technical knowledge are required for up-grading from one class to the next. The licences are free and except for the Novice, are valid for five years. Separate mobile or TV licences are not required. The segments of the bands available to the different classes of licence are summarised in Fig. 1.

The band split between phone and c.w. is decided by the FCC for the amateurs, and not by the amateurs themselves as in most other parts of the world. In general the input power limits are 1kW input d.c. or 2kW input p.e.p. except on Top Band, which is segmented in both frequency and power depending on geographical location as shown in Fig. 2.

The HF Bands

Operation on the h.f. bands is very different to that in Europe. The vast majority of the stations appear to be using the full legal limit and beam antennas. Thus the bands are crowded with strong signals all originating from the states, and it is difficult to hear non-stateside signals at times. The USA is so large that in general, any foreign station is DX.

The bands are so crowded that if you want to work the states from outside, you should get up into the General parts of the bands when they are open to the USA. You may then be giving the stations you work, their first G contact. If they want your QSL they will probably offer to QSL direct and even send you IRCs. There are many more of them than there are Gs, so if they are not in a rare state such as Utah or Delaware, let them QSL first. If they want your card, they will. If you operate in the Extra or Advanced segments of the bands the chances are greater that you will be working someone for his umpteenth G contact.

The 3·5MHz band is so wide (3·5-4·0MHz) that the c.w. part is called 80 metres, but the phone part is called 75 metres. At this point of the solar cycle, it

TABLE: US Amateur Radio Classes

Class	Morse Requirements	Technical Knowledge Required	Operating, Privileges
Novice	5 w.p.m.	Hardly any	10, 15, 40 and 80m
Technician	5 w.p.m.	About RAE level	6m and higher
General	13 w.p.m.	About RAE level	All bands, some frequencies
Advanced	13 w.p.m.	A little more than RAE level	All bands, more frequencies
Extra	20 w.p.m.	As Advanced	All bands, all frequencies

offers cross continent contacts late at night. The 40 metre band has similar characteristics but is little used at night due to the vast amount of broadcast station interference. Sectors of the band allocated to broadcast stations in Europe are allocated to amateurs in the Americas and those broadcast stations come in loud and clear in the USA. The 20, 15 and 10 metre bands are pretty much the same as in Europe, in terms of distance worked, but are generally without the language barrier, because the common language in the states is English (more or less). There is thus very very little incentive for the American amateur to learn a foreign language.

Traffic Handling

American radio amateurs have third-party traffic handling privileges. This means that they can pass messages for people other than radio amateurs. For example, a station in New York can contact a station in Los Angeles and ask that station to pass on a message to a non-amateur. He can even have him connect his radio to the telephone line via a phone patch and make a radiotelephone call, thus saving on his long distance telephone bill. There is a number of countries that have reciprocal agreements with the USA about third-party traffic; in other words they allow traffic to be passed between their country and the states. Thus on all bands one can hear a number of nets passing traffic messages. Once a year the American Radio Relay League (ARRL) organises a traffic handling contest (called Sweepstakes), in which the information exchanged simulates message traffic.

The VHF Bands

At v.h.f. there is no 4 metre band, but there are operating privileges at 50MHz (6 metres) and 220MHz (1¼ metres). Six metres opens up to sporadic E much more often than 4 metres, and thus a lot of the activity is on c.w. and s.s.b. It has properties very similar to 10 metres in terms of ground-wave communications capabilities, but DX is of course much more scarce on 6 than on 10.

The 2 metre band is 4MHz wide (144-148MHz). The top two megahertz are filled with f.m. repeaters and simplex channels spaced 30kHz apart. Small segments of localised s.s.b./c.w. activity exist close to 144 and 145MHz, but in the main the lower two megahertz comprise the wide open spaces. At the time of writing, the FCC is proposing to open some of it up for repeaters. There is OSCAR-related activity at about 145·9MHz. Thus apart from narrow and sparse areas of activity at 144, 145 and 145·9MHz the lower two megahertz is an uncharted wilderness at this time. Local s.s.b. or c.w. activity on a nationwide basis is rare.

In most big cities, tuning the low end of the band by day will be very unrewarding with little to be heard. Even in the evenings you would be lucky to hear more than three simultaneous contacts taking place in the low half of the band, but during a contest a tremendous number of stations suddenly crawl out of somewhere and fill up the one or two hundred kilohertz. However, in the major cities the f.m. channels will be crowded. In most big cities all the repeater channels between 146 and 147MHz are in use as well as some of the 147-148MHz ones. There is no f.m. calling channel as such, just find a repeater and use it seems to be the rule.

In the states, the pioneers on v.h.f. set up repeaters to extend the range of their converted taxicab f.m. mobile equipment. As newcomers came on the band, they found the repeaters in existence and joined in. If people did not like a particular machine they were free to build and use their own on an adjacent frequency. In some parts of the country there were even repeater "wars" over choice frequencies between two repeater groups, each trying to force the other group to change frequency (this was before the days of synthesisers, when everyone was crystal controlled). Eventually voluntary frequency control was established by area-wide organisations. In the main how-

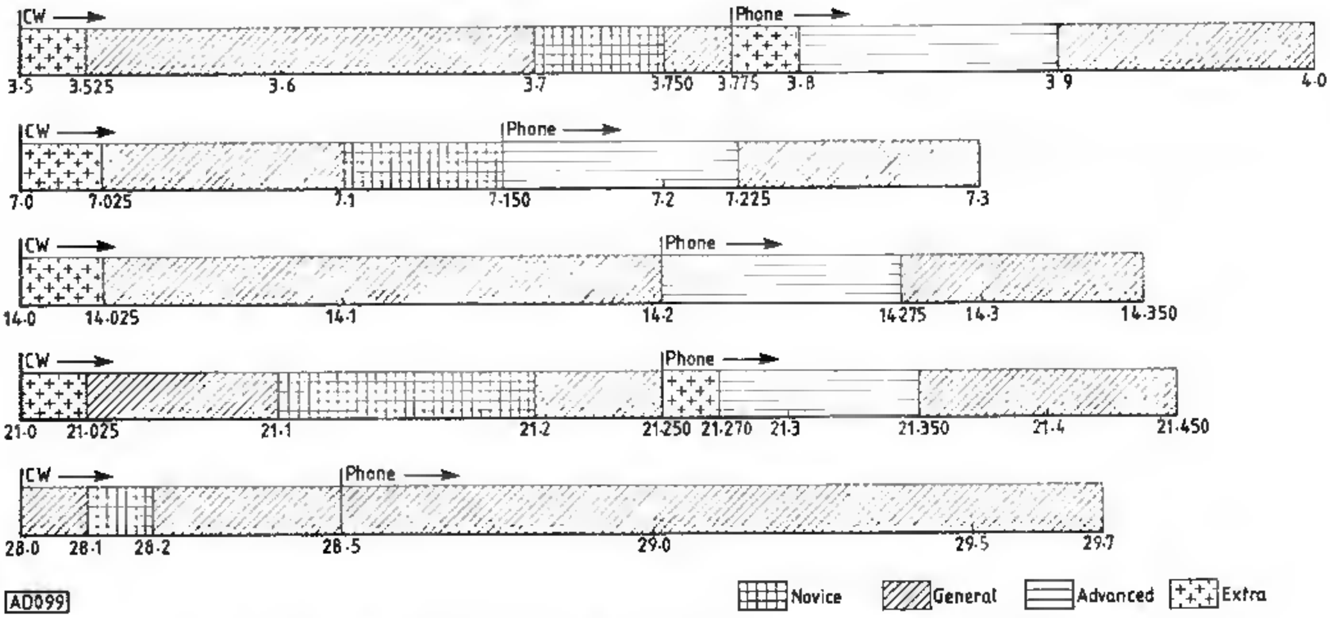


Fig. 1: HF Frequency Assignments in the USA. Note that higher class licensees have privileges in lower class segments, the table shows the lowest class allowed in each segment

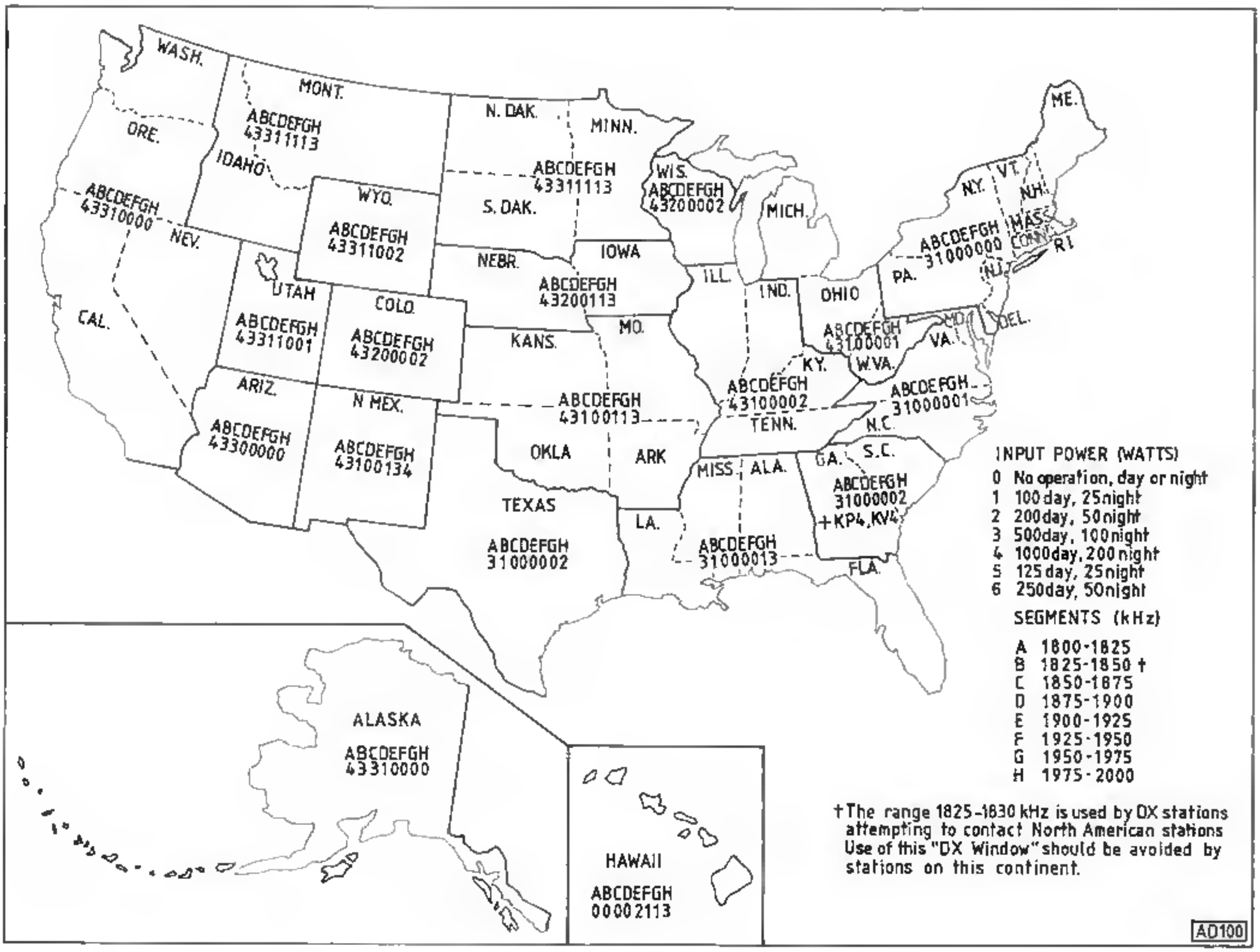


Fig. 2: Top Band frequency allocations in the USA

ever there have been few cases of deliberate interference with repeaters, because the newcomers to v.h.f., especially to 2m, generally only used f.m. and soon learned the advantages of the extended range and continuous monitoring of the repeaters.

In the UK the situation is different, the bands were in use before the advent of the repeaters. Also the 2m band is only two megahertz wide and everyone has to fit into it. Hopefully it will take just a short while for everyone to find out the advantages of repeaters and common sense will then prevail.

The 220MHz band is similar in characteristics to 2m. There is little in the way of s.s.b./c.w. commercial equipment for the band, and hence most of the activity is f.m. The same applies to 70cm. Here, most of the activity is f.m. between 440 and 450MHz, i.e. right at the top of the band, so that conversion of surplus equipment involves the minimum of changes. The 70cm band is also used for remote control of lower band repeaters and for inter-repeater links. Activity on higher frequencies is at par with Europe, namely very rare and due to only a few individuals.

Using Repeaters

Many f.m. repeaters are connected to telephone lines. This allows for "auto patch" facilities, whereby amateurs can actually access the telephone network via the repeater and dial calls using the tones. They can report accidents to the police, call home and ask the wife if they should stop off at the local supermarket and pick up some groceries, or do as one radio amateur did over one of the local machines here in Washington DC; while sitting in the garden by the side of the pool, he used his walkie talkie equipped with a touch-tone pad to dial his house phone and ask his wife to bring him out another can of beer!

The number of repeaters is constantly growing. The ARRL publishes an annual directory that is free for the asking to members. The frequencies are based on a 600kHz split with a spacing of 30kHz between channels. They are known by the kilohertz values, i.e. a repeater on 146·25MHz (in), 146·85MHz (out) is commonly known as the 25/85 machine. In the 146/147MHz region the input frequency is the lower one, whilst in the 147/148MHz region the reverse is true and the higher frequency is the input channel. This was carefully arranged this way so that receivers could be peaked up at 147MHz and work with the whole range of channels. These frequencies are of course not allocated to the amateur radio service in Europe, and on my last trip to the UK, I found that some of the American repeater output channels that I had in my rig were in use by the police.

Apart from f.m. the majority of activity on 2m and 70cm seems to involve OSCAR. Project Oscar started the whole thing in California with the launch of the OSCAR I satellite in 1961, and AMSAT took over in 1969. The ARRL puts out a lot of free

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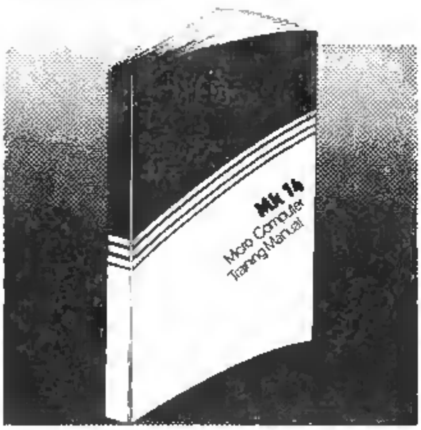

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PW6

educational stuff about the OSCAR satellite programme, which by-the-way is available to anyone worldwide, for the asking. Worked All States via OSCAR is just possible for Eastern stations and is well within the capabilities of anyone in the continental United States west of the Mississippi river.

Equipment

Salaries in the states are generally at between two and four times the level of the equivalent salary for the same job in the UK. Thus on a basis of hours worked, equipment is much cheaper over here. The large number of amateurs support a few manufacturers so that there is quite a variety of domestic gear available as well as the ubiquitous Japanese black boxes.

Parts for the homebrewer are also readily available by "mail". Many suppliers advertise in the various magazines, and their wares can be ordered by post, or by telephone quoting credit card numbers.

Crystals for 2m transceivers are available over the counter in most major cities and the prospective visitor can wait until he arrives in the USA to purchase the bulk of his crystals. If he is lucky the store may even have facilities for tuning the rig frequency. If you are interested in operating in the USA when visiting this country you can obtain detailed information from the RSGB, or write to the FCC, Washington DC, 20554 for an application form (Form 610A). Make sure that you send in your application at least three months before your trip, because it will take them that long to reply.

Listening and Viewing

The receiving side of the hobby is also somewhat different. The medium waves, f.m. and v.h.f. TV bands are filled in most major urban areas. Medium wave DX-ing is a little easier than in Europe, because most of the stations broadcast in English. Stations are spaced 10kHz apart, which enables the intercontinental DX to creep in between the cracks. The majority of stations are east of the Mississippi. The FCC recognise the sky-wave effect at night and regulate the band occupancy such that many local stations are required to close down at local sunset. This allows clear-channel stations to be heard over continental distances at night. It is thus for example possible to drive through downtown Los Angeles in the evening, tune the car radio a little and listen to broadcasts from Denver, Oklahoma and Iowa, or to drive around in Washington DC and listen to stations in Montreal, Chicago and New Orleans.

The v.h.f. TV bands are also full in most cities with some additional channels in the u.h.f. bands in use. All transmissions in the Americas are 525-line 30-fields, thus there are no modifications necessary to the TV sets for their use in TV DX-ing. The f.m. band is 20MHz wide in the range 88-108MHz, with 88-92MHz being reserved for public broadcasting stations. These stations, usually run by universities or local authorities, broadcast educational programmes, classical music and selected shows from the BBC (including the *Goon Show*) as opposed to the popular music or news churned out by the commercial stations. There are three major networks in the states that broadcast commercial programmes, and each city usually has a local outlet of each as well as one or more independent stations and the public station. This allocation applies to television as well as radio. Recent broadcasts on public televsion have included, *I Claudius* and *Upstairs-Downstairs*.

Many of the independent TV stations broadcast old films and TV shows including *UFO*, *The Saint*, *The Prisoner*, *The Avengers* and *Danger Man*. The f.m. stations usually broadcast in stereo. Both medium wave and f.m. stations usually churn out popular music, each specialising in a particular type, and there may be one or two stations that continually broadcast news. The u.h.f. TV band is relatively sparsely populated, its growth being curtailed by cable television systems.

Citizen's Band

Closely related to amateur radio is Citizen's Band Radio. The Citizen's Band is a small allocation of spectrum space at about 27MHz. It seems to have been originally allocated for personal communications between a fixed base station and a mobile (so that for example, a husband could talk to his wife on the way home from work) or between mobiles, so that the drivers of two cars travelling together can communicate.

Licences are now available free for the asking, with no tests involved. Power input is limited to 5 watts d.c. a.m. and equipment is cheap. A forty-channel transceiver can be purchased for about $50. There are estimated to be millions of CB stations in service, the majority of them being unlicensed.

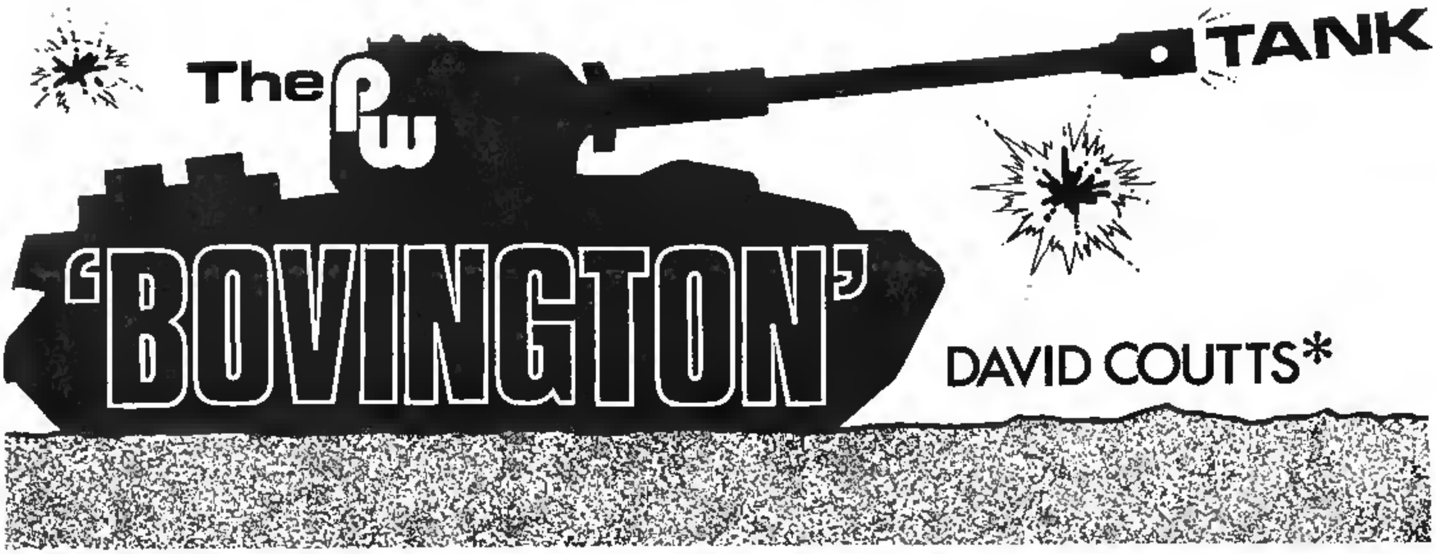
Homo sapiens is a creature of invention. The American branch of that species, perhaps more inventive than other branches, has devised new uses for the Citizen's Band. Lorry drivers use it to warn each other of impending police radar speed traps. Prostitutes have been known to solicit customers via CB radio. Hobby operation including QSL'ing abounds and most stations use self-given "handles" rather than their official call signs, always assuming that they have an original call sign.

Illegal power amplifiers are often used and some operators are even equipped with amateur band equipment such as Yaesu FT101s. In the cities the channels are overcrowded and communication ranges are limited by the numbers of conversations taking place on the frequency. One channel has been set aside for emergency use (ch 9) and one is used as a calling channel (ch 19). Almost everyone monitors channel 19 when on the road unless they have QSYd for a particular reason to another channel, and contribute traffic and police location information. Hitch-hikers also solicit rides over channel 19. One neighbour of mine estimated that in two weeks of use he recouped the cost of the equipment due to the timely warning he received about the locations of police radar speed traps that would otherwise have caught him. Citizen's Band is a boon if used correctly, but if abused is a mess.

Microprocessors

The latest arrival on the electronics hobby scene is the home computer based on the microprocessor. Thousands have been sold and clubs are forming all over the country. Microcomputers can be the subject of many articles in themselves, but suffice it to say for now that their use is invading the home as well as the amateur radio shack. It is estimated that within five years the vast majority of homes in the US will contain at least one microprocessor.

This article has been an introduction to amateur radio and the electronics scene in the United States. Future articles will go into more detail about the various aspects of the hobby. ●



The General Instrument AY-3-8710 integrated circuit is a 625 line interlaced "TV Tank Battle Game" for two players. The "battleground" consists of white barriers and a series of black mines. There is one white and one black tank, each controlled by two single pole double throw paddle switches biased to centre off. A push button for each player controls gun firing and a push button allows the battle to be reset. Pin 22 of the i.c. is switched to control the tank traps. In the open position the tanks can drive through these barriers, in the other position (grounded) the tanks halt when they collide with them. Motor sounds are provided for each tank as well as gun fire and shell explosions, and the score is coded to each tank. The tanks are driven like real tracked vehicles, pushing both switches forward causes the tank to go forward. If the switches are held the tank automatically speeds up after a few seconds. If the switches are released the tank continues at the speed reached at the time of release. Pulling both switches back causes the tank to reverse, while holding one switch back and one forward causes the tank to rotate. To stop the tank when it is going forward momentary selection of reverse is required. The shell has a range of about two thirds of the screen and after firing there is a reload period before you can fire again. The shell can be steered during its flight by rotating the tank. The shell will pass over the mines but will explode on hitting barriers. A hit on your opponent counts one point, while running over a mine counts one against you. When one player reaches 16 hits the scores flash to show that the game has ended.

Circuit Description

The circuit diagram is shown in **Fig. 3.** T1 provides 12-0-12 volts which is full wave rectified by D1 and D2 and smoothed by C1. IC1 regulates the supply VP to approximately 6·5 volts, VR1 adjusting the voltage and C2, 3 and 4 providing decoupling. IC4 a and b provide the 4 MHz clock to the AY-3-8710, L1 being adjustable to allow the oscillator to be set to the correct frequency. IC3 a and b, with their associated Rs and Cs, provide the shaping for the fire and explosion sounds. IC3c does the same for the motor sounds which are all fed via IC3d to the output transistors TR1 and TR2. Switches S4, 5 and 6 control the left tank and S7, 8 and 9 control the right tank. S3 is the game reset and S2 is the tank trap switch. R2 to R4 mix the video signals and the composite video is buffered by the emitter follower TR3 and fed to the modulator.

TR4 and its associated components act as the modulator which runs at a frequency of approximately 160-170MHz, with harmonics extending into the u.h.f. band.

Construction

Construction is relatively straightforward, most of the components being mounted on the p.c.b. It is, however, advisable to use sockets for IC2, 3 and 4. The component layout is shown in **Fig. 7.** Drill 6BA clearance holes for board fixing, FS1, T1 and IC1, and a 6mm hole for L1. Drill other holes to suit the component leads. Before mounting any components on the board place the p.c.b. in the box with a modulator at the front right, and the p.c.b. about 10mm from the right side of the case. Drill 4 fixing holes in the bottom of the case using the p.c.b. as a template. Also drill a 6mm hole in the bottom to line up with L1 core. Put the p.c.b. to one side and drill the box and front panel as shown in **Fig. 1.** Also drill a few 6mm holes in the base and rear of the case for ventilation. Stick a small piece of speaker cloth over the rear of the speaker hole on the front panel, fix the speaker in place with epoxy adhesive and mount the switches S1, 2 and 3. The sound output is controlled by VR3 which is mounted on the front panel.

Assemble the p.c.b. using the layout Fig. 7 and parts list as a guide but do not fit IC2, 3 or 4 into their sockets yet. R9 can be either a 20MΩ resistor or two 10MΩ resistors (R9a and R9b). Fit a TO5 heatsink to TR2, cut and bend a piece of aluminium sheet 60mm x 35mm as a heatsink for TR1 as shown in **Fig. 4,** drilling through the p.c.b., and retaining IC1 and the heatsink with a 6BA screw. Cut and bend

*An Engineer with General Instrument Microelectronics, Glenrothes

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IC of the MONTH by B. Dance

KINDLY NOTE

Points arising from articles in the previous volume

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PRODUCTION LINES

SHOW REPORTS

LEADERS

BOOK REVIEWS/NEW BOOKS

MISCELLANEOUS

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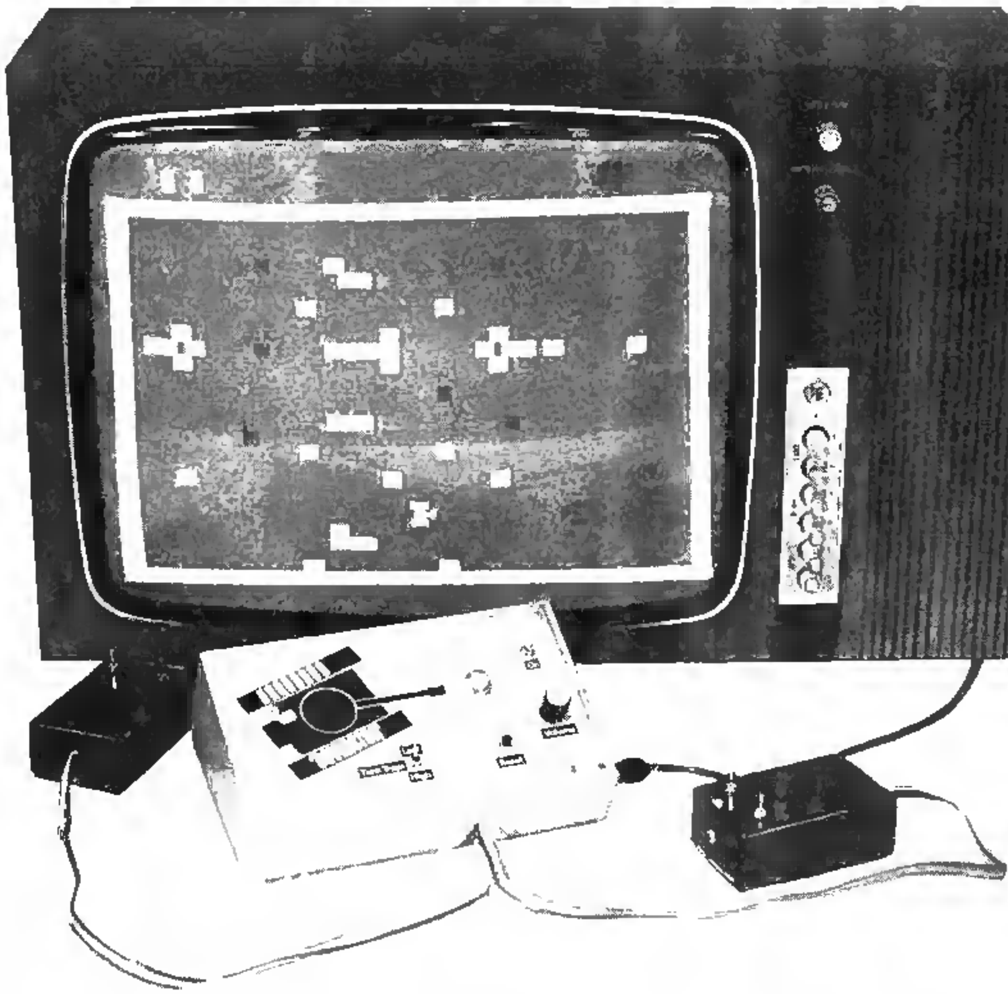
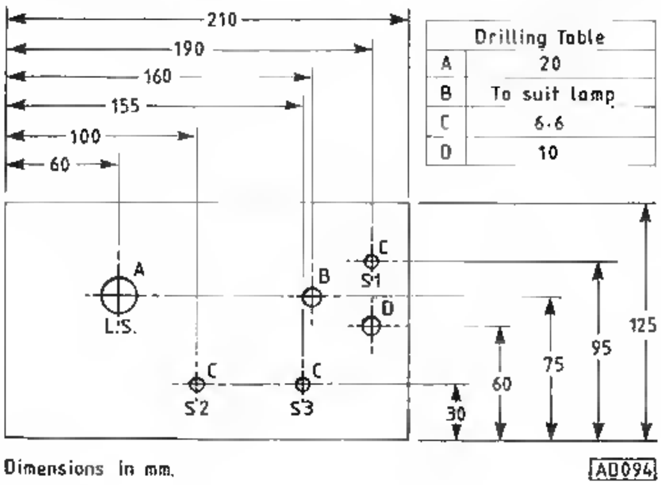
BATTLE GAME



a piece of tinplate (cocoa tin) as shown in **Fig. 5** to form a box for the modulator screening, fit the sides and bottom by soldering to four Veropins as shown in the drawing but leave the top plate off until the unit is working and displaying a picture on the television screen.

Carefully check the p.c.b. for correct assembly and freedom from inadvertent shorts such as solder



Drilling Table	
A	20
B	To suit lamp
C	6·6
D	10

▲
Fig. 1: Front panel drilling diagram

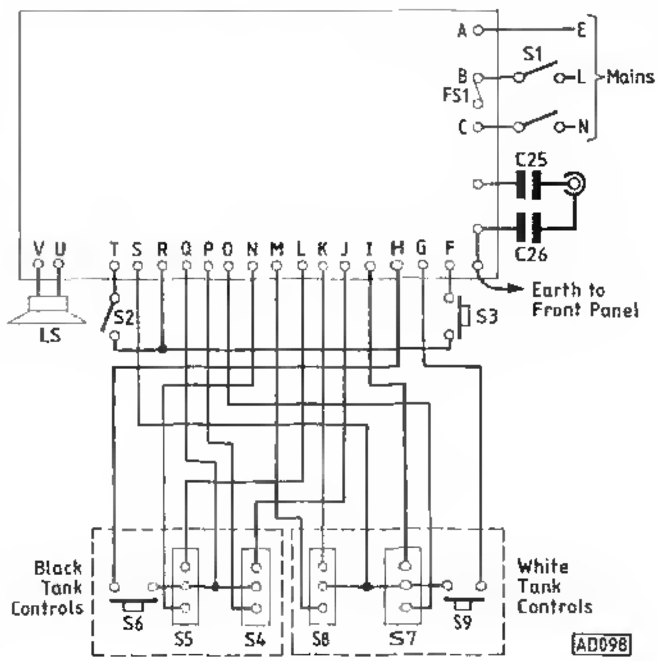


Fig. 2: Main printed circuit board connections ▶

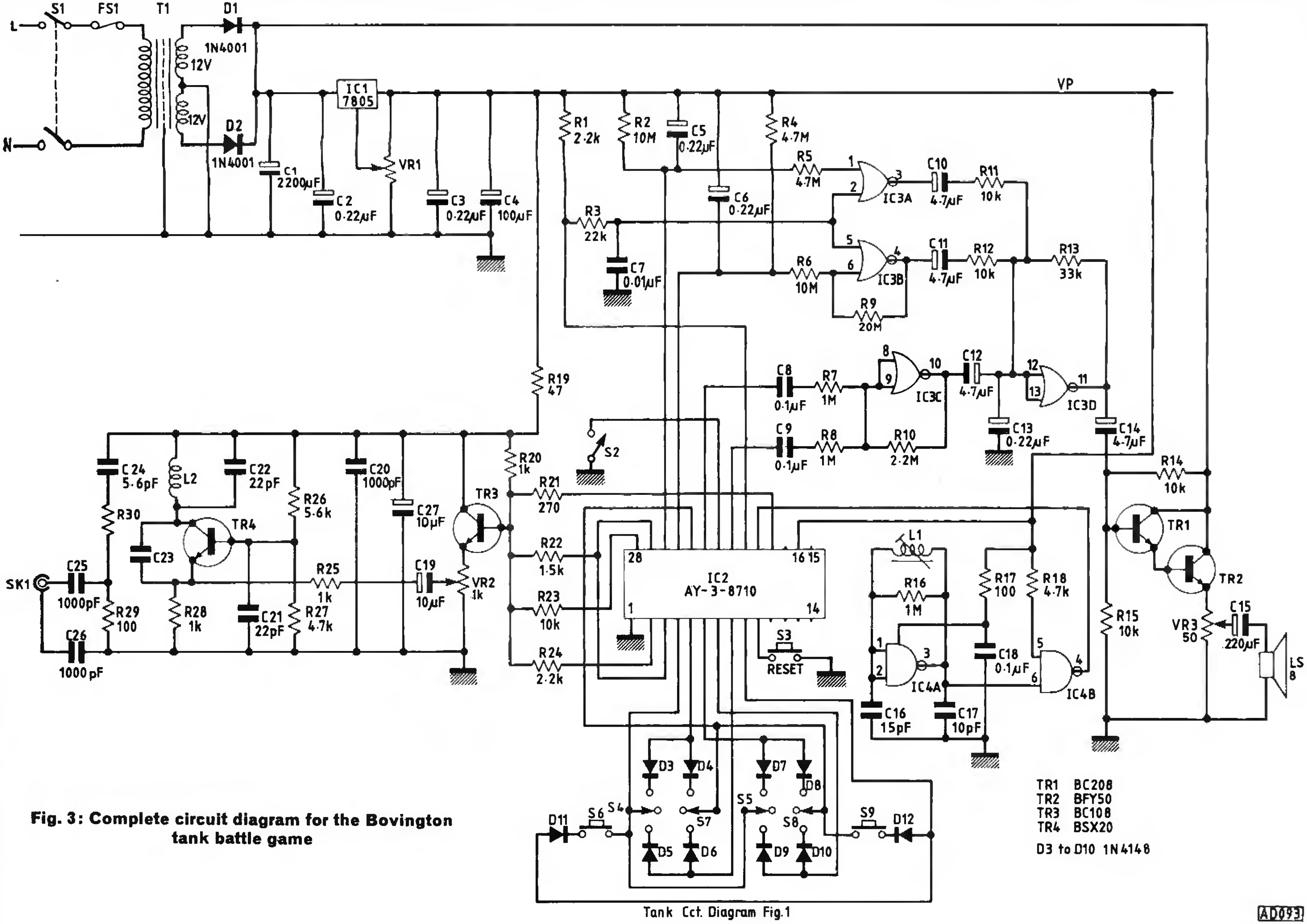
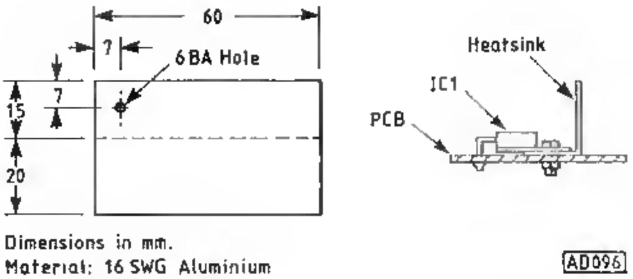


Fig. 3: Complete circuit diagram for the Bovington tank battle game



▲ **Fig. 4: Heat sink for IC1**

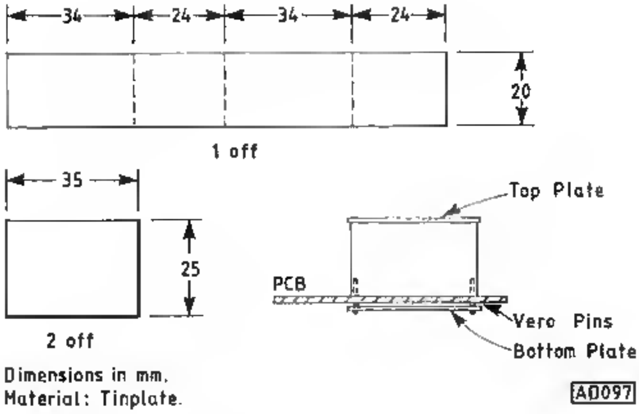


Fig. 5: Details of modulator screen ▶

bridges, set VR1 fully clockwise and VR2 to midrange and fit the unit in the case with 6BA screws through the fixing holes. Wire the unit up as shown in Fig. 2. Fix two 6 pin DIN sockets in the front of case connected to points G-Q & S on the p.c.b. to feed the hand controllers. These sockets may be omitted and the multicore wires fed through suitable holes fitted with grommets. The hand controllers can be assembled in any convenient small plastic boxes.

Switch the power on, monitor the voltage VP across C4 and adjust VR1 to obtain 6·5 volts. If you have a scope or counter fit IC4, power up and adjust L1 for 4MHz. If not, set the top of the core of L1 approximately 6mm into the former. Fit the remaining inte-

★ components

Resistors
All ¼W 5%

47Ω	1	R19
100Ω	3	R17, 29, 30
270Ω	1	R21
1kΩ	3	R20, 25, 28
1·5kΩ	1	R22
2·2kΩ	2	R1, 24
4·7kΩ	2	R18, 27
5·6kΩ	1	R26
10kΩ	5	R11, 12, 14, 15, 23
22kΩ	1	R3
33kΩ	1	R13
1MΩ	3	R7, 8, 16
2·2MΩ	1	R10
4·7MΩ	2	R4, 5
10MΩ	4	R2, 6, 9a, 9b

Capacitors
Plate Ceramic

3·3pF	1	C23
5·6pF	1	C24
10pF	1	C17
15pF	1	C16
22pF	2	C21, 22

Disc Ceramic

1000pF	3	C20, 25, 26
0·01μF	1	C7
0·1μF	3	C8, 9, 18

Polyester

0·22μF	2	C2, 3

Tantalum

0·22μF 10V	3	C5, 6, 13
4·7μF 10V	4	C10, 11, 12, 14
10μF 10V	2	C19, 27
100μF 10V	1	C4

Electrolytic

220μF 25V	1	C15
2200μF 25V	1	C1

Potentiometers

1kΩ Horizontal preset	1	VR2
4·7kΩ Horizontal preset	1	VR1
50Ω Wirewound	1	VR3

Semiconductors
Diodes

1N4001	2	D1, 2

Integrated circuits

4001A	1	IC3
4011A	1	IC4
7805 regulator	1	IC1
AY-3-8710	1	IC2

Transistors

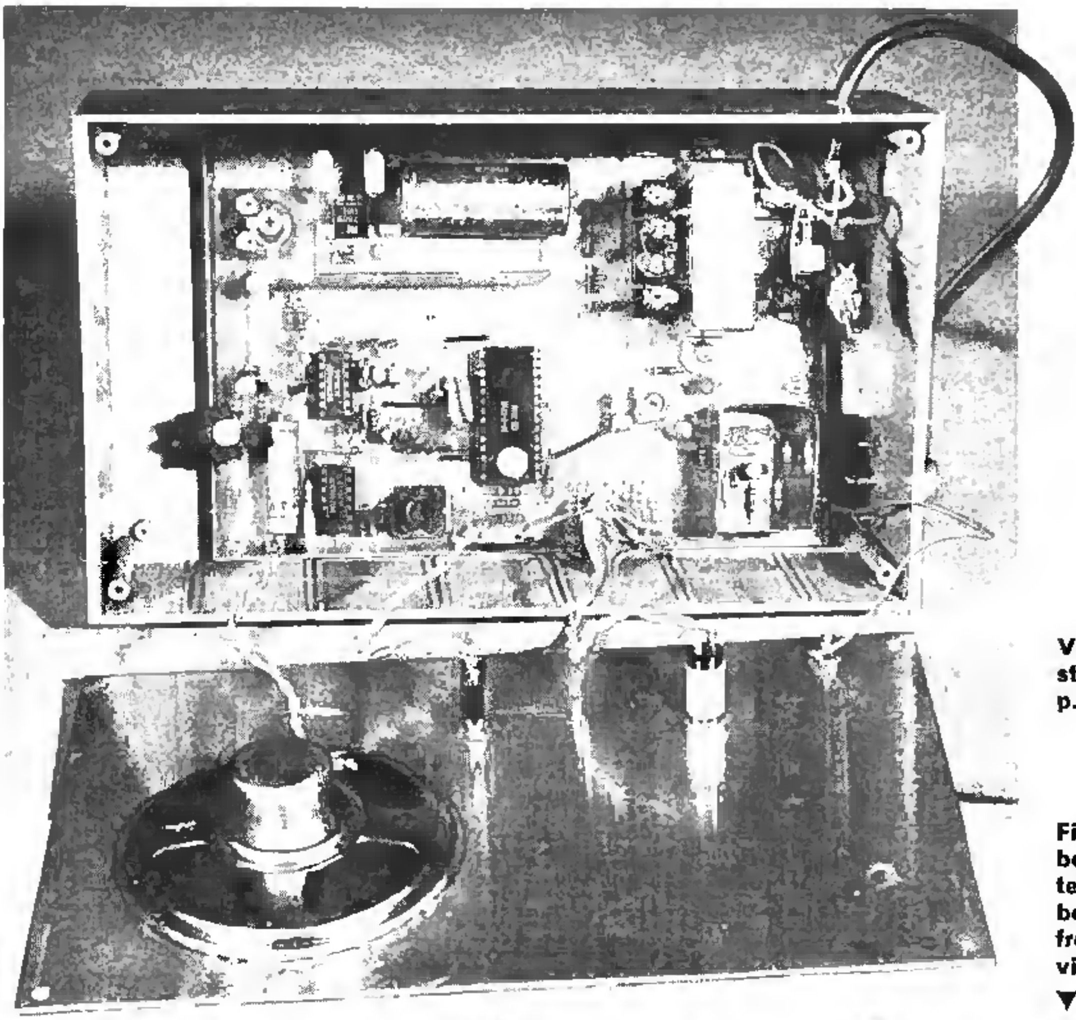
BC108	1	TR3
BC208	1	TR1
BFY50	1	TR2
BSX20	1	TR4

Switches

Paddle s.p.d.t. (Arrow CPM3 Black)	2	S4, 5 (Biased to centre off)
Paddle s.p.d.t. (Arrow CPM3 White)	2	S7, 8 (Biased to centre off)
Push-button s.p.	3	S3, 6, 9
Toggle s.p.d.t.	1	S2
Toggle d.p.s.t. (Mains)	1	S1

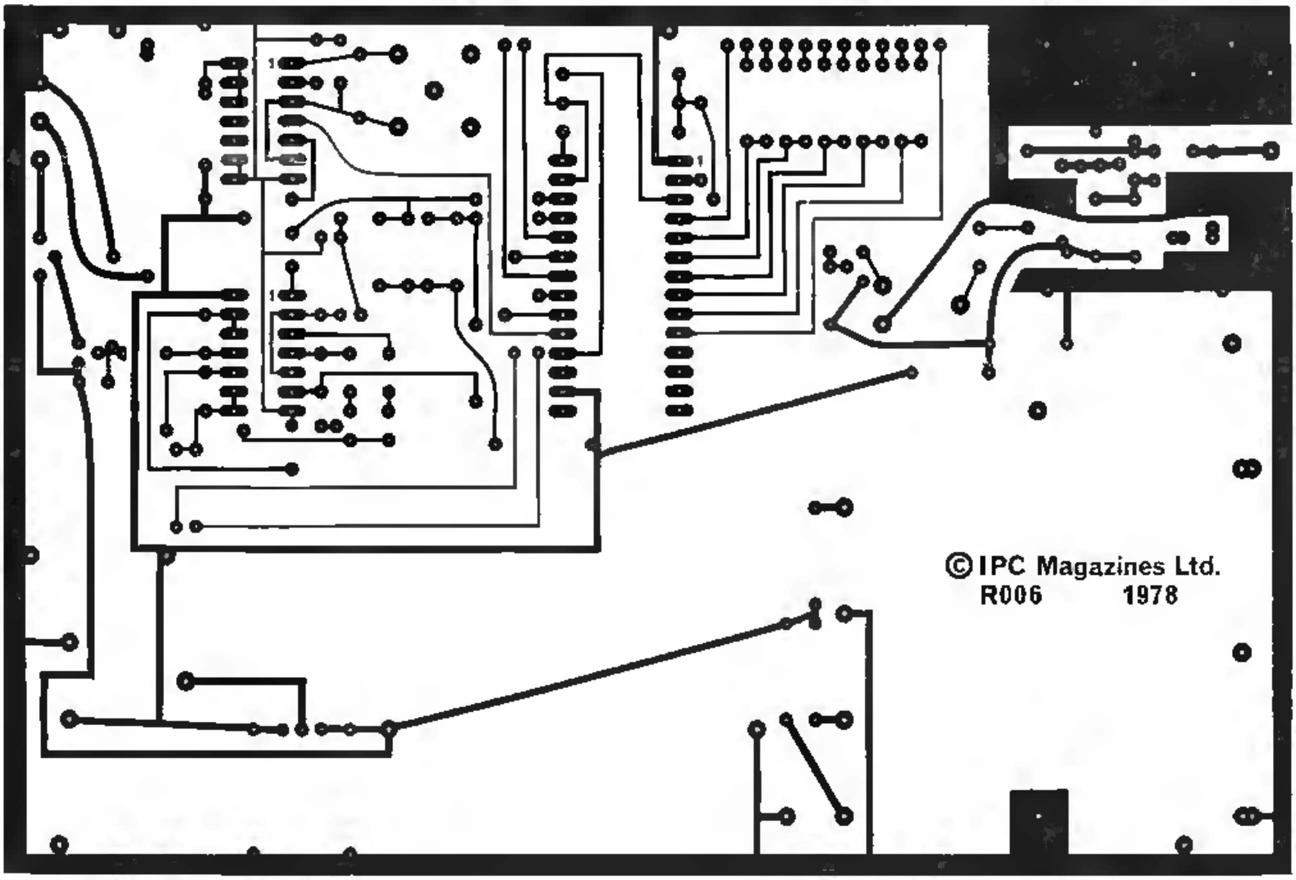
Miscellaneous

Transformer 12V, 12V 250mA MT12 (Marshall's)
Loudspeaker 2¼ inch 8Ω
Case RS Type 509·608
Hand control boxes (2) RS Type 509·298
350mA fuse and holder
Miniature multicore cable (9-way) 4metres
Miniature mains cable
Indicator lamp 12V
Knob for volume control
6-way DIN plug and socket (2) Optional for hand control leads.
TO5 heat sink
Co-axial TV socket surface mounting type.
28-way d.i.l. socket (1)
14-way d.i.l. socket (2)



View of the internal construction of the main p.c.b. and case

Fig. 6: Printed circuit board copper track pattern. Ready drilled boards are available from Readers PCB Services (see page 68)



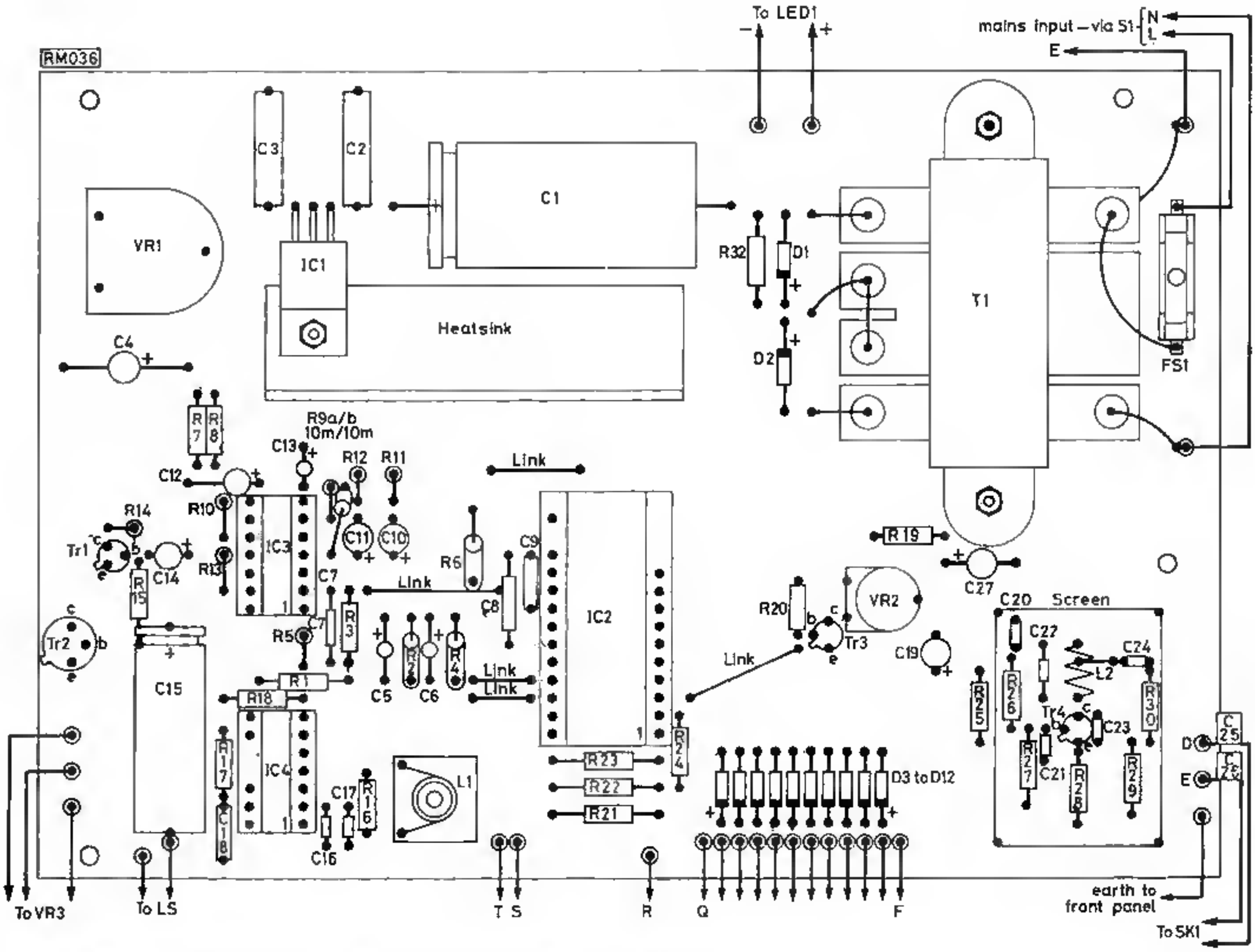


Fig. 7: Main printed circuit board component placement drawing

grated circuits, connect to the aerial input of the television and switch on. Push the reset button, release it and tune the television until a signal from the games unit is found. Several signals may be found, if so choose the best one. L1 may need to be slightly adjusted. When a good picture has been obtained adjust VR2 for the optimum picture, and fit the top cover to the modulator. Check that all the switches function as required and fit the front panel.

Fault Finding

If the unit fails to function check all your construction carefully, then:—

1. Check that the voltage across C4 is 6·5 volts.
2. Vary VP over the range 6 to 7 volts by means of VR1, if this does not help reset it to 6·5 volts.
3. Check with a scope that pin 19 of IC2 has a 4MHz clock input and pin 16 is at 6·5 volts.
4. Check that composite sync is appearing at IC2 pin 18, pushing and releasing the reset.
5. Check for composite video at TR3 base and again at VR2 wiper. If it is appearing at VR2 wiper try again to tune the television to the game signal. If you still cannot get a picture, substitute a new transistor for TR4.
6. If the tanks only go forward under control of the switches you will probably find that one pair of wires to the switches are crossed.

IC2 Pin Functions

1	Ground
2, 3, 18, 27, 28	Video outputs
4, 5, 6, 7, 8, 9, 24	Control inputs
10	Reset
16	VP (+6·5V)
19	4MHz clock input
20, 21, 23, 25, 26	Sound output
22	Tank trap select
11, 12, 13, 14, 15, 17	Do not connect

Four Players

Extra excitement and skill can be introduced into the game by splitting the tank controls between four players, two to each tank. The steering controls are operated by the "drivers" while the tank commanders have control of the firing buttons.

The modifications needed to make this a four-player game are very simple, especially if DIN plugs and sockets are used for connecting the control boxes to the main unit. The commander's firing control can be fitted into a simple box wired into the DIN plug. If a duplicate set of controls is not desirable then a permanently fitted "commander's" control can be wired into the game unit with a switch arranged to select either the firing button on the "driver's" box or the button on the "commander's" box. ●

PRODUCTION LINES

alan martin

Psssst wanna watch?

When l.e.d. and l.c.d. watches first came onto the British market, they cost between £50 and £100 and any available in the £20 range were either advertised on 'Police Five' or came off the back of that proverbial lorry.

We are informed by W.K.F. Electronics, that they have a selection of watches available at very reasonable prices.

First, an l.e.d. watch (left in photograph) that features a rather novel touch sensitive operating pad to display hours and minutes, seconds, day and date, also day and month. Price £10·75 plus VAT.

Second, the standard l.c.d. watch (centre in photograph), which displays hours and minutes continuously, press the button for day and month, press again for seconds. The watch also has a separate back-light function. Price £10·50 plus VAT.

Finally the chronograph l.c.d. watch (right in photograph) whilst possessing the standard watch functions of hours, minutes, seconds, day, date and month, also features a lap and continuous stop watch facility, with timing to 100th of a second. Price £18·95 plus VAT.

All the watches are supplied with an adjustable stainless steel bracelet and the two l.c.d. watches are powered by batteries costing only 42p (retail) with an estimated life of twelve months.

W.K.F. Electronics, Fleet House, Welbeck Street, Whitwell, Workshop, Notts. Tel: 0909 720-695.

No tick TAC-1

The Polycal TAC-1 is a pocket size, liquid crystal display, travel alarm clock. Measuring 65mm × 32mm × 11·5mm, it weighs only 45g with batteries. The 3V d.c. power input is provided by two silver oxide or manganese alkaline batteries (type GS-14, A-76 or equivalent). Power consumption is 3mW max. (with the alarm sounding). Accuracy is claimed to be ±30 seconds per month at 20°C (68°F). With a separate backlight, the multi-digit liquid crystal displays hours, minutes, clock-working sign and am/pm indication.

Priced at £22·50, which includes VAT and p & p, the TAC-1 is available from: *Tempus, Dept. P.W., 19/21 Fitzroy Street, Cambridge CB1 1EH. Tel: 0223 312866.*

Vero interesting

Vero Electronics Ltd. introduce a new range of cases with their 'Series II Boxes AB 010'.

These boxes are moulded in light grey high-impact polystyrene in two parts. The anodised aluminium front panel supplied with the box is retained between the two halves, avoiding the need for fixing screws. Slots and bosses are moulded into the interior of the box, so that a choice of mounting positions, either horizontal or vertical, is available for p.c.b.'s or component decks.

Many of the boxes have a battery compartment which is accessible without dismantling the box.

The standard range consists of fifteen boxes varying from 110mm × 68mm × 33mm to 190mm × 138mm × 91mm, and other sizes are available to special order at a minimum quantity of 100.

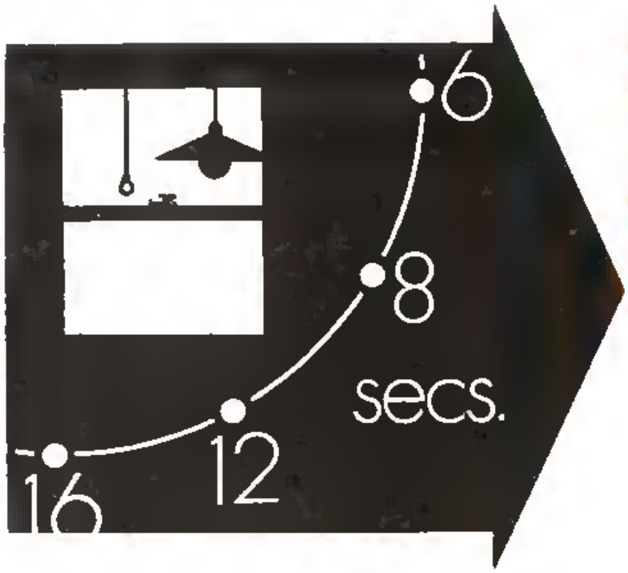
Further details from: *Vero Electronics Ltd., Industrial Estate, Chandler's Ford, Eastleigh, Hampshire S05 3ZR. Tel: 042 15 69911.*

Rechargeable iron

A new version of the Engel B.50 Rechargeable Soldering Iron is now available from Kelgray Products Ltd. and is complete with charger unit. The iron now incorporates a built-in spotlight to illuminate the working area and uses long-life rechargeable nickel-cadmium batteries. Providing up to 100 intermittent operations (300 continuous use) without recharging, which can be achieved in about 8 hours (overcharging is impossible). A safety switch is fitted to the trigger-switch to prevent accidental operation. The iron heats up to an operating temperature of approx 350°C in about 7 seconds; a variety of bits are available.

Designed for recharging from a.c. mains, the B50 comes complete with cleaning pad, protective cover, 2 lighting fittings and screwdriver. A particular advantage of this iron is that no stray eddy currents which might damage a sensitive i.c. are generated when the iron is being used.

Priced at £16·50 which includes p&p and VAT, the B50 is obtainable from: *Kelgray Products Ltd., Kelgray House, Sandy Lane, Crawley Down, West Sussex RH10 4HS. Tel: 0342 715066.*



SIMPLE DARKROOM TIMER

A.P. DONLEAVY

This article describes a simple timer which switches an enlarger on and off for predetermined periods. The instrument can handle exposures up to 32 seconds although this can be easily increased as will be described. The accuracy is better than 10% which is adequate for black and white printing.

The instrument uses a switch which enables the exposure time to be set by feel rather than by having to peer at some dimly lit switch setting.

Circuit

The circuit is shown in **Fig. 2.** The 555 i.c. is connected as a monostable multivibrator and on application of a negative pulse to pin 2 a positive pulse emerges at pin 3. The duration of this pulse is determined by the R-C values of R1 to R8 and C1, and also by the voltage on pin 5. This pulse is applied to the gate of the s.c.r. which causes it to conduct for the duration of the pulse. The s.c.r. is essentially being used as a mains switch. If the mains were applied directly to the s.c.r. it would only conduct on the positive-going part of the cycle and the light would only have about one third of its normal intensity. A bridge rectifier is used to rectify the mains supply and thus overcomes this problem.

SW2 applies the pulse to start the timing. Pin 2 is tied to Vcc via R9 to prevent unwanted triggering. Application of a negative pulse via SW1 will prematurely terminate any timing interval.

The length of the timing pulse is proportional to the value of the resistance at pins 6 and 7. The values R1 to R8 are chosen to give sequence times of 2, 4, 6, 8, 12, 16, 24 and 32 seconds, within 10% but the values can be altered to suit the needs of the individual constructor. Every 27kΩ added to the resistor chain will give an extra two seconds time. Hence if a 48 second timing period is required, an extra 8 x 27kΩ or 216kΩ resistor would be needed to be added in series with R1 to R8. In practice a 220kΩ resistor would suffice. The final calibration is made by adjusting VR1.

The unit should consume no more than 8mA, so the power supply uses a miniature mains transformer, with a full wave rectifying circuit.

The timer is built into a small instrument case with all the controls on the front panel

Components

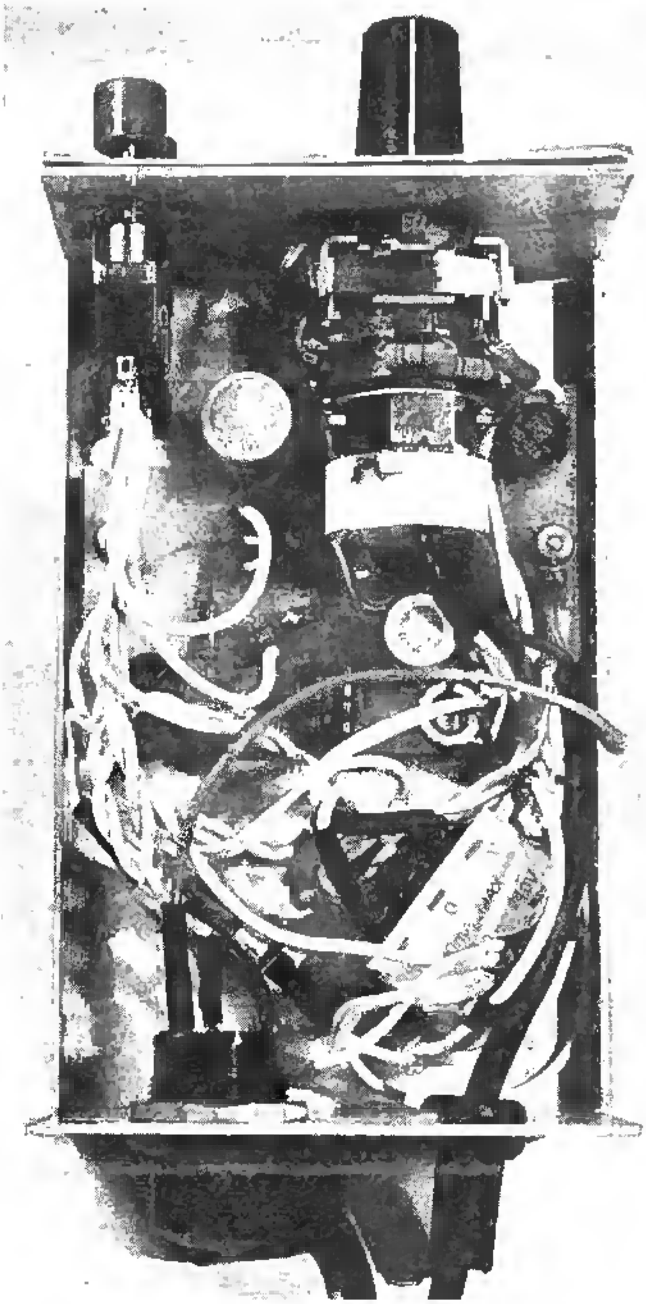
Any 555 timer i.c. can be used, e.g. LM555, SN72555 NE555, and any s.c.r. and bridge rectifier that can handle at least 400V at 500mA can be used for SCR1 and D1.

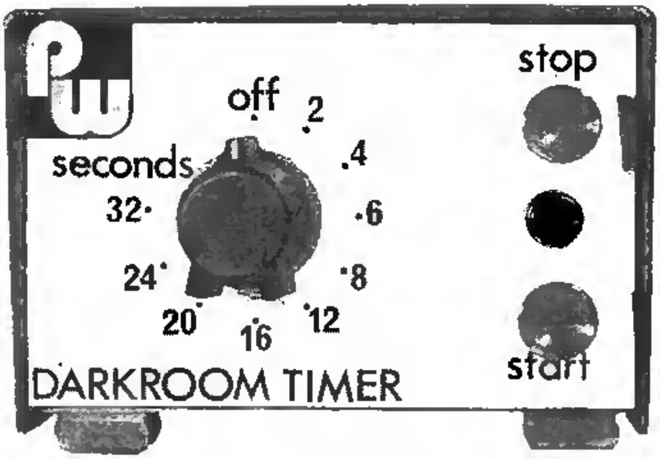
SW3 is made up from a Doram Mini-Maka switch. The minimum requirement is one pole eight way. The prototype had an open position at one end of the scale, which gives a timing pulse of almost indefinite length. This is used for leaving the enlarger permanently switched on. The mains transformer need only be capable of supplying between 6V and 15V at 50mA at the secondary.

Construction

The unit is built on a printed circuit board 105mm x 57mm. The layout of the copper tracks is shown in **Fig. 4** and the component layout in **Fig. 3.** The unit is housed in a metal instrument case and to complete the front panel a *PW* overlay is available.

The p.c.b. is supported by two short 4BA screws with a nut between the board and case bottom. Remember that some of the copper tracks carry live

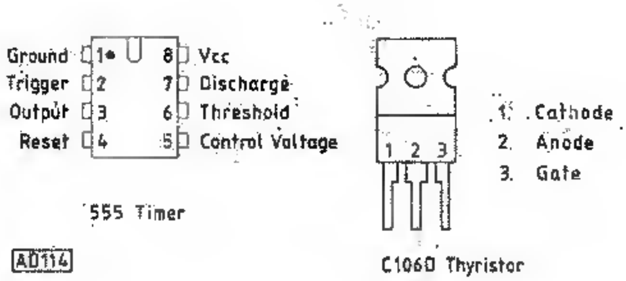




Front panel layout of the darkroom timer. A transparent overlay is available from the PW Editorial Offices which will enable readers to achieve a professional finish to their equipment. The overlay is cut out and placed over the front panel, being held in place by the switch nuts and washers. A coloured background can be used behind the overlay if desired

Inside view of the complete unit showing the positioning of the transformer, p.c.b. and switch

Fig. 1: Pin connections for the 555 timer i.c. and the C106D thyristor



★ components

Resistors
All ¼W 2%

R1	27kΩ	R6	56kΩ
R2	27kΩ	R7	120kΩ
R3	27kΩ	R8	100kΩ
R4	27kΩ	R9	4·7kΩ
R5	56kΩ	R10	68kΩ

Potentiometers
VR1 10kΩ min. horizontal skeleton

Capacitors
C1 47pF 16V
C2 100pF 16V

Semiconductors
IC1 555 timer
SCR1 TIC 106D or similar 400V working
D1, D2 1A bridge rectifier 400V working

Miscellaneous

Transformer	3-0-3V 1·2VA Sub-miniature
SW3	1 pole 12 way miniature wafer switch
SW4	Mains switch to fit SW3 mechanism
SW1 and 2	Miniature push-button push to make. Lamp output plug and socket (RS components 488-567 and 488-593). Fuse and holder 2A
Printed circuit board	Reader's PCB Services
Case	RS components 509-715
Knob	15mm Sifam W15 collet fixing with nut cover and cap
PW Front Panel Overlay	

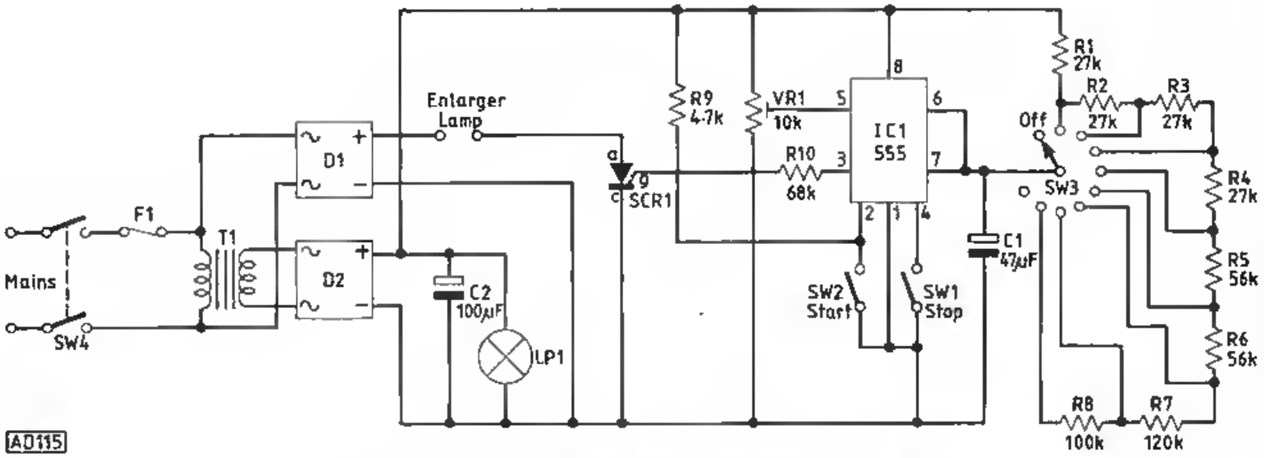


Fig. 2: Circuit diagram of the darkroom timer

Fig. 3: Component layout diagram. Care must be taken to avoid solder bridges or other forms of short circuits between tracks or components as mains voltages appear at several points on the board. A piece of self adhesive plastic sheet should be placed on the metal base of the case underneath the p.c.b. to avoid any possibility of component leads shorting to chassis

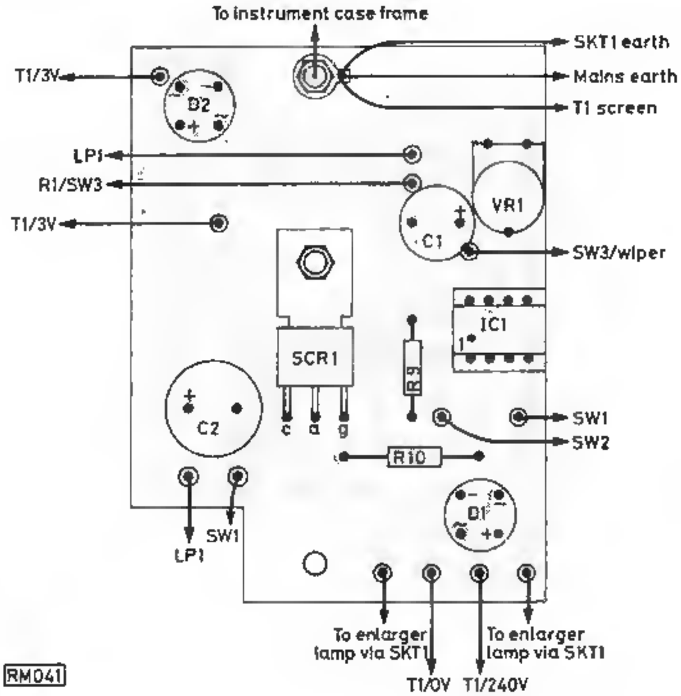
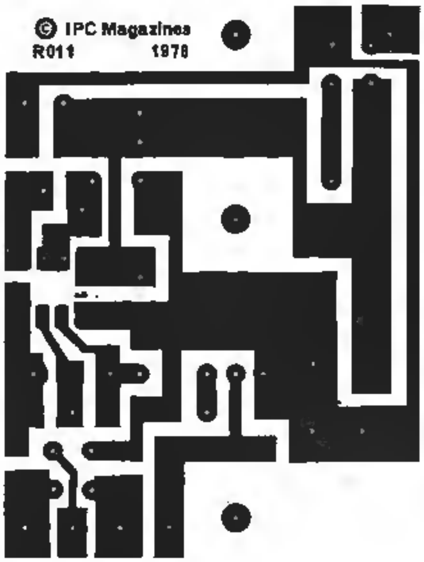


Fig. 4: Copper track pattern for the darkroom timer p.c.b. Ready drilled boards are available from Reader's PCB Service. (see page 68)



mains voltages and that these should be kept well clear of the supporting bolts.

A shielded miniature mains plug and socket are used to connect the enlarger lamp to the unit and this is fitted into the back of the case. If desired the fuse can be a panel mounting type and also fitted into the back. A mains switch is fitted to the end of the wafer switch. Resistors R1 to R8 are soldered directly on SW3.

Switch to the maximum time period of 32 seconds, then depress SW2 and measure the period. Adjust VR1 until a 32 second period is obtained and your darkroom is calibrated. ●

So you want to pass the R.A.E. (Radio Amateurs' Examination)? No.10

John Thornton Lawrence GW3JGA & Ken McCoy GW8CMY

Here is the final section of this series and this month we are to consider aerials, feeders, matching and also interference. At the conclusion, we give some hints on actually sitting the examination.

AERIALS, TRANSMISSION LINES AND MATCHING

The subject of aerials is a complex one and in the space available we will be confining our attention to basic essentials. For further information please refer to the appropriate section in the RSGB *Radio Communication Handbook* or the *Radio Amateurs' Examination Manual.*

The fundamental aerial is a length of wire which is half a wavelength long; this is known as the **half-wave dipole** and is shown in **Fig. 85.** The aerial is said to be resonant at a specific frequency which is determined by its length, and the distribution of voltage and current along the wire is known as **standing waves.**

The ratio of voltage to current varies along the conductor, but at the centre of a resonant half-wave dipole it gives a convenient impedance of approximately 70 ohms. If the aerial is broken here, the r.f. power can be fed into the dipole at its resonant point.

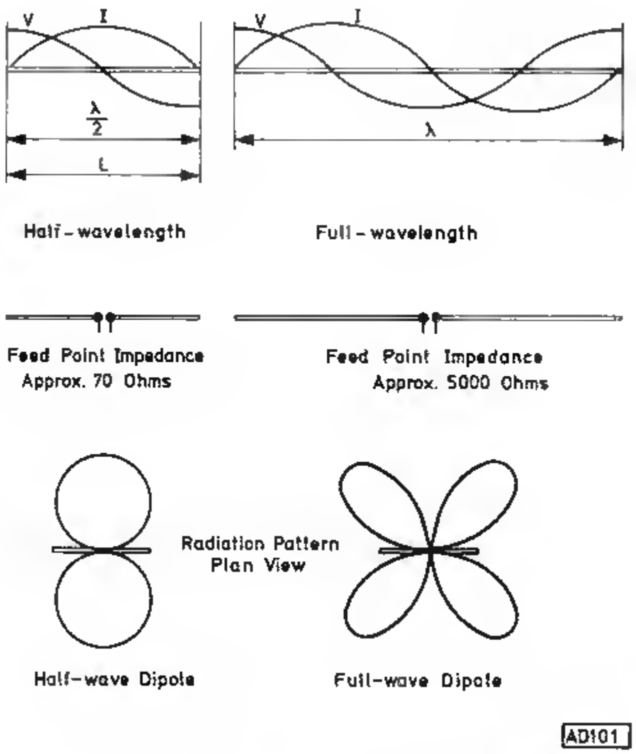


Fig. 85: Dipole characteristics

The full-wave resonant aerial has, as might be expected, a standing-wave pattern similar to two half-wave aerials joined end-to-end. The centre impedance in this instance is very high; inconveniently so in fact and special matching arrangements are called for, as we shall see later.

The radiation pattern of a half-wave dipole is in the form of a "doughnut" shape which in section becomes the characteristic figure "8" shape, as shown in Fig. 85.

With a full-wave resonant aerial, the radiation patterns of the two half-wave sections affect one another, producing the four-lobe shape shown.

Dipole Length

The length of a half-wavelength in free space is given by:

$$L = \frac{300 \times 0{\cdot}5}{\text{Frequency (MHz)}} \text{ metres}$$

However in practical application, due to (a) capacitance effects at the ends, (b) the velocity of the radio wave being slower in the wire than in free space and (c) the effect of the wire diameter, it has been found that the actual aerial dimensions are about 5 per cent shorter than the calculated free-space length. (Free-space length x 0·95.)

For example, the length of a practical, resonant, half-wave dipole for 3·6MHz would be given by:

$$L = \frac{300 \times 0{\cdot}5 \times 0{\cdot}95}{3{\cdot}6 \text{ MHz}} = \frac{142{\cdot}5}{3{\cdot}6} = 39{\cdot}6 \text{ metres}$$

The Vertical Aerial (Quarter wave λ/4)

When looking at the radiation characteristics of a quarter-wave vertical aerial, it is necessary to take into consideration the reflective properties of the ground. If we consider the ground as a mirror to the radiation from an aerial, it will be seen that the vertical aerial AB, in **Fig. 86** has an image BC in the ground mirror (just as in optics).

Thus, radiation leaving the aerial from point D will travel by two paths in the direction E: one direct from D and the other from the ground reflection. (The position F is a mirror-image of the aerial in the ground). The radiation pattern is similar to the half-wave dipole but being in the vertical plane it is omni-directional in the horizontal or plan view.

Vertical aerials fitted on the roofs of vehicles for v.h.f. and u.h.f. utilise the excellent reflective properties of the metal as ground.

Directional Aerials

The pattern and direction of the maximum radiation of an aerial can be modified by the addition of extra elements, which may be **driven** by feeding

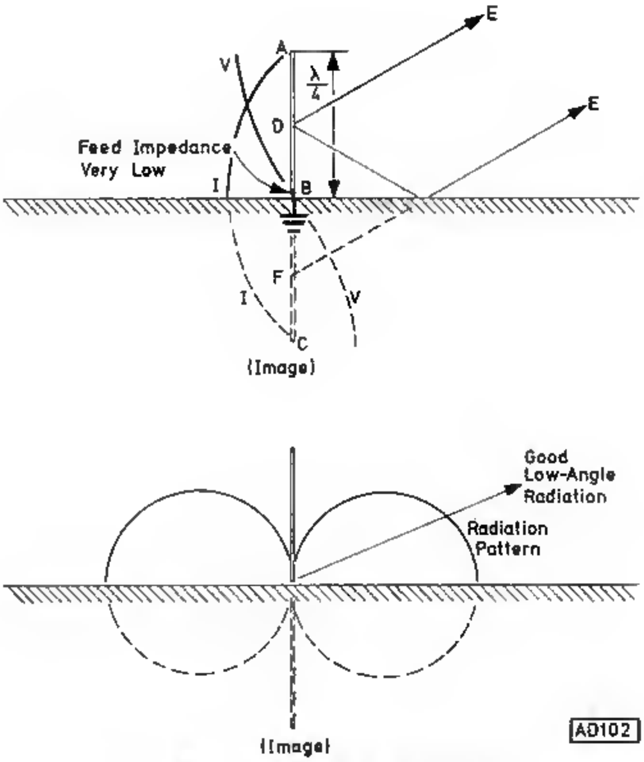


Fig. 86: The $\frac{1}{4}$-wave vertical aerial

power to them or **parasitic**, where no direct electrical connection is made.

The "Yagi" array shown in **Fig. 87** has a half-wave dipole with parasitic **director** and **reflector** elements. The lengths and spacings are chosen to give increased "gain" in the forward direction and reduced gain in the reverse direction (as compared with a plain dipole).

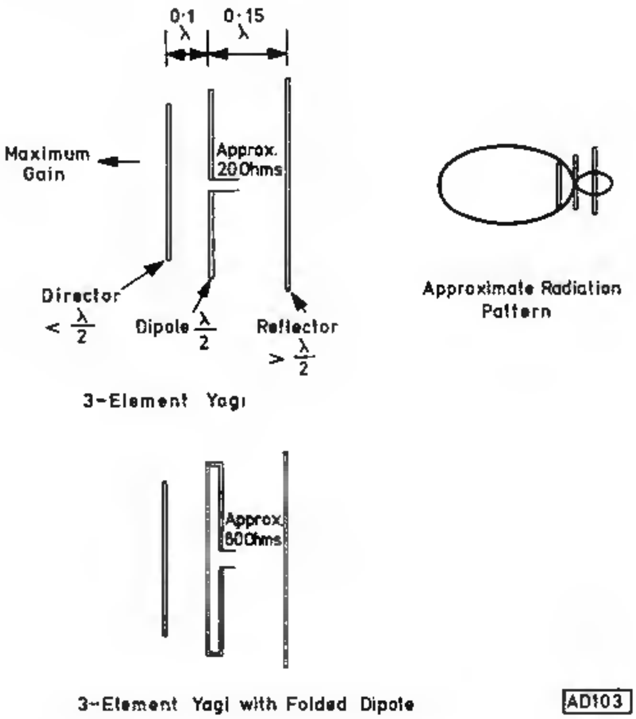


Fig. 87: Simple directional aerial arrays

One of the consequences of adding parasitic elements is that the dipole impedance becomes inconveniently low (about 20 ohms) and to overcome this a **folded dipole** is often used. This has the effect of transforming the impedance up by a factor of four to give a value of around 80 ohms.

Transmission Lines and Feeders

The source of r.f. power is quite often not the place of utilisation. For convenience we need to have the transmitter indoors, but the aerial has to be outside, as high and far away from buildings as possible. In some instances it may be possible to bring the aerial directly to the transmitter but in most cases a transmission line or feeder cable is required.

Impedance Matching

For maximum power transfer from one circuit to another the input impedance of the circuit receiving power must equal the output impedance of the circuit delivering it. The output impedance of a valve-type transmitter final amplifier is in the order of a few thousand ohms and a transistorised version would present about five ohms or less. The aerial impedance required can therefore vary between about twenty ohms and several thousand ohms, depending on the type and the point of connection.

The impedance of the transmission line or coaxial feed cable connecting the transmitter to the aerial is defined by its physical construction. Usual values for coaxial cables are 50 or 75 ohms and for twin transmission lines, 70 to 600 ohms, depending on the method of manufacture.

Some form of matching arrangement is therefore required between the various sections of the system which convey r.f. power from transmitter output stage to aerial. A typical example is shown in **Fig. 88.**

There are three basic types of lines or feeders.
(a) Single wire feeder (which carries a true travelling wave.)
(b) Coaxial feeder.
(c) Parallel wire line.

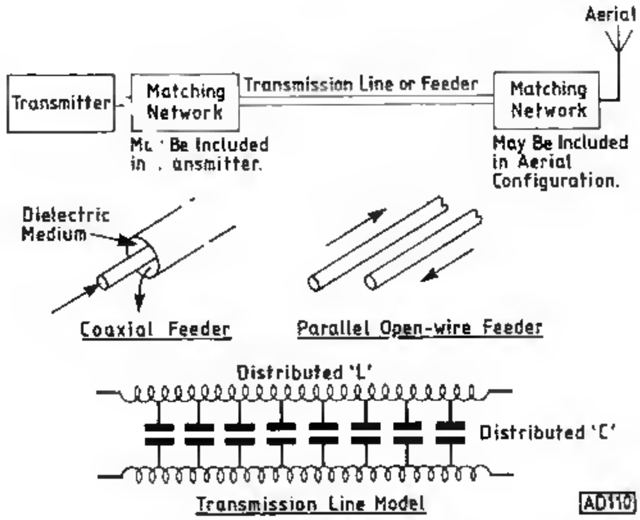


Fig. 88: Transmission lines

Single feeders (a) are not commonly used because they tend to act as radiators themselves. In the coaxial type (b) the r.f. field is restricted to the inside of the structure, whilst in parallel wires the field is confined to the immediate vicinity of the conductors.

Characteristic Impedance (Z_0)

A transmission line or feeder may be considered as consisting of a **distributed inductance** with associated **distributed capacitance**, as shown in Fig. 88. It is the relative value of inductance and capacitance which gives the transmission line a property known as characteristic impedance (Z_0). When a transmission line is connected to, or terminated with, a pure resistance which is equal to the characteristic impedance, a current travelling along it does not see any change in conditions when it meets the load. In other words, a short transmission line terminated in a purely resistive load equal to the characteristic impedance of the line, acts as though it were of infinite length. Such a line is said to be matched, and here power travels outwards from the r.f. source until it reaches the load, where it is completely absorbed. Let us look at what happens if the transmission line is terminated by its characteristic impedance and then by an impedance other than Z_0. This is shown diagramatically in **Fig. 89.**

Where the line is terminated in its characteristic impedance (Z_0) the voltage or current will have the same value at any point along it. (a) If however it is terminated with (b) an open circuit or (c) a short circuit, then standing waves are produced along the feeder as shown. This is because the power is not being absorbed at the end of the line but is being reflected: the reflected wave adds to the incoming wave and produces a standing-wave pattern along the line. These examples are extreme cases, but any mismatch produces a resultant standing-wave pattern.

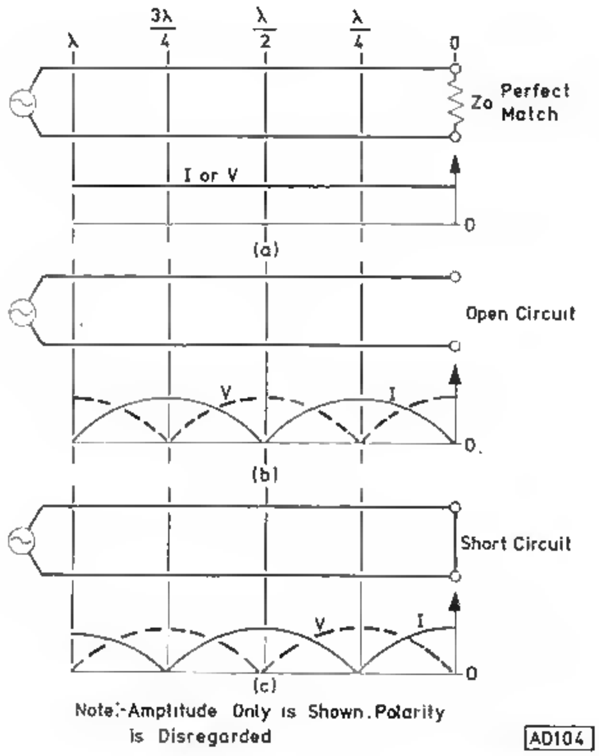


Fig. 89: Transmission line terminations

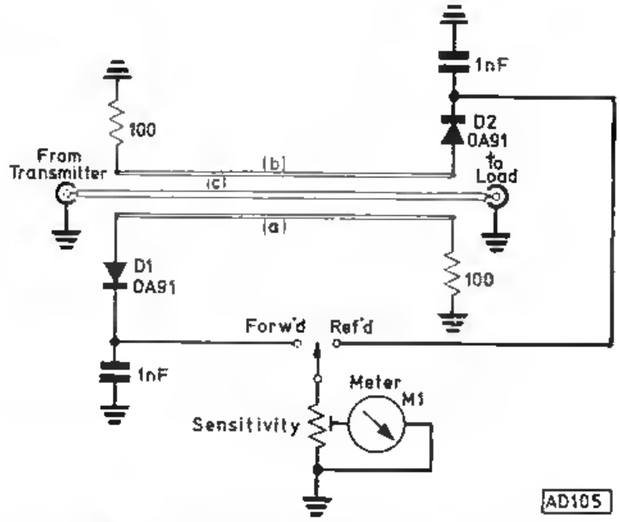


Fig. 90: A simple standing wave ratio meter

The ratio of the maximum value of the standing-wave to the minimum is known as the **standing-wave ratio** (s.w.r.). Values will vary from unity (matched condition) to infinity (complete mis-termination).

Standing Wave Ratio Meter

A useful device for looking at the s.w.r. in a coaxial feeder cable is shown in **Fig. 90**. Loops of wire, (a) and (b), sample forward and reverse power passing through the centre conductor (c). The voltages developed in the coupling loops are rectified by D1 and D2 and the resulting d.c. output deflects the meter M1, thereby giving an indication of the forward and reverse (reflected) power.

The s.w.r. meter is particularly useful when making adjustments to aerial matching and tuning. Constructional details for a v.h.f. unit were carried in the May 1978 issue of *PW*.

Matching

Most transmitter and aerial matching circuits are of the resonant type and are tuned to the operating frequency. We have already described the "Pi" matching network for a valve output stage (*PW* March 1978, p. 821), shown again in **Fig. 91(a)**: an "L" type network for transistorised output stages is shown in **Fig. 91(b)**. This configuration allows for more convenient component values when working at the low output impedances encountered.

In both circuits the impedance transformation is adjusted by the relative capacitances of C1 and C2, whilst maintaining resonance at the operating frequency. It is usual in this instance to arrange for the transmitter network to provide an output impedance which matches the characteristic impedance of a readily available type of coaxial cable, e.g. 50 ohms or 75 ohms.

When the coaxial cable is operated with a low s.w.r., losses within it are also low, so it is very convenient to fit any filters necessary here.

Some aerials, such as the dipole, have a characteristic impedance at the feed point which will match directly the characteristic impedance of the feeder cable and an aerial matching network is therefore unnecessary. However, if a symmetrical or balanced aerial such as the dipole is fed by coaxial cable, a

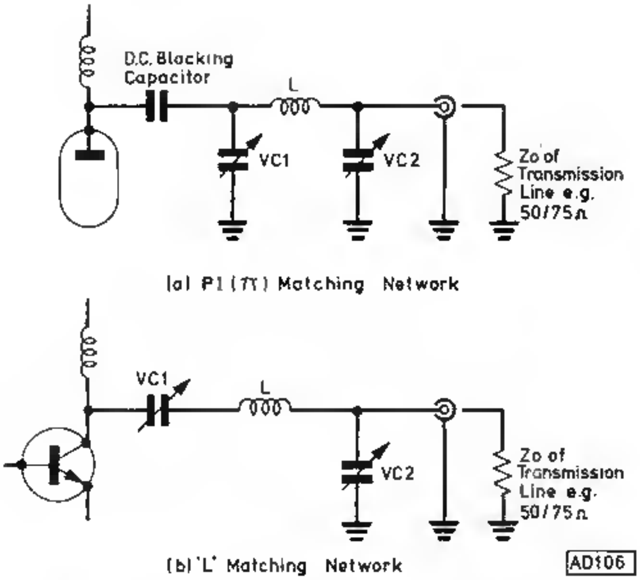


Fig. 91: Transmitter output matching networks

state of imbalance will exist, because one arm of the dipole is connected to the centre conductor whilst the other is connected to the outer shield. The currents flowing in the shield cannot be cancelled by those in the centre conductor which it surrounds.

Balance to Imbalance Transformer (Balun)

Diagrams of **balun** transformers are shown in **Fig. 92**. In (a) a quarter-wavelength coaxial sleeve surrounds the coaxial cable and in (b) a quarter-wavelength of rod, forming a "stub", balances the output to the aerial. For low frequencies, it is more convenient to wind the balun transformer on a ferrite ring. This type is less frequency-conscious and may be used over a wide range.

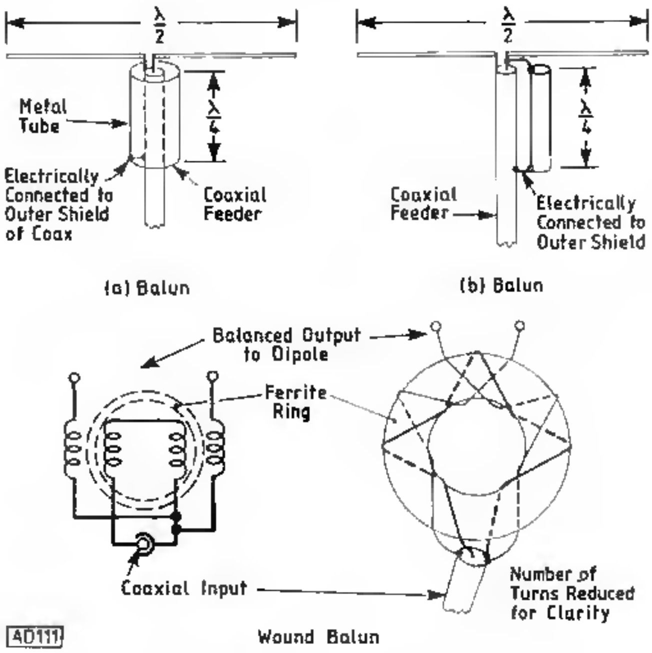


Fig. 92: Balun transformers

Quarter Wave Transformer

Where it is necessary to transform an aerial impedance to match a particular feeder cable, use can be made of a quarter wave "stub" as shown in **Fig. 93**. Here, a full-wave aerial is to be fed in the centre (where the impedance is around 5,000 ohms) with twin feeder whose characteristic impedance is 72 ohms. If the quarter-wave stub is made to have the correct characteristic impedance then the aerial impedance is transformed down by the stub to match that of the feeder.

$$Z_{m\ (\text{matching stub})} = \sqrt{Z_{\text{aerial}} \times Z_{\text{line}}}$$

$$= \sqrt{5000 \times 72}$$

$$= 600 \text{ ohms}$$

(An open-wire line of 16 s.w.g. conductors spaced 112mm ($4\frac{1}{2}$in) apart would have a Z_o of 600 ohms).

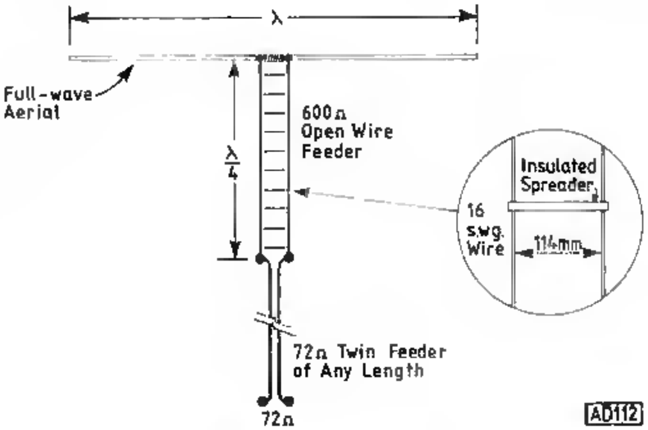


Fig. 93: A $\frac{1}{4}$-wave transforme

Interference

Non-interference with other radio users, whether they be military, commercial, amateur or domestic, is a condition of the Licence.

An understanding of the way in which interference is caused and how it can be avoided or cured is needed, not only for the RAE, but later on, when you obtain your licence; you will then be in a position to maintain a good clean transmission and live in peace with your neighbours (and the Home Office Inspector).

No practical transmitter is absolutely perfect and in addition to its correct output, is bound to radiate some spurious signals, however small. If these are not kept to a very low level, interference with receivers (TV or radio) operating nearby may result.

Similarly, no practical receiver is absolutely perfect, so when it is tuned to a particular frequency it may be subjected to interference by strong signals on other frequencies, as may be the case if it is situated in close proximity to a radio transmitter.

Interference can also be caused to audio systems, etc., when subjected to strong r.f. fields. Here, the signal enters the equipment and is then rectified or amplitude demodulated, usually by the emitter-base junction of a transistor in the audio pre-amplifier stages, resulting in breakthrough. An increasing number of hi-fi systems employing transistors are prone to interference of this nature.

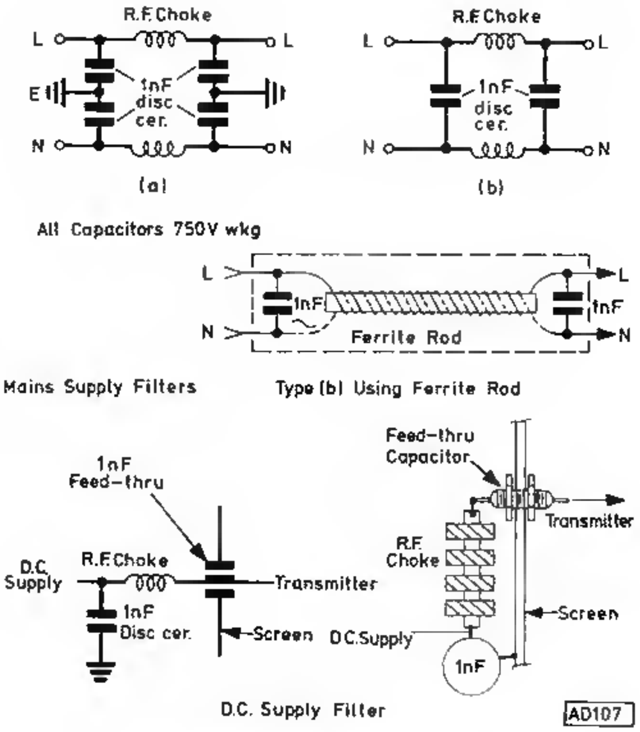


Fig. 94: Power supply filters

TVI, BCI, AND AFI

Interference can usually be separated into three main categories: television (t.v.i.), radio broadcast (b.c.i.), and audio (a.f.i.).

Television and radio broadcasting are "protected" services and the Post Office may be called upon to investigate cases of interference with these and other authorised transmissions. Audio amplifiers, on the other hand, are not intended to be radio receivers and so will not be afforded the same facilities.

In general, all interference results either from deficiencies in the transmitter or the apparatus being interfered with. Let us look initially at the transmitting end.

DEFICIENCIES AT THE TRANSMITTER

Design and Construction

It is important that the various r.f. signals present within the transmitter are not allowed to radiate directly. Efficient screening is essential, as is the filtering of h.t. and other power supplies, particularly the mains input. A suitable mains filter is shown in **Fig. 94.** Decoupling and bypass capacitors should be of mica or ceramic, having low inductance properties. (See section on capacitors.) Wiring should be short and direct to minimise stray inductance and capacitance.

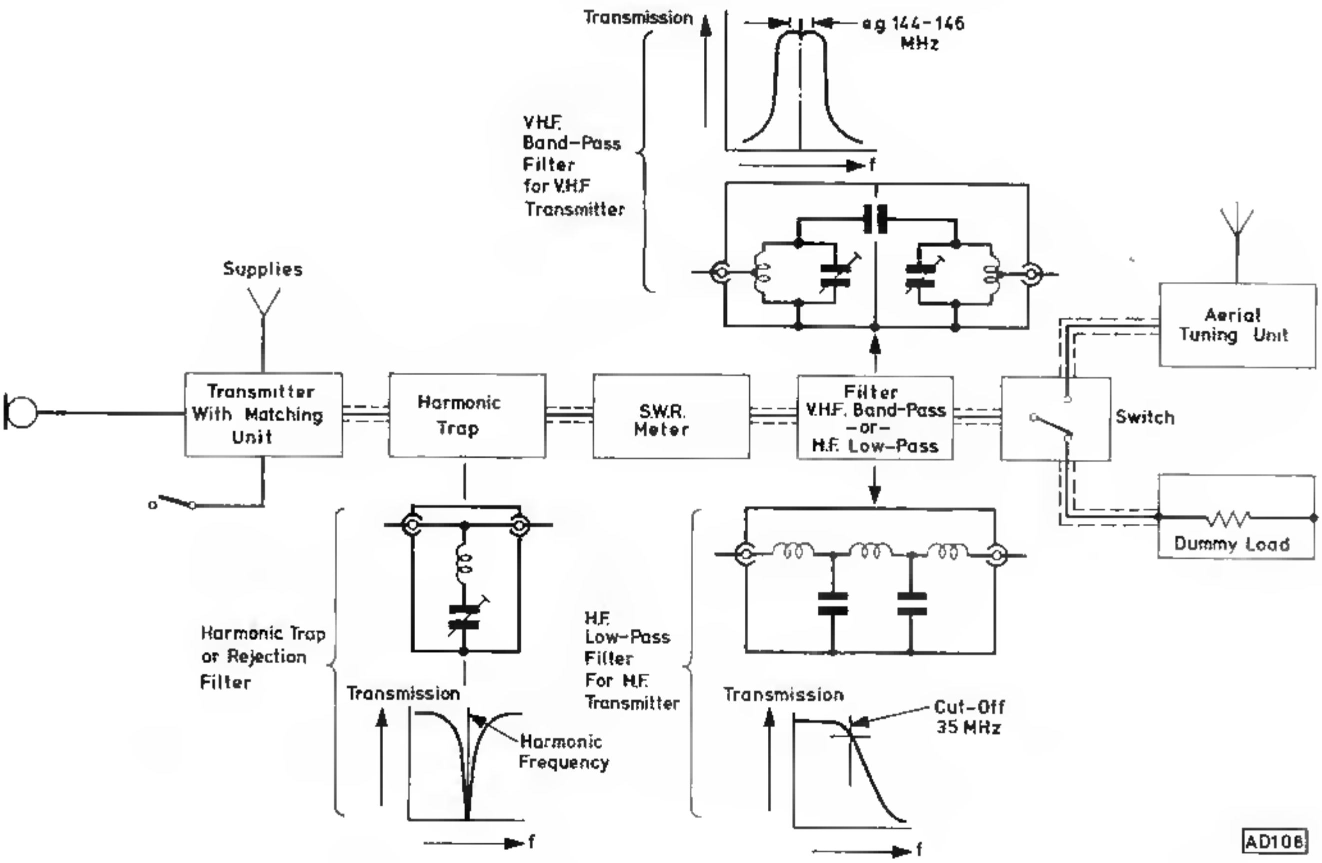


Fig. 95: Block diagram of a well-screened transmitting station

Tuning capacitor spindles protruding through front panels are often a source of spurious signals and should therefore be of an insulated material or have an insulated coupling.

The cut-out for a panel meter can often cause problems and a screening can over the rear of the meter is desirable. In general, try to ensure that the case of the transmitter is radiation-proof. Commercially made transmitters, including those for the amateur market, already incorporate most of these features and the maker's data sheet usually quotes the level of spurious emissions one may expect.

The block diagram of a well-screened transmitting station is shown in **Fig. 95**. The transmitter is well protected and its supply leads filtered, ensuring negligible direct radiation. The output passes via a coaxial cable to a harmonic trap, which usually consists of a series-resonant circuit, housed in a screened box and tuned to the particular harmonic likely to cause interference. For example, it might be tuned to 42MHz, attenuating the 3rd harmonic of 14MHz which could be the source of t.v.i. in a Channel 1 reception area. The output then passes via a coaxial cable to the standing-wave ratio (s.w.r.) bridge, which indicates relative forward and reflected power levels.

From here it is fed through a filter, again housed in a screened box which, in the case of a transmitter operating on bands up to 30MHz, would be of the low-pass type, attenuating spurious signals above this frequency. For a v.h.f. (2m) transmitter, a band-pass filter attenuating spurious signals either side of the pass-band frequencies, would be used.

In practice, the transmitter tuning would first be adjusted into a dummy load. The output would then be switched to an aerial tuning unit which is used to provide optimum matching to the aerial with the minimum of reflected power (indicated on the s.w.r. bridge).

Note: All interconnecting coaxial cables and terminations should be well soldered.

Aerial and Feeder

The aerial should be sited as high as possible away from neighbouring buildings, TV and radio aerials, etc.

A vertical transmitting aerial is more likely to induce strong fields into nearby equipment than a horizontal one. This is due to the fact that it relies on a ground connection which can cause interfering currents in nearby conductors. In addition, vertically polarised signals are much more likely to be picked up by vertical down-leads, such as those used for television aerials.

It is important that all the transmitter power should be radiated by the aerial proper and that no emission should take place from the feeder cable itself. This means that the currents in each conductor of the feeder should be equal and opposite.

Where a dipole aerial is fed by an unbalanced coaxial cable, there is significant imbalance in the current distribution and some radiation from the feeder results. The feeder, usually being vertical, readily causes interfering currents to be induced into nearby television down-leads. To overcome this problem, a balance-to-unbalance transformer (balun) is connected at the centre of the dipole, as shown in Fig. 92. In other types of aerials and feeders, correct adjustment of the tuning unit is all-important in reducing feeder radiation to a minimum.

Operation

Excessive drive in any of the transmitter stages will increase the level of harmonics, so power should be kept to the minimum consistent with efficient operation.

Tuning of the final power amplifier and adjustment of the aerial tuning unit will have a considerable effect on the amount of spurious signals radiated. When tuning the transmitter power amplifier into a dummy load, increase the coupling only until the correct power level is obtained. Do not overcouple the transmitter or the Q of the p.a. tank circuit will be reduced, with a consequent increase of spurious emissions. This also applies when adjusting the aerial tuning unit.

An abrupt keying characteristic causes excessive side frequencies, so check each side of your transmission for key clicks (see page 819).

Overmodulation produces excessively wide sidebands and causes splatter; always monitor the modulation level and ensure that overmodulation does not occur (see page 925).

The audio bandwidth necessary for good speech communication is about 3kHz. The modulation circuit of the transmitter should therefore have a rapidly falling response above 3kHz in order to avoid the radiation of excessive and unnecessary sidebands.

Summary

Let us summarise the requirements for keeping deficiencies at the transmitter to a minimum:

1. Use correct components in the transmitter, well laid out.

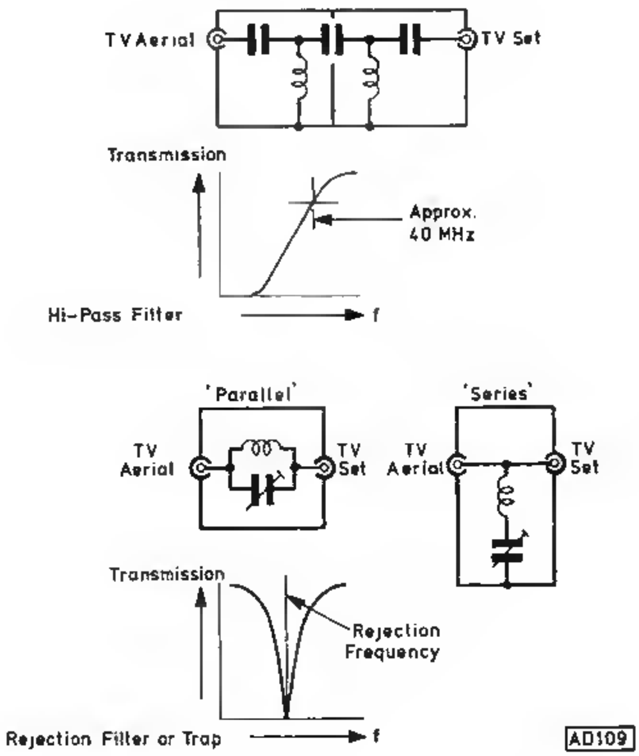


Fig. 96: TV interference rejection filters

2. Prevent direct radiation from the transmitter and associated leads by screening and filtering.
3. Use appropriate filters in the transmitter output.
4. Use a dummy load for tuning up and a suitable aerial tuning unit. Do not overcouple.
5. Keep aerials in the clear and avoid radiation from the feeder cable (balun transformer).
6. Tune up carefully: do not overdrive or overmodulate.

Check your transmission regularly.

DEFICIENCIES AT THE RECEIVER

The latest statistics (for 1976) indicate a dramatic fall in the number of complaints regarding transmitter interference. However, the greater proportion of those made were attributed to deficiencies in receiver design.

In many instances, interference is the result of a receiving installation of poor standard; e.g. indoor aerial, aerial incorrect type for area, downlead incorrectly installed, receiver incorrectly installed, excessively long mains leads or speaker leads, etc. etc.

Considering the problem of t.v.i., strong signals can enter the receiver via the aerial and cause interference by cross-modulation in the r.f. or subsequent stages. A high-pass or rejection filter for the frequency concerned must be fitted in the aerial lead, as shown in **Fig. 96**: the series-tuned filter being generally more effective.

Masthead amplifiers are a notorious cause of interference as they have broadband input characteristics, some extending from 10MHz to 1,000MHz. Cross-modulation and swamp effects are common. A high-pass filter should be fitted between the aerial and the input to the amplifier, but in practice difficulties arise here because the aerial has to be taken down and the filter made weatherproof.

However, the most common method by which r.f. will enter the receiver is by the presence of "braid" currents in the aerial downlead. These r.f. currents flow through earthy parts of the receiver causing r.f. voltages to be produced in susceptible parts of the circuit.

A "braid breaker", suitable for u.h.f. television, is shown in **Fig. 97**. The reactance of the series capacitors is high at frequencies up to 30MHz, effectively "breaking" the downlead, but at u.h.f. it is low, resulting in negligible attenuation of the television signal.

Where "braid currents" in the downlead cause interference at h.f. and v.h.f., an alternative circuit can be used. Here a short length of the coaxial downlead cable is wound on a ferrite ring, increasing the inductive reactance of the outside braid without affecting the signals within. An alternative to the ferrite ring, and almost as effective, is to wind the co-ax around a ferrite aerial rod.

If the interference is entering the receiver by way of the mains lead, a mains filter as shown in Fig. 94 should be installed. In the case of hi-fi systems, it can also be picked up on speaker leads, so decoupling these with a disc ceramic capacitor of 1nF to 10nF is often effective. A ferrite ring may be required in addition, if the problem is really severe.

It is unwise to incorporate modifications inside the receiver, as you may invalidate its warranty and be held responsible for any subsequent malfunction. In difficult cases it would be wise to consult the dealer or manufacturer.

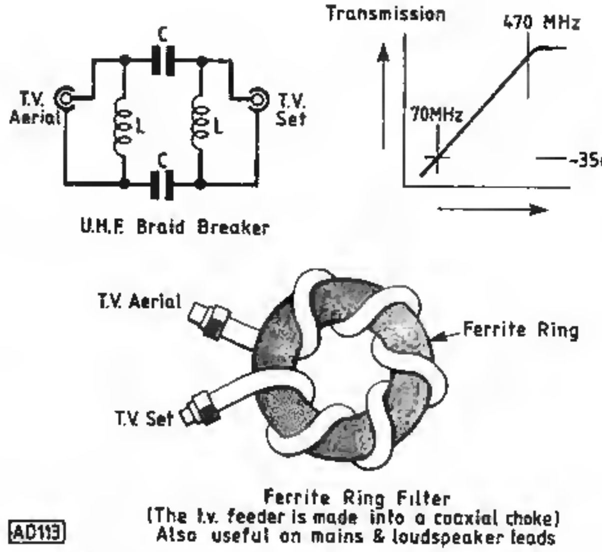


Fig. 97: "Braid-breakers" for u.h.f. and h.f./v.h.f.

Summary

1. Check that the receiving installation is of adequate standard for the reception area.
2. If the interference is entering via the aerial lead, fit a high-pass or rejection filter.
3. If cross-modulation occurs in a mast-head amplifier, fit a high-pass filter in the aerial feed to it.
4. If the interference is entering via the downlead braid, fit a ferrite ring or capacitive braid-breaker.
5. If the interference is entering via the mains lead or other cables, fit a mains filter or ferrite ring.
6. If the problems are caused by direct radiation, try repositioning the aerials, feeders, etc. Wherever possible, avoid making internal modifications to receivers or audio systems. In difficult cases, refer to manufacturer.

Note:

An excellent series of articles on interference appeared in *Radio Communication*, May 1975. Some back-issues are available from the Radio Society of Great Britain, 35 Doughty Street, London WC1N 2AE. Alternatively your local Radio Club or a nearby radio amateur may be able to help with a copy.

SITTING THE R.A.E.

It is a good plan to set yourself regular revision two or three nights a week prior to the examination. Allocate specific subjects each night so that everything is covered in good time and practice answering specimen questions in writing and time yourself.

It is best to leave the night before the exam relatively free from commitments. This is a good time for collecting together the things you need, including your thoughts!

Take with you, two pencils and a pencil sharpener, two pens (in case one runs out), ruler, symbol stencil (if you have one), eraser and your examination card. Calculators are permitted provided they are of the electronic, battery-operated type. There are no restrictions on the functions the machine will perform.

You should receive your card at least a week before the examination. If not, contact the Examination Centre/Night School immediately and confirm that you are, in fact, registered.

When going to the Examination Centre, allow plenty of time; your bus may be delayed, you may have difficulty in parking your car. Aim to be in the building at least 30 minutes before the start. Locate the examination room, and be seated well before the examination commences.

When appropriate, your invigilator will distribute the papers: do not look at them until he gives the signal. Timing will begin from the point at which you are allowed to turn the paper over—don't panic! Give yourself at least ten minutes to read things through carefully and note any special instructions.

If, through no fault of your own, you arrive late, apologise to the invigilator then settle into your place quietly and attempt as many of the questions as you are able in the period remaining.

Remember, the paper is divided into two parts; Part 1 has two compulsory questions on licensing conditions (15 marks) and interference (15 marks). Part 2 requires six questions from a choice of eight to be answered (10 marks each). Failure in either section will regretfully result in failure of the examination as a whole.

Give yourself about twenty minutes for each of the eight questions and this will allow a little time at the end to look through your answers. The answers should not be over-elaborate or padded out: make your point as quickly and as clearly as possible, there is no time to waste. It is probably best to tackle the compulsory questions in Part 1 first and then move on to Part 2 where you have a choice. Here you can answer the easiest first and so gain a little extra time.

With answers containing calculations, it is a good idea to set out all the steps in detail. Then if a slip is made in the arithmetic, the examiner will see the correct formulae and methods have been used, and will mark accordingly.

Hints and tips on the drawing of diagrams were given earlier in this series (February 1978, page 764), but remember drawings take time, so keep them simple. You are not being examined in grammar or indeed spelling but neatness and cleanliness are relatively important, if only to avoid ambiguity. The examiner will not be impressed by illegible writing, scribbled diagrams, etc. If you make a mistake, cross it out with a single ruled line; it will then be ignored and you will not lose marks.

A few minutes before the end, stop, read through your answers and correct any minor omissions. Make sure all are numbered and lettered correctly and that your examination reference is quoted.

We wish you every success and hope to meet some of you on the air in the near future.

73 de GW3JGA es GW8CMY. ●

NOTE

The syllabus and examination pattern for the R.A.E. are changing in 1979. We plan to publish a follow-up article to update this series

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ON THE AIR

AMATEUR BANDS

by Eric Dowdeswell G4AR

Our SSTV expert **Paul Barker** of Sunderland has now become G8OVD and soon will be able to look back at the other chaps! Paul studied at home for the RAE and had only the RSGB's RAE manual and a few library books to see him through. He managed to "copy" three VKs on 20m SSTV so completing his SAC! Best of luck on the air OM. Likewise **John Overton** did the trick in Milngavie, Glasgow and so sports GM4GUA now, having already passed the code test. He's using an HW32A on 20m s.s.b. for the time being but a KW2000B is on the way.

Brian Smith is well away in Barry, Glam, with his new FRG7. Having been disgusted with what he has heard of the CB band just below 28MHz he says he'll get stuck into the RAE studies and get a proper ticket! After a spell of ten years away from the amateur bands **Ken Proctor** of 35 Hertford Close, Eastfield, Scarborough, Yorks, is active again and would like to hear from old friends including Bernard Hughes BRS25901 who contributes to this column. Ken has a Trio 9R59DS and 90ft of wire and covers all the bands.

The note on **David Greenhalgh** in the February column resulted in G3SHW of stockport coming up with a Lafayette HA350 for him which illustrates a little of the fine spirit of amateur radio. David, in Poynton, Cheshire is delighted and hopefully he'll be contributing to the column in future.

After using a domestic portable for a while **J. Goodier** of Marple, near Stockport, acquired an FRG7 and really found out what the amateur bands are all about. He wants a good prefix list and so, as ever, the answer is Geoff Watts of 62 Belmore Road, Norwich who will deliver the goods for just 40p. From Newport, Gwent comes a first report from **Martin Liezers** and a note on his local ARS, reported later. He has 250ft of wire on his Realistic DX160 and an 8ft rod aerial for "the h.f. bands". I've suggested that he try the long wire on those bands too!

Now here is an interesting letter from **Bill Land** BRS34761, 7 Wellbrook Road, Bishops Clare, Cheltenham, Glos, who admits to being 72 years young and an addict of RTTY for which he has a Creed 7B printer running from his Eddystone 750 and Trio 9R59DS. Bill wants to hear from others using this mode and can help with a list of parts for the 7B. Another old-timer is **John Whiting** of Fareham, Hants, who started with crystal sets in 1922 but now sports an FRG7, listening mainly on 10m for the moment. He can cope with the code test so is contemplating studying for the RAE.

Fame at last! **Bob Griffiths** writes for the first time to say we have a keen young reader on the Isle of Wight! He, too, has had a lay-off of 14 years but is now back in the swim again but with a lot of pertinent remarks on the plethora of UA stations! Must come as a shock after the relative hush of the bands in days gone by. Bob uses an EA12, AR88D plus converters for 2m and 70cm. His aerial farm consists of 132ft wire, 20m ground-plane, 20m V-dipole and a vertical for 80m.

From Morpeth, Northumberland comes **John Hodgson** again with DX heard on his Realistic DX160 and long wire. He has received QSL cards from CB'ers in Sweden and Norway! John is keen on RTTY so suggest he writes to Bill Land mentioned above. **Bob Bell** of 5 Byron Avenue, Blyth, Northumberland can't be too far from John just quoted above and they ought to get together since Bob would like to start a club in the area. Bob is yet another FRG7 owner, having been SWLing for some 25 years and worked his way through a number of sets.

CLUB NEWS **Geoff Cole** G4EMN, secretary of the Wessex ARG, oft mentioned here, had applications for membership from a couple of readers situated a long way from Wessex. Although flattered, he says that this is not quite the idea! So, anyone who wants to join a club, try to locate your local group or write to the RSGB, 35 Doughty Street, London WC1 for the address. Geoff rightly says that every reader of this column ought to belong to a club.

Blackwood and District ARS GW6GW meets every Friday 1930hrs at Oakdale Community College, near Blackwood, Gwent. On May 12th GW8LJJ talks on *Practical Construction* and the 19th is film night, *Printed Circuit Manufacture*. Write to Steve Cole GW4BLE, 10 Llanthewy Road, Newport.

Mid-Warwickshire ARS first and third Mondays 2000hrs at 61 Emscote Road, Warwick with G3UDN on the air. They'd like to see *PW* readers, particularly Nick Smith A9050 and C. J. Roe of this column.

Contact Norman Read G8CXL, 86 Telford Avenue, Leamington Spa.

Bury RS G3BRS, every Tuesday at Mosses Centre, Bury at 1930hrs with RAE courses, code training, local c.w. nets, new local repeater GB3MA on 70cm. Whew! It's all go! Hon. Sec. is Eric Thirkell G4FQE, Mosses Community Centre, Cecil Street, Bury.

Stevenage and District ARS get together at 2015hrs on first and third Thursdays at Staff Canteen, Hawker Siddeley Dynamics. Morse classes and RAE course at local college by G3SJR. May 18th is the date for a lecture by members of London UKFM Group, while on June 1st G3AGP talks on *Electronics in Medicine*. Contact Trevor Tugwell G8KMV, 11 The Dell, Stevenage, Herts.

Silverthorn RC produces a ten-page newsletter "Spurious" so they're pretty active, meeting every Friday 1930hrs at Friday Hill House, Simmons Lane, Chingford, London E4. Contact C. J. Hoare, Hon. Sec., at this QTH.

Newport ARS meets Mondays 1930hrs at Brynglas House Community Centre, Newport with RAE and code classes coming up. Write to Martin Liezers, 32 Barrack Hill, Newport.

Log extracts

B. Smith:—80m C5ABC (Gambia) 4U1ITU **20m** C5AAF FC9UC JY5HH ZL2AM **15m** CE3BPC C31LU

K. Proctor:—80m EA8QJ ZB2G PJ8CO KL7AVX ZL3BX CO7RS 9Y4NP **40m** CO4DC HP1XYA ZL1BAQ ZL2BDP ZL3RD **20m** VP8PT HP3XKB HL1JI HK0BBF **15m** FP8DX KL7JEJ JA9IWN 10m FG7BA

J. Hodgson:—80m J3AAG OY5NS PJ8CO 8P6FV **40m** TG4NX YV5APF **20m** FM7WV HK1NR VE8RCF VK7AE VP2DAW **15m** HK0QA KL7GRP ZS2MI (Marion Is) ZB2G **10m** EA9FL HH2MC VU2DK.

J. Whiting:—10m CT2AX EA8BS SV1HX.

B. Land:—RTTY 20m DK6RY EA3ABU IT9BWT JY5KR K6XP OE2KO SM6HUG YU2BOR W2WIX.

M. Liezers:—80m KZ5JM ZB2G 5B4DI **20m** HK0QA KM6FC YB0HH **15m** KL7GRP VP1AB **10m** C5ABC EP2RL.

J. Goodier:—20m CT4YN FC9UC.

All s.s.b. except where stated otherwise.

VHF BANDS

by Ron Ham BRS15744

Richard Staples, G8MME, Lymn, Cheshire, is active on both 2m and 70cm s.s.b. On 2m he runs 400 watts from a pair of 4-250A valves to a couple of 10-element parabeams, at 40ft a.g.l., and on 70cm, his 2m exciter, TS700G, drives a Microwave Modules Transverter and a home-brew 4CX250B amplifier producing 250 watts to a 48-element multibeam, mounted above his 2m array. Richard is looking for s.s.b. skeds on 70cm and will be reporting on future activity in the north-west of England. **Vic Hartopp**, G8COB, Northampton, uses an IC201 transceiver for all modes on 2m and has recently been enjoying himself rebuilding a Mohican receiver, and listening to the American CBers on his HRO.

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.

A couple of newcomers to v.h.f., **Henry Hatch**, G2CBB, South Croydon, using an IC215 is working through the repeaters and **Robin Bellerby**, G3ZYE, Hove, Sussex, taking part in his first 2m opening, did not realise there could be such pile-ups of stations on the repeaters. In Littlehampton, Sussex, **Norman Langridge**, using the v.h.f. section of his Yaesu FR400-Super DX receiver with a 3-element home-brew, loft mounted beam can always hear traffic through GB3SN, but, during the opening on March 7th he heard GW mobiles working through GB3BC which has encouraged Norman to modify his aerial system. Along the coast to Worthing where **David Wakefield**, BRS39756, uses the receiver of a Pye Vanguard on 2m, with a roof mounted dipole, and CR100 and R1475 receivers, fed by a long wire aerial, on the h.f. bands. David's interest in radio is further stimulated through his activities as a Cadet Wireless Operator in the Air Training Corps.

Despite the poor conditions and the low atmospheric pressure, 29·3in, **Alan Baker**, G4GNX, Newhaven, had a 59 contact on 2m s.s.b. at 1800 on February 26th with F1ENH/P, Boulogne, both running 15 watts, and at 1730 on March 2nd, in thick fog, on Beachy Head, near Brighton, Alan heard signals from repeaters ON0HT and ON0OV and a Buckingham station working through the Kent repeater, GB3KR, R4.

The atmospheric pressure remained around 29·5in from midnight on February 27th to midnight on March 2nd when it took off and climbed to 30·4in by noon on the 6th, and, true to form, the v.h.f.s opened up as the high pressure began to fall. During the evening of the 6th, **John Kuipers**, G4GUX, Brighton, worked G8LY, in Hampshire, on 70cm, first via GB3AW, Ashmansworth, Berks, RB10, and then through GB3BR, Brighton, RB6, and GB3PH, Portsmouth, RB2. Later he heard signals through GB3BK, Upper Basildon, RB6, GB3SD, Weymouth, RB14, had a c.w. contact with ON4VN and heard 2m signals through GB3BC, R6, GB3MH, on its new channel, R3, GB3WW, Carmel, Dyfed, R7 and FZ3THF, R4.

Around 1945 on the 6th, **Ken Smith**, BRS 20001, Horsham, received several French broadcast stations in Band II and patterning on u.h.f. TV channels, and earlier, **Graham Laucht**, G8OQM, Birmingham, worked G8KSN, Ramsgate, Kent first via GB3PI, Cambridge, R6, and then direct. Like Graham, **Brian Fenwick**, G8BTC, Brighton, heard a variety of repeater signals on 2m, including Cornwall, GB3NC, R5; Brian noticed that signals were often stronger on the input frequency than from the repeater. Frequently, on the

6th and 7th, I received a good picture from Lichfield, Ch 8, 189MHz, Continental f.m. stations in Band II and strong signals from GB3BC, BM and KR, with only dipoles feeding the respective receivers. At 0125 on the 7th, I heard two Portsmouth stations, G8NUI and G8OQN/M in contact via the London repeater, GB3LO, R7, and at 2152, another pair, G4GUX and **Martin Newell**, G8KOE, both in Brighton carried out a similar test on 70cm and had a QSO via the Portsmouth repeater.

At 0900 on the 7th, G4GNX/M using his new IC-240 to a $\frac{5}{8}$ whip aerial, heard strong signals through GB3BC, from a low point in Brighton, F1EBE, Rouen, via GB3LO, and at midday on the 6th, he received signals from the Malvern Hills, GB3MH, R3, and Paris repeaters. At 2206, from Newhaven, Alan had a c.w. contact with ON6FT and at 0011 on the 7th he worked F1EVM/P, Caen, on 2m s.s.b.

The atmospheric pressure continued falling until 1800 on the 8th when it began rising rapidly, reaching 30·4in by midday on the 10th, and then fell back to 30·0in by noon on the 12th which, as expected, caused a tropospheric opening.

At 2230 on the 8th, newly licensed G8OQM/M, using a FT227R to a $\frac{5}{8}$ whip aerial, travelled down to Beachy Head, Sussex, and heard GB3BM, his home repeater and then had QSOs through GB3BC. From Brighton's Race Hill, at 1900 on the 9th, G4GNX/M worked F1BBZ and F3KT via FZ8THF, Vichy, R0, a distance of 320 miles. **Roy Bannister**, G4GPX, Lancing, Sussex, succeeded in accessing the Vichy repeater but owing to UK traffic on R0 he could not complete a QSO. Both Alan and Roy heard the Ghent, ON0ON, R4, and Paris, R6, repeaters and during the evening of the 10th, **Clive Penna**, G3POI, Orpington, Kent, worked EA1AB on 2m c.w. and **Mike Rowe**, G8JVE, East Preston, Sussex, heard an EA1 and worked into France and Wales on 2m s.s.b. Around 2330 on that evening, **Alan Belfield**, G4GLN, Streatham, contacted an EA on 70cm c.w.

John Branegan, now licensed GM8OXQ, Saline, Fife, worked his first three countries, G3GZX, GI8JTS, and GW4GTE during the 2m contest weekend, March 4th and 5th. John said "there was a definite lift on March 4th, and by 2200, GI signals into Scotland were very good and they could hear the Central Scotland repeater in GI".

Throughout the period, 9th to 12th there was frequent co-channel interference an Band II and u.h.f.-TV and at 0914 on the 11th I received a 599 signal from the Emley Moor beacon, GB3EM, on 70cm with only a dipole feeding the receiver.

The 10m band has been open almost daily from February 20th to March 15th with a familiar pattern of strong signals from Russian amateurs in the morning and from north-American amateur and CB stations during the afternoon and early evening. I heard VKs during the early mornings of February 26th and March 7th and JAs on March 5th and 11th working into Europe. On most days signals averaging 539 were heard from the Cyprus beacon, 5B4CY and the project TESSA beacon, ZE2JV. During the afternoons of March 1st and 2nd, **Don Butterworth**, G3IKO, Redhill, Surrey, heard the Bermuda beacon VP9BA and I logged the Bahrain beacon, A9XC, during the afternoons of the 5th and 6th.

February 26th was a good day on 10m for **Gordon Goodyer**, BRS 37345, Petworth, Sussex, who heard both A9XC and VP9BA in the morning as well as signals from amateurs in 22 countries. Although signals were very strong throughout the day Gordon reports a drop off in strength around midday and a quiet band from 1430 to 1515. **Roger Bunney**, DX TV columnist, using his Hallicrafters 5-10 receiver logged transatlantic signals up to 37MHz on the 26th. **Nigel Golds**, BRS 36910, West Chiltington, Sussex, noted the powerful American stations around 1730 on March 11th and the Russians during the afternoon of the 12th.

The exceptional 10m conditions observed by Gordon and Roger on February 26th were followed by ionospheric disturbances, reported by the BBC World Service, on the 27th and 28th which may well have been caused by the solar storm recorded by **Cmdr Henry Hatfield**, Sevenoaks, Kent, **John Smith**, Rudgwick, Sussex, and myself from February 21st to 26th. What's more John Branegan, reported auroral activity, with plenty of 2m c.w. from EI, GW and LA, from 1830 to 1912 on February 27th and from 1657 to 1912 on March 1st. John has built a projection box attachment for his 2in telescope so that he can record the number of sunspots and since 2048 on March 5th he has been monitoring the telemetry signals from the new amateur radio satellite, OSCAR-8.

Despite frequent overcast skies, Henry Hatfield got a glimpse of the sun through his spectroheliscope on March 6th when, in addition to sunspots, he saw several filaments and a ribbon flare, on the 10th he counted some 15 spots in four main groups, and on the 15th he noted a bright plage on the east limb. Henry, John Smith and myself recorded solar noise at 136 and 142MHz on March 2nd, and then daily from the 6th to the 13th with noise storm conditions on days 6th, 8th, 10th and 15th.

According to comments heard both on and off the air by Alan Baker and myself the "Slim Jim" 2m aerial described in our April issue works well and is very popular.

Let's hope that conditions will be good to provide plenty of DX for the RSGB's HF National Field Day on June 3rd and 4th and VHF NFD and SWL contest on July 1st and 2nd. Thanks again for all your reports, and good luck if you compete in the contests.

What do the VHFs have to offer?

The accepted part of the radio frequency spectrum known as Very High Frequency ranges from 30 to 300MHz, (10-1 metres), and is generally used for communications by aircraft (108-136MHz), amateur radio (4m, 70·05-70·7 and 2m 144-146MHz), private and business mobile radio (71-88 and 165-174MHz), shipping (156-165MHz), satellites (136-137MHz), military, various emergency services and broadcasting by f.m. radio, Band II (88-108MHz) and television, Band I (41-67MHz) and Band III (176-215MHz).

The effective range of a v.h.f. signal is naturally limited by the terrain beneath its path and the prevailing atmospheric conditions. Broadly speaking, the propagation of signals between 30-80MHz is governed by the E region of the ionosphere, and above 80MHz, by conditions in the troposphere. These bands are therefore a challenge to both the listener and the transmitting amateur, to be ready for sudden sporadic-E disturbances between April and August and at any time, for a tropospheric opening, when the weather is fine and the atmospheric pressure is high. These v.h.f. openings are exciting, because the signals travel more than ten times their normal range and as the v.h.f. bands are shared throughout Europe, there is a mine of DX, both sound and vision, to be found among the mix-up of continental signals while the event lasts.

During sporadic-E events, very strong signals are heard in the UK from east-European broadcast stations between 65-73MHz and even stronger signals, from a variety of continental mobiles, interfere with the Band I television channels. There are two beacons in the 4m band to listen for, GB3SU, 70·695MHz and GB3SX, 70·685MHz.

The 2m band is full of surprises throughout a tropospheric opening; and like most v.h.f. enthusiasts, our readers have heard and worked amateur stations, using all modes, over a wide area from Scandinavia to the Mediterranean Sea, and all parts of the UK.

First indications of an opening can come from any of the chain of 2m beacons ranging from Cornwall, GB3CTC, 144·915MHz, to Angus, GB3ANG, 144·975MHz, and northern Ireland, GB3GI, 144·137MHz, to Wrotham, Kent, 144·150MHz. Having decided, from the number of UK beacons heard, the extent and predominant direction of the prevailing lift, it is worth looking for the continental beacons such as; DL0PR, 144·910MHz, EA3URE, 144·042MHz, FX3THF, 144·905MHz, LA1VHF, 144·860MHz, OH6VHF, 144·900MHz, OK0EB, 144·970MHz, ON4VHF, 145·990, OZ7IGY, 144·930MHz, PA0JTA, 144·148MHz, SK4MPI, 144·960MHz, SP2VHF, 144·980MHz, and YU1VHF, 145·990 to name a few. A beacon's signal is a continuous note, frequently interrupted with its call-sign.

Another good propagation indicator is the 2m repeater network, using f.m., which now provides considerable coverage of the UK and is rapidly spreading through Europe. Each repeater shares a carefully planned channel numbered from R0 through R9, covering a series of input frequencies from 145·000MHz, in 25kHz steps, to 145·225MHz. The range of output frequencies, also in 25kHz steps, is 600kHz higher, from 145·600 to 145·825MHz. In addition to handling the amateur radio traffic, these unmanned, automatic duplex transceivers periodically identify themselves by transmitting their official call-signs.

At some time during a tropospheric opening, continental f.m. broadcast stations will be heard in Band II, often stronger than the "local" BBC stations, and Band III television will suffer from co-channel interference.

Space enthusiasts can use the AMSAT-OSCAR 7 satellite which has two repeaters (transponders) aboard, 2m to 10m and 70cm to 2m. Signals received by the satellite between 145·85 and 145·95MHz are re-radiated between 29·4 and 29·5MHz and signals going in between 432·125 and 432·175MHz come out, inverted, between 145·975 and 145·925MHz. The satellite's telemetry beacon can be heard on 145·980MHz.

Every year, the RSGB, in conjunction with the IARU, arrange a number of contests, on 4m and 2m, for licensed amateurs and SWLs. These events are interesting because they are well supported by individual and group entries operating from their home QTH, or from portable or mobile locations. Should a contest coincide with an atmospheric disturbance then there is plenty of DX about.

Sections of the 2m band are used for Slow Scan TV, RTTY, the Radio Amateurs Emergency Network (Raynet), and scientifically, for moon-bounce experiments, meteor scatter and the study of auroral propagation.

I suggest that readers who are interested in v.h.f. should obtain a copy of the RSGB *VHF/UHF Manual* and talk to the v.h.f. operators in their local radio club.

BROADCAST BANDS

SHORT WAVE BROADCASTS

by Charles Molloy G8BUS

Harmonics, though familiar enough to the radio amateur, may well be an unknown phenomenon to the broadcast band DXer. A harmonic in this context is a spurious transmission on twice or three times the frequency of a broadcasting station. The basic frequency is called the fundamental, twice that frequency is the second harmonic, three times the frequency is the third harmonic and so on. Harmonics occur naturally inside a radio transmitter but great efforts are made to suppress them so that they do not reach the aerial and radiate. High power transmitters are now commonplace and when connected to a directional array the effective radiated power (e.r.p.) may easily be in megawatts. Under these circumstances it is easy for a few watts of the second or third harmonic to be radiated along with the fundamental. Normally, this is not a problem as the s.w. broadcaster ought to be transmitting near to the maximum usable frequency (m.u.f.) to obtain optimum results. Harmonics would then be above the critical frequency and will penetrate the ionosphere and not come back to the earth.

Now that the higher frequencies are opening up again after the recent sunspot minimum, reception of harmonics should occur more often. Radio amateurs make world-wide contact on 10 metres using only a few watts, and reception of harmonics in the range 23 to 30MHz should occur over a similar range. Harmonic DXing is the broadcast band DXer's equivalent of QRP (low power) and as such has a challenge and fascination all its own. One snag though. Be sure you are listening to a genuine harmonic and not to a spurious signal generated within your receiver. A check for the fundamental or a check of conditions on 10 metres is a help.

From Guernsey in the Channel Islands comes a letter from **George Le Couteur** who heard Radio Moscow when he was tuning through the 10m band. The exact frequency was 28·350MHz which is three times 9·450 in the 31m band and sure enough he "found them putting out their usual huge signal on the frequency". The second harmonic is 18·900 and George found them on this out-of-band frequency as well. Other DX heard, on fundamental this time, is Radio New Zealand regularly around 0830 on 11820kHz, faint but clear of QRM.

Harold Brodribb, St Leonards-on-Sea has also picked up harmonics of Radio Moscow, on 23·920MHz (2×11960), 24·110 (2×12055) on 29·1 (?) and 29·8 (?). Harold is now using a home-made converter with his CR100 which gives very much better results in the range 25-30MHz and he reports increased activity in the 11m broadcast band (25605 to 26095kHz) with reception of Tel Aviv on 25605 at midday and of the Voice of America (location unknown) on 26000kHz at 1800.

Short-wave crystal sets are in the news again with a report from **Rod Hunt** of Darlington who pulled in Radio Canada, Finland, Norway, Sweden, Austria and a number of others, using a home-brew crystal set and a 50ft outdoor aerial. Rod says that one definitely needs patience and persistence and it is only a matter of time until Australia is caught!

Radio Australia has attracted the attention of **George Norris** of Stowmarket (FRG7 and Windom Antenna) who says that propagation on this path at the moment seems to favour the morning between 0700 and 1000. "Try 11740kHz (25m) first and then 21680 and 21570 (13m). The former seems to hold up well most of the day with QRM at times". **William Stevenson** (Manchester) has a Vega 206 which he uses with a folded dipole in the loft for the 19m band and a 45ft Zepp with a.t.u. for the rest of the bands. His log included Radio Australia on 11705kHz at 1500 SIO 434. Fifteen-year-old **Robert Pound** of Cambourne in Cornwall is a regular listener to Radio Australia on 11740 but has been trying without success on 4920 for the 10kW VLM4 which relays the Domestic s.w. Service between 1930 and 1400. Has anyone logged this station? Robert, who uses an ex-WD receiver (type unknown) and an end-fed aerial situated in the loft, has beeen trying to pick up Radio Kaduna, Nigeria on 3396kHz in order to hear the talking drum interval signal. The NBC international service is also using this interval signal. **Chris Howles** of Lichfield (Vega 206 and 50ft long wire) reports hearing Lagos signing on at 1800 on 15120kHz in the 19m band and according to the *World Radio and TV Handbook* the interval signal precedes signing-on.

BROADCAST BANDS

MEDIUM WAVE DX

by Charles Molloy G8BUS

A long interesting letter, just bursting with enthusiasm from **Mike Kuske** of Folkestone describes how he heard his first North American m.w. station. His National Panasonic GX600M had been purchased for short wave listening but after reading *PW* he decided to try the medium waves for, although interested in North American domestic radio, he never thought it could be heard in the UK. With 100ft of wire wound around the loft for an aerial he pulled in WINS in New York City on 1010kHz at 0045 and he continued to listen to it until 0400. Subsequent night listening between 0100 and 0330 produced WHN New York on 1050, CHUM Toronto 1050, CFRB Toronto 1010, CHNS Halifax 960, CJYQ St John's 930, WCAU Philadelphia 1210, WOWO Fort Wayne Indiana 1190, CJCH Halifax 920. Mike now intends to obtain one of the new Yaesu Musen digital receivers and he also plans to construct a loop. A number of points arise out of Mike's letter.

Reception of North American m.w. stations is not limited to the winter. DXing is possible throughout the year. All that is required is a path of darkness between transmitter and receiver and this occurs some five hours after local sunset in the UK. Even on the longest day, sunrise occurs seven hours after sunset at this QTH though this period may vary according to location in the UK. At my QTH this means about 1½ hours DXing of NA before dawn on June 21st and much longer periods during April, May, July and August. Only stations on the eastern seaboard of North America will be heard in June but on the other hand European QRM is light as Central and Eastern Europe will be in daylight. DXing North America in summer can be rewarding. I once logged the 40 watt relay at Glovertown in Newfoundland on 1090kHz during the month of July.

Mike noticed that fade-outs lasting for periods of several days are common on the North American path and he wonders if there is any set pattern for good reception. Fade-outs do recur sometimes after 28 days, which is the period that a disturbance or spot on the surface of the sun takes to rotate and face the earth again—that is if it lasts that long. Reception is often at its best just before a fade-out so it might be possible to predict such a peak. Matters are not so simple, though, as the ionosphere is a complex medium and long range propagation on the medium waves has not been studied to any degree. After all the band is intended for local broadcasting! In any event the medium waves are never dead, there is always some DX to be heard. If North America cannot be heard at all then South America will be at its best. If you hear an American voice during a fadeout then listen carefully for it may be something special such as Puerto Rico or perhaps the American Virgin Islands. I shall give up medium wave DXing if it ever becomes possible to predict what can be heard as most of the fun will then have disappeared.

Finally, Mike offers a tip to QSL hunters. International Reply Coupons cost 25p in the UK but stamp dealers can supply unused postage stamps for most foreign countries. These are more convenient for the recipient to use and, a lot cheaper to buy (for Canada in Mike's experience). A very good idea if you know what value of stamps to obtain for a return letter.

Central and South America are often heard well during the summer. **D. R. Mayhew** (Littlehampton), who uses a Philips receiver and the *PW* 40in loop reports hearing Radio Managua, Nicaragua on 620kHz, La Voz de Mexico on 730, Radio Cadena el Salvador on 760, 'ROK 80' in Juarez Mexico on 800, Radio Sutatenza Colombia 810 and Radio la Versatil El Salvador on 1300kHz. More Latin American DX is reported by **Steve Whitt** (Cambridge) who used an Eddystone 940 with a 2ft square loop and the *PW* balanced amplifier to pull in Radio Margarita 1020 and Radio Coro 1210, both in Venezuela. "It was very interesting to receive my first South American DX, I don't know how I missed it before," writes Steve. It is very easy to pass over Latin Americans, especially during a North American fade-out, and class

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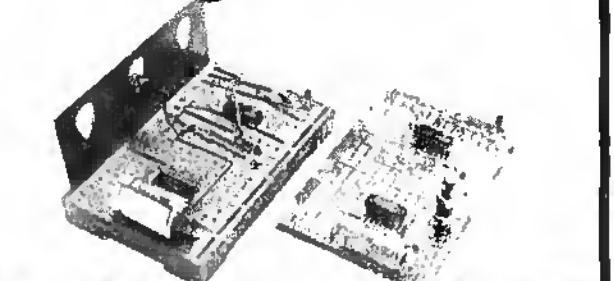

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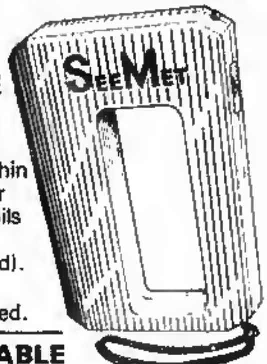

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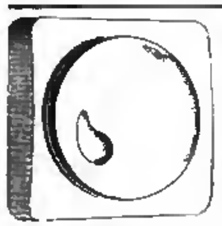

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them, as one newcomer to this column did, as unidentified Spaniards. At this time of year listen for Latin Americans after midnight, the peak occurring just before sunrise. There are very strong signals to be heard at times.

Steve asks what type of equipment is in use at my QTH. The main receiver is a GEC BRT400, a valved communications type that was designed some 25 years ago for broadcast band monitoring. Also in service is an Eddystone EC10 which is very useful as a second receiver if it is necessary to check two channels. A 90ft long wire with a.t.u., a 40in loop, crystal calibrator, audio notch filter, portable tape recorder and a home-made switching unit to switch aerials and calibrator, completes the set-up.

Another DXer who continues to use valved equipment is **J. Gaines** of Surbiton who has a Marconi CR100/8 which is giving splendid service. I used a CR100 for m.w. DXing for a number of years and it is a really first-class receiver on this band, though its performance on the short waves leaves a lot to be desired. One "mod" carried out by J. Gaines was to split the r.f. and i.f. gain controls.

This is a feature of the BRT400 that appeals to me as the r.f. gain control on many receivers controls both r.f. and i.f. gain at the same time. With the BRT400 the two are separate and there is an advantage to be gained at times by adjusting them separately, Overloading and cross-modulation occur at, or before the mixer and it is often necessary to reduce r.f. gain to eliminate this, with of course a reduction in i.f. gain as well when a common control is in use. It is in the mixer stage that the bulk of receiver noise is generated and in order to obtain a good signal-to-noise ratio, the r.f. gain should be as great as possible. Backing off the i.f. gain is the way to follow signal strength in this case, especially with the a.g.c. switched off, which should be normal practice when DXing on the medium waves. I set the r.f. gain as high as it will go without giving trouble and then I control signal strength with the i.f. gain control.

A good substitute for an r.f. gain control, if none is fitted, is an external attenuator. The simplest is a potentiometer of about 1000 ohms The lead from the aerial goes to the central tag. One of the outer tags goes to the receiver aerial socket and the other outer tag goes to the receiver earth socket. Overloading and cross-modulation can be controlled very easily by this method.

From Farum in Denmark comes a letter from **Mick Evans** who describes himself as a London guy who has gone to live and work in Denmark. Mike says that *PW* is very expensive in DK land, working out at well over £1 a copy. Why not take out an annual subscription? This service has recently been re-introduced at £10·60 per annum to any UK or overseas address. Mike's main trouble though is a buzz spread over a portion of the medium wave band and he asks if a mains filter would help. If the buzz is being radiated by the house wiring, as seems the case, then it would be necessary to filter the whole mains supply to the house. Contact the Danish Shortwave Club International, Greve Strandvej 144, DK2670 Greve Strand, Denmark, who should know the correct body to complain to. The DSWCI incidentally, is international, it publishes a bulletin in English called Short Wave News, which contains a medium wave section, in spite of the name. Enquiries in the UK should go to Noel Green, together with a stamped addressed envelope. Noel's address is 14 Marsden Road, Blackpool FY4 3BZ.

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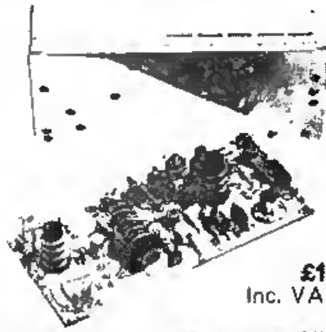

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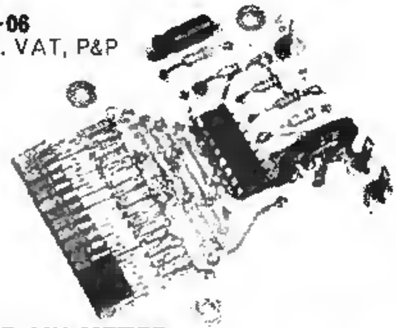

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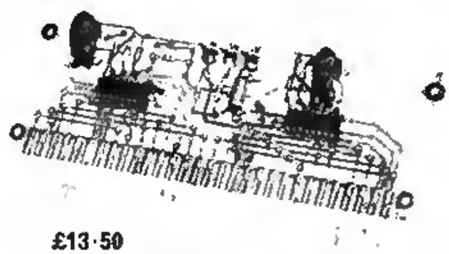

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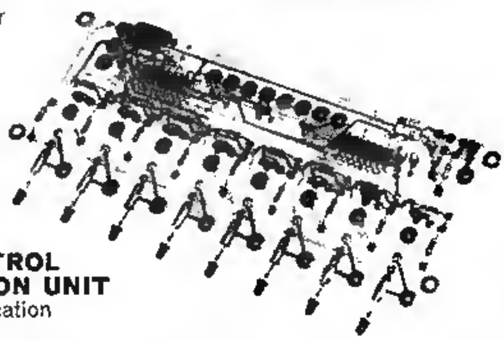

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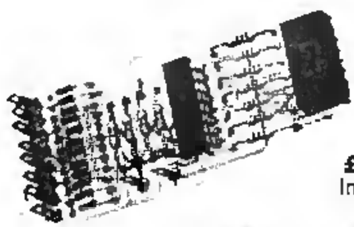

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200V	0·64	0·64	0·75	0·75	0·87	0·87	0·97	0·01	1·17	1·17
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7470	0·32
7472	0·28
7473	0·30
7474	0·32
7475	0·47
7476	0·36
7480	0·55
7482	0·75
7486	0·32
7489	2·02
7490AN	0·49
7491AN	0·65
7492	0·57
7493	0·45
7494	0·85
7495	0·67
7496	0·82
74100	1·07
74107	0·35
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74122	0·47
74123	0·65
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74165	0·93
74174	1·40
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AC187K	0·38
AC188	0·18
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AF115	0·20
AF116	0·20
AF117	0·20
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BC108B	0·12
BC109	0·12
BC109B	0·12
BC109C	0·15
BC117	0·18*
BC119	0·25
BC125	0·18*
BC126	0·20*
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	0·35
BC168	0·08*
BC169	0·12*
BC169C	0·14*
BC182	0·11*
BC182L	0·12*
BC183	0·10*
BC183L	0·10*
BC184	0·11*
BC184L	0·12*
BC185	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	0·48
BCY30	0·55
BCY31	0·55
BCY32	0·60
BCY33	0·55
BCY34	0·55
BCY38	0·50
BCY39	1·15
BCY40	0·75
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BF181	0·38
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BF183	0·30
BF184	0·20
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BF194	0·10*
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BF197	0·12*
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BF335	0·35*
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BFW60	0·38
BFX29	0·28
BFX30	0·30
BFX84	0·23
BFX85	0·25
BFX86	0·25
BFX87	0·20
BFX88	0·20
BFX89	0·80
BFY11	1·10
BFY18	0·50
BFY40	0·50
BFY41	0·60
BFY50	0·20
BFY51	0·18
BFY52	0·18
BFY53	0·25
BFY64	0·35
BFY90	0·90
BSX19	0·18
BSX20	0·18
BSX21	0·20
BSY52	0·28
BSY53	0·38
BSY54	0·33
BSY55	0·74
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2N697	0·26
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	0·80
2N1711	0·24
2N2102	0·44
2N2217	0·30
2N2369	0·14
2N2369A	0·14
2N2483	0·28
2N2484	0·16
2N2646	0·50
2N2711	0·20
2N2712	0·15
2N2904A	0·20
2N2905	0·18
2N2905A	0·22
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2N2925	0·14*
2N2926O	0·09*
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2N3137	1·10
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2N3442	1·20
2N3570	3·00
2N3702	0·10*
2N3703	0·10*
2N3704	0·10*
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2N3707	0·10*
2N3708	0·09*
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2N3711	0·10*
2N3715	1·70
2N3716	1·80
2N3771	1·60
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4013BE	0·50
4014BE	1·00
4015BE	0·85
4016BE	0·54
4017BE	1·00
4018BE	1·10
4019BE	0·58
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	0·65
4041BE	0·80
4042BE	0·83
4034BE	1·80
4044BE	0·94
4046BE	1·32
4049BE	0·54
4050BE	0·54
4069BE	0·30
4070BE	0·50
4071BE	0·28
4072BE	0·28
4081BE	0·20
4082BE	0·28
4510BE	1·42
4511BE	1·50
4516BE	1·35
4518BE	1·25
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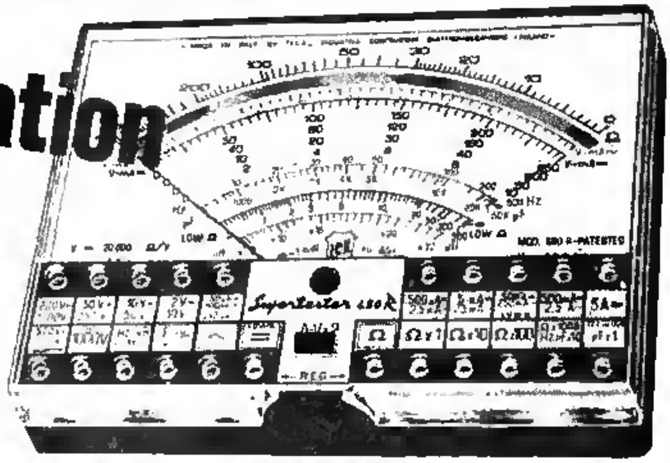

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7414	85p	74123	75p
7416	40p	74125	70p
7417	40p	74126	65p
7420	18p	74128	62p
7421	43p	74132	81p
7422	26p	74136	81p
7423	38p	74141	65p
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7427	40p	74147	205p
7428	40p	74148	160p
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7433	43p	74153	81p
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7454	18p	74172	750p
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7470	38p	74174	120p
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7473	30p	74176	130p
7474	37p	74177	120p
7475	43p	74180	120p
7476	37p	74181	324p
7480	54p	74182	150p
7481	108p	74184	250p
7482	90p	74185	180p
7483	88p	74188	900p
7484	108p	74190	120p
7485	120p	74191	120p
7486	36p	74192	100p
7489	340p	74193	100p
7490	38p	74194	100p
7491	90p	74195	110p
7492	58p	74196	100p
7493	38p	74197	130p
7494	90p	74198	250p
7495	75p	74199	250p
7496	90p	74221	175p

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74LS00	30p
74LS02	30p
74LS04	30p
74LS08	30p
74LS10	32p
74LS13	55p
74LS20	32p
74LS22	34p
74LS27	43p
74LS30	34p
74LS47	150p
74LS55	45p
74LS73	60p
74LS74	60p
74LS75	75p
74LS83	120p
74LS85	144p
74LS86	65p
74LS90	80p
74LS93	80p
74LS107	55p
74LS112	120p
74LS123	110p
74LS138	140p
74LS139	150p
74LS151	110p
74LS153	200p
74LS157	130p
74LS158	150p
74LS160	180p
74LS161	180p
74LS162	180p
74LS163	180p
74LS164	120p
74LS165	225p
74LS173	230p
74LS174	100p
74LS175	160p
74LS181	375p
74LS190	250p
74LS191	200p

74C

74C00	25p
74C02	25p
74C04	27p
74C08	27p
74C10	27p
74C14	90p
74C42	119p
74C48	230p
74C73	75p
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74C85	200p
74C86	65p
74C90	90p
74C93	90p
74C107	125p
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74C161	155p
74C162	155p
74C163	155p
74C164	140p

CMOS

4000	20p
4001	20p
4006	95p
4007	20p
4008	115p
4009	50p
4010	60p
4011	20p
4012	20p
4013	50p
4014	115p
4015	90p
4016	50p
4017	100p
4018	110p
4019	52p
4020	120p
4021	115p
4022	100p
4023	22p
4024	80p
4025	22p
4026	170p
4027	65p
4028	80p
4029	120p
4030	55p
4033	250p
4034	240p
4035	130p
4040	120p
4042	90p
4043	100p
4044	100p
4046	140p
4047	100p
4049	55p
4050	57p
4051	110p
4054	120p
4055	144p
4056	135p
4060	130p
4066	45p
4067	425p
4068	24p
4069	27p
4070	85p
4071	27p
4072	27p
4073	30p
4078	170p
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14507	55p
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14515	160p
14518	110p
14520	110p
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12V	7812	115p	24V	7924	160p
15V	7815	115p	Heat Sink 17°/W		25p
18V	7818	115p	suitable for		
24V	7824	115p		T0220	
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6·25V	78L62	70p			
12V	78L12	70p	12V	79L12	80p
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AD161	45p	BF256B	60p
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BC108/B	10p	BFR80/1	34p
BC109	10p	BFR88	37p
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BC147	9p	BFX29	30p
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BC157	11p	BFX84/5	30p
BC158/9	13p	BFX86/7	30p
BC169C	15p	BFY50	22p
BC172	11p	BFY51	22p
BC173C	11p	BFY52	22p
BC177	20p	BFY56	40p
BC178	17p	BFY90	80p
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BC213	12p	MJ491	210p
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2N930	19p	2N6254	140p
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2N1304/5	75p	3N128	85p
2N1306/7	75p	3N140	87p
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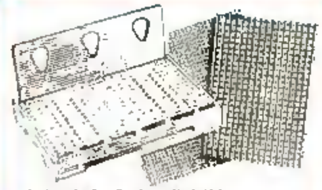

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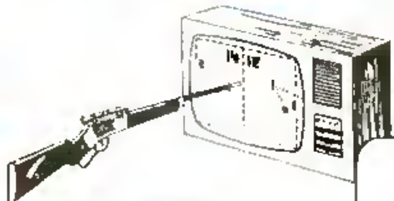

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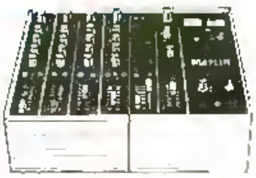

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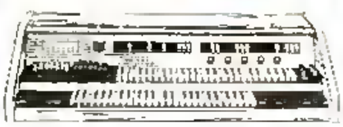

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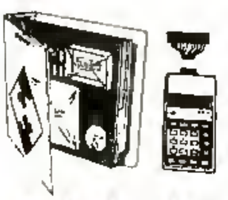

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