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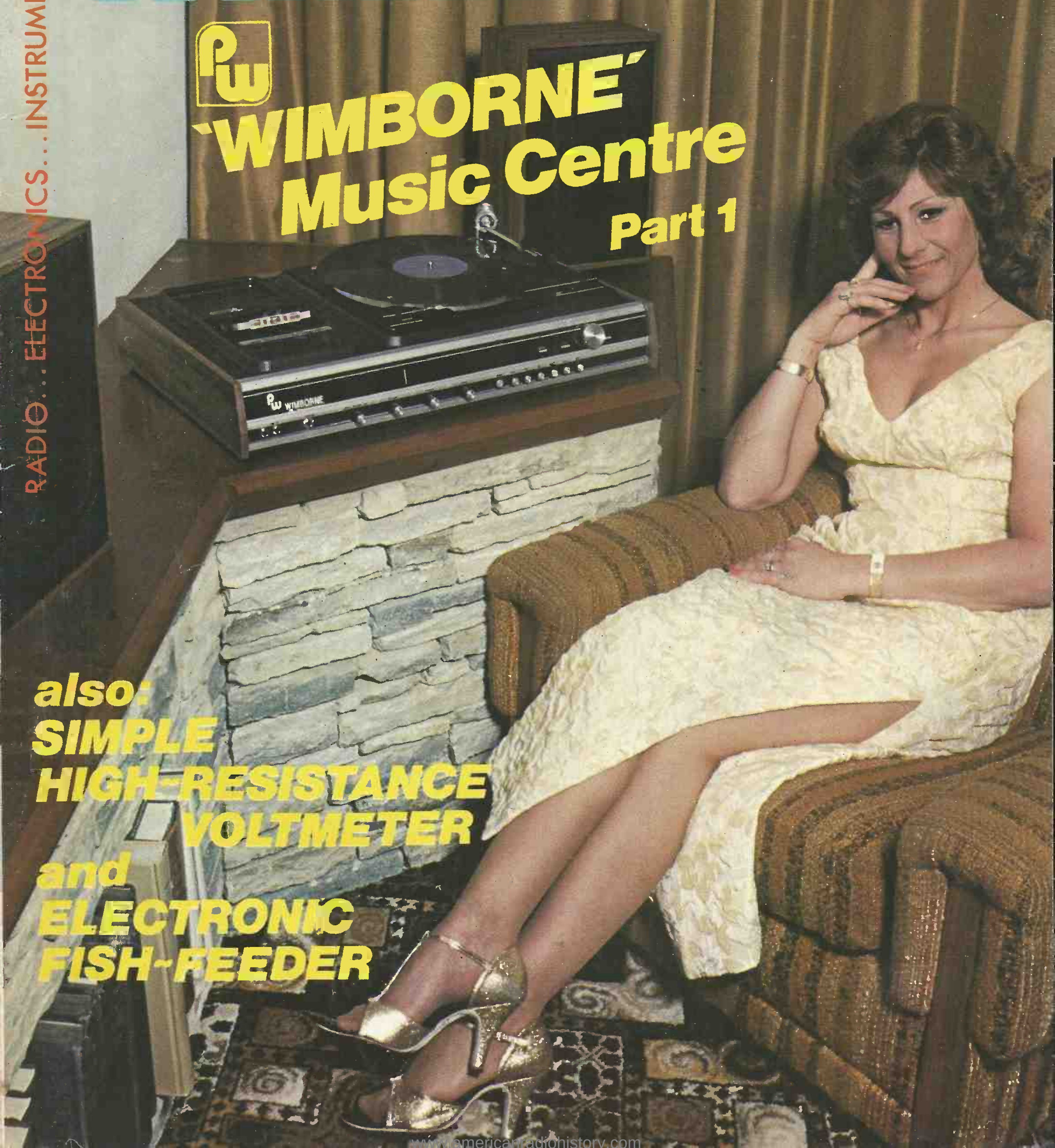

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All queries must be accompanied by a stamped self-addressed envelope, otherwise a reply cannot be guaranteed. We cannot answer technical queries over the telephone.

☐ NEWS & VIEWS

☐ FOR OUR CONSTRUCTORS

☐ GENERAL INTEREST

Our October issue will be published on September 1st
(for details see page 43)

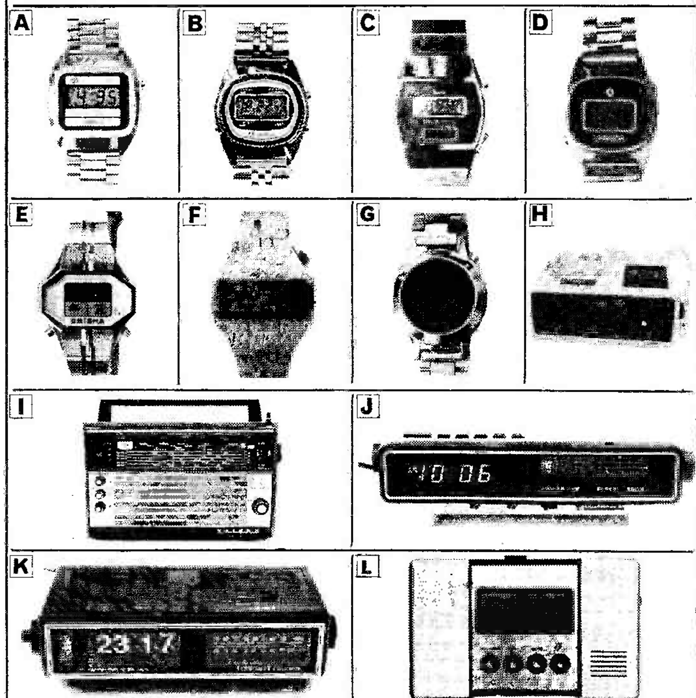
OUR COVER
Relaxing to music from the "Wimborne" Music Centre is our PW secretary Sylvia Barrett

READERS PCB SERVICES

AND NOW WE ARE PLEASED TO ANNOUNCE OUR

SPECIAL OFFERS SERVICE

BELOW ARE OUR SPECIALLY SELECTED-BRANDED PRODUCTS OFFERED AT MUCH REDUCED PRICES TO P.W. READERS. ITEMS OFFERED WILL VARY MONTHLY.



WATCH BATTERIES ALWAYS AVAILABLE—ANY TYPE 49p each

[A] GLCDB4. L.C.D. WATCH
7 Function Gents L.C.D. quartz watch combining American electronics with a Stainless Steel case & fully adj. strap. FUNCTIONS: Hrs, mins, secs, date, month, alternating time/date, back light. Water resistant. PRICE: £11·88 + 50p P & P.

[B] LCCRO1. L.C.D. CRONOGRAPH WATCH
Up to 25 Function: 6 digit display of Hrs., mins, seconds, day, date, month. Measures nett times, Lap times, place times to 1/100th second. Swiss Stainless Steel case & fully adj. strap: Back light. American electronics. Will record time elapsed whilst displaying watch functions or date. Water resistant. PRICE: £20·56 + 50p P & P.

[C] SOLAR 1. SOLAR POWERED/ CHARGED WATCH
A superbly engineered 10 function SOLAR watch. Will operate without batteries even in subdued or artificial light. Batteries fitted provide power at night for watch & back light, these being charged by the solar panel during the day. Functions: Hrs, mins, secs, day, date, month AM/PM Indc, Date Ind. Alternating Time/Date. Super stylish 'Polished' stainless steel case & fully adj. strap. PRICE: £25·98 + 50p P & P.

[D] LLCD8. LADIES L.C.D. WATCH
American/Swiss very practical every-day ladies watch. Functions: hrs, mins, secs, date, month, back light, alt, Time/Date. In a water resistant, stainless steel case & Adj. strap. Size: approx, 18mm facex8mm thick. PRICE: £15·99 + 50p P & P.

[E] LLCD/3S. LADIES COCKTAIL L.C.D. WATCH
Very, very elegant indeed. A beautifully finished slender cocktail bracelet housing a 7 function L.C.D. watch. This watch goes to all the best dinners and parties. Fully fash-ioned stainless steel fully adj. Functions: Hrs., mins, secs, date, month, alt, time/date. PRICE: £26·50 + 50p P & P.

[F] LLED/43. SHUGAR L.E.D. COCKTAIL
For the night bird: A 6 function L.E.D. watch housed in a pretty cocktail bracelet. Func-tions: Hrs, mins, secs, day, date, month. Gold or silver. PRICE: £13·99p. + 50p P & P.

[G] LLED/45. LADIES L.E.D. WATCH
As LLED/43 but housed in an everyday stainless steel case & strap. PRICE: £9·50 + 50p P& P.

[H] TRA/CA12. L.E.D. ALARM/CLOCK RADIO
(FM/MW) Radio combined with L.E.D. Alarm clock. PRICE £24·65 + £1·25 P & P.

WATCH THIS PAGE FOR OUR FUTURE OFFERS AT TRADE PRICES.

[I] RA1. 8 Waveband AM/FM/SW Mains/batt RADIO
The UNIQUE VEGA SELENA FEATURES:— 5 short Wave Bands: 80 to 180 + 42 to 50 + 30·4 to 32·5 + 24·7 to 26 + 19·3 to 20 Mtrs. A/M—L/W & M/W. F.M. with A.F.C. Panel lighting: Full tone control: Extending rod aerial. Opprts., S/W & F/M: Batt/Tuning Indc. SOCKETS FOR: External 60 ohm Aerial + A/M Aerial: Tape Recorder Rec/ playback: Earth. The Vaga Selena WEIGHS 9 lbs. Finished in black with silver trims and a real wood surround. PRICE: £32·95 + £1·75 P & P.

[J] MR/218C L.E.D. Clock Radio Alarm (Mains)
FEATURES: 24 hr time and alarm clock + A/M, F/M Radio. Full alarm features include snooze timer, radio set and off. Radio sleep timer. Bright green 12hr LED display with A/M, P/M indicator. PRICE: £21·75 + £1·25 P & P.

[K] AM/FMIL DIGITAL CLOCK/RADIO/ ALARM
As MR/218C but available AM/FM only and Mech., digital display. Usual full, sleep, snooze, radio/buzzer alarm facilities. PRICE: £16·95 + 50p P. & P.

[L] CRA28 L.C.D. TRAVELLING ALARM CLOCK
Features: 12 hour time and alarm clock (12 hour display with AM/FM indicator). Nitelife. 4 minute snooze timer. Large 12·5mm display. Super elegant design. The alarm effective not silly. Brush finish. Size: 3" x 4½" x 20mm thick. 2 cheap dry batteries provide over 1 year's normal use. PRICE: £16·95 + 50p P&P.

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Dec 75	Disco System, Amp (2 req'd) each	AM0421	4·40+22	☐
Dec 75	Disco System, Light Modulator	AM0429	3·50+22	☐
Mar 76	CMOS Crystal Calibrator	AM0438	1·19+12	☐
July 76	Disco Preamplifier	A003	0·65+12	☐
Oct. 76	Digital Car Clock (set)	A011/012/013	2·58+12	☐
Oct 76	Interwipe	DN8JM	0·80+12	☐
Oct 76	Video-Writer (set)	D002/3/4/6 A1007	21·44+50	☐
Nov 76	Cirtest Probe	A018	0·48+12	☐
Nov 76	Burglar Alarm	A019	0·50+12	☐
Dec 76	Chromachase	A021	5·70+22	☐
Jan 77	Oscilloscope Calibrator	A023	1·25+12	☐
Apr 77	Gas/Smoke Sensor Alarm	A028	0·65+12	☐
May 77	2-Way Intercom	D019	1·28+12	☐
May 77	Protected Battery Charger	A027	2·38+12	☐
May 77	Seekit Metal Locator	A031	3·38+12	☐
June 77	Versatile AF Generator	A033	2·38+12	☐
June 77	Tele-Games	D029	3·22+12	☐
July 77	20W IC Amplifier	A034	1·38+12	☐
July 77	Radio 2 Tuner	A035	1·68+12	☐
July 77	Digital Clock Timer	A036	3·28+12	☐
Aug 77	Shoot (Telegames)	D035	1·55+15	☐
Aug 77	Atomic Time Receiver	D038	2·65+15	☐
Aug 77	Morse Code Tutor Cards (SRBP)	A037	4·75+15	☐
Sept 77	Jubilee Electronic Organ	A038	19·00+75	☐
Sept 77	Electronic Car Voltage Regulator	D037	1·25+12	☐
Oct 77	Audio Level Indicator	D039	0·98+12	☐
Oct 77	Sine-Square Wave Generator	D040	2·35+15	☐
Nov 77	Laboratory Power Supply	A039	3·50+12	☐
Jan 78	Direct Conversion Receiver	D043	1·85+15	☐
Jan 78	Proportional Power Controller	DN9JM	0·78+12	☐
Mar 78	Audio/Visual Logic Probe	R001	1·40+15	☐
Apr 78	Europa Stereo Amplifier	R002	9·55+45	☐
May 78	DX'ers Audio Filter	D001	2·35+15	☐
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July 78	Digital Lock	R002	1·25+15	☐
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Aug 78	Point Motor C.D. Supply	D005	1·25+15	☐

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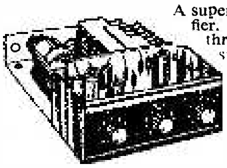
SUPERSOUND 13 HI-FI MONO AMPLIFIER



A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohms. Frequency response 12Hz 30KHz ± 3db. Fully integrated pre-amplifier stage with separate Volume. Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3" high × 6" wide × 7½" deep. AC 200/250V. PRICE £15·00. P. & P. £1·20.

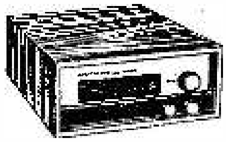
HARVERSONIC MODEL P.A. TWO ZERO

An advanced solid state general purpose mono amplifier suitable for Public Address system, Disco, Guitar, Gram., etc. Features 3 individually controlled inputs (each input has a separate 2 stage pre-amp). Input 1, 15mv into 47k. Input 2, 15mv into 47k. (suitable for use with mic. or guitar etc.). Input 3 200mv into 1 meg. suitable for gram. tuner, or tape etc. Full mixing facilities with full range bass & treble controls. All inputs plug into standard jack sockets on front panel. Output socket on rear of chassis for an 8 ohm or 16 ohm speaker. Output in excess of 20 watts R.M.S. Very attractively finished purpose built cabinet made from black vinyl covered steel, with a brushed anodised aluminium front escutcheon. For ac mains operation 200/240v. Size approx. 12½" w. × 5" h. × 7½" d. Special introductory Price £28·00+£2·50 carr. & pkg.

Mullard LP1159 RF-IF Module 470 kHz £2·25+ P.&P. 20p. Full spec. and connection details supplied. Pye VHF/FM Tuner Head covering 88-108 M/Hz. 10·7 M/Hz I.F. output. 7–8 Volt + earth. Supplied pre-aligned, with full circuit diagram with precision-geared FM gang and 323Pf + 323Pf A.M. Tuning gang only £3·15 + P. & P. 35p.

STEREO DECODER
SIZE 2" × 3" × ½" ready built. Pre-aligned and tested for 9-16V neg. earth operation. Can be fitted to almost any FM VHF radio or tuner. Stereo beacon light can be fitted if required. Full details and instructions (inclusive of hints and tips) supplied. £6·00 plus 20p. P. & P. Stereo beacon light if required 40p extra.

MAINS OPERATED SOLID STATE AM/FM STEREO TUNER



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LIMITED NUMBER ONLY at £28·00 + £1·50 P. & P.

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10/14 WATT HI-FI AMPLIFIER KIT
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Overall Size 12"w. × 8"d. × 2½"h.
Fully detailed 7 page construction manual and parts list free with kit or send 25p plus large S.A.E.

AMPLIFIER KIT	£13·50 P. & P. 80p
(Magnetic input components 33p extra)	
POWER PACK KIT ..	£5·50 P. & P. 95p
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SPECIAL OFFER—only £23·75 if all 3 items ordered at one time plus £1·25 p. & p.
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Also avail. ready built and tested £31·25, P. & P. £1·50.

HARVERSONIC STEREO 44
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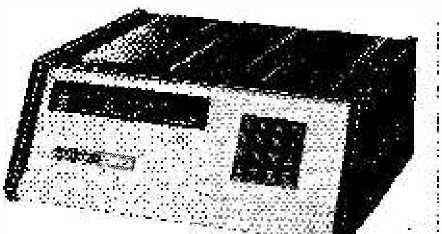

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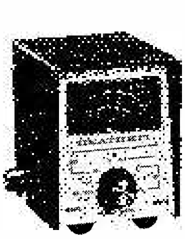

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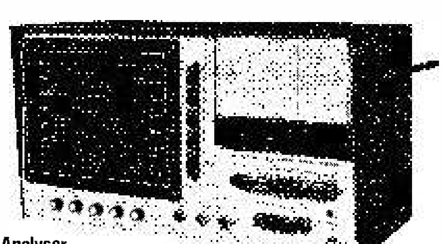

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Also available by weight 1lb **£3·95** 10lbs **£32·50.**
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Send SAE for our relay list—84 types listed and illustrated.

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LM380	**80p**		

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555	25p	BD132	25p
1N4148	2p	2N3819	18p

CAPACITOR BARGAINS
800mfd 250V 76 × 38mm **82p**: 400mfd 400V 75 × 38mm **78**: 1500mfd 40V PC mount 40 × 25mm **7 for £1**
200mfd 10V 38 × 18mm **10 for £1**
1000pF discs **100 for £1** ·05mid 30V discs **100 for £1·68**
·1mfd 20V discs **100 for £2·36**
2·2mfd 3V discs **100 for £3·94**
4·7mfd 100V polyester **6 for £1**

POT BARGAINS
Standard size pots—spindle is 12mm long. In the following values only; 10k lin; 4k7 semi-log; 680R lin; 2k7 lin. **10 for £1** any mix.

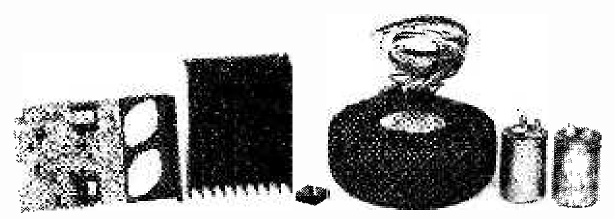
VEROCASES
Plastic top and bottom alloy panels front and back

1237	154 × 85 × 40	**£2·53**
1238	154 × 85 × 60	**£2·79**
1239	154 × 85 × 80	**£3·32**
3007	180 × 120 × 40	**£3·30**
3008	180 × 120 × 65	**£3·50**
3009	180 × 120 × 90	**£3·74**
1410	205 × 140 × 40	**£3·51**
1411	205 × 140 × 75	**£4·05**
1412	205 × 140 × 110	**£5·12**

VERO PLASTIC BOXES
Professional quality two tone grey polystyrene with threaded inserts for mounting PC boards

2518	120 × 65 × 40	**£2·17**
2520	150 × 80 × 50	**£2·45**
2522	188 × 110 × 60	**£3·23**

TWO NEW SUPERMODULES: 170W INTO 4 OR 8 OHMS



By popular demand we have designed higher powered versions of our well known modules. The CE 1704 which gives 170W into 4 ohms and the CE 1708 which gives 170W into 8 ohms are physically similar to the original types and have the same combination of compatible performance features which makes CRIMSON amplification audibly superior to the competition and the only choice if you have an ear for music. We have also produced suitable power supplies which again use our superb TOROIDAL TRANSFORMERS, only 50mm high, with a 120-240 primary and single bolt fixing.

Write or phone for more information and biased opinions.

POWER AMPLIFIER MODULES	*Home*	*Europe*
CE 608 60W/8 ohms 35-0-35V	£16·30	£16·60
CE 1004 100W/4 ohms 35-0-35V	£19·22	£19·30
CE 1008 100W/8 ohms 45-0-45V	£23·22	£23·00
CE 1704 170W/4 ohms 45-0-45V	£29·12	£28·46
CE 1708 170W/8 ohms 60-0-60V	£31·90	£31·04
TOROIDAL POWER SUPPLIES		
CPS 1 for 2 × CE 608 or 1 × CE 1004	£14·47	£18·40
CPS 2 for 2 × CE 1004 or 2/4 × CE 608	£16·82	£20·57
CPS 3 for 2 × CE 1008 or 1 × CE 1704	£17·66	£21·35
CPS 4 for 1 × CE 1008	£15·31	£19·18
CPS 5 for 1 × CE 1708	£22·68	£26·50
CPS 6 for 2 × CE 1704 or 2 × CE 1708	£23·98	£27·70
HEATSINKS		
Light Duty 50mm 2°C/W....	£0·90	£1·30
Medium Power 100mm 1·4°C/W....	£1·60	£2·40
Disco/Group 150mm 1·1°C/W....	£2·30	£3·65
THERMAL CUT-OUTS RECOMMENDED FOR IMPROVED RELIABILITY 70°C	£1·60	£1·90

T.H.O.:	Typically < ·01% any Power. 1 kHz.8 ohms.
T.I.D.:	Insignificant.
Slew Rate Limit:	25V/μs.
S/N Ratio:	110dB.
Freq. Response:	10Hz-35kHz, —3dB.
Stability:	Unconditional.
Protection:	Drives any load safely.
Sensitivity:	775mV (250mV or 100mV on request).
Size:	120 × 80 × 25mm.

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Telephone: (0533) 537722

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DORAM

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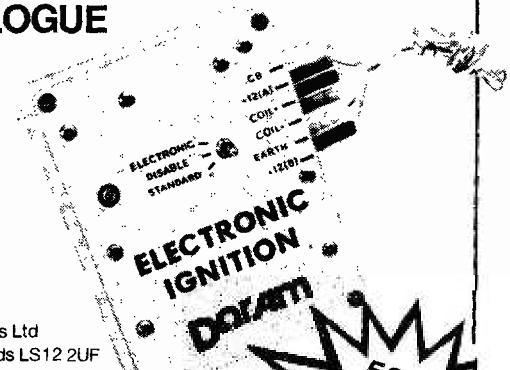

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This Month's Snip. 35w speaker kit, all good British made speakers, the kit consists of 8" woofer, 4½" mid range, 3½" tweeter all for 8 ohm and finally the terminal panel which also houses crossover unit. 100 sets only to first comers, price **£16·50 including post and VAT.**

Project Boxes. Nicely made in black plastic with threaded brass inserts to hold the lid which is fixed by four corner screws. There are three sizes available 75 x 56 x 35mm, price **60p**, 95 x 71 x 36mm price **70p** and 115 x 95 x 36mm price **80p.**

Instrument Buzzers, made for the GPO ex unused equipment price **54p.**

Klaxton Type Alarm. Battery operated gives a good loud note with only a 1·5v battery, gets unbearable as voltage increases, ideal for personal or car alarm, price **80p.**

Stereo Headphone Lead. Black curly 10ft approx. teminations, stereo jackplug one end—miniature two in plugs the other. Price **56p**

Stereo Decoder Kit uses latest techniques, size approximately 3½" x 1" x ¾" complete price **£5·05** or made up and tested **£1·50** extra.

Stereo Beacon Light if required **45p** extra.

Cassette Microphone. Dynamic 600 ohm with on/off switch and stand for desk top work, price **£1·42.**

Mains Operated Pump. Most readers will know that we stock the Jabsco pump which was made to work with portable drills, the price is **£2·00**, now in response to demand for a mains operated pump we have coupled this to a 110 rpm motor, mounted them on a metal chassis and offer this as a general purpose pump. It is suitable for most liquids and certainly for water. The pump is self priming and will lift the liquid up to quite a head but naturally the delivery will fall off depending upon the lift. Price **£11·26.**

Flexible Conduits made from a thin but very tough plastic ribbed to give extra strength but very lightweight and very flexible and can be bent through a very small radius. Uses in addition to carrying most fluids, these conduits can also be used for cable tidying and protection and even make do flexible drive for a slow speed turning operation. Two sizes available ⅝" and ⅞" internal diameters approximately. It is interesting to note that the ⅝" one is a reasonably good fit on the inlet/outlets of the above mentioned Jabsco pump. Price 27p per metre, post 11p per metre.

Double Ended Motor, mains operated, capacitor run approx. ⅛ h.p., this has spindle coming out each side and should be very suitable for converting into a double ended polisher or grinder, holes conveniently placed in the housing make it very easy to stand in the right position and the speed although not high is adequate. Limited quantity only, we are offering these with capacitor at **£6·50.**

¼ H.P. Motors. Normal base mounting, ex computors but tested, 230–240v 50hz good length spindle mostly American make, **£8·50.**

13 Amp Rocker Switch made by Carr Fastener Co. (Dot) again available, price **27p.**

Luminous Rocker Switch, suitable for 13 amps at mains voltage, these are illuminated with neon through amber panel, snap-in fixing into hole size 1⅛" x 1⅛". Special bargain **38p.**

Three position Rocker Switch. 10 amp changeover with a centre off standard size clip fixing pushes into hole area size approximately 1" x 7/16" which is standard for many rockers. Special bargain this month, 10 for **£1·62.**

60 Minute Clockwork Time Switch made by Smiths and as fitted to many tumble dryers, washing machines, etc. Very useful for other timed applications, when rotated 15 double pole main switch makes circuit and stays on for up to 1 hour depending on the amount you turn the spindle. Special snip price **£1·23.**

Clockwork Air or Gas Switch made by the famous Smiths Company, winding the clockwork opens the valve and lets the air or gas come through for maximum of two hours depending upon the amount the clockwork is rotated. Inlet and outlet are threaded normal gas size, price **£3·78.**

Connecting Wire Bargain 100 yards PVC insulated connecting wire 14/36 on a drum, conductors made by BICC, price **£1·38.**

Calculator Key Board Ex broken up calculators, these are approx. 2½" square and have the normal 0-9 buttons plus on/off switch, divide, multiply, plus, minus button as well. Limited quantity only **81p.**

Versatile Performer our 12v 1 amp ref. No. TM10 is a very useful transformer, there is plenty of space between the winding and the laminations to add (or subtract turns) if for instance you want an additional 2 or 3 volt winding this can be very easily added without de-lamming the transformer. We have adequate stocks of these and can give a discount of up to 30% depending on how many you buy. One off price is **£2·14.**

Just Arrived Few only so hurry if you want one. **Garrard Mini Auto Record Changers Model CC10,** very neat deck size only 11¾" x 8½" requiring only 2" clearance below deck. This plays all sizes of records and is fitted with a stereo ceramic cartridge, price **£10·50.**

I.C.'s on Computor Board Total of 16 I.C.'s as follows: 3 off 7403, 2 off 7406, 1 off 7407, 1 off 7408, 2 off 7409, 2 off 7413, 1 off 7414, 1 off 7352. One metal encased type numbers look like 14406. Panel with other components one of which we believe to be a crystal. Price **95p** per board. List price of only 14 of the I.C.'s came to over £4 and we understand that these are unused boards.

Charge Rate Meters As our old friends will know we have in stock 2 amp and 3 amp charging meters, we have now acquired some 5 amp and 6 amp. These are all the same size that is 1¾" diameter and all the same price, **81p** each.

3 Plug and Socket Bargains 3 way plug and socket **32p.** 6 way plug and socket **49p**, 12 way **64p** per pair.

Multiple Slide Switch. This is a 6 pole changeover with centre off, price **54p.**

Heavy Duty 3 Core Appliance Lead 15 amp wire, 6ft long, conventional yellow-green, brown and blue, Grey pvc outer, prepared ends, this flex normally sells at **30p** per metre. 10 leads for **£3·70.**

Heavy Duty and 4 Core Appliance Lead Black rubber out, copper cores adequate for 13 amps, coloured as follows: yellow/green, brown, grey and green. 6ft long. 10 leads for **£4·24.**

2 Core Appliance Lead with continental 2 pin plug, black and blue insulated 5 amp cores with very flexible grey rubber outer, **£3·00.**

Chrome Plated Metal Legs, heavy duty, really good quality, made originally for an expensive Decca outfit. height 12". **£2·19** per set of four.

Experimenters Relay Parcel. A special offer is 10 type 600 relays all different coil values covering most experimenters needs. Total retail value **£8·10**—yours for **£3·75.**

Motor with fan blade—if you want something to cool a cabinet or if you are making a cooker hood or a blower heater, this may be the answer. 1" stack induction motor with a set of Smith's fan blades, approx. 5" diameter. Price **£3·20.**

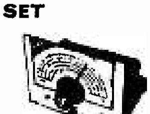
MULLARD AUDIO AMPLIFIERS

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 and VAT.

Model 1172 1W, power output £1·85.
Model EP900 4 watt power output £2·00.
EP 9001 twin channel or stereo pre-amp. £2·90.

SHORTWAVE CRYSTAL SET

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

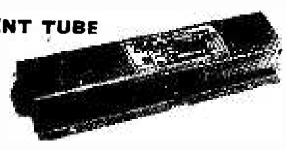


BREAKDOWN PARCEL

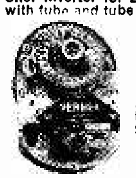
Four unused, made for computer units containing most useful components and these components unlike those from most computer panels, have wire ends of usable length. The transistors for instance have leads over 1" long—the diodes have approx. ½" leads.

List of the major components is as follows:—17 assorted transistors—38 assorted diodes—60 assorted resistors and condensers—4 gold plated plugs in units which can serve as multipin plugs or as hook up boards for experimental or quickly changed circuits (note we can supply the socket boards which we made to receive these units). The price of this four unit parcel is **£1** including VAT and post (considerably less than value of the transistors or diodes alone). DON'T MISS THIS SPLENDID OFFER.

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" 13 watt miniature tube for only **£3·75** with tube and tube holders as well.

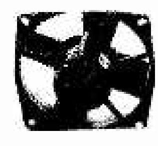


24 HOUR TIMERS VENNER

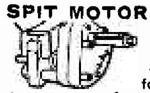
As illustrated with sun correction made for G.P.O. phone boxes used perfect **£2·95** 20 amp switching contacts.

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.**



SPIT MOTOR WITH CARTER G/BOX



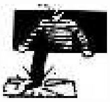
Probably one of the best spit motors made. Originally intended to be used in very high priced cookers, however this can be put to plenty of other uses, for instance your garden barbeque or to drive a tumbler for stone polishing; in fact there are no ends to its uses. Normal mains operation. **£4·32.**

HONEYWELL P.B. MICRO SWITCH

1-2 or 3 10 amp 250V changeover micro-switch thro panel mounting by cock nuts 1" dia black knob 1 switch 40p, 2 switch 55p, 3 switch 70p.

LATCHING RELAY

by Guardian Electric, mains operated it is in fact two relays mounted on a metal base plate. The relays being mounted in such a way to ensure that when one closes the other opens and vice versa thus when closed relay A would remain locked until manually released or electrically released by energising relay B. Each relay has 2 sets of 10 amp changeover contacts. Should be ideal for burglar alarms and similar applications **£2·11.**



SWITCH TRIGGER MATS

Wiring dig, supplied for complete house protection—'Keep Those Robbers Away'.
13" × 10"—£2·10
24" × 18"—£2·60

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 CR8 1SG

Fluorescent Choke for 5ft. Tube. This is another exceptional bargain. It is a polyester filled almost silent running **65 watt choke made by GEC at only £1·87. Just what sort of** bargain this is will be realised when you look at the new prices for chokes, the recommended list price of 65 watt is now over **£3·50.**

Car Plugs. These go in the cigar lighter socket. They have been out of stock for a long while, but we are pleased to say they are once again in stock, new price of course **44p** + 4p each.

Self-adhesive paper discs ¾" ideal for marking leads as you take them off, or for providing quick insulation of soldered or twisted joints. £1·38 for box of 5,000.

Pick-up Cartridges. We have two extra special bargains this month—"Sure" magnetic type number 77DB for **£3·36** + **36p** and "Ronette" turnover mono cartridge standard replacement for DC4000 series price **£1·70.**

Multi-core Cable. 7 cores each pvc insulated and colour coded, screened overall then with pvc outer covering. A miniature cable diameter approx. ¼", price **20p** per metre available in lengths up to 15 metres.

Tape Deck, solenoid operated. This comprises mains motor mounted on a frame with heavy flywheel and capstan. Record, play, rewind, etc., intended to be operated by solenoids but the solenoids have never been fitted nor are these available. It should require little ingenuity to make this manually operated or even to adapt other solenoids to control it. Price, complete with record/playback head and erase head, **£4·75.**

Break before make wafer switch. We are sometimes asked for these but we do not normally keep a range. However, we have some 2 pole 5 way with 1½" wafer, a well made switch which we can offer **45p** + 5p each.

Latching Relay, i.e. a relay that once closed stays closed until deliberately opened, is often needed in a circuit. Some relays latch mechanically, but these are expensive. Our relay DB500 having multiple contacts and a double wound coil lends itself to electrical latching, simply use one of the surplus pairs of contacts to maintain the closing current or to bring in an auxiliary closing current, a very useful relay—will close on 6 volts, 12 volts, 124 volts or from the mains through 15 watt 1 amp (or 5K resistor) and small rectifier. Special snip price on **54p** + 4p. Good quantities in stock, usual discounts.

AM/FM Tuning Condenser as fitted to many Japaense and Hong Kong portables, this has two tuning sections and four trimmers, approximate size 1" x 1" x 1". Price **67p.**

Battery Charger Kit comprising 2 amp transformer, 2 amp full wave rectifier and 2 amp meter suitable for charging 6v or 12v battery. Special bargain price **£3·10.**

Battery condition testers. This is another item which has been out of stock temporarily but we are pleased to say in stock again. Price now **£4·86** + 36p post 60p.

RF Attenuator fitted into a die-cast 10 sectioned case with a line of switches on the top panel and co-ax input and output sockets. Switches give db attenuation of 1, 2, 3, 5, 10, 10, 10, 10. Not new but in perfect condition. Price **£3·74.**

Pendant phones ex G.P.O. very useful as extensions, these do not take up any room on the desk, just screw the hook switch to the wall. Limited quantity **£2·20.**

Solenoid 4-6v, size approx. 1" x 1" x ·4" thick twin coils give excellent pull. Fitted with lever giving approx. ·4" push or pull. Price **43p.**

Cold cathode tube Swiss made "Elasta" type no. ER 12A. We have no technical information on this tube and if any reader has this we will be obliged for any information. Price of the tubes **43p.**

AC mains operated relay with single changeover 10 amp contacts, open type single screw fixing through the base, price **81p.**

Frequency changing auto transformer for the operation of American equipment off our mains. These have an output of 115v at 60c.p.s. loading 100w. The frequency of the output is shown by a vibrating reed type indicator. Limited quantity **£39** each.

Push Switch, metal body and metal push, normally on. These are replacement in many "break glass" fire alarms. Made by Arrow, contact rating 250v 5 amps. Price **54p.**

Push Switch, double pole changeover contacts rated at 10amps 250 volts made by the American Honeywell Co. A very reliable and robust switch with plenty of applications. Oblong plastic body, snap fitting into a hole size 1½" x ½" **27p** + 2p each.

Ditto but latches down and has to be pulled up, price **45p.**

Power Supply for 12v cassette players the "Smooth Flow". Give 12v up to ·75 amps, as in neat plastic case with lead for mains, terminals for connecting to cassette, also the mains transformer is double insulated and has overload protection. Price only **£4·20.**

Simmer Stats, very useful device where you want to control the heat from an element, used on most electric cookers, these are really pulsed thermostatic switches, the length of the "on" time depending upon the setting of the knob and heat at sensor head. The simmer stat will control up to 15 amps. Price **£2·16.** Knob is not supplied but is available at **33p.**

Multi-voltage transformer 13 watts, an extremely versatile transformer and it is quite surprising the number of different voltages which may be obtained by using its two windings or parts of these windings in assisting or opposing modes. In addition to these, such voltages as 20-0-20 or 25-0-25 or 130-0-130 may be obtained. The two secondary windings are (1) 50v tapped at 30v and (2) 260v tapped at 240, 220, 200 and 130. Special snip price only **£1·38.**

Quick Cuppa. Mini immersion heater, ideal for taking on holiday, for making a "quick cuppa" tea, or for having by the bedside for baby's feed etc. 250w heater @ 230 volts or approximately 90 watts @ 110 volts. Price **£2·95.**

Neon Screwdrivers. Two useful models:– 7½" price **70p** and 5½" price **55p.**

240° 1mA Moving Coil Panel Meter. A large instrument, size approximately 4¼" square at the front and 4½" deep. Intended for panel mounting, its scale is calibrated 0–7 and it was intended to be used as rev. counter. **£14** each.

Pressure Switch. Adjustable through a range of pressures from where it can be operated by sucking or lowing to approx. 50 psi–10 amp changeover microswitch, metal body with threaded inlet. Price **£2·90.**

Push-Push Switch. Fixed through panel this is a ratchet action, double pole changeover switch, the contacts we understand are hard gold plated. Spindle is ¼" diameter so that a standard radio knob can be fitted. Price **30p** + 3p. Good quantity available at usual discounts.

C.R.T. Display Unit. We feel this would be easy to convert to an oscilloscope, it has all the necessary ingredients. It is in a case size 15" × 10" × 11" approx. with a carrying handle and a front protection flap. Plenty of controls and is mains operated through step down transformer. Size of the tube is 3". Price **£16·75.**

NEW FROM CASIO

NEW **THE INCREDIBLE FX8000**

43 Scientific funct.
1/100 sec. Stopwatch.
Five Alarm-Timers, sequential (self-clearing) or repeat.
2 level parenthesis.
Memory. Deg, Rad, Gra.
Standard deviations.
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Rect/Polar convert.
LCD. 1300hr batteries.
$\frac{1}{4} \times 2\frac{3}{4} \times 5\frac{3}{4}$". 2·7 oz.
RRP £35·95
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NEW **CQ-81 CALCULATING ALARM CLOCK PLUS 2 ALARM/TIMERS AS**

Two AA batteries last for 10,000 hrs (1 year)
LCD 6 digit clock, large angled display.
24 hr Alarm, also two 24 hr Alarm/Timers with countdown (one self-clearing, one repeats).
Full Memory, Constants %, √. $1\frac{5}{8} \times 2\frac{3}{4} \times 5$".
RRP £22·95
£17·95

NEW **FX-48 SCIENTIFIC MINI CARD**

Full scientific with 2 level parenthesis.
Full Memory. Deg, Rad, Grad. Sexagesimal.
Standard deviations.
600 hrs battery life.
RRP £24·95
£19·95

NEW **CALCULATING ALARM CLOCK**

MINI CARD. Available Aug./Sept. Similar size to FX-48. Similar specification to CQ-81. RRP £24·95. Our Price **£19·95**

NEW **MORE POWERFUL LCD SCIENTIFIC CALCULATORS**

Available Aug/Sept. FX-2500 **£19·95**
FX-3100 **£25·95**

CASIO QUALITY AND VALUE

31QR-17B
Left. 8·4mm
£29·95

31QS-12B
Right. 7·7mm
£39·95

Stopwatch, Dual Time. Water Resistant. All s/s

31QR-17B 31QS-12B

31QR-16B (Round face—not illustrated). Luxury version of 31QR-17B. Only 7·45mm thick £34·95

SPORTS WATCHES.

F-100 (left)
9·45mm thick
£24·95

52QS-14B
8·0mm
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Net, Lap and 1st & 2nd Place times to 1/100. Water res. 66ft.

38CS-14B Chronograph **£49·95**

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WORLD TIME WATCH. 29CS-11B £59·95

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LCD. LC 822 £10·95. LC 78 £16·95
AQ-1000. Clock, alarm, stopwatch £21·95

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DIGITRON: FX-31 £11·95. FX-39 £15·95
FX-140 £17·95. FX-120 £19·95. FX-360 £49·95

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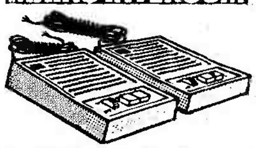
MAINS INTERCOM



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ONLY
£29·99
PER PAIR
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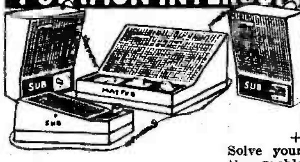
The modern way of instant 2-way communications. Supplied with 3-core wire. Just plug into power socket. Ready for use. Crystal clear communications from room to room. Range ½-mile on the same mains phase. On/off switch. Volume control. Useful as inter-office intercom. between office and warehouse in surgery and in homes. P. & P. 99p.

4-STATION INTERCOM



£22·95
+ V.A.T. £1·84

Solve your communication problems with this 4-Station Transistor Intercom system (1 master and 3 Subs), in robust plastic cabinets for desk or wall mounting. Call/talk/listen from Master to Subs and Subs to Master. Ideally suitable for Business, Surgery, Schools, Hospitals and Office. Operates on one 9V battery. On/off switch. Volume control. Complete with 3 connecting wires each 66ft. A Battery and other accessories. P. & P. 99p.

NEW! AMERICAN TYPE CRADLE TELEPHONE AMPLIFIER

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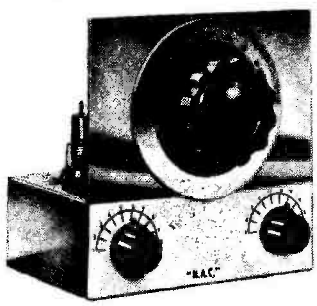

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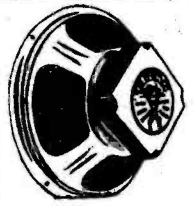

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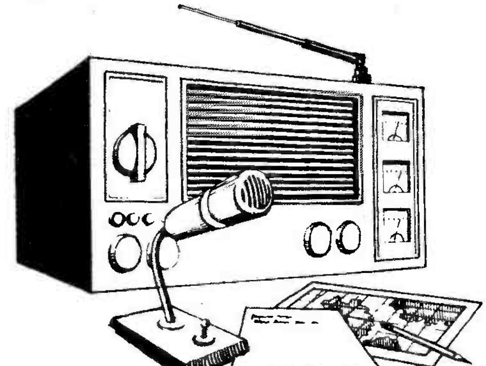

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2N4062	0·18*
2N4124	0·17*
2N4126	0·17*
2N4286	0·20*
2N4288	0·25*
2N4289	0·25*
2N5457	0·35*
2N5458	0·35*
2N5459	0·35*
3N125	1·75

VALVES

AZ31	1·10*
CBL31	1·50
CL33	2·00*
CY31	1·00*
DAF91†	0·40*
DAF96	1·00*
DF91†	0·40*
DF96	1·00*
DK91†	0·55*
DK92	1·25*
DK96	1·10*
DL92	0·75*
DL94	1·20*
DL96	1·10*
DY86/7†	0·55*
DY802	0·80*
E88CC†	1·00
EABC80	0·50*
EAC91	0·50
EAF42	1·25*
EAF801	1·75*
EB41	2·00*
EB91†	0·40*
EBC33	1·75*
EBC41	1·25*
EBC81	1·10*
EBC90	0·75*
EBF80	0·50*
EBF83	1·25*
EBF89†	0·45*
EBL31	2·50*
ECC40	1·25*
ECC81†	0·50*
ECC82†	0·47*

ECC83†	0·55*
ECC84†	0·60*
ECC85†	0·55*
ECC88†	0·75*
ECC91†	0·55*
ECC189	1·00*
ECF80†	0·60*
ECF82†	0·70*
ECH35	2·00*
ECH42	1·15*
ECH81†	0·55*
ECH83	0·85*
ECH84†	0·85*
ECL80†	0·60*
ECL82†	0·60*
ECL83	1·50*
ECL86†	0·85*
ECLL800	7·00*
EF37A†	2·50*
EF39†	1·60*
EF40	1·15*
EF41	1·20*
EF42	2·00*
EF50†	0·60*
EF80†	0·50*
EF83	1·75*
EF85†	0·50*
EF86†	0·60*
EF89	0·60*
EF91†	0·70*
EF92†	0·75*
EF98	1·25*
EF183†	0·70*
EF184†	0·70*

EH90	1·28*
EL32	1·50*
EL33	3·50*
EL41	1·25*
EL42	1·75*
EL81	1·10*
EL84†	0·45*
EL86†	0·75*
EL91	4·35*
EL95†	0·80*
EL360	2·75*
EM80	1·10*
EM81	1·00*
EM84	1·00*
EM85	1·25*
EM87	1·50*
EN91†	2·24*
EY51†	0·75*
EY86†	0·50*
EZ40	1·25*
EZ41	1·25*
EZ80†	0·50*
EZ81†	0·50*
EZ90†	0·60*
GZ32	0·75*
GZ33	4·00*
GZ34†	1·52*
KT61	3·50*
KT66	5·00*
KT88	6·25*
KTW61	1·75*
KTW62	1·75*
KTW63	1·75*
MU14	1·00*
N78	9·00*
OA2†	0·55
OB2†	0·60

OC3†	0·75
OD3†	0·75
OZ4	0·75*
PC86†	0·85*
PC88†	0·85*
PC97	1·08*
PC900†	1·00*
PCC84†	0·45*
PCC88	0·65*
PCC89†	1·05*
PCC189†	1·00*
PCF80	0·96*
PCF82†	0·50*
PCF86†	0·75*
PCF87†	1·00*
PCF200†	1·15*
PCF201†	1·10*
PCF801†	0·60*
PCF802†	0·88*
PCF805	1·44*
PCF806	1·44*
PCF808	1·44*
PCL82†	0·80*
PCL83†	0·92*
PCL84†	0·75*
PCL85†	0·96*
PCL86†	0·85*
PCL805/85†	0·96*
PD500	3·60*
PFL200	1·12*
PL36†	1·12*
PL81	1·12*
PL81A†	1·12*
PL82	0·60*
PL83†	0·55*

PL84†	0·60*
PL504/500†	1·20*
PL508†	1·60*
PL509†	2·72*
PL519†	3·60*
PL801	1·10*
PL802†	3·00
PY33	0·68*
PY81†	0·72*
PY82	0·55*
PY83	0·70*
PY88†	1·16*
PY500A†	1·60*
PY800/81†	0·92*
PY801	0·92*
QQV02-6	9·90
QQV03-10†	2·00
QQV03-20A†	10·50*
QQV06-40A†	13·00*
R17	1·65
R19	1·00
R20	1·44
U18-20	2·50*
U25	1·16*
U26	1·44*
UABC80†	0·58*
UAF42	0·75*
UB41	1·25*
UBC41†	0·75*
UBF89	0·60
UCC84	0·75*

UCC85†	0·55*
UCF80	0·75*
UCH42	1·20*
UCH81†	0·65*
UCL82†	0·50*
UCL83	1·44*
UF41	1·00*
UF80†	0·50*
UF85†	0·65*
UF89†	0·55*
UL41	1·00*
UL84†	0·85*
UM80	1·00*
UY41†	0·75*
UY85†	0·65*
1B3GT†	0·65*
1R5†	0·55*
1S5†	0·40*
1T4†	0·40*
2AS15	10·00
2D21†	0·80
3A5	1·35
3CX100A5	20·00
3S4†	0·75*
3V4†	1·00*
4CX250B	17·50
5R4GY†	1·00*
5U4G	1·52*
5U4GB	2·26*
5V4G†	0·65*
5Y3GT	0·85*
5Z3	1·50*
5Z4G	1·12*
5Z4GT	1·00*
6-30L2	1·56*
6AB7	0·75*

6AC7	0·75*
6AF4A†	0·70*
6AG7	0·75*
6AH6†	0·70*
6AK5†	0·50*
6AK6	0·95*
6AL5†	0·30*
6AM4	2·30*
6AM5	3·85*
6AM6†	0·65*
6AN5	2·50*
6AN8A†	0·70*
6AQ5†	0·85*
6AR5	0·70*
6AS6†	0·80*
6AS7G†	1·50*
6AT6†	0·65*
6AU5GT	4·26*
6AU6†	0·55*
6AV5GT	3·74*
6AV6†	0·50*
6AW8A†	1·00
6AX5GT	3·10*
6B7	0·75
6B8	0·75
6BA6†	0·50*
6BA7	5·12*
6BA8A	3·75
6BC4	3·71
6BE6†	0·45*
6BH6†	1·20*
6BJ6†	1·20*
GBK4	4·21*
6BL6	85·00
6BL7GT	3·86*
6BN6	0·80*
6BQ7A	1·55*

6BR7	4·00*
6BR8†	1·20*
6BS7	4·00*
6BW6	3·75*
6BW7	1·40*
6BX7GT	4·96*
6BZ6	1·78*
6C4†	0·55*
6CB6A†	0·55*
6CD6GA	4·90*
6CG7	1·72*
6CH6	4·42*
6CL6†	0·75*
6CW4	7·24*
6D2†	0·30*
6DK6	2·49*
6DQ6B	3·90*
6EA8	2·21*
6EB8	2·12*
6EW6	0·80*
6F6	0·75
6F23	1·60*
6F28	1·16*
6H2N	0·75*
6H3N	0·75*
6H6	0·75*
6J4†	0·75*
6J6†	0·55*
6J7	0·75*
6K4N	0·75*
6K6GT	0·75*
6K7	0·75*
6K8	0·75*
6KD6	4·79*
6L6G	2·50*
6L6GA	1·50*
6L6GT	0·85*

6L6GC	1·95*
6L7	0·75
6N2P	0·75
6N3P	0·75
6N7	0·75*
6P25	3·60*
6Q7	0·80*
6R7	0·80*
6SA7	0·80*
6SC7	0·80*
6SF7	0·80*
6SH7	0·80*
6SJ7	0·80*
6SK7	0·80*
6SL7GT†	0·70*
6SN7GT†	0·70*
6SQ7	0·75*
6SR7	0·75*
6SS7	0·75*
6U5G	2·00*
6U8†	0·40*
6U8A†	0·55*
6V6GT†	0·65*
6X4†	0·60*
6X5GT†	0·60*
7B7	1·00*
7C5	1·75*
7C6	1·25*
7H7	1·00*
7R7	1·50*
7S7	2·25*
7Y4	0·75*
7Z4	0·75*
12AT6	0·45*
12AT7†	0·50*

12AU6	0·55*
12AU7†	0·45*
12AV6	0·60*
12AV7	2·84*
12AX7†	0·55*
12AY7†	0·82*
12B4A†	1·00*
12BA6	0·50*
12BE6	1·60*
12BH7†	0·60*
12BY7†	0·80*
12E1	7·10
30C15	1·56*
30C17	1·56*
30C18	1·44*
30F5	1·60*
30FL1/2	1·12*
30FL12	1·72*
30FL14	1·44*
30L1	0·84*
30L15	1·72*
30L17	1·72*
30P4	0·92*
30P19	1·12*
30PL1	1·32*
30PL13	1·72*
30PL14	1·68*
30PL15	1·72*
35W4	0·60*
50C5	0·70*
85A2	1·50
90AG	7·26
90AV	7·16
90C1	1·50
90CG	5·74
90CV	13·30
92AG	7·26

92AV	7·16
150B2	1·80
150C2	1·50
150C4	2·30
211	5·00
723AB†	8·00
807†	1·00
811A†	3·80
812A	8·35
813†	10·00
833A	30·00
866A	8·85
872A	13·75
931A	12·24
2050	2·50
5642	5·26*
5654	3·61*
5651	1·80*
5670	2·86*
5814A	2·60*
6080†	6·85*
6146A	5·58*
6146B	4·65
6159	6·00
6442	15·00
6973	3·52
7586	11·38
7587	19·60
7868	3·94*
8068	5·50
8136	2·44

INTEGRATED CIRCUITS

7400	0·20
7401	0·20
7402	0·20
7403	0·20
7404	0·26
7405	0·23
7406	0·55
7407	0·55
7408	0·28
7409	0·28
7410	0·20

7412	0·26
7413	0·45
7416	0·40
7417	0·40
7420	0·20
7422	0·25
7423	0·35
7425	0·35
7427	0·35
7428	0·50
7430	0·20

7432	0·36
7433	0·37
7437	0·42
7438	0·37
7440	0·22
7441AN	0·92
7442	0·78
7447AN	1·20
7450	0·20
7451	0·20
7453	0·20

7454	0·20
7460	0·20
7470	0·35
7472	0·36
7473	0·36
7474	0·40
7475	0·59
7476	0·42
7480	0·60
7482	0·85
7483	1·00
7484	1·00
7486	0·40
7490	0·52

7491AN	0·85
7492	0·60
7493	0·70
7494	0·80
7495	0·80
7496	0·90
7497	3·67
74100	1·75
74107	0·45
74109	0·86
74110	0·57
74111	0·86
74116	1·89
74118	0·95

74119	2·00
74120	1·10
74121	0·45
74122	0·60
74123	1·00
74125	0·80
74126	0·80
74128	0·80
74132	0·80
74136	0·68
74141	0·85
74142	3·00
74143	3·00
74144	3·00

74145	1·00
74147	2·45
74148	2·00
74150	1·75
74151	0·90
74154	2·00
74155	0·90
74156	0·90
74157	0·90
74159	2·50
74170	2·90
74172	5·00
74173	1·75
74174	1·57

74175	1·00
74176	1·10
74178	1·65
74179	1·65
74180	1·65
74190	1·48
74191	1·48
74192	1·25
74193	1·25
74194	1·25
74195	1·10
74196	1·20
74197	1·00
74198	2·25

74199	2·25
76013N	1·75*
LM309K	1·50
TAA570	2·30*
TAA630S	3·50*
TBA480Q	1·84*
TBA520Q	2·30*
TBA530	1·98*
TBA540Q	2·30*

TBA550Q	3·22*
TBA560CQ	3·22*
TBA673	2·19*
TBA700	1·52*
TBA720Q	2·30*
TBA750Q	2·07*
TBA990Q	2·99*
TCA270Q	2·99*
TCA760A	1·38*

DIL Sockets

8 PIN	0·15
14 PIN	0·15
16 PIN	0·17

BASES

BG7 unskirted	0·15
B7G skirted	0·30
B9A unskirted	0·15
B9A skirted	0·30
Int Octal	0·20
Nuvistor base	0·55
Loctal	0·55
8 pin DIL	0·15
14 pin DIL	0·15
16 pin DIL	0·17
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1CP31	31·00
2AP1*	8·50
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3EG1*	7·00
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3JP7*	10·00
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4EP11	25·00
5ADP1	35·00
5BP1*	10·00
5CP1*	5·00
5CP1A	40·00
5FP15A	5·00
5UP7*	5·00
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DG7-32	38·00
DH3-91	31·00
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VCR138A*	12·50
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No. THY3A/50	3 Amp.	50 volt	TO64	25p
No. THY3A/200	3 Amp.	200 volt	TO64	32p
No. THY3A/400	3 Amp.	400 volt	TO64	40p
No. THY5A/50	5 Amp.	50 volt	TO66	25p
No. THY5A/400	5 Amp.	400 volt	TO66	40p
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Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
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AC126	14p	BC178	12p	BF194	*9p	TIP32B	35p	2N1711	15p
AC127	18p	BC179	12p	BF195	*9p	TIP32C	36p	2N1893	28p
AC128	16p	BC182	*9p	BF196	*12p	TIP41A	34p	2N2218	15p
AC128K	24p	BC182L	*9p	BF197	*12p	TIP41B	35p	2N2218A	18p
AC176	18p	BC183	*9p	BF200	25p	TIP41C	36p	2N2219	15p
AC176K	24p	BC183L	*9p	BFX29	22p	TIP42A	36p	2N2219A	18p
AC187	16p	BC184	*9p	BFX84	18p	TIP42B	37p	2N2221	15p
AC187K	26p	BC184L	*9p	BFY50	12p	TIP42C	38p	2N2221A	16p
AC188	16p	BC212	*10p	BFY51	12p	TIP2955	65p	2N2222	15p
AC188K	26p	BC212L	*10p	BFY52	12p	TIP3955	42p	2N2222A	16p
AD161/		BC213	*10p			ZTX107	*6p	2N2369	10p
162MP	80p	BC213L	*10p	MPSA05	*22p	ZTX108	*6p	2N2904	14p
AF139	30p	BC214	*10p	MPSA06	*22p	ZTX109	*7p	2N2904A	15p
AF239	30p	BC214L	*10p	MPSA55	*22p	ZTX300	*7p	2N2905	14p
BC107	6p	BC251	*10p	MPSA56	*22p	ZTX301	*7p	2N2905A	15p
BC108	6p	BCY70	12p	OC44	12p	ZTX302	*9p	2N2906	12p
BC109	6p	BCY71	12p	OC45	12p	ZTX500	*8p	2N2906A	14p
BC118	*10p	BCY72	12p	OC71	9p	ZTX501	*10p	2N2907	12p
BC147	*8p	BD115	40p	OC72	12p	ZTX502	*12p	2N2907A	13p
BC148	*8p	BD131	*35p	OC75	*10p	2N696	10p	2N2926G	*8p
BC149	*8p	BD132	*37p	OC81	14p	2N697	10p	2N2926Y	*7p
BC154	*16p	BF115	17p	TIP29A	35p	2N706	7p	2N3053	12p
BC157	*9p	BF167	19p	TIP29B	36p	2N706A	8p	2N3055	35p
BC158	*9p	BF173	20p	TIP29C	38p	2N708	8p	2N3702	*7p
BC159	*9p	BF180	25p	TIP30A	36p	2N1302	12p	2N3703	*7p
BC169C	*10p	BF181	25p	TIP30B	37p	2N1303	15p	2N3704	*6p
BC170	6p	BF182	25p	TIP30C	38p	2N1304	15p	2N3903	*11p
BC171	*6p	BF183	25p	TIP31A	32p	2N1307	18p	2N3904	*11p
BC172	*6p	BF184	25p	TIP31B	33p	IN1308	22p	2N3905	*11p
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BA144	5p	BY127	*10p					IN5402	12p
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CD4006	£0·80	CD4017	£0·80	CD4028	£0·80	CD4045	£1·15	CD4072	£0·20
CD4007	£0·17	CD4018	£0·85	CD4029	£0·95	CD4046	£0·95	CD4081	£0·20
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A Professional Finish

FROM comments made by readers we know that one of the features which they seek in any constructional project is the means of achieving a presentable appearance to the finished item of equipment. Whether it be a piece of test gear, a radio transmitter or receiver, or a hi-fi unit, to be able to answer "Yes, and I built it myself" to a friend's praise of its appearance, is very good for the ego!

The availability to the home constructor of a wide range of cases, both metal and plastics, has made the task much simpler, and the traditional "metal-bashing", whereby complete cases were produced from aluminium sheet in the home workshop, is tending to become a thing of the past. There are those who still practise it—several readers have written urgently requesting fully dimensioned drawings of the metalwork for the "Purbeck" oscilloscope, even though this is available in finished form from one of our advertisers.

For hi-fi equipment, an attractive cabinet presents more difficulty, since instrument cases and boxes do not blend well with the decor of most lounges. Veneered chipboard can help the competent handyman, but there are still various items of trim required. For the *PW* "Wimborne" Music Centre, which begins in this issue, we have arranged with an advertiser for the supply of purpose-made cabinet parts. These should allow you to produce a unit whose appearance will rival that of a ready-built commercial music centre. For the "Wimborne", we are giving details of the cabinet first, since it forms a box into which the various modules are later assembled. I hope we will not receive too many complaints that we should have published the electronics first!

Reverting to constructional projects in general, a neatly lettered front panel is undoubtedly the most important factor in achieving that professional finish. We have recently introduced on a trial basis, film front panel overlays for some of our projects. Clamping the overlay between the front panel and a thin Perspex sheet, secured by the control fixing nuts, produces a fully marked panel which is very durable indeed. We are presently working on a number of other ideas in similar vein, and hope to present these in *PW* later in the year.

PW PERSONALITY

Geoffrey C. Arnold T. Eng. (CEI) FSERT (ex G3GSR)—Editor

Like many others in electronics, Geoff began his career as a seagoing Radio Officer, first with Marconi Marine, then with the P & O shipping company. Transferring to P & O shore staff, he was engaged in installation and repair of all types of ship-borne radio, electronic and sound equipment. A spell with Redifon Marine, working on the design of special systems, brought a deep involvement with handbook writing, which inspired his transfer to technical journalism.

Spare-time interests include music (more or less anything except modern classical), d.i.y., and studying for a degree with the Open University. Geoff is married, with a son reading Electrical and Electronic Engineering at University of Surrey, and two daughters still at school.

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

RAE courses

Three courses for radio amateur's are being offered by North Trafford College of Further Education. Course ERA1 will cover RAE theory and ERA2 the morse code, both these courses will be on one evening each week between 18.30 and 21.00 hours. Enrolment will be on 11th, 12th and 13th September. Another advanced course is available for amateurs who have passed the RAE and would like to broaden their expertise. The lecturer will be J. T. Beaumont G3NGD. *North Trafford College of Further Education, Talbot Road, Stretford. Tel: 061-872 3731.*

A similar course is also offered at Hucknall Adult Education Centre. The course starts on Monday 18th September 1978, and enrolment is on Monday 11th, Tuesday 12th September 1978, from 2pm until 8pm. *Hucknall Adult Education Centre, Portland Road, Hucknall, Nottingham. Tel: (06075) 2798.*

All being well Blackburn Technical College will again be running an RAE course, commencing on Wednesday evenings at the end of September. Enrolment will be at the College on 6th, 7th and 8th September 1978. For further details telephone G3LLL on Blackburn 40762 in the evening and Blackburn 59595/6 during the day. *College of Technology and Design, Feilden Street, Blackburn.*

Moving south to the London area, we are notified of two courses, the first at Amberly Road Adult Education Centre, on Mondays and Thursdays with Morse, starting 18th September 1978. Enrolment will be on 7th, 8th, 11th and 13th September. We understand this is the nearest RAE course to the centre of London. The second will be held at Hatch End High School, Hatch End, Middlesex, on Wednesdays, with Morse starting 27th September 1978. Enrolment will be on 16th and 17th September at Nower Hill School. Both courses will be conducted by *D. T. Busby, G8ELB, 46 St. Kilda's Road, Harrow, Middlesex.*

And last but not least, an RAE course will start on Thursday 21st September 1978, beginning at 7.30 pm. There will also be a Morse Proficiency Course beginning on Monday 18th September 1978 at 7.30 pm. For further information contact J. Brett, Principal, *North and West Farnborough Further Education Centre, Cove School, St. John's Road, Farnborough, Hants.*

The British Vintage Wireless Society

The second annual meeting of the society, was held on Sunday 21st May 1978, at St. Albans, with a grand turnout of over 60 members, their friends and guests. It was decided that in the future, meetings would be held every six months.

After the official business was concluded, a grand bartering session was held.

The aim of the BVWS, formed in 1976, is to promote the study of wireless history, to record existing sources of information on all aspects of early wireless, and to encourage the preservation of early wireless equipment.

The society currently has a membership of over 80, including several overseas. It publishes a quarterly bulletin, containing articles on collecting, restoring, members exchanges and wants, vintage circuit diagrams, etc., and will extend a warm welcome to any new members. Further details can be obtained from the Hon. Membership Secretary BVWS, Mr. Jon Hill, 14 Victoria Court, Kingsbridge Avenue, London W3.

Science and Security

An international conference on the application of science to security techniques and equipment will be held in conjunction with the 1st International Science and Security Exhibition at the Metropole Hotel, Brighton. The conference is organised by the Institute of Physics, in collaboration with the Electrical Research Association.

It is anticipated that the three day conference will be in six sessions, each with one or two keynote speakers and several contributed papers. Topics to be covered will include: Protection of data and communication; Intruder detection and alarm systems; Access control systems; Identification of persons and documents; Sensing techniques; Security strategy; Industrial and commercial applications.

The conference will be held in a hall immediately adjacent to the associated exhibition. Residential accommodation will be available in the Metropole Hotel and the University of Sussex. Further details from: *The Institute of Physics, 47 Belgrave Square, London SW1X 8QX. Tel: 01-235 6111.*

Mobile Rally

Preston Amateur Radio Society Mobile Rally, is to be held on Sunday 20th August 1978 at Walton le Dale County High School, Bamber Bridge, Preston, Lancs., which is situated one mile from the M6, junction 29.

There is to be a talk in on S22 and the usual attractions including a bring and buy stand. Plenty of free parking and the rally starts at 11.00am. Details from: *G8KTM, QTHR.*

Summer sale

We are informed by Chromasonic Electronics that they are currently holding a summer sale of, integrated circuits, seven segment displays etc. A list of the offers can be obtained by applying, enclosing a s.a.e.

Also available is their popular IC Booklet, priced 35p. *Chromasonic Electronics, 56 Fortis Green Road, Muswell Hill, London N10 3HN. Tel: 01-833 3705.*

On the move

A. Marshall (London) Ltd. inform us that from 20th June, they are moving their Offices, Industrial Sales Department, Mail Order Department and Central Stores to new premises at Kingsgate House, Kingsgate Place, London NW6. Tel: 01-624 0805/6/7/8.

The new premises are considerably larger than their existing ones, and it is hoped in quite a short time to achieve a very high service level, and eliminate the difficulties they have been experiencing recently due to lack of space.

Their existing premises at 40 Cricklewood Broadway are being refitted as a new branch, and will be trading as and from 28th June.

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-June), so, the earlier I can have details, the better. *Alan Martin*

WIDEBAND CALIBRATED ATTENUATOR

M. TOOLEY

Often it is required that a known degree of attenuation be introduced between a source and a matched load, for example, between a signal generator output and the input of a receiver when carrying out sensitivity measurements. The unit described provides accurate 1dB steps of attenuation from 0dB to 20dB. The attenuator is designed for a 50Ω system but details are also given on how to calculate suitable component values for alternative impedances. The frequency response of the attenuator is sufficient to allow for operation up to and beyond 150MHz. The attenuator can be built for an extremely modest outlay and is a valuable addition to the test gear owned by any serious radio experimenter.

Attenuators

Attenuation is usually expressed on the decibel scale. Both power and voltage ratios are normally expressed in decibels (dB) where:

$$N\,(\mathrm{dB}) = 10\log_{10}\left(\frac{P_2}{P_1}\right)$$

P_1 and P_2 are the powers being compared. If both the source output and load input impedances are the same, then the corresponding voltage ratios may be used, in which case:

$$N\,(\mathrm{dB}) = 20\log_{10}\left(\frac{V_2}{V_1}\right)$$

In the case of attenuators, V_2 would be the output of the signal generator when it is feeding a matched load and V_1 would be the voltage developed across the load. In this case N (in decibels) would be the attenuation of the signal between the source and the load which is imposed by the attenuator network. In order for the relation to be true, however, the attenuator must present a matched load to the source and it must of course attenuate the voltage applied by the desired amount.

General Points

For the purpose of analysis and design it is possible to reduce any active circuit, however complicated, to a single voltage generator together with a series impedance. This is known as the Thevenin equivalent circuit. It can be shown that, for maximum power transfer to an external load, the impedance of the load should be equal to the series impedance in the equivalent circuit (the so called "output impedance") Fig. 1. It is common practice to adopt a convenient value for this impedance and to design accordingly. In audio work a value of 600Ω is often chosen, whereas in radio work 300Ω, 75Ω, and 50Ω are common values. Having adopted a value for the

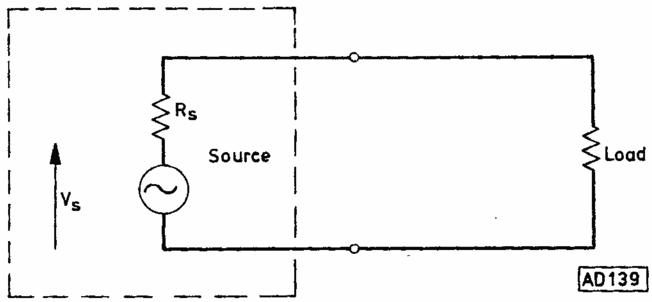


Fig. 1: Equivalent circuit showing a source coupled to a load

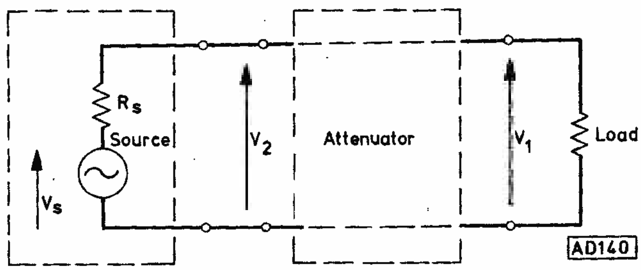


Fig. 2: Attenuator connected between the source and load

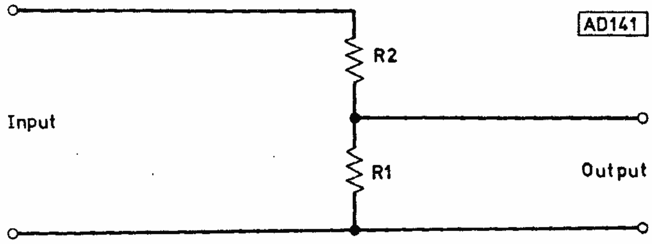


Fig. 3: Simple potential divider type attenuator

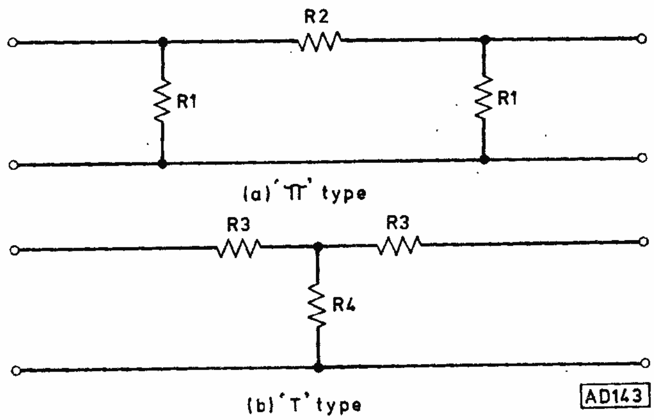


Fig. 4: Essentials of "π" and "T" type unbalanced attenuators

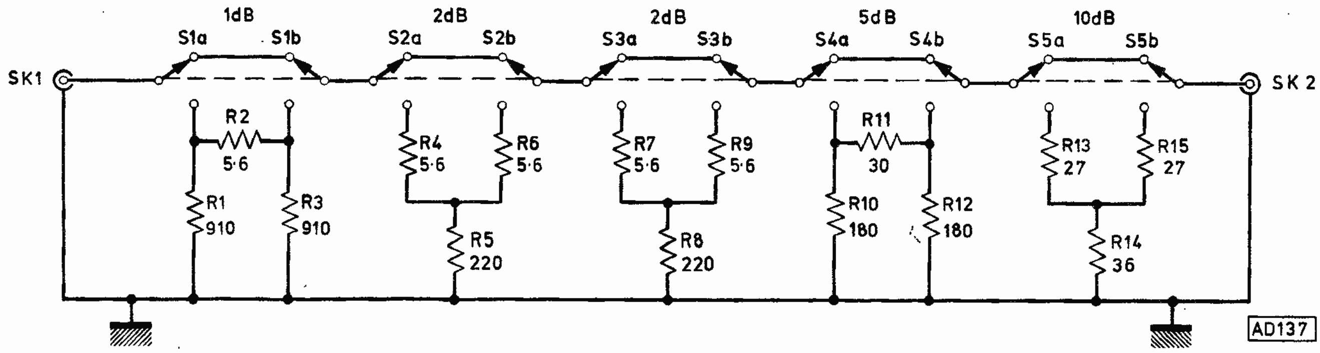
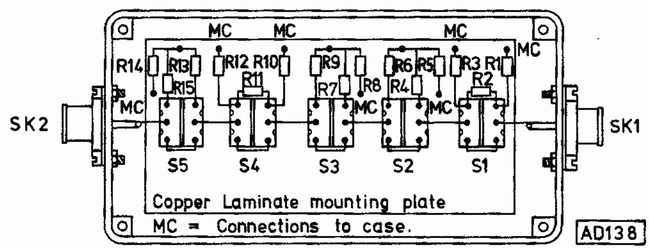


Fig. 5: (above) and Fig. 6 (below): Circuit and physical layout of the complete attenuator



★ components

Resistors	**Switches**
¼W carbon film	S1-5 Sub min. d.p. changeover
5·6Ω 5 R2, 4, 6, 7, 9	**Sockets**
27Ω 2 R13, 15	SK1-2 Standard surface mounting
30Ω 1 R11	coaxial, or 50Ω types
36Ω 1 R14	
180Ω 2 R10, 12	**Miscellaneous**
220Ω 2 R5, 8	Diecast box 120 × 60 × 44mm
910Ω 2 R1, 3	Copper laminate 100 × 45mm

impedance, it is possible to design individual units with common input and output impedances in the knowledge that, when connected together, there will be a maximum transfer of signal power between the units.

Fig. 2 shows how an attenuator is inserted between a source and load. Due to the fact that the source and load impedances are equal, the attenuator networks in common use are usually symmetrical in design unlike the simple potential divider arrangement which is shown in Fig. 3. Hence attenuators may be used either way round, and, if the networks are all matched to the same impedance, they may also be connected in series to provide an attenuation in decibels which is the sum of the individual attenuation, also in decibels.

Basic Forms

The two commonest forms for attenuator networks to take are the "π" and "T" types shown in Fig. 4. They perform exactly the same function and use the same number of components, but the component values may be more convenient using one form rather than the other for a given amount of attenuation. It is, of course, quite permissible to mix the two types of attenuator when several attenuators are to be connected in tandem. The use of a binary sequence of 1,2,4,8 . . . dB in switching will give the maximum attenuation range for a given number of switches, but the authors chose to use a more convenient sequence of 1,2,2,5, and 10dB. This arrangement permits the selection of any degree of attenuation from 1dB to 20dB in 1dB steps. If a greater degree of attenuation is required, then it is simply a matter of constructing another attenuator and placing it in series with the first. Two identical 20dB switched attenuators will provide a maximum of 40dB when they are connected in series.

The use of low capacitance switches enables a wide bandwidth to be achieved. The maximum power input will be determined by the rating of the component resistors used. These should be carbon film types using short connecting leads.

Circuit Description

The circuit diagram of the attenuator is shown in Fig. 5. It is desirable to use the standard range of carbon film resistors available in the construction of the attenuator and thus the attenuator type, "π" or "T", has been chosen with this in mind. After performing the calculations it appears that, for a 50Ω system, 1dB and 5dB are more accurately achieved using the "π" circuit and that 2dB and 10dB are more accurately achieved by the "T" circuit. Miniature toggle switches are used to select, or bypass, each individual attenuator circuit.

Construction

Construction is straightforward and should closely follow the layout shown in Fig. 6. Note that all resistor leads should be kept as short as possible in order to ensure good high frequency performance, and resistor values quoted are for a 50Ω system; for alternative impedances, multiply each resistor value by a factor of Z/50, where Z is the impedance for the system. BNC or 239 (u.h.f.) type connectors may of course be used in place of the coaxial type used on the prototype. The use of a diecast box is strongly recommended since adequate screening is vital if the maximum value of attenuation is to be achieved. To facilitate a very low resistance common earth connection, a small piece of copper laminate is used to line the underside of the front panel of the instrument. This, of course, also helps minimise the length of the resistor leads. The calibration of the instrument should only be checked against another known attenuator. Reliance should not be placed on the calibration scales of signal strength meters normally fitted to receivers! ●

IC OF THE MONTH 70

Brian DANCE M.Sc

TBA 120 I.F. AMP./LIMITER/DEMOD.

The TBA 120 Series of I.F. Devices

The TBA 120 series consists of devices designed for use as 10·7MHz i.f. amplifier-limiter and demodulator circuits in f.m. receivers. They are also suitable for performing the same functions in the 5·5MHz inter-carrier sound channels of television receivers. The devices incorporate an electronic volume control circuit which enables long leads to be used to the volume control potentiometer without the danger of hum pick up, since only a direct current passes through these leads.

Types

The TBA 120 device is encapsulated in a 14 pin dual-in-line package with the connections shown in Fig. 1. The TBA 120A is an electrically identical device which is encapsulated in a 14 pin quad-in-line package with the same connections (alternate pins on each side of a quad-in-line device are bent so that they are at different distances from the body of the device).

The TBA 120S is a more sensitive device with similar connections; it employs an 8 stage amplifier/limiter instead of the 6 stage internal circuit used in the TBA 120. Each of the three devices contains a separate internal transistor which is suitable for use as an audio frequency preamplifier or as a switching transistor for treble cut using a resistance-capacitance network. The TBA 120AS (Siemens) and the TBA 120SQ (National Semiconductor) are quad-in-line versions of the TBA 120S. Constructors intending to use a socket are advised to purchase the dual-in-line devices, since quad-in-line sockets are not very readily available.

The other two devices in the series are the TBA 120T and the TBA 120U; these have a sensitivity similar to the TBA 120S, but have an internal audio amplifier rather than the separate internal transistor. The TBA 120T has an internal 820 ohm resistor connected across its i.f. input (between pins 13 and 14) so that no matching resistor is required when the device is fed from a 5·5MHz ceramic i.f. filter of this impedance. This extra resistor is not present in the TBA 120U; this latter device is mainly intended for use with tuned circuits rather than ceramic filters and has a much higher input impedance (about 40 kilohms in parallel with 5pF).

The TBA 120T and TBA 120U are more conveniently used with a video tape recorder than the other types, since they have two audio outputs, the output from pin 12 being unaffected by the setting of the volume control.

This series of devices is produced by various manufacturers including AEG-Telefunken, ITT Semiconductors, National Semiconductor, Plessey, Thomson-CSF, etc., but not all of these manufacturers offer every type. Most of the types are readily available from various advertisers in this magazine. It is wise to study the data sheet issued by the particular manufacturer concerned before using any device, since minor differences can occur between the products of different manufacturers.

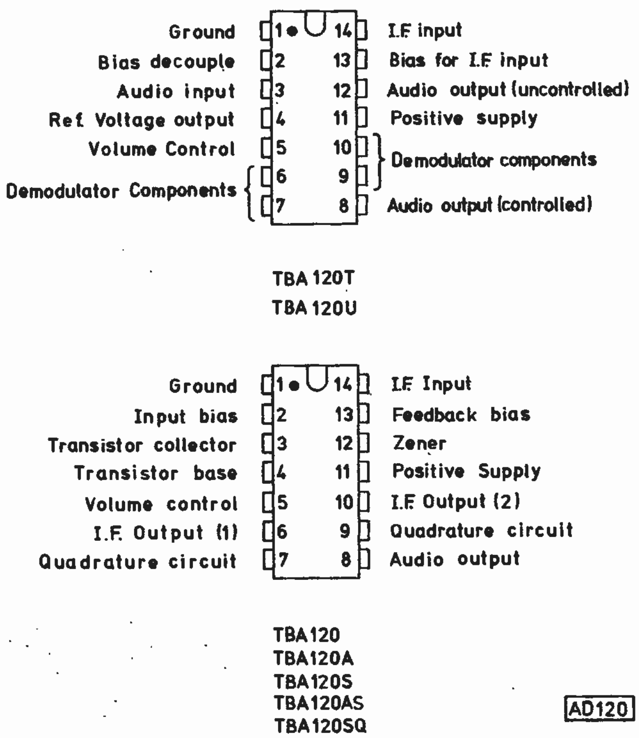


Fig. 1: Connections of the TBA 120 series of devices

Circuits

A typical f.m. i.f. circuit for use with the TBA 120 and the TBA 120A is shown in Fig. 2. A similar circuit can be used with the TBA 120S, but the connections to pins 6 and 10 and the capacitors C7 and C8 can then be omitted, since the signals are conveyed by suitable internal connections in the TBA 120S.

Component values for the circuit of Fig. 2 are shown in Table 1 for monaural and stereo 10·7MHz f.m. radio operation and also for 5·5MHz television use.

The internal transistor and Zener diode are not used in the circuit of Fig. 2. The pins associated with these components are therefore connected to ground. A +12V power supply line is usually convenient, but the device will operate satisfactorily with a supply of only +6V; the maximum permissible supply is about +18V.

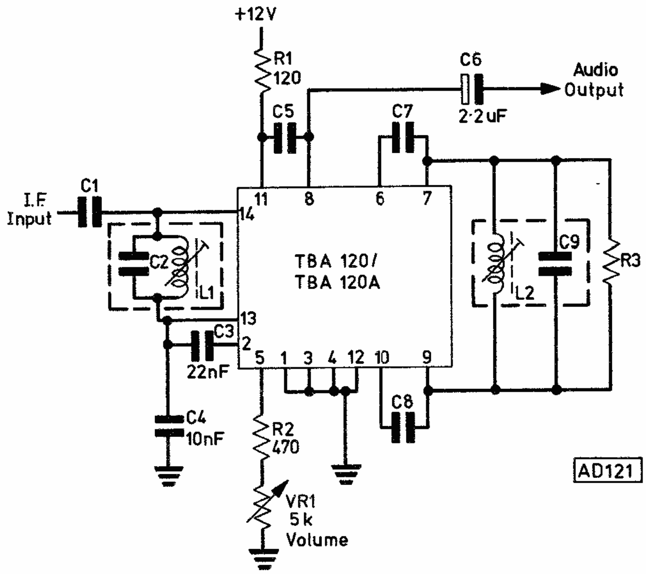


Fig. 2: A TBA 120 i.f. amplifier circuit with volume control and de-emphasis

	FM Monaural	FM stereo	Television inter-carrier sound
C9	470pF	330pF	1·5nF
C5	22nF	470pF	22nF
L2	8 turns	12 turns	8 turns
R3	Omit	1 kilohm	Omit

(L1 and C2 may be similar to L2 and C9.)

Table 1. Component values recommended for the Siemens TBA 120 device in the circuit of Fig. 2.

The typical current consumption of the Fig. 2 circuit is 14mA. The internal Zener diode is connected from pin 12 to ground, so if one wishes to use this component to provide a stabilised supply for the operation of the device itself or for the operation of any other circuit, one merely connects pin 12 via a suitable resistor to a positive supply line of not less than about 15V. The resistor must limit the Zener current to not more than 15mA. The emitter of the separate internal transistor is connected to ground, but the base and collector are each brought out to separate pins.

The tuned circuit L1/C2 is shown in the input of Fig. 2, but a ceramic filter may be used instead of this tuned circuit. A ceramic filter has the advantage that no alignment is necessary, but the use of such a filter makes it necessary to connect a resistor between pins 13 and 14 to provide a path for the bias voltage to reach pin 14. This resistor should have a value which is approximately equal to the characteristic impedance of the filter used. In the circuit shown, L1 provides the required bias path.

A quadrature demodulator coil tuned to the i.f. frequency is connected between pins 7 and 9. As shown in Table 1, the component values used in this tuned circuit may be slightly different in an f.m. stereo radio receiver (where bandwidth is important) than in an f.m. monaural receiver (where one requires optimum results in a narrower bandwidth circuit). However, these suggested values are not at all critical. The resistor R3 provides some damping on the tuned circuit and therefore an increased bandwidth, but is required only in stereo systems.

The capacitor C5 may have a value of 22nF in monaural systems where it provides the required de-emphasis. In a stereo circuit, however, the much smaller value of 470pF is recommended to attenuate the i.f. signal in the audio output; there will be two separate de-emphasis capacitors following the stereo decoder circuit.

Gain

The i.f. gain of the TBA 120 is about 60dB and that of the TBA 120S about 68dB. The amplifier-limiter provides i.f. outputs at pins 6 and 10 which have an almost constant amplitude irrespective of the i.f. input voltage provided that the latter exceeds about 70μV in the case of the TBA 120 and about 30μV in the case of the TBA 120S. The input impedance is about 40 kilohm in parallel with 5pF.

The volume is controlled by the setting of VR1, a range of about 70dB being typical. As the value of VR1 is reduced, the output falls, the control characteristic being approximately logarithmic.

The performance of the circuit is somewhat dependent on the quality factor (Q value) of the inductances used, and a.m. rejection is of the order of 40dB at an input of 1mV, but increases with the input voltage. The audio output voltage is of the order of 1V, but increases with the Q of L2 and with the supply voltage.

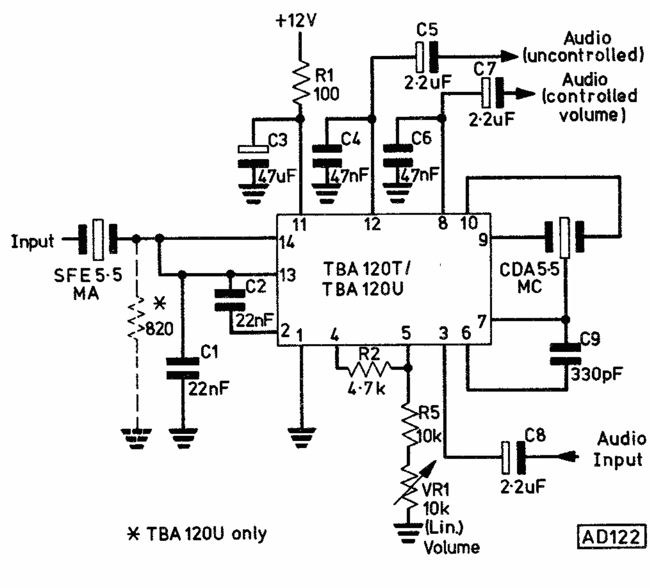


Fig. 3: A circuit using the TBA 120T or TBA 120U for 5·5MHz television inter-carrier sound

TBA 120T and TBA 120U

A circuit using a TBA 120T or TBA 120U device is shown in **Fig. 3** for intercarrier 5·5MHz television sound use. A similar circuit can be used with a 10·7MHz f.m. radio input, but the appropriate filters must be used. The resistor shown dotted in the input circuit is required only in the case of the TBA 120U, since it is included in the internal circuit of the TBA 120T.

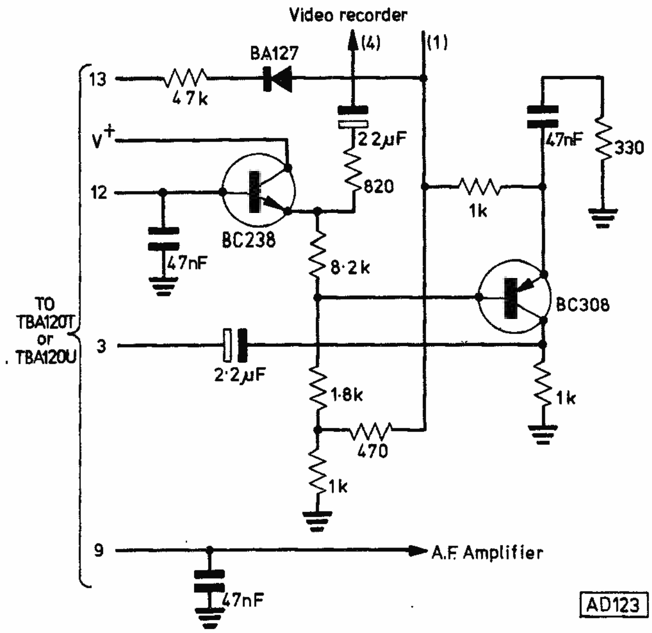
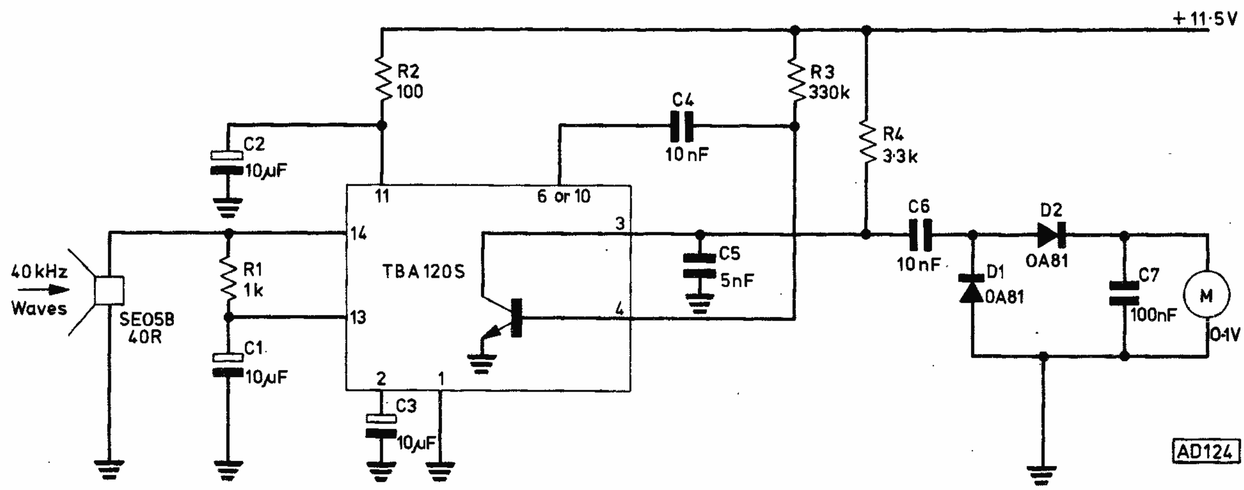


Fig. 4: A coupling circuit to match Fig. 3 to the sound section of a video tape recorder

Fig. 5: A TBA 120S circuit for detecting ultrasonic waves



In the TBA 120T and TBA 120U devices a voltage stabilising circuit is connected from pin 11 to ground (unlike the TBA 120). A resistor must therefore always be included between pin 11 and the positive supply line. If the decoupling capacitor C3 is omitted, the volume control range is altered.

The circuit of **Fig. 4** may be used for coupling a TBA 120T or TBA 120U to a video tape recorder. A switching voltage of +12V should be applied to pin 1 at playback, but this pin should be left open-circuited during recording. When the switching voltage is applied, the BC238 emitter follower is switched off, whilst the BC308 buffer is switched on. In addition, the switching voltage is applied via the BA127 diode and the 47 kilohm resistor to pin 13 of the device so as to put the i.f. amplifier out of action.

Ultrasonic circuit

The TBA 120S, like many other f.m. i.f. devices, can be employed to amplify the signals from an ultrasonic transducer. The circuit shown in **Fig. 5** has been used by the writer to detect 40kHz ultrasonic waves falling on a SEO5B 40R transducer (available from Hall Electronics, 48 Avondale Road, London E17 8JG). The 40kHz signal from this transducer is applied to the amplifier-limiter at pin 14, the resistor R1 being used to convey the bias from pin 13 to pin 14.

The amplified 40kHz signal is taken from either pin 6 or pin 10 and is fed to the base of the internal transistor at pin 4 together with an appropriate bias current obtained using R3. The further amplified signal appears across the collector load resistor R4, C5 being used to assist stability.

The output signal is connected via C6 to the diode pump circuit which causes the meter to be deflected whenever the waves fall on the transducer. ●

THE PW 'AVON' 2 metre f.m. transmitter

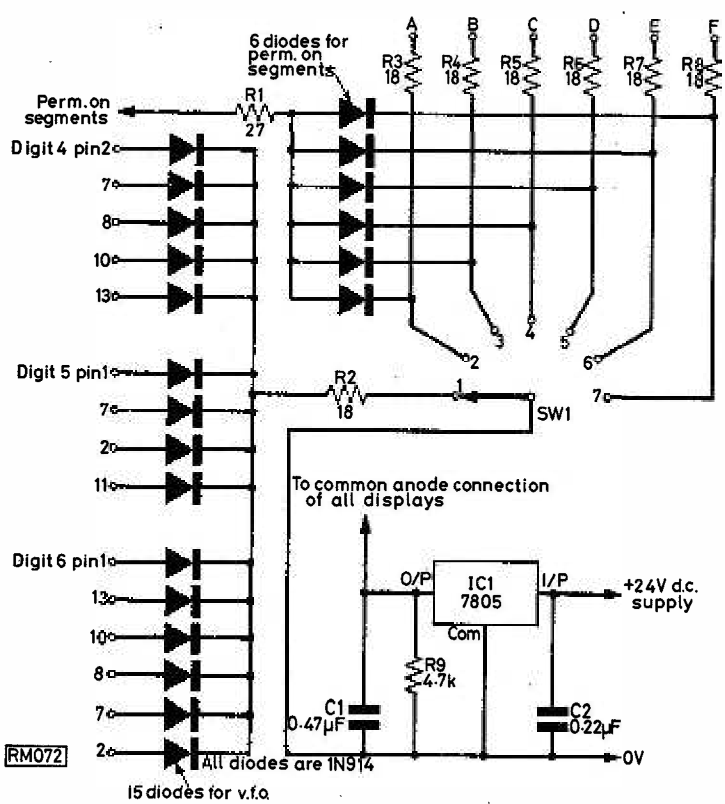
PART 3

DIGITAL DISPLAY

DICK GANDERTON

One of the attractive features of the Avon is the digital display giving the frequency on which the transmitter is working. This display is not an essential part of the design and can be left out if the constructor so wishes, although in this case he will have to annotate the frequency select switch accordingly on the front panel.

The display is very simple, being merely a static display which is switched, via a diode matrix, to show the frequency selected.



★ components

Resistors
½W 5%
18Ω 7 R2, R3, R4, R5, R6, R7, R8
27Ω 1 R1

Semiconductors
Diodes
1N914 The number needed will depend on the total number of segments to be lit (approx 110)
7 Segment displays (0·3 in)
Green l.e.d. com. anode 5 (RS Components 586-532) Digits 2 to 6
Green l.e.d. com. anode 1 (RS Components 586-901) Digit 1
Integrated circuits
7805 1 ICI

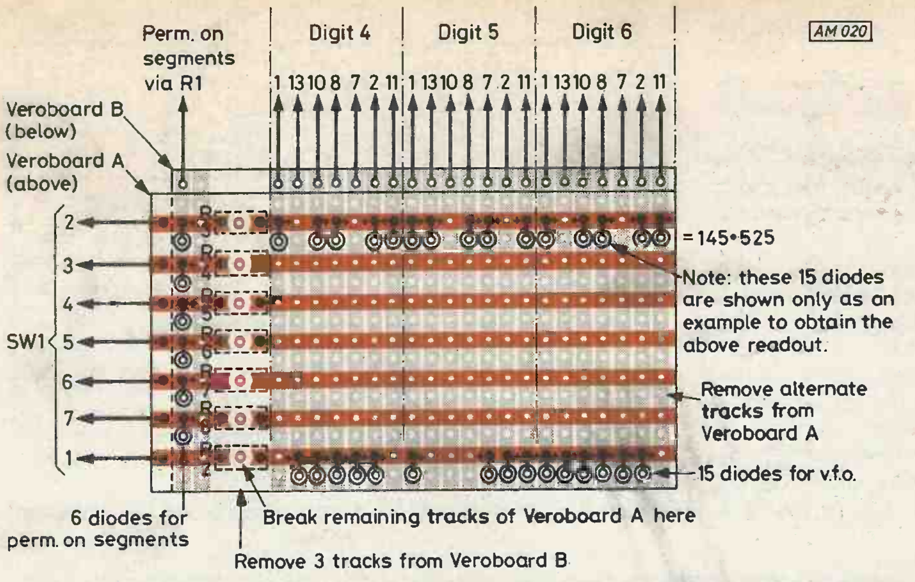
Miscellaneous
Display Bezel (for 6 displays) RS Components 587-002
Veroboard A, 15 tracks × 27 holes (1)
Veroboard B, 26 tracks × 16 holes (1)
Double sided adhesive tape
Switch wafer 1p, 11w. to fit frequency select switch mech.

Construction is straightforward and is based on the display bezel recently introduced by RS Components. This assembly accepts six of their 0·3 inch seven segment displays and only requires a simple rectangular cut-out in the front panel which is covered by the bezel itself. This enables the amateur to achieve a professional finish without the need for exotic tools.

The sockets fitted to the bezel are intended for use with a wire wrapping technique although wires may be soldered to the pins if so desired. In this case the pins should be carefully shortened and rubber sleeves must be used to cover the soldered joints.

The prototype display used a construction for the diode matrix which proved to be fiddly to assemble. The diodes were sandwiched between two pieces of Veroboard with the copper tracks running at right angles to each other.

Fig. 1: Circuit diagram of the display



Note: connections to Veroboard A are shown as black blobs, and to Veroboard B as open rings.

Fig. 2: The method of mounting the diodes and other components on the matrix board. Care must be taken to ensure that the tracks of the two Veroboards are correctly prepared and lined up when fastening the two boards back-to-back

A much neater and simpler design has been evolved and is shown in Fig. 2. The two pieces of Veroboard are assembled back to back, again with the tracks at right angles, using double sided adhesive tape and ensuring that the holes are in alignment.

Alternate copper tracks are carefully removed from the board with them running lengthwise. To make this easier a hot soldering iron is laid on the track until the copper starts to bubble. This loosens the adhesive and allows the copper to be peeled off easily.

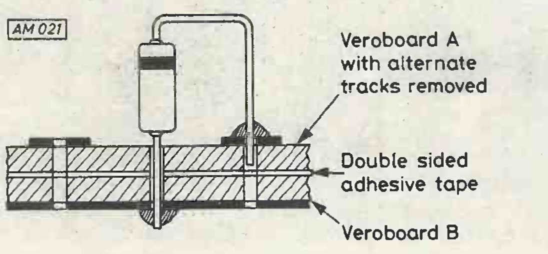
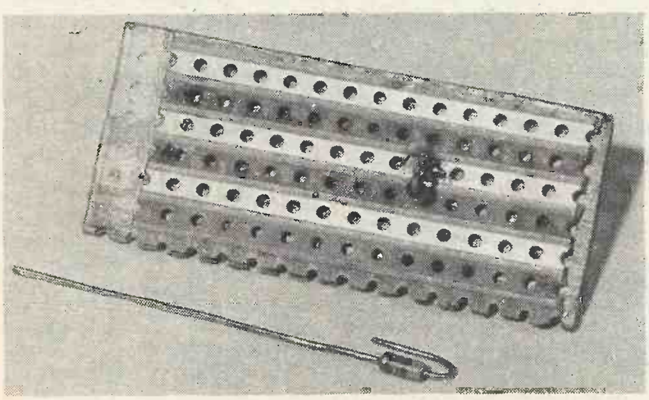


Fig. 3: Section through the matrix board showing how the diodes are bent and soldered to the tracks

The diodes, all 1N914, are then prepared as shown in Fig. 3. The length of the bent lead is important as, with the diode pushed into the board as far as its body, the bent lead must not penetrate further than the first board.



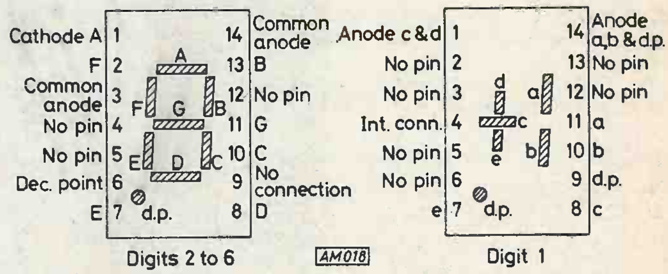


Fig. 4: Pin connections for the two types of display digit used

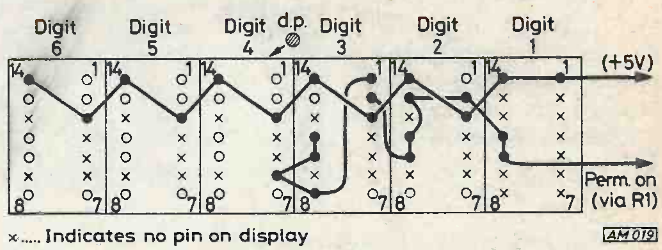


Fig. 5: The wiring of the back panel of the display bezel

Before the diodes can be positioned the six frequencies, for which crystals have been fitted, must be noted and the segments to be lit up worked out. This is somewhat simplified by the fact that the first three digits will always read 145. And it follows that these can therefore be permanently wired leaving the only last three digits to be switched. (If you happen to pick one of the few frequencies starting with 144. You will need to add an extra section to the matrix to accommodate the third digit as well.)

I used a wire wrapping tool to hardwire the display sockets on the prototype so suitable pins were soldered into the Veroboard holes used to take connections to and from the matrix.

The wire wrapping system used was a recently introduced system known as "Slit'n'Wrap" distributed by Rhopoint Ltd. This is a novel tool which enables you to wrap perfect joints, by hand, using the special wire held on a reel fitted to the tool.

I found this a very easy and convenient method of wiring the display bezel. Wire wrapping is not generally considered by the amateur as it is limited in applications to his projects and the basic equipment tends to be expensive.

However with the advent of hand wrapping tools such as the Slit'n'Wrap, it should be within the reach of the home constructor, and used in the appropriate place will prove very useful.

The display is driven from a 5V regulator i.c. which is bolted to the chassis to act as a heat sink. An extra wafer is added to the frequency select switch and used to switch the display as required.

The diode matrix board can be fitted either to the back of the display bezel, utilising the bezel fixing screws, or placed anywhere in the chassis.

A final check should be made to ensure that all the diodes are the correct way round, before switching on and running through each switch position to see that the correct frequency is displayed.

AM 017

Display / Pin No.	1	2	3	4	5	6	7	8	9	0
1		●	●		●	●	●	●	●	●
13	●	●	●	●			●	●	●	●
10	●		●	●	●	●	●	●	●	●
8		●	●		●	●		●		●
7		●				●		●		●
2				●	●	●		●	●	●
11		●	●	●	●	●		●	●	

●.....Indicates diode to be inserted in this position on matrix board

Fig. 6: Table showing diode placement for different numbers

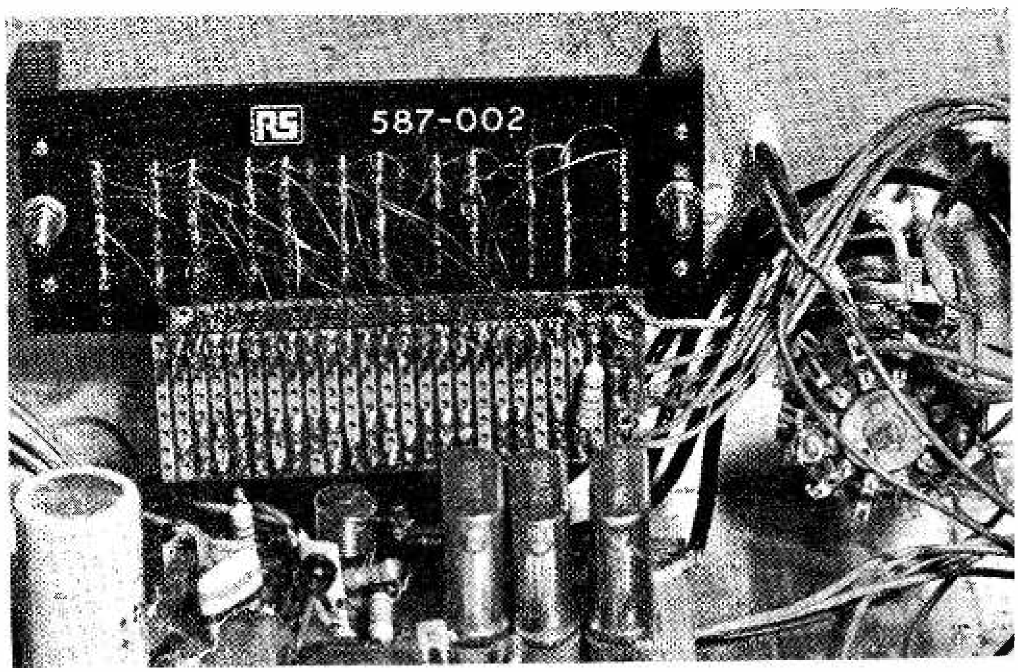


Fig. 7: The back of the prototype display showing the hardwiring and the original diode matrix

POWER SUPPLY

N. FOOT G8MCQ

The circuit shown in Fig. 1 provides a regulated output of 24 volts d.c., with overload and short-circuit protection, and will easily power the Avon transmitter.

Low current demands flow through resistor R1 and the 7824 regulator until 200mA is reached and the voltage drop across the resistor becomes 0·6V. At this point Tr2 turns on to carry a proportion of the current being drawn, until the pre-determined maximum of 2·5A is attained. Here the majority of output current is being passed through the transistor and the resistor R2; the voltage drop across the resistor causes Tr2 to turn on, and the unit shuts down.

Note the capacitors C4 and C5, which prevent the possibility of problems arising from r.f. entering the output.

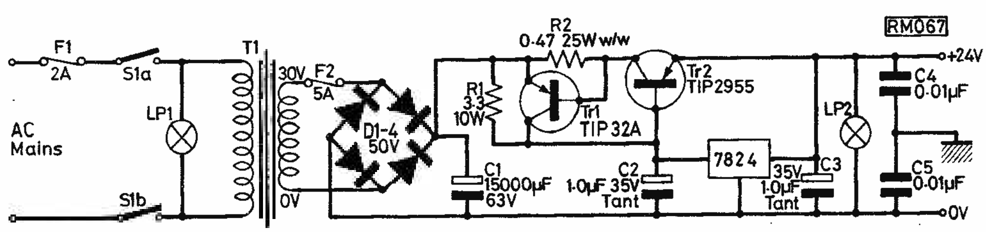
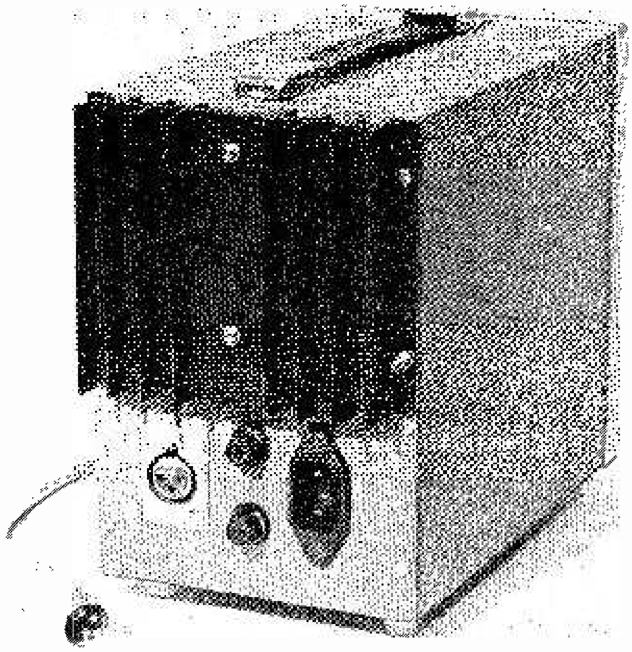


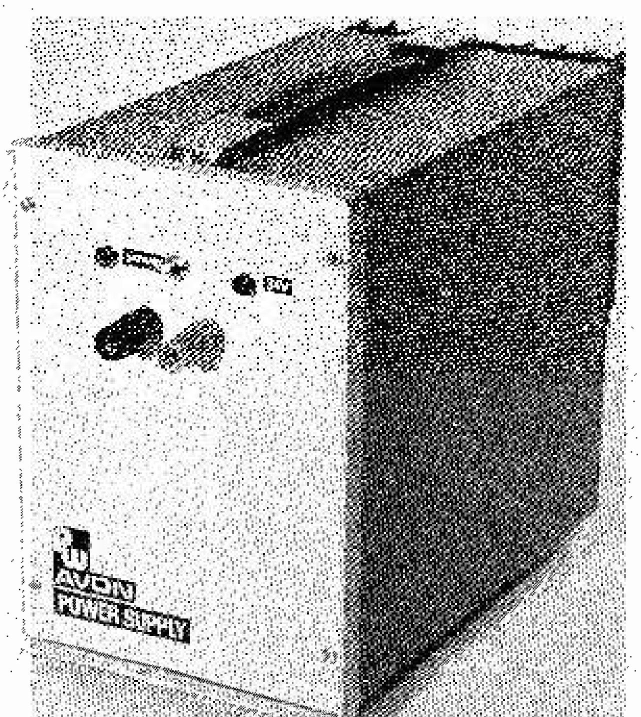
Fig. 1: Circuit diagram of the power supply unit



The power supply described was housed in a Foxall instrument case type T.7058 which matches the Avon in appearance. In addition to an output socket at the rear, two terminals were fitted on the front panel to facilitate the use of the unit as a separate piece of test equipment.

A 4°C/W heatsink fits conveniently on the back panel, and the regulator and transistors can be fitted to the underside if a little care is taken with the construction.

The d.c. output on the prototype was via a Cannon type XLR 3-31 socket, and XLR 3-12C mating line plug, but barrier strip would be somewhat less expensive and still quite serviceable.



★ components

Resistors
11 watt 5% wirewound
3·3Ω 1 R1
Precision 25 watt wirewound—MIL-R-18546C (5%)
0·47Ω 1 R2

Capacitors
Single-ended high ripple (17A)
15000µF 63V 1 C1 (RS 102-623)
Solid Tantalum
1µF 35V 2 C2, 3
Disc Ceramic
0·01µF 25V 2 C4, 5

Semiconductors
TIP32A 1 Tr1
TIP2955 1 Tr2
7824 1 24 volt regulator

Rectifiers
6A Bridge 1 D1-4 (RS 262-078)—Minimum 50V v.r.r.m.

Transformers
30V 4A 1 T1

Switches
DPDT 1 S1 Miniature toggle

Indicators
250V Red, sub-miniature 1 LP1 (RS 575-891)
28V Green, sub-miniature 1 LP2 (RS 575-857)

Fuseholders
20mm Bulgin panel-mounting 2

Fuses
20mm 2A 1 F1
20mm 5A 1 F2

Connectors
3-pole 6A rectangular I.E.C. panel-mounting 1 (mains input)
3-pole 6A rectangular I.E.C. line socket 1 (mains input)
Non-reversible panel-mounting 5A socket 1 (D.C. output)
Non-reversible 5A line plug 1 (D.C. output)

Hardware
Capacitor Fixing Clip 63·5mm (2·5in) (RS 543-507) 1
Heat Sink 4°C/W 100 × 64·5 × 15mm (RS 401-403) 1
Mica insulating washers as spacers for Tr2 and 7824 regulator

Case
*Foxall type T.7058

Miscellaneous
Insulated terminals for front panel—2, if required, of 10A capacity
* Available from Watford Electronics.

NOTE: The following amendments should be noted. Components list: L2, 4, 6, 8, 10. Delete 'on 1MΩ carbon resistor' and insert '6·3mm diameter'.

In Fig. 9, please alter the component references as follows: C8 to C6, C9 to C7, C12 to C8, C11 to C9, R4 to R3. ●

Introduction to LOGIC ~ 3

S.A. MONEY

So far in this series we have explored the various types of logic gate. We can now go on to look at a second major group of logic elements, called flip-flops. Although they are, in fact, built up from groups of gates the flip-flops exhibit their own special characteristics and are generally treated as logic elements in their own right.

Set-Reset Flip-Flop

Suppose we take a pair of 2-input NAND gates and cross connect them as shown in Fig. 27. Let us assume that input 1 is set at *0* and that input 2 is at *1*. Gate G1 will be closed by the *0* at its input and hence its output will go to the *1* level. Gate G2 now has both of its inputs at *1* and is therefore open so that its output will be at *0*. Since the *0* output from gate G2 is fed back to the second input of G1 it will hold G1 closed even if the *0* state is removed from input 1. We now have a stable condition where output 1 is at *1* and output 2 is at *0*.

If we now apply a *0* signal to input 2 whilst input 1 is at *1* then gate G2 will be forced to close and in its turn will cause G1 to open so that the circuit will switch states. If this input is removed we have a second stable state with output 1 at *0* and output 2 at *1*.

When a *0* level pulse is applied to input 1 of the circuit it will "flip" into the state with output 1 at *1* and output 2 at *0*. Applying a *0* pulse to input 2 will cause the circuit to "flop" back into its original state. This "flip-flop" action gives the circuit its name.

If output 1 is at the *1* level the flip-flop is said to be in the "set" state, whilst the condition where output 1 is at *0* is called the "reset" state. The two inputs, 1 and 2, of the circuit are called the Set and Reset inputs respectively. Sometimes these two signals may be called Preset and Clear but their functions are the same.

Generally the output of flip-flop devices will be labelled Q and $\bar{Q}$. The Q output will be at *1* when the flip-flop is in the Set condition.

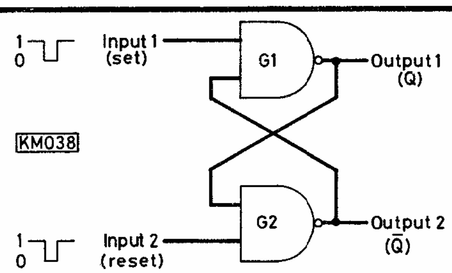


Fig. 27: Set-reset flip-flop using NAND gates

Fig. 28 (left) and Fig. 29 (right): Two alternative flip-flop circuit symbols

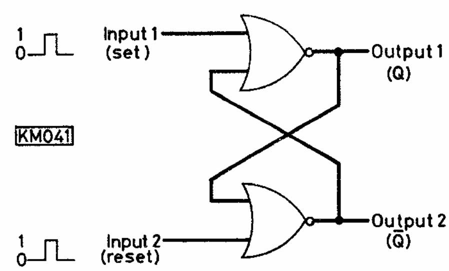
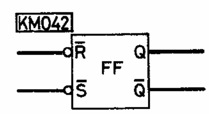


Fig. 30: S-R flip-flop using NOR gates ▲

Fig. 31: Symbol for inverted inputs ▶



Logic Symbol

In most cases no special symbol is used to denote a flip-flop. The device is shown simply as a square box as in Fig. 28. Occasionally the symbol shown in Fig. 29 may be used instead.

A flip-flop can be built up using NOR gates as shown in Fig. 30. Here a *1* level pulse is needed to trigger either the Set or Reset inputs and make the flip-flop switch states.

If the input pulse needed to trigger the flip-flop goes to *0* when it switches the circuit, as in the case of a NAND flip-flop, this may be shown by drawing a small circle on the input point as shown in Fig. 31. The two inputs would then be labelled $\bar{R}$ and $\bar{S}$ to indicate that the logic action is inverted.

D-Type Flip-Flop

Although S-R flip-flops are sometimes used in logic systems they have the disadvantage that they need a pair of separate input trigger signals to switch them from state to state.

By employing a more complex arrangement of gates to form the flip-flop circuit, we can arrange that a single "clock" pulse will trigger the circuit.

Moreover we can have a second input called the D (data) input which will determine the state that the flip-flop will take up after the clock pulse has been applied.

With this type of flip-flop, when the D input is set at *1* a clock pulse applied to the flip-flop will cause the Q output to go to *1*. If the Q output is already at *1* when the clock pulse occurs, there will be no change in the state of the circuit. When D is at *0* whilst a clock pulse is applied, the Q output will be changed to *0* unless it is already in that state.

This type of circuit is called a D-type flip-flop but may sometimes be referred to as a D-type latch. Practical D-type flip-flops usually have direct Set and Reset inputs as well as the Clock and D inputs. These Set and Reset inputs work independently of the clock and will have the same functions as in an S-R flip-flop.

Truth Table

We can draw up a truth table to summarise the action of a D-type flip-flop and this will be as shown in Table 7.

Table 7

Input at t_n	Outputs at t_{n+1}	
D	Q	$\bar{Q}$
0	0	1
1	1	0

Here we see the state of the D input before the clock pulse occurs (time t_n) and the resultant states of the outputs after the clock pulse (time t_{n+1}).

Typical D Flip-Flops

In the 74 series logic, the most familiar D-type flip-flop is the 7474 which actually contains two D flip-flops. Its pin layout and logic functions are shown in Fig. 32. The 7474 is an edge-triggered device where the circuit responds to its clock only when the clock line (CK) makes a transition from the *0* to *1* level. In the 7474 the Preset and Clear inputs need to be driven to the *0* level to switch the state of the flip-flop.

Another common TTL D-type flip-flop is the 7475. It contains four separate D flip-flops. Unlike the 7474 this device does not use an edge-triggered clock action. If the Clock of a 7475 flip-flop is set at *1* the Q output simply follows the state of the D input. When the clock line drops to the *0* level the Q output freezes at the state it is in at the moment. The clock inputs to the flip-flops are paired together since there aren't enough pins to bring out all four clock lines separately. The pin layout and logic of the 7475 are shown in Fig. 33.

In CMOS the equivalent to the 7474 is the 4013 dual D flip-flop which is shown in Fig. 34. The Set and Reset inputs of a 4013, unlike the 7474, respond to pulses at the *1* level.

J-K Flip-Flop

By using a logic arrangement which is slightly more complex than that of a D flip-flop we can produce another rather more versatile type of flip-flop. Here the D input is replaced by two separate inputs

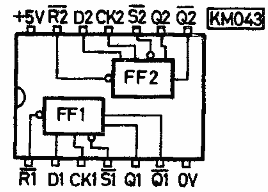


Fig. 32: The 7474 dual D flip-flop

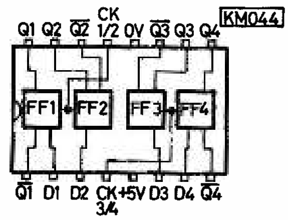


Fig. 33: The 7475 quad D latch

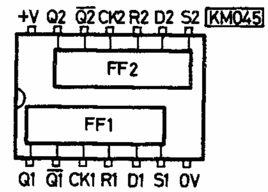


Fig. 34: The 4013 dual D flip-flop

labelled J and K. Now when a clock pulse is applied to the flip-flop the action which is produced will depend upon the combination of states present at the J and K inputs. For this type of flip-flop the truth table is as shown in Table 8.

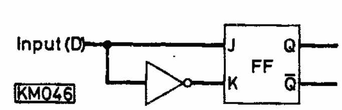
Table 8

Inputs at t_n		Outputs at t_{n+1}	
J	K	Q	$\bar{Q}$
0	0	Q	$\bar{Q}$
1	0	1	0
0	1	0	1
1	1	$\bar{Q}$	Q

Here we see that if both J and K are at *0* the clock pulse has no effect upon the state of the outputs. With J at *1* and K at *0* the clock pulse causes the flip-flop to "set" with Q at *1*. Having J at *0* and K at *1* produces a clocked "reset" action where Q goes to the *0* level. When both J and K are at *1* however a rather interesting action occurs. Now the application of a clock pulse simply causes the flip-flop to change state. We shall see later that this can be a very useful action.

If we connect an inverter between the J and K inputs as shown in Fig. 35 we should effectively produce a D-type flip-flop. Some J-K flip-flop circuits do have an inverted K input line so that they can readily be used as D flip-flops if desired.

Fig. 35: A J-K flip-flop used as a D-type



J-K flip-flops are generally used where the action required of the circuit is dependent upon the states of two or more logic signals. Although D flip-flops might equally be used in such systems they would generally need more external logic gates to achieve the required action, so that a J-K type will simplify the logic system.

Typical of the J-K flip-flops is the 7470 in TTL which has three J inputs and three K inputs for extra flexibility. In CMOS the 4027 contains two separate J-K flip-flops with direct Set and Reset capability.

Using Simple Flip-Flops

How is a flip-flop used in practical logic systems? One typical application is to use the flip-flop as a "flag" indicating that an event has taken place. As an example suppose that you are leaving home for a shopping trip and wish to know if any visitors called whilst you were away. A Set-Reset flip-flop could be wired to the doorbell so that operating the bell will set the flip-flop. The flip-flop is reset before you leave on your trip and if there have been any visitors whilst you were away the flip-flop will be "set" when you return and may be used to light an indicator lamp to show that visitors have called. This is a particularly useful technique in electronic systems if you need to know whether a pulse has appeared on a logic signal line during a particular period of time.

Another application of the single flip-flop is to use it as a latch circuit. In our coffee making machine we could set a flip-flop as soon as one of the ordering buttons has been activated. Now the flip-flop can be used to latch out the button circuits until the coffee has been delivered. A pulse from the delivery mechanism will reset the flip-flop when the operation is complete and the button circuits will then be released ready for the next customer. This type of circuit is often used to stop false triggering caused by "contact bounce" in a push-button switch.

Parallel Registers

A frequent requirement in logic systems which deal with digital data signals is that of "freezing" the states of a number of varying logic signals at a particular point in time. To do this we might use the circuit of Fig. 36. Here the four flip-flops are clocked simultaneously and they will take up and hold the current states of the input signals at the instant the clock pulse was applied. This logic arrangement is called a parallel data register.

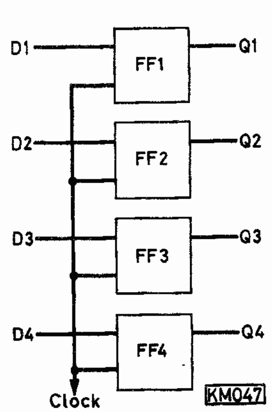


Fig. 36: A parallel data register

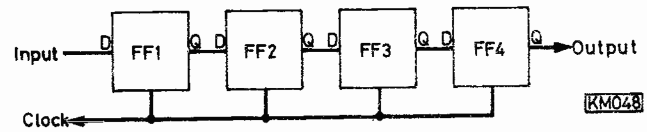


Fig. 37: A serial shift register

The Shift Register

Let us now consider another method of connecting a group of flip-flops together. Here the Q output from one flip-flop is fed to the D input of the next flip-flop so that they form a chain as shown in Fig. 37. Once again all of the flip-flops are clocked simultaneously. When a clock pulse is applied each stage takes up the previous state of the preceding stage in the chain.

Suppose there is a *1* in the first stage of the chain and *0* in all of the others. We'll also assume that the D input of the first stage in the chain is held at *0*. After the first clock pulse has been applied the *1* state will move to the second stage in the chain and the first stage will change to *0*. Each succeeding clock pulse will move the *1* along the chain by one stage until eventually it is moved out of the last stage in the chain to leave all of the flip-flops at the *0* state.

This technique of moving a single *1* state through a shift register chain can be used to control a sequence of events. As a very simple example we might connect the lamps on a Christmas tree to a shift register so that each lamp is controlled by one stage of the shift register. Now as clock pulses are fed to the register and the *1* state moves through it each lamp will light in turn. If we connect the output of the last stage to the D input of the first the action will go on continuously since as the *1* state leaves the end of the chain it will be fed back again at the beginning.

Instead of a single *1* we can have a pattern of *1*s and *0*s in the register and this time when clock pulses are applied the whole pattern will shift along the register by one stage for each clock pulse.

Parallel-Serial Conversion

Now let's see another way in which we might use a shift register. Suppose we wanted to generate Morse code signals using a logic system. Morse symbols are made up from groups of dots and dashes. The dashes are usually three times as long as the dots and each dot or dash is spaced from the other by a period equal to the length of a dot. We can let the dots and dashes be *1* states and the spaces between them be *0* states.

To send the letter **A** we need a dot followed by a dash. If we can generate a clock pulse at the rate of one pulse for each dot period then we can use a shift register to generate the Morse symbol. In Fig. 38 we have a shift register loaded with a pattern of *1*s and *0*s to produce the **A** symbol. The *1* corresponding to the "dot" is set up in the last stage of the register so that it will be the first to appear at the output. If clock pulses are now applied to the shift register the pattern will move to the right and produce the required voltage outputs to produce the dot-dash of the **A** symbol. To accommodate all of the Morse code symbols we would need a longer shift register since the numeric codes may require up to five dashes and four spaces to make up the symbol pattern.

So far we have assumed that by some magic or other the required pattern has appeared in the shift register ready to be clocked out. Practical shift registers often have additional logic to allow the individual stages to be loaded in parallel via a series of D input lines. In some cases there may be two clock signals, one being used to parallel load the register with the desired pattern and the other being used to shift the pattern along the register. An alternative scheme used on some devices is to have a common clock drive and use a control line to determine whether the register is being loaded or shifted.

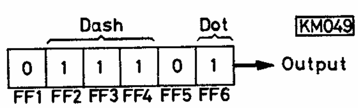
This technique of converting signals from a parallel pattern of *1*s and *0*s into a serial stream of pulses is regularly used in data communication since only one line is now needed to carry the patterns of signals. Of course here we have simplified the technique to show the principle involved and in practical systems the logic used may well be more complex.

Serial-Parallel Conversion

To convert our received Morse symbol back into a parallel logic signal we can simply clock the received signal pattern through a shift register using the same clock speed as at the transmission end. As the pattern moves through the shift register the parallel pattern corresponding to the transmitted symbol will appear at the outputs of the individual stages of the shift register.

Here we run into a problem of synchronisation. In order to recover the received symbol pattern we need to know when it is properly positioned in the shift register. In radioteletype (RTTY) codes every symbol consists of the same number of *1*s and *0*s so that the pattern will be of a known length. In addition an extra bit called the start bit is added at the beginning of each symbol code and this is always a *0*, whilst a stop bit is added at the end of each code and this is always a *1*. Any spaces between symbol codes are always at *1*. Now if we detect when the first start bit of a message gets to the end of the receiving shift register then the rest of the bits for that symbol will be set up in reverse order in the other stages of the register. At this point the pattern can be transferred in parallel into a parallel data register and held there whilst the next symbol pattern is being moved into the shift register. Since each symbol contains the same number of bits of data we can simply count off the clock pulses to find out when the next symbol pattern is set up in the shift register. The logic arrangement for a serial-parallel conversion system is shown in Fig. 39.

Fig. 38: Shift register loaded with the pattern for Morse code "A"



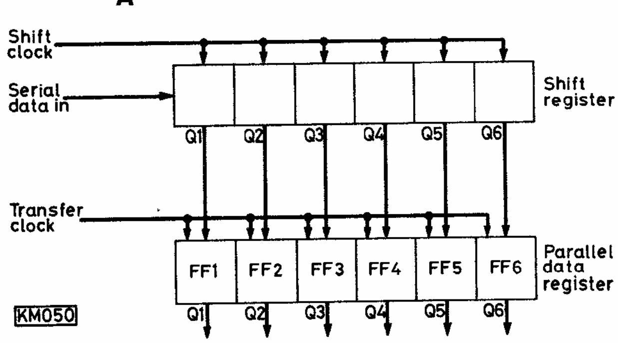


Fig. 39: Serial-parallel conversion

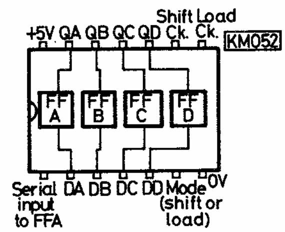


Fig. 40(a): The 7495 4-stage shift register

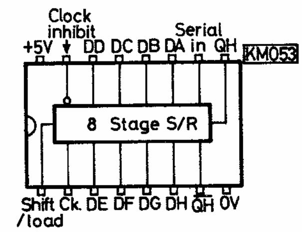


Fig. 40(b): The 74165 parallel-serial shift register

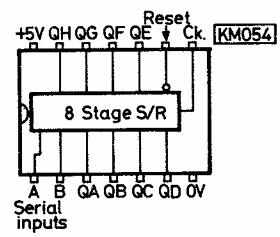


Fig. 40(c): The 74164 serial-parallel shift register

Typical Shift Registers

Usually shift registers are not built up from the separate flip-flop devices but come already packaged as shift registers. Typical of these is the 7495 shown in Fig. 40(a). This has four stages which can be loaded in parallel and uses two separate clocks one for shifting and one for parallel loading. The 74165 shown in Fig. 40(b) has eight stages and is designed for parallel-serial conversion. It has eight parallel inputs and a load/shift control line and uses a common clock signal for shifting or loading. The 74164 shown in Fig. 40(c) also has eight stages but is arranged for serial-parallel conversion use. Some shift registers, such as the Signetics 2533 may have 1024 stages in one package.

Timing Problems

So far in this series we have assumed that the logic states change instantaneously when a gate or flip-flop is made to switch. In practice this is not so. There is some delay between the application of the input signal and the change in state at the output. This delay is called the "propagation delay" of the circuit. It also takes some time for a signal to change from the *0* level to the *1* level and this is called the "rise time". Similarly there is a "fall time" when a signal goes from *1* to *0*.

These time delays are quite short but may be very important if the logic system is to work properly. In a typical TTL gate or flip-flop, propagation delays will be of the order of tens of nanoseconds, whilst for CMOS circuits delays of perhaps a hundred or so nanoseconds might well be found. Rise and fall times are often of the same order.

Continued on page 39

ELECTRONIC FISH FEEDER

G. F. SMITH B.Sc. M.Sc.

Electronic Fish Feeder

This article describes a device which can be fixed to the side of an aquarium to dispense small amounts of fish food at regular intervals of time. The quantity of food supplied can be adjusted to allow for the size and the number of fish to be fed. The fish feeder is battery powered and uses a low power CMOS i.c. and will run for many months on four HP7 batteries.

The fish feeder is easy to build and should be well within the scope of most constructors. No special mechanical tools are required: a small file, a hacksaw and a hand drill will suffice.

Fish Food Dispenser

The dispenser itself is constructed from Perspex, and is driven by a model railway point motor.

It uses a novel method devised after experimenting with various other arrangements. The granulated fish food is held inside a Perspex tube by a laminate (e.g. Formica) disc with a serrated edge. To dispense fish food, the serrated disc is pulled upwards by the solenoid and then allowed to drop again. This small movement is sufficient to shake a small amount of food past the serrated edges of the disc and out of the dispenser.

Solenoid

The solenoid used is a modified Peco SL-70 point motor obtainable from railway model shops.

The motor has two coils, one of which should be removed. This can be done, quite easily, by snipping the connecting wires and untwisting the retaining lugs, The s.r.b.f. supports can then be cut and filed as in Fig. 1, and the metal fixing lugs sawn off. The steel armature is easily modified as shown. A small plastic band was cut from the outer cover of a 5A cable and positioned on the core to avoid all possibility of the armature sticking in the solenoid. To fix the serrated disc to the armature a plastic nut (to save weight) is secured to the end of the armature with epoxy adhesive. A small screw passes through the serrated disc and into the nut thus securing the disc.

Mechanical Construction

The body of the dispenser is made from a Perspex tube with an outside diameter of 38mm and an inside diameter of 32mm. It should be possible to obtain this inexpensively from most Perspex merchants. A few off-cuts of 2·5mm sheet and a piece of thin laminate are also needed, and obviously, the dimensions of the dispenser could be changed to suit locally available materials.

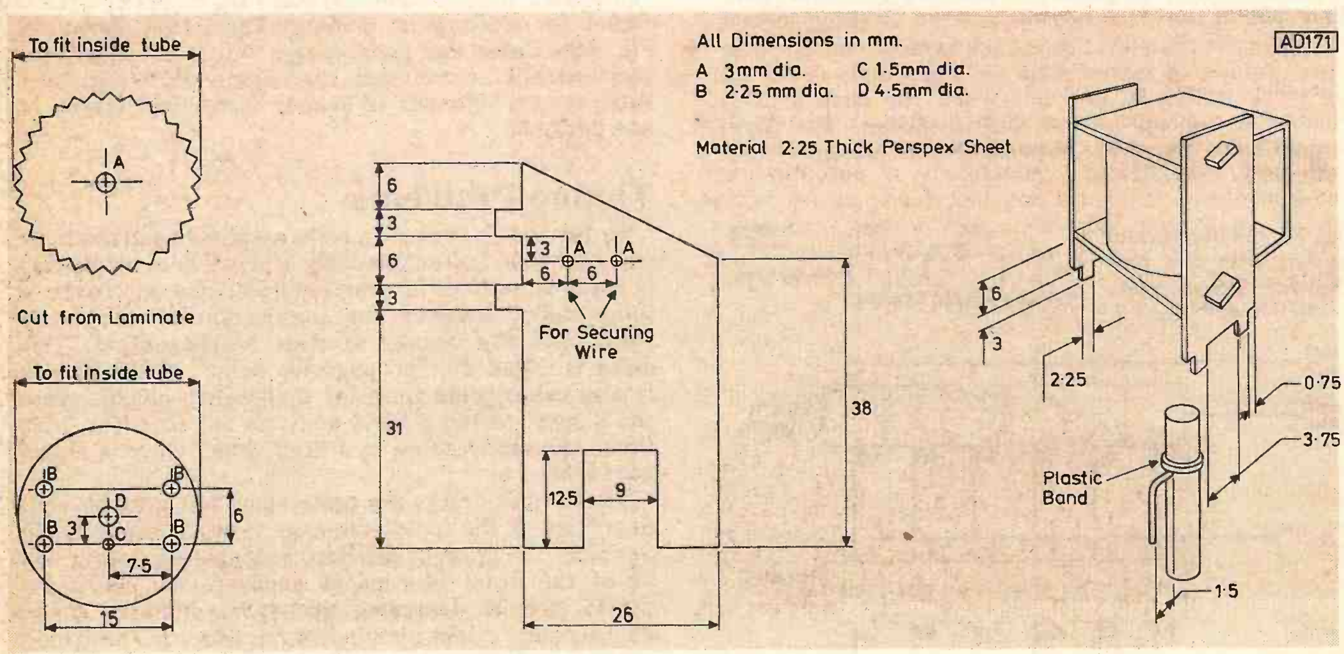


Fig. 1: Constructional details

Cut a 38mm length of tube and drill the holes for the support bracket components which are cut from Perspex sheet (Fig. 1). The fixing screw passes through a Perspex block made by glueing three small rectangular pieces of Perspex to the support bracket. There is no need to tap a thread for the screw; Perspex is a soft material and a steel bolt will tap its own thread through a suitably sized hole. The support bracket lugs should be carefully filed so that they fit snugly into the holes in the Perspex tube.

Cut two 32mm diameter discs from the Perspex sheet and drill as shown in Fig. 1. Make a disc from the laminate and file the serrated edge as shown in Fig. 1. There should be approximately 30 serrations, each about 1·5mm deep, and the disc should fit easily into the tube.

The dispenser can now be assembled from its component parts. The application of a little glue will help to hold the parts together, but it should be used sparingly until the dispenser has been thoroughly tested and the constructor is convinced that no adjustments will be needed.

The wire from the solenoid passes through the hole in the Perspex tube and is secured using the holes in the support bracket.

Mechanical Testing

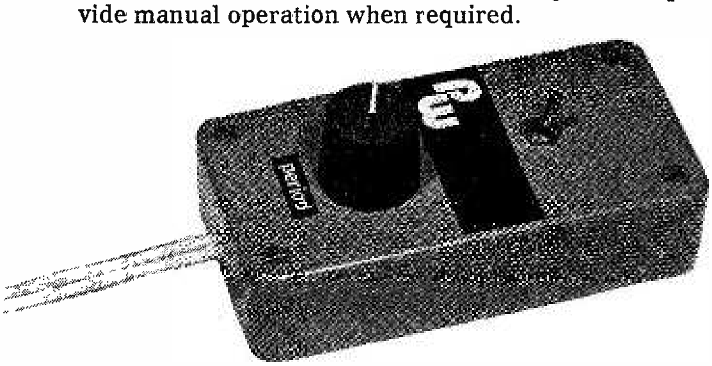
Before proceeding with the electronics it is well worthwhile spending a few minutes testing the dispenser.

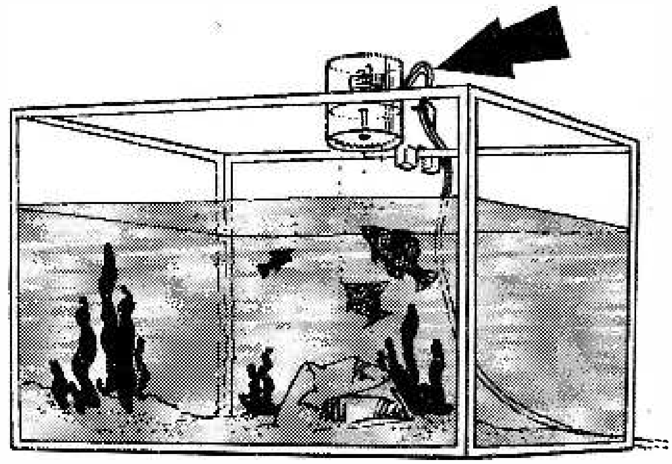
Place four HP7 batteries in the battery holder to produce a nominal 6V Supply. The feeder should be left empty and mounted vertically.

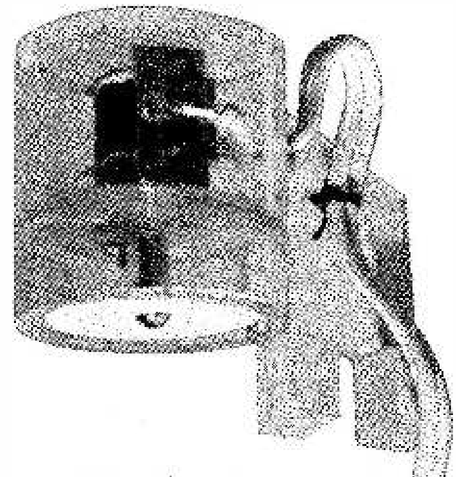
Momentarily connect the supply to the solenoid wires. The laminate disc should rise and fall. After repeating the test a few times, unscrew the serrated disc and fill the feeder with fish food (taking care not to overfill). Again, momentarily, connect the supply. This time a small amount of fish food should be dispensed. Five minutes of experimentation should convince the builder that his device will operate reliably. If the dispenser does jam, then it is a simple matter to file the offending part until the operation becomes free and reliable.

Operation

The fish feeder has only two controls. These are mounted in a plastic case together with the associated circuitry. The 'Hours' control is a potentiometer which allows the time between feeds to be varied from two and a half hours up to thirty-two hours. Obviously, the setting required will depend on the number of fish to be fed and their size. The re-set control, is used to initialise the circuitry and to provide manual operation when required.





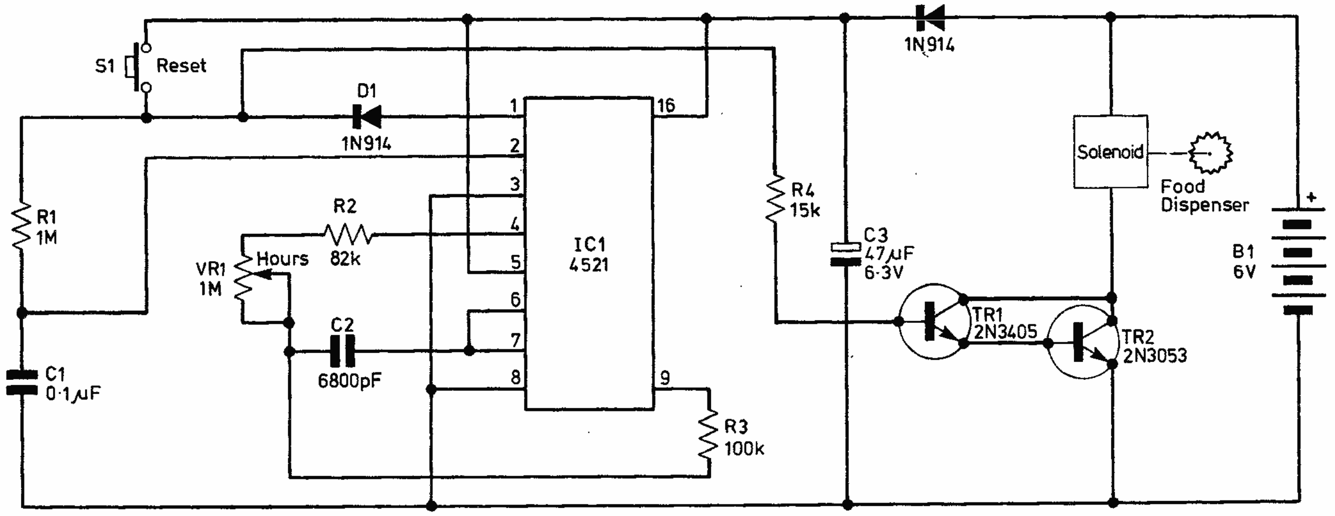


★ components

Resistors		
¼W 5%		
15kΩ	1	R4
82kΩ	1	R2
100kΩ	1	R3
1MΩ	1	R1
Potentiometers		
1MΩ	1	VR1 (Linear)
Capacitors		
Disc Ceramic		
6800pF	1	C2
0·1μF	1	C1
Tantalum		
47μF 6·3V	1	C3
Semiconductors		
Diodes		
1N914	2	D1, D2
Transistors		
2N3053	1	Tr2
2N3405	1	Tr1
Integrated circuits		
4521	1	IC1

Miscellaneous

Plastic case, 121 × 63·5 × 38mm. Point motor, Peco SL70. Push-button switch, push to make. Veroboard, 57 × 28·5mm, 0·1" pitch. Battery holder, 57 × 57mm. HP7 batteries, (4). Laminate (Formica), 25 × 25mm. Perspex sheet, 152 × 76mm 2·4mm thick. Perspex tube 38mm long, 30mm o.d. × 24mm i.d., Perspex adhesive. IC socket. Knob.



Circuit Operation

The complete circuit diagram is shown in Fig. 2. The heart of the device is a CMOS, 4521, 24 stage, frequency divider. A block diagram of this is shown in Fig. 3. Gate A is a straightforward digital buffer, whilst gate B is an inverting buffer. Stages 1 to 24 are simply flipflops connected to form a 24 bit counter.

In operation, gates A and B are connected, as shown in Fig. 4, to form an RC oscillator whose frequency, f, is given by:

$$f = \frac{1}{2 \cdot 3 R_{TC} C}$$

The oscillator drives stages 1 to 24. The outputs from the last 7 of these stages are available from pins: 1, 10, 11, 13, 14 and 15 of the i.c. as shown in Fig. 6. After 2^{17} (=131072) cycles from the RC oscillator, pin 10 goes from digital low to digital high; after 2^{18} (=262144) cycles, pin 11 goes from low to high; and so on. For the fish feeder circuit, the output of pin 1 has been used. Pin 1 goes high after 2^{23} (=8388608) cycles of the RC oscillator. The output of pin 1 is then used to drive the solenoid and also (after a delay) to cause a re-set.

In Fig. 2, R2, VR1, C2 and R3 form the RC network of the RC oscillator. The frequency can be adjusted between 70Hz and 1kHz; depending on the setting of VR1. After the relevant amount of time (between 2·4 and 32·1 hours. depending on VR1). pin 1 goes high. This has two effects. First, Tr1 and Tr2, connected as a Darlington pair, can draw base current via R4 and hence current flows through the solenoid coil, L1, to drive the dispenser. Secondly, after a delay of about 100ms., determined by R1 and C1, a re-set pulse is applied to pin 2. This causes counting to re-start and drives pin 1 low, switching off the drive to the solenoid coil.

Fig. 2: Complete circuit diagram

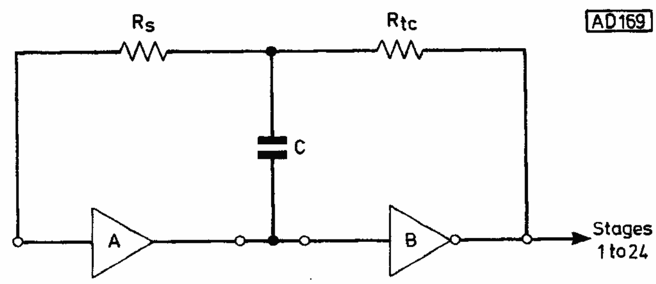


Fig. 4: Gates A and B form an RC oscillator

The dispenser can be manually operated using the re-set button, and this will also re-start the counting.

A collector resistor is not used with the Darlington pair as it was found that the internal resistance of the four HP7 batteries was sufficient to limit the current. However, anyone considering using other power supplies would be well advised to include some form of current limiting. C3 was included to maintain the power for the 4521 when the batteries were effectively short circuited by the solenoid coil was found not to be needed because of its very low inductance.

The measured power consumption of the prototype varied from 8μA at the lowest frequency of operation to 67μA at the highest. The batteries should last for many months—even years on the lowest frequency setting.

The layout of the components is not critical and Fig. 5 shows a suggested layout on a piece of Veroboard.

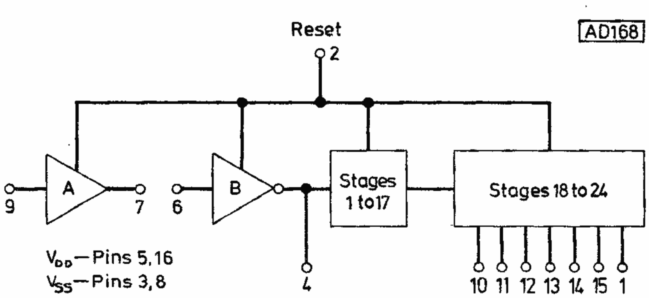


Fig. 3: Block diagram of the CMOS 4521

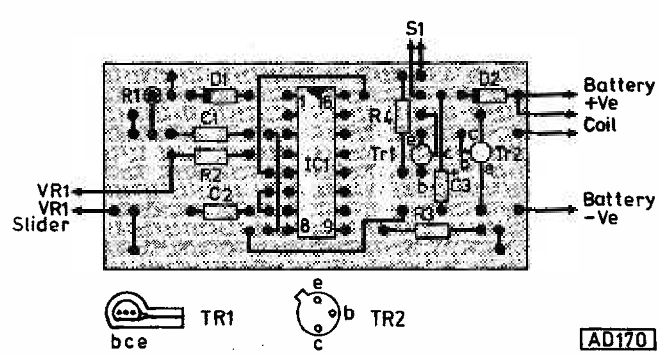


Fig. 5: Suggested component layout

Testing

Before proceeding, the wiring should be carefully checked. The i.c. should then be removed from its protective covering and placed in its socket. The battery holder and Veroboard can now be mounted in the case.

Connect the batteries, making sure that the polarity is correct. If a micro-ammeter is available, the supply current can be monitored and should be between 8μA and 67μA depending on the setting of VR1. If an oscilloscope is available, pin 4 of the i.c. can be monitored. There should be a square wave signal whose frequency is variable between 70Hz and 1kHz.

Pressing the re-set button should cause the dispenser to operate.

For further testing of the timing, it is possible to increase the frequency of operation by a factor of 64 by disconnecting the anode of D1 from pin 1 of the i.c. and linking it to pin 10 instead. At the fastest setting of VR1, the feeder should then operate.

Finally, the front panel of the plastic case can be appropriately labelled. ●

letters

The Editor,
PRACTICAL WIRELESS,
Westover House,
West Quay Road, Poole,
Dorset BH15 1JG

Sir: On looking through some very old QSL cards, I came across a Membership Certificate of The British Long Distance Listeners' Club, and I wondered how many of these members are still around in an active capacity. The date of the certificate is August 31st, 1939, it was "signed" by "Thermion" who was a regular columnist of that era, adding humour to his technical dissertations. Another thing I came across was a set of BA spanners given as a "Free Gift" many years ago. It may be of interest to say that these were carried by me during my Army Service with REME as a Radio Mechanic, and very useful they proved too. Also taken, was a series of cuttings from *Practical and Amateur Wireless* which were later published as a *Radio Engineers Pocket Book*. It is now well worn and somewhat dogeared, but still used.

I ought to add that the number of the Certificate mentioned above is 6308. All this was well before the days of transistor and integrated circuits, when "Ham Radio" was really amateur equipment, very often built on the kitchen table, with improved and home made "bits and pieces". We sure had fun and most of all, we achieved something to be proud of!

A. C. H. Waters, G2DMT
Knowle Park
Bristol

INTRODUCTION TO LOGIC
continued from page 35

If we have a very long shift register, especially where the clock is distributed to groups of stages via separate lines, we can have the state of affairs where the stage being clocked does not operate until after the stage driving it has already changed state. Now the wrong data will be set up and passed along the register because of the delayed response of one stage. This can be a major problem in systems where the output from the end of a long shift register is "re-circulated" back to its input.

Master-Slave Flip-Flops

The problems with timing on a long shift register can be overcome by using a pair of flip-flops for each stage of the register. This is known as a "master-slave" combination and is shown in Fig. 41. Here the master and slave flip-flops are actuated by opposite edges of the clock pulse. As the clock pulse changes from *0* to *1* the master flip-flop takes up the state of the D input but the slave is unaffected. When the clock level falls from *1* to *0* the data from the master is transferred to the slave but the master is unaffected. Now in a long shift register using master-slave flip-flops there can be no problems with timing delays because when the masters are being clocked the slave stages feeding them with data are static and vice versa.

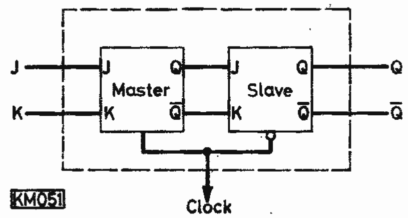


Fig. 41: Master-slave flip-flop

In the 74 series TTL there is a range of J-K master-slave flip-flops, such as the 7472 which is a single flip-flop or the 7473 and 7476 which are dual J-K master-slave flip-flops. Some long shift registers make use of two separate clocks to drive the master and slave stages. This gives what is referred to as a two-phase clock input and the clock signals are often labelled Ø1 and Ø2.

Next month we shall see how flip-flops can be used as frequency dividers and counters.

So you want to pass the R.A.E. (Radio Amateurs' Examination)? * NEW SCHEME

John Thornton Lawrence GW3JGA & Ken Mc Coy GW8CMY

After the 1978 examinations, the form of the Radio Amateurs' Examination will be changed from the old traditional script answer type to the new multiple choice "Objective Testing" type known as the "765, Radio Amateurs' Examination (New Scheme)".

Objective Testing

An Objective Test is defined as a series of questions each of which has only one pre-determined correct answer, so that subjective judgement in marking is eliminated. The RAE will be carried out using a four-option multiple choice type of objective question. In this type, a question is asked or implied, followed by four possible answers or options, only one of which is correct. The candidate is required to select the correct answer.

The questions are normally chosen to test the candidate's "factual recall", "comprehension" and "application". In general, the "factual recall" question tests the candidate's ability to remember the facts which he has been taught, and a "comprehension" question tests his understanding of what he has been taught. An "application" question, while requiring him to both know and understand what he has been taught, asks him to go further and apply his knowledge and understanding to a given problem.

An example of a "factual recall" question is given below.

Class A3J amplitude modulation uses:

a. only the upper sideband with a bandwidth of about 4kHz
b. either one of the sidebands with the carrier suppressed
c. morse telegraphy using either sideband
d. one telephony sideband with reduced carrier.

In a pre-test conducted to see how candidates would answer the question, the results were as follows:

a. 6%
b. 64% (correct answer)
c. 8%
d. 19%
O. 3% (no answer attempted)

The number of candidates choosing a particular answer is shown as a percentage of the total number of candidates.

The next example is of a "comprehension" question.

In a series-resonant circuit, to halve the resonant frequency the LC product must be:

a. halved
b. doubled
c. quadrupled
d. tripled

COMING SOON
A reprint of the complete RAE series in booklet form. Watch PW for a further announcement.

In a pre-test conducted with this question, the results came out rather differently.

a. 17%
b. 55%
c. 23% (correct answer)
d. 0%
O. 5%

As you can see, the majority chose answer "b", which was unfortunately incorrect.

Since $f = \frac{1}{2\pi\sqrt{L \times C}}$, halving the frequency would mean doubling $\sqrt{L \times C}$ and doubling the square root of the LC product would require **quadrupling** the LC product itself (answer c.).

Finally, an example of an "application" question dealing with Ohms law.

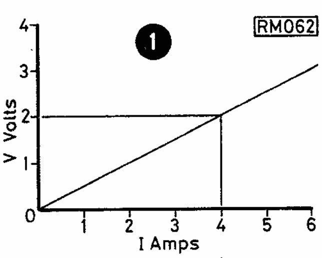


Fig. 1 shows the relationship between V and I in a d.c. circuit. The resistance of the circuit is:

a. 8Ω
b. 2Ω
c. 0·5Ω
d. 0·2Ω

The results of a pre-test conducted with this fairly easy question are as might be expected.

a. 8%
b. 6%
c. 83% (correct answer)
d. 2%
O. 1%

Advantages and Disadvantages

From the examiners' point of view, there are several advantages in Objective Testing. Because it is possible to have a greater number of questions, the paper can include questions on all areas of the syllabus, whereas traditionally only a limited number of topics can be covered. Also no "choice" questions are included, so all candidates answer the same questions.

The preparation of the question paper can be more systematic in covering the syllabus and "pre-tests" can be held to estimate the degree of difficulty of each question before it is included in an examination paper. Marking is completely objective and eliminates the possible variations due to points awarded by different markers or by the same marker on different occasions.

From the candidate's point of view, there is less emphasis on his ability to express himself in his own words, his performance depends primarily on his technical knowledge and understanding. He is not hampered by time as adequate time is available. All things being equal his paper will be marked more accurately and impartially, and the results should be available to him sooner.

There are a number of common objections to Objective Testing, the most common being the view that someone with no knowledge can, by guessing the answers, obtain adequate marks. However, experience has shown that a rational elimination of one or more of the incorrect options is also likely and that applying a correction factor for guessing does not have a significant effect on the rank order of candidates. The policy of the City and Guilds of London Institute is, therefore, not to apply a correction for guessing.

Another objection is that candidates should be tested on their ability to express themselves in writing. In the case of the RAE this ability is not one of the essential factors, whereas knowledge and understanding are. Objective Testing is, therefore, considered suitable for this examination.

Some candidates like to see previous question papers in order to know the general standard of the questions that will be asked. At this stage it is the policy of the CGLI not to issue copies of a question paper for security reasons, although sets of sample items are available.

Of course, the setting of questions for Objective Testing requires considerable expertise. Subject experts submit questions to the Institute and these are considered by an editing panel.

If the questions are accepted they are put forward for pre-testing. The results of the pre-test are analysed and reviewed before the question is considered acceptable to be placed in the Question Bank. By the time a question is placed in the Question Bank a considerable amount of information is known about its suitability and effectiveness for a particular examination.

Objective Testing, from the Candidates point of view

The candidate will answer his multiple choice examination paper on special answer sheets using a pencil. He should attempt all questions and should find little difficulty in completing the answers in the time allotted. If he has difficulty in expressing himself but knows and understands the items in the syllabus, then this form of examination will be to his advantage. If he does not know the subject then it is highly unlikely that guessing will help him to gain marks. If he knows all the items in the syllabus reasonably well the overall result is likely to be better than knowing some items very well and some not at all, as all parts of the syllabus will be tested. There are no "choice" questions or "likely subjects".

A personal impression of the new Objective Testing Radio Amateurs' Examination, formed from the information available, is that the questions may be more searching but the marking will be more reliable than the conventional examination method.

New Examination Pattern

In comparing the old and new schemes, the Syllabus remains broadly the same. The old Radio Amateurs' Examination was of three hours' duration and the paper consisted of two sections. The new examination will consist of two separate papers, a 1-hour paper containing 35 Multiple Choice questions on Licensing Conditions and Transmitter Interference and a $1\frac{3}{4}$-hour paper containing 60 Multiple Choice questions on Operating Practices, Procedures and Theory. Details are given below.

765-1-01 LICENSING CONDITIONS AND TRANSMITTER INTERFERENCE (1 HOUR)

SYLLABUS	QUESTIONS
1 Licensing conditions	23
2 Transmitter Interference	12
	—
	35

There will be a break of 15 minutes between the two papers.

765-1-02 OPERATING PRACTICES, PROCEDURES AND THEORY ($1\frac{3}{4}$ HOURS)

SYLLABUS	QUESTIONS
1 Operating Practices	5
2 Electrical Theory	11
3 Semiconductors	7
4 Radio Receivers	9
5 Transmitters	8
6 Propagation and Aerials	14
7 Measurement	6
	—
	60

New Syllabus

Full details of the new syllabus are given in the Institute's booklet *765 Radio Amateurs' Examination (Old and New Schemes)*. In addition, the booklet contains details of "Examination Objectives" which describes the nature of the examination questions. In all, the new scheme is much more specific in stating what the candidate is required to know in the various sections.

A notable new addition is the "Operating Practices and Procedures" which includes methods of accessing repeaters, use of satellites, etc., and sections on safety in the Amateur Station.

Information on operating procedures, etc., is given in the Home Office publication *How to become a Radio Amateur*, it can also be found in *A Guide to Amateur Radio* and the *Radio Communication Handbook* both published by the RSGB.

Acknowledgements

We would like to express our grateful thanks to the City and Guilds of London Institute for permission to publish various extracts from their broadsheet and sample tests relating to the Radio Amateurs' Examination.

Our personal thanks go to Mrs Jackie Richards of the Testing Services Department of the CGLI for her helpful comments during the preparation of this article.

Further Information

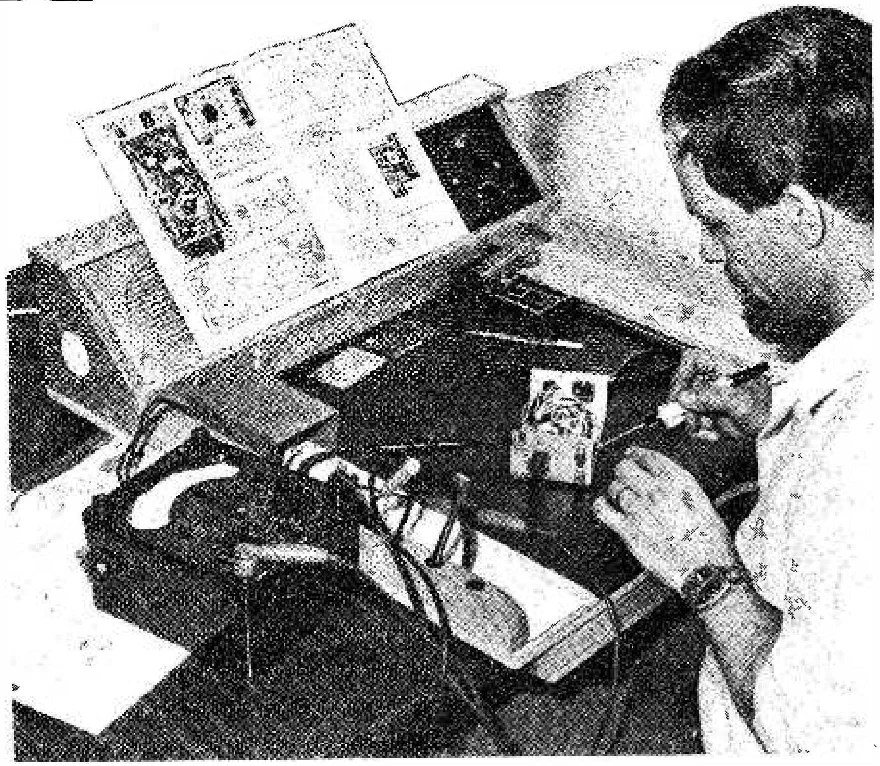
Full information on the new examination is available in the booklet *765 Radio Amateurs' Examination (Old and New Schemes)*, price 40p from the City and Guilds of London Institute, Sales Section, 76 Portland Place, London W1N 4AA. A complete set of "sample items" (questions) is also available, price 40p.

A broadsheet entitled *City and Guilds Objective Testing* is available to teachers and other interested parties, free of charge, from the above address. For teachers requiring more detailed information, a booklet *Objective Testing* is available, price 50p. ●

SPECIAL PRODUCT REPORT

HOME RADIO

THE ELECTRONIC WORKSHOP



A lot of readers probably use the kitchen table as the basis of their "workshop", despite the comments from the lady of the house. Whilst this may have the advantage of convenience and nearness to the rest of the family it becomes a nuisance when mealtimes approach and one is evicted from the "bench". In fact the thought of all the aggro which is likely to come might well put you off from even starting a project.

Home Radio have produced their answer to this problem in the Electronic Workshop which they are offering in either kit form or ready built.

The basic idea is not new but this one has several novel features.

As can be seen from the photograph the basis of the Workshop is a sturdily built base equipped with four rubber feet, to prevent damage to the wife's best table, and a rubber mat on the top to provide a suitable working surface. A carrying handle, attached to the underside of the base, provides a positive stop to prevent the Workshop walking all over the table. The sides have various holes drilled in them to hold different tools such as pliers and screwdrivers.

The biggest innovation is the provision of a simple power supply and a small loudspeaker in the back panel together with a lockable storage cupboard to hold tools and components. Each end of the back panel is fitted with a 13A mains socket while the mains lead is detachable from the back.

Also contained inside the rear panel structure are three reels intended to be fitted with flexible wire and solder, with the wire being easily pulled out through holes.

The Workshop has been thoroughly tested by *PW* staff and found to be useful. There are several points, however, which could detract from the usefulness of the Workshop and which the average reader should be able to do something about.

Although one of the main attractions of this unit would appear to be its ability to allow the constructor to pack up quickly this tends to be nullified by the awkwardness and small capacity of the lockable storage cupboard. It would probably be of greater use if this space was used to house a simple and cheap multimeter, using a separate "toolbox" to hold and transport tools and components.

The 20V d.c. power supply is not stabilised or calibrated, so that its usefulness is rather limited. However the addition of a simple stabiliser should not prove too difficult for the user to do. In fact one could think of several additions and improvements which could be made to the Workshop such as an audio oscillator and a simple a.f. amplifier but they would all add to the overall cost of the unit, and each of us would have different opinions of what is needed.

At a price of £39 for the unwired version and £46 for the ready-to-use Workshop (+£2·06 VAT and £2·50 carriage) the Electronic Workshop provides a useful basis for a kitchen table worker, and should help to overcome any domestic objections.

Home Radio (Components) Ltd, 240 London Road, Mitcham, Surrey CR4 3HD. Tel: 01-648 8422.

Dick Ganderton

NEXT MONTH IN...

practical WIRELESS

ON SALE 1ST. SEPT.

Free TRANSISTOR MOUNTING PADS

Do you have difficulty mounting your transistors onto p.c.b.s? These mounting pads will help you to achieve that professional look to your work and help with the reliability of your finished projects

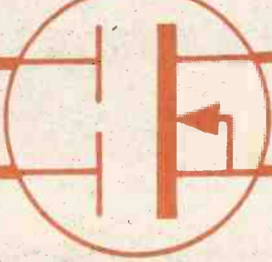
S.W. RECEIVER FREQUENCY READOUT

the PW 'Gillingham'

This one-chip design will enable you to keep an accurate track of the frequency your short wave receiver is tuned to regardless of the accuracy of its dial. Simple to build, it can also cover the medium wave broadcast band

The display works with any receiver having an i.f. of 460kHz or 455kHz (l.o. high) and is accurate to within 5kHz up to 29·999MHz

Also: 2m Mosfet Converter



A high performance module, having a noise figure of 3·5dB and a gain of 26dB from the 2m input to the 10m output. A compact, well-designed unit, which is easily aligned

PW WIMBO

Music

PART 1

The *PW* "Wimborne" is a complete audio system designed to combine a high standard of performance with good mechanical and electrical reliability. This integrated system comprises:

1. Stereo record/playback cassette deck with radio to tape, phono to tape, and auxiliary to tape, record facility.
2. A long wave/medium wave/f.m. stereo radio ready for **all** the new BBC domestic radio channels.
3. A three-speed turntable with a choice of manual or auto change types and with the option of either magnetic or ceramic cartridges.
4. A stereo amplifier capable of delivering 8 watts r.m.s. per channel into 8 ohms or 11 watts r.m.s. into 4 ohms with full treble and bass boost.
5. A professional-style cabinet featuring a wooden baseboard, pre-drilled aluminium extrusions and silk screened perspex front with matching knobs and push buttons and trim.
6. A choice of speaker enclosures.

Design Philosophy

The major consideration in the design of the *PW* "Wimborne" was to give the home constructor the opportunity to produce a really professional piece of equipment. The level of performance would have to equal or excel currently available mid-range music centres, while providing circuitry which could be added to at a later date to bring it into the true high fidelity class. Extensive use of readily available and well proven integrated circuits was made! Another object was to use components well below their maximum ratings to ensure reliability and a long trouble-free life.

The tuner and amplifier modules were fitted with quick-release connectors to facilitate final testing and fault finding. Flying leads were kept to a minimum to reduce a common source of failure through soldered joints being put under tension. Because the power amplifier, pre-amplifier tone controls and power supply are mounted on a common board, construction is greatly speeded up and good results are guaranteed. The alignment of the r.f. module has been reduced to a bare minimum using basic test equipment. The radio module, amplifier module and

★ specification

AMPLIFIER SECTION

POWER OUTPUT: (r.m.s.) 2 × 8W into 8 ohms, 2 × 11W into 4 ohms
TOTAL HARMONIC DISTORTION: 0·5% at 5W into 8 ohms
FREQUENCY RESPONSE: 20Hz—20kHz, −3dB
SIGNAL TO NOISE RATIO: 55dB
TONE CONTROLS: ±12dB at 100Hz; ±12dB at 10kHz
INPUT SENSITIVITY AND IMPEDANCE: 60mV, 470k Ω

TUNER SECTION

FREQUENCY RANGES: F.M. 87·5–108MHz; M.W. 530–1605kHz; L.W. 150–350kHz
INTERMEDIATE FREQUENCY: F.M. 10·7MHz; A.M. 470kHz
USEABLE SENSITIVITY: F.M. 2·2μ V(for 26dB S/N); M.W. 350μV/m; L.W. 600μV/m (for 20dB S/N)
STEREO SEPARATION: more than 35dB at 1kHz
F.M. SIGNAL TO NOISE RATIO: 70dB
F.M. CAPTURE RATIO: 4dB
F.M. FREQUENCY RESPONSE: 40Hz–15kHz
SELECTIVITY: F.M. 26dB (400kHz) M.W. 24dB (9kHz)

COVER PROJECT

RNE Centre

N.B.MATTEY

CASSETTE TAPEDECK

TYPE: Otake N99
RECORDING LEVEL CONTROL: Automatic
TAPE SPEED: $1\frac{7}{8}$i.p.s. (4·75cm/s)
RECORDING SYSTEM: A.C. bias
BIAS FREQUENCY: 60kHz
ERASE SYSTEM: A.C. erase
FREQUENCY RESPONSE: 100Hz–10kHz, −6dB
SIGNAL TO NOISE RATIO: 48dB
CHANNEL SEPARATION: 25dB
CROSS TALK: −50dB
WOW AND FLUTTER: 0·25% r.m.s.

RECORD PLAYER

TYPE: BSR 162 automatic single player, 33/45/78 r.p.m.
CARTRIDGE: SC 12 M
STYLUS: ST 16
(optional magnetic cartridge and pre-amp)

LOUDSPEAKERS

TYPE: Single $6\frac{1}{2}$in twin-cone speaker or
8in bass unit plus tweeter, with crossover network

mains transformer are mounted on a base board. The p.c.b.-mounting potentiometers are held firmly in position by being fixed into the rear front-panel extrusion. This rigid form of construction greatly reduces mechanical stress. The cassette mechanism is supplied fully working with its electronics.

Construction

Constructional details of the cabinet will be described this month. As can be seen from the exploded drawing, Fig. 1 and the internal photograph, Fig. 2, the cabinet is formed of two parts. The first part consists of the base board, on which are mounted the front panel and the control mounting panel, the amplifier/power supply module and mains transformer, and the tuner module and ferrite rod aerial.

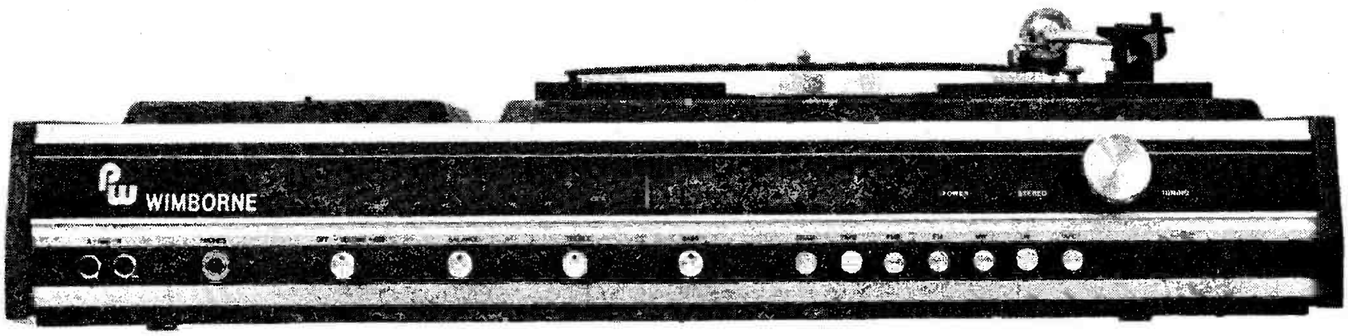
Front Panel Assembly

The front panel is an aluminium extrusion, with jacks for stereo microphone inputs to the tape deck, and for stereo headphones. Control identities are silk-screened onto the panel and the perspex trim strip which is secured by means of double-sided adhesive tape.

A second aluminium extrusion, the control mounting panel, is bolted to the base board immediately behind the front panel. The four potentiometers mounted on the amplifier/power supply module are secured to the control mounting panel by their mounting bushes and nuts, thus anchoring the front end of the p.c.b. Also mounted on this panel are the perspex tuning scale with its associated pointer and drive arrangements, and lamps for scale illumination and indication of power on, plus a stereo beacon. Details of the base board are given in Fig. 3.

Cabinet Top Section

The second part of the cabinet comprises most of the woodwork. The turntable mounting board, with cut-outs suitable for gramophone turntable and cassette mechanism (see Fig. 4), is surrounded on three sides by the two side boards and the back board. These should be of veneered chipboard, suitably



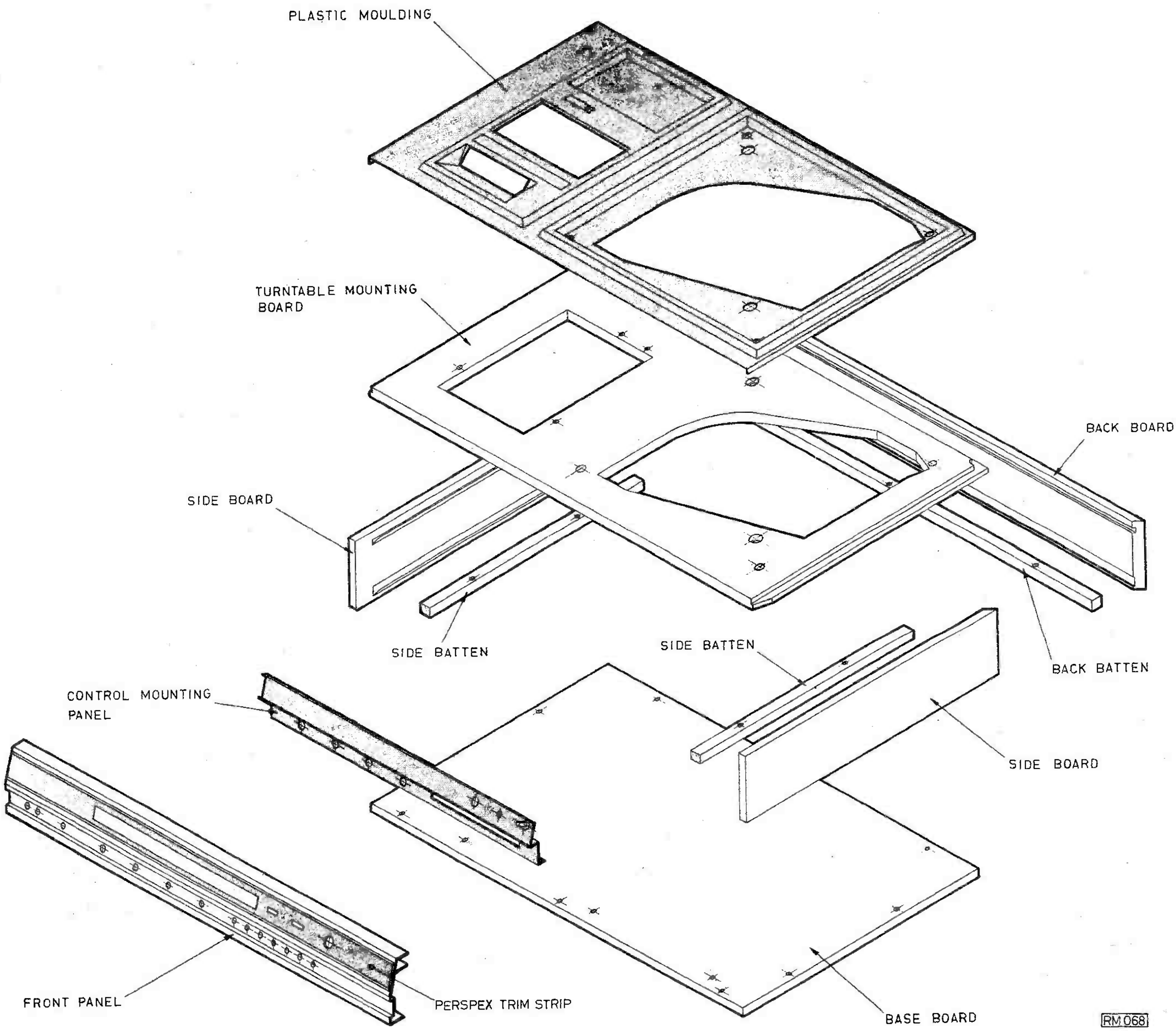


Fig. 1: Exploded view of the cabinet assembly

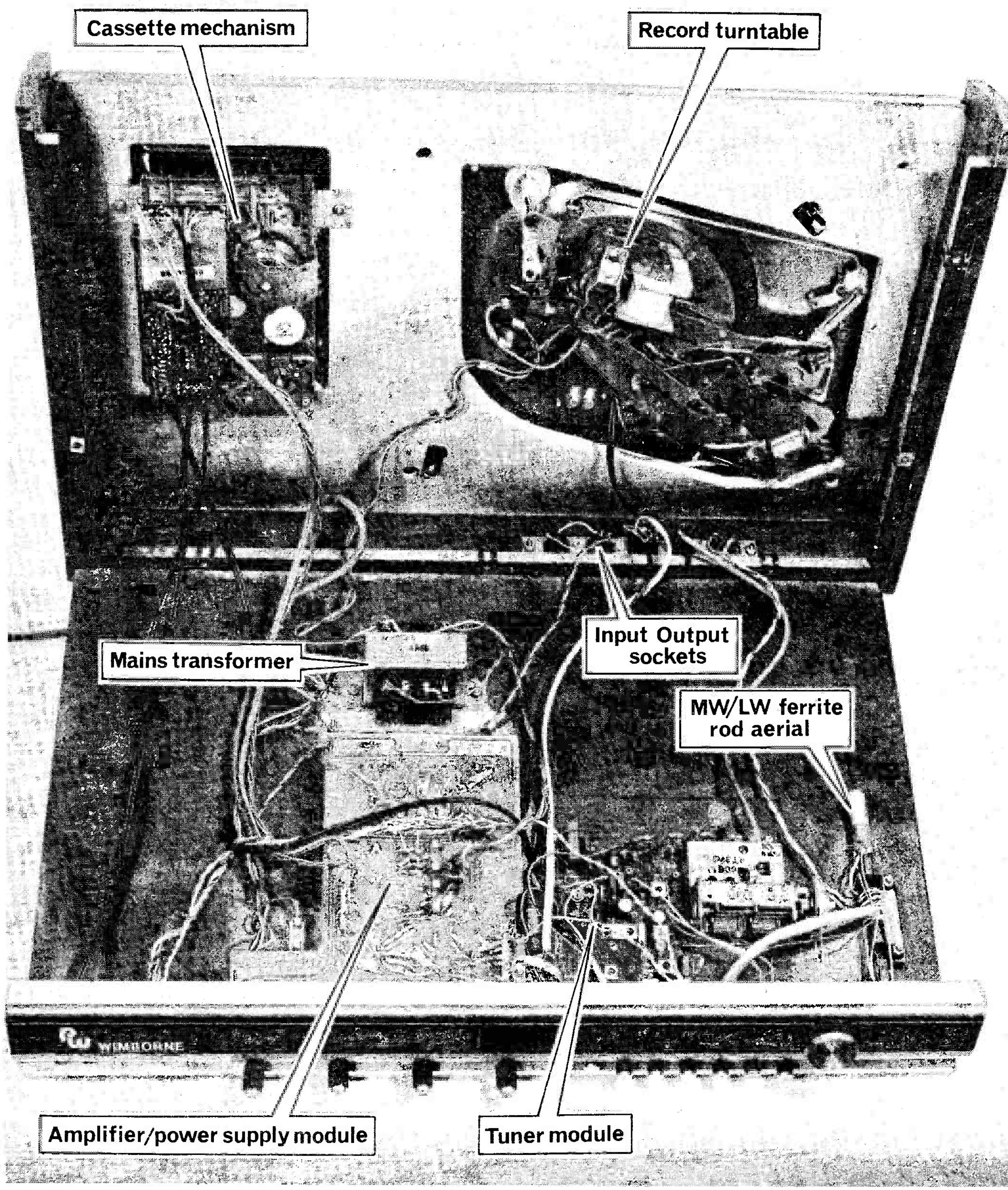


Fig. 2: Inside view of the PW "Wimborne", with all units identified

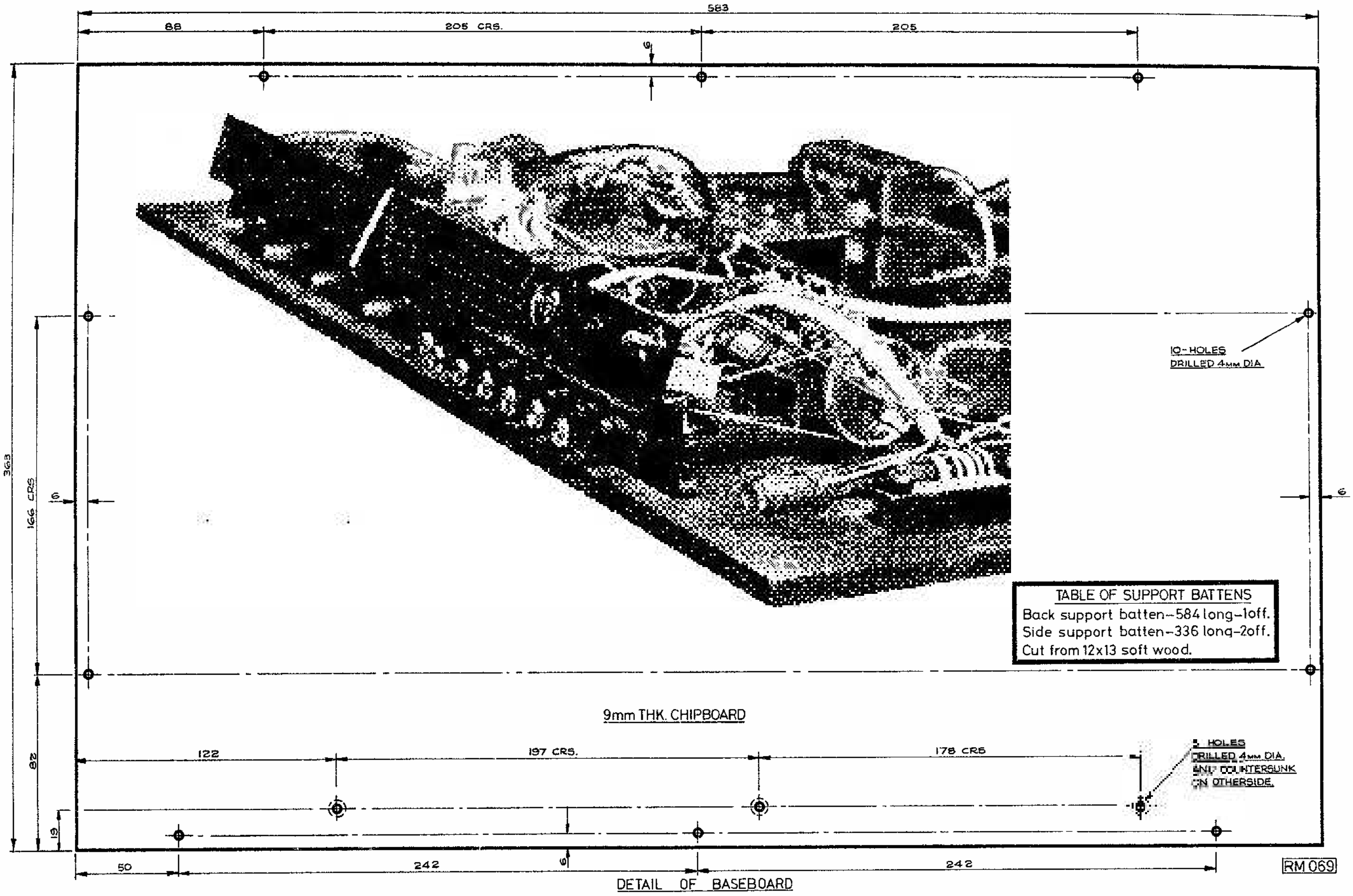


Fig. 3: Baseboard details, with a view of the control mounting panel and tuning drive assembly

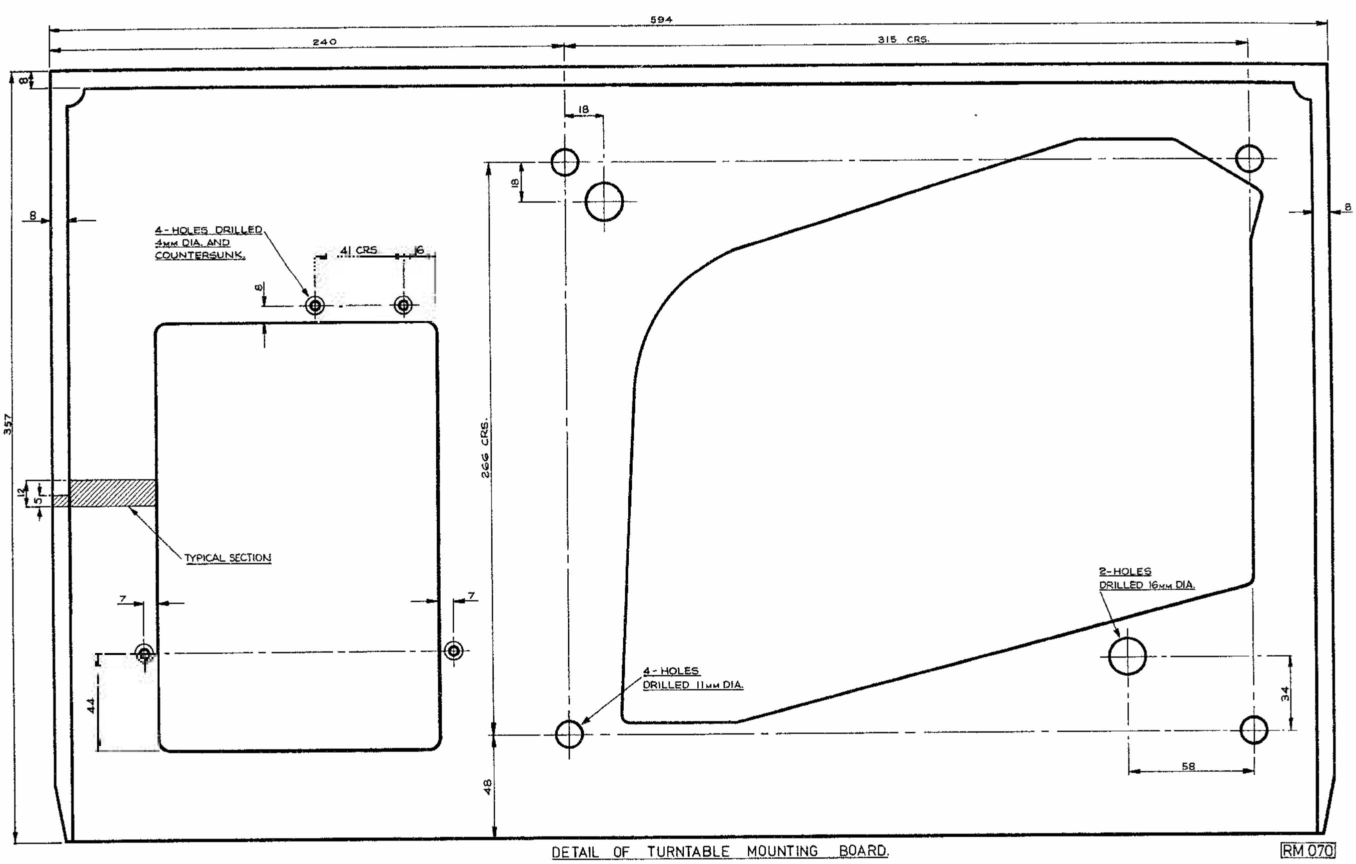


Fig. 4: Turntable mounting board details

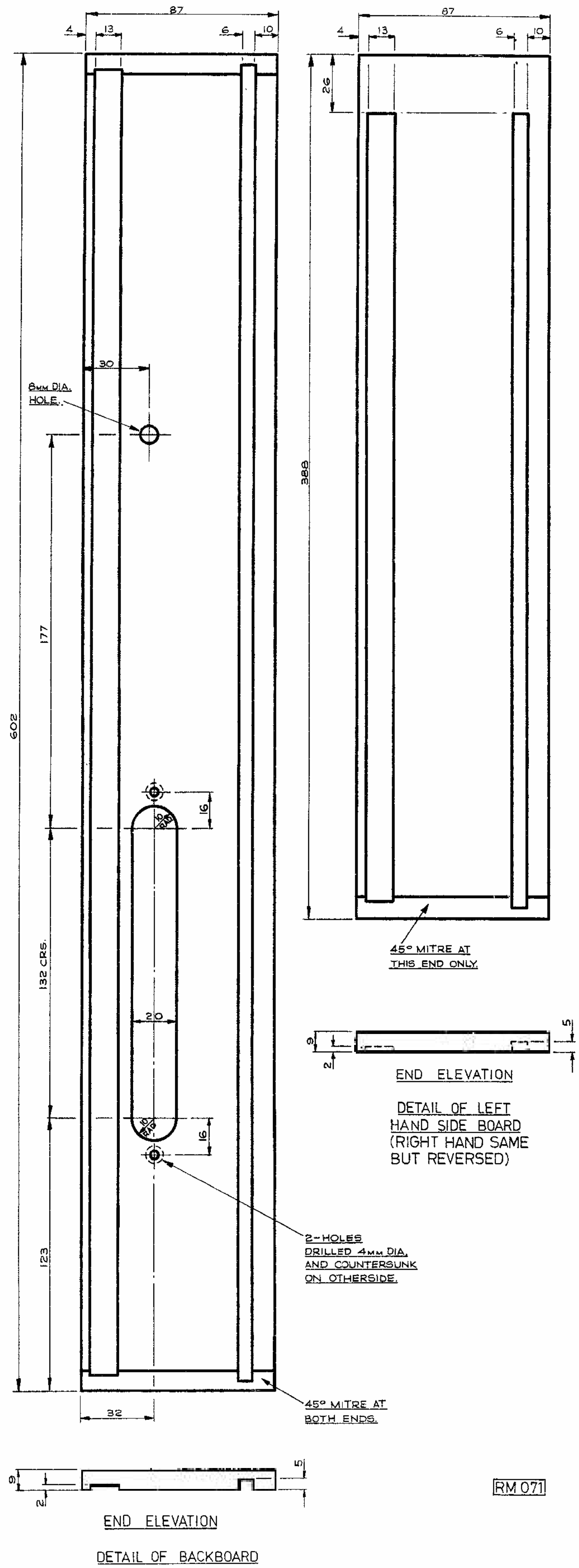


Fig. 5: Backboard and sideboard details

grooved on the inside faces to house the turntable mounting board and the three battens to which the base board will be screwed.

A black plastic moulding is available to cover the turntable mounting board. This moulding is suitable for a range of BSR single-play and autochange turntable units (deck size 303 x 286mm), but so far as the cassette mechanism is concerned only that listed in the specification will fit.

Should a constructor wish to use a different mechanism or turntable then the turntable mounting board should be veneered chipboard, instead of plain, or covered with black rexine. The cassette mechanism would need to be a drop-in, top mounting design, or some special arrangements made for a finishing trim by the constructor. The cut-outs in the board may need to be changed in these circumstances. **Warning—** Check that the under-board parts of any alternative units which you may wish to use will clear the other modules. There is a fair bit of room, but some designs could present problems. It might also prove necessary to move the mains transformer slightly to reduce hum pick-up.

The turntable mounting board, side and back boards and battens are all glued together. The plastic moulding is secured by using double-sided tape.

External Connections

The back board carries a small panel on which are mounted sockets for loudspeakers, a.m. and f.m. aerials, and auxiliary inputs and outputs. A securing clamp for the mains lead is also fitted. Details of the side and back boards are shown in Fig. 5, while information on the battens is inset into Fig. 3.

Loudspeakers

Constructional details of suitable loudspeaker enclosures will be given in a later article.

Cabinet Parts

The aluminium extrusions for the front panel and control mounting panel, the perspex trim strip, the plastic moulding to cover the turntable mounting board and a smoked acrylic dust cover for the whole unit (as shown in the heading photograph) will be available from Reed Hampton Ltd., 19 Church Lane, Wallington, Surrey. See their advertisement for further details.

NEXT MONTH

FULL CIRCUIT AND

CONSTRUCTIONAL DETAILS

OF THE AMPLIFIER

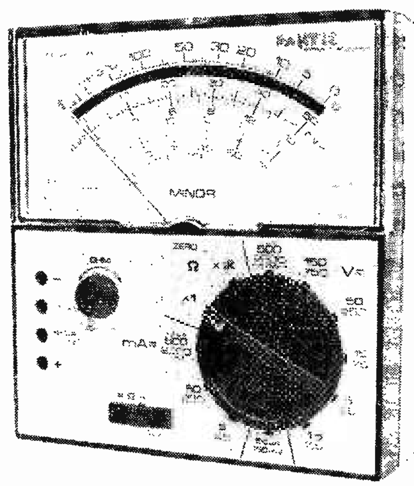
AND POWER SUPPLY

PRODUCTION LINES

alan martin

Multimeter

The new light robust Pantec Minor comes complete in tough plastic case with test leads, and offers 33 separate ranges, reliable fuse protection, a.c. current to 12·5A, a.c./d.c. volts to 1·5kV and resistance to 20MΩ. Sensitivity is 20kΩ/V and the meter has a 92mm scale length with an anti-parallax mirror. Range selection is by one rotary switch with a slide switch selecting a.c., d.c. or resistance. An optional high voltage probe is available, to extend the voltage range to 30kV d.c. Priced at £28·00 plus 8% VAT the Pantec Minor is available from, *Precision Instrument Laboratories, Instrument House, 212 Ilderton Road, London SE15 1NT. Tel: 01-639 0155.*



Cheap Cheap

Three economy priced amplifier packages can be obtained from Radio and Television Components Ltd., utilising proven Mullard modules which show savings of up to 75% in comparison with listed prices.

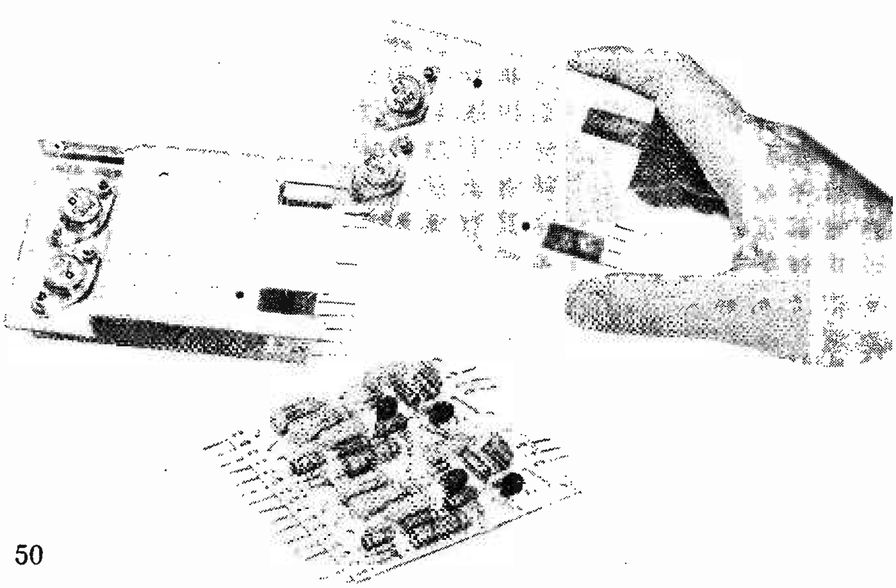
Package 1 consists of two LP1173 audio modules and an LP1182/2 stereo pre-amplifier module. Price £4·95 (normally £25·50).

Package 2 features two LP1173 modules plus an LP1184/2 pre-amp with integral magnetic pre-amp. Price £6·95 (normally £27·50).

Package 3 includes two LP1173 modules, LP1182/2 stereo pre-amp, LP1179 f.m. tuner and a 1165 a.m./f.m. i.f. strip. Price £9·95 (normally £37·00).

The three packages can be used to build stereo amplifiers for ceramic or magnetic cartridges, and a f.m./a.m. receiver. To complete the construction volume controls and power supply can also be obtained from R & TVC for 95p and £1·95 respectively.

P & P for any of the packages is £1·00, and may be obtained from, *R & TVC, 323 Edgware Road, London W2.*



Check mate

A new and more versatile version of Chess Challenger, has now been introduced by Spectrum Marketing.

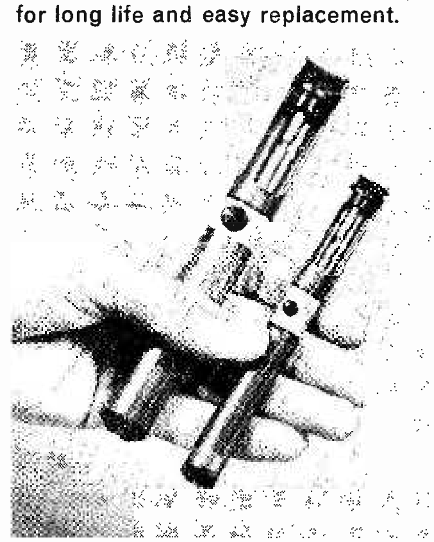
Comprising a chessboard and built-in keyboard, with windows to display move codes, the new Master version of Chess Challenger looks like the original version but offers many more features. Advantages for the chess buff include three levels of play; for beginners, average and better players, the board also allows the player to select offence or defence — i.e. white or black pieces.

A microprocessor 'mini-computer' is the brain of the three level Master game. At level one, the board will display its best counter move almost immediately. At level two the computer

Sipping solder

Recently introduced by BOSS Industrial Moldings Ltd. are two new desoldering tools specifically designed for removal of molten solder from both large and small p.c.b. pad areas.

Measuring only 150mm and 180mm, and having all metal bodies, both these Minor and Major BIMPUMPS develop high suction power with an anti-recoil system for efficient solder removal and have screw-in Teflon tips for long life and easy replacement.

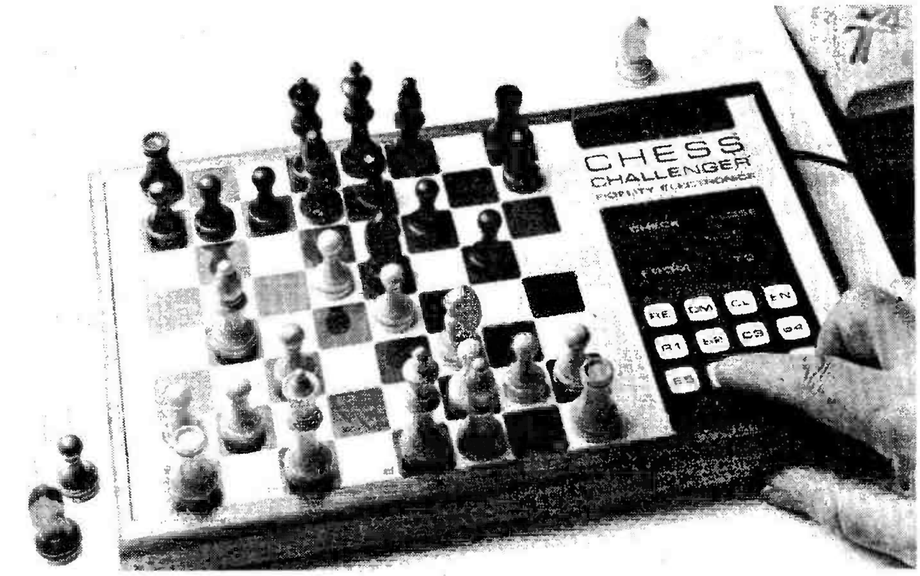


Both BIMPUMPS are operated by priming the main plunger, and when the solder to be removed is molten, press the release button, the solder is then sucked into the Teflon tip. The unwanted slug of solder is ejected when the plunger is next primed. The Minor is priced £5·95 plus 8% VAT and the Major £6·95 plus 8% VAT. Available from, *Boss Industrial Mouldings Ltd., Higgs Industrial Estate, 2 Herne Hill Road, London SE24 0AU. Tel: 01-737 2383.*

examines the player's move in greater depth and responds in 11-16 seconds, while at level three it thinks even more deeply and responds in up to 34 seconds.

Other features include the ability to set up move problems and end games and, the computer never forgets a move. It can verify the position of every piece left on the board at the touch of a key at any stage during the game.

Chess Challenger is available from many different shops and stores throughout the country at £139·95 which includes VAT. However, if no local stockist is available, the company will supply direct by post. *Spectrum Marketing, 12 The Shrubberies, George Lane, South Woodford, London E18 Tel: 01-989 2235.*



KINDLY NOTE!

Active Tone Control, March 1978 page 814

The value of R13, Collector Load for Tr2, should be 10kΩ.

A.M. Receivers, August 1978: Some of the pin connections to the LM380 are incorrect. Pin 3 should read pin 6 (inverting input), pin 4 should read pin 7 (ground), pin 6 should read pin 14 (Vcc), and pin 5 should read pin 8 (V out).

Bovington Tank Battle Game, June 1978

It is possible that problems may be experienced with the 4MHz clock pulse oscillator. If you have difficulty in obtaining a stable picture or obtain multiple pictures of the battleground on the TV screen then the operation of the 4MHz oscillator is probably suspect. If an oscilloscope is available then the output of the oscillator can be checked at pin 4 of IC4. Gently touch the top of IC4 and observe the waveform at Pin 4. If the oscillator stops or the output changes then solder a capacitor of between 27pF and 47pF across the pins of L1. This should cure the problem enabling a stable picture to be obtained.

PW "Jubilee" Electronic Organ, September 1977

Owing to an error in the General Instruments Microelectronics data book for the year 1976 we have now been officially advised that the power supply connections to pins 8 and 14 of ICs 3 to 6 in the Jubilee organ have been reversed. Fortunately it is unlikely that any damage will have been sustained. In fact very few readers will have experienced any problem because of this transposition, but this is more as a result of luck than for any other reason. It is possible that some readers might have experienced "break up" of one or two notes because of faulty division.

Although your system may appear to be working quite satisfactorily it is not recommended that you permit this fault to go unremedied as no one can be sure what the long term effects might be on the i.c.s involved. Correction is very simple and should be carried out as follows:

1. Break the copper conductor on the underside of the board at the point marked in Fig. 1 and use a piece of tinned copper wire to make a bridge connection to the adjacent copper land.
2. On the upper side of the board remove, or cut through, link wire as shown, and using a short length of insulated wire run a connection from the hole adjacent to pin 8 of IC3 to the board pin nearest C44 of the three that are to the right of IC2.

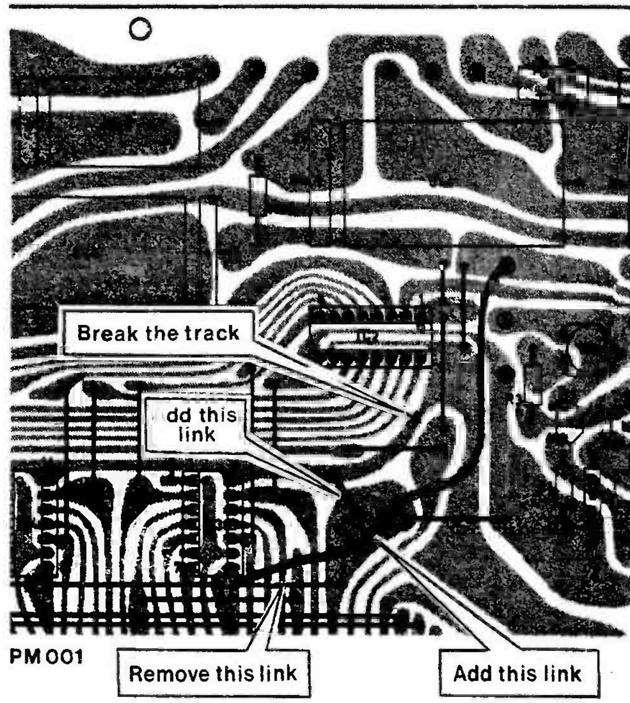


Fig. 1: The area of the p.c.b. to be amended

SIMPLE HIGH RESISTANCE VOLTMETER

C. ATTENBOROUGH

The CA 3130 op.amp. i.c. provides, for around £1, a performance for which one would have paid ten times as much only a few years ago.

Its high input impedance (typically 1,500,000 MΩ) and low input currents (a few tens of picoamps) make it very attractive as a buffer amplifier to a simple voltmeter, giving it a very high input impedance.

Fig. 1 shows how this can be done with the op.amp. shown connected to give a voltage gain of 1. This preserves the original calibration of the voltmeter.

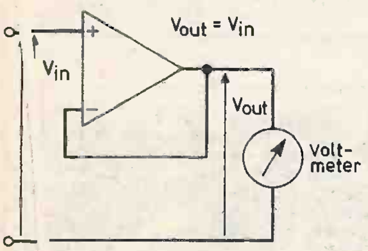
However, if we want to make a self-contained instrument, rather than an add-on buffer for an existing meter, we have a slight problem. Microammeters are more readily obtainable than voltmeters. Of course we could convert the microammeter into a voltmeter by adding a series resistor. For example, to convert a 100μA meter into a voltmeter with an f.s.d. of IV we would need a total resistance including the meter of 10kΩ.

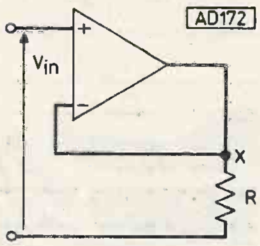
From this we have to deduct the meter resistance, if we know it, or use a variable resistance to set the f.s.d. of the voltmeter.

Fig. 2 shows how we can define the current flowing through the microammeter. The circuit is similar to Fig. 1. The high gain of the op.amp. forces the two inputs to be at the same potential. The input voltage appears across R and the current through R is $\frac{V_{in}}{R}$.

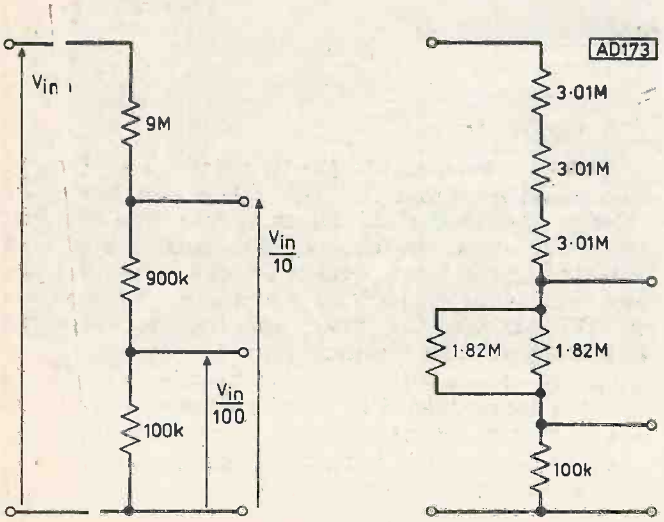
If we insert the microammeter at Point X, then the current through the meter will be the same as the current through R (we can neglect the op.amp. input current since it is only a few picoamps.)

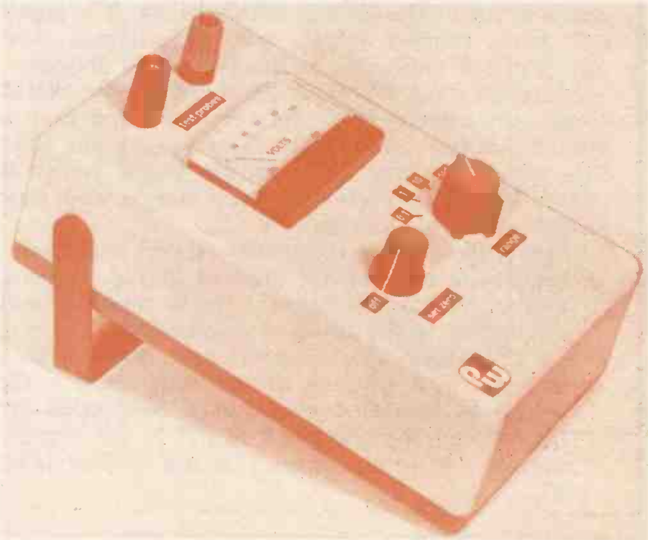
If we make R 10kΩ and apply 1V to the input we get 10μA flowing through Point X and this will hold for any meter resistance.

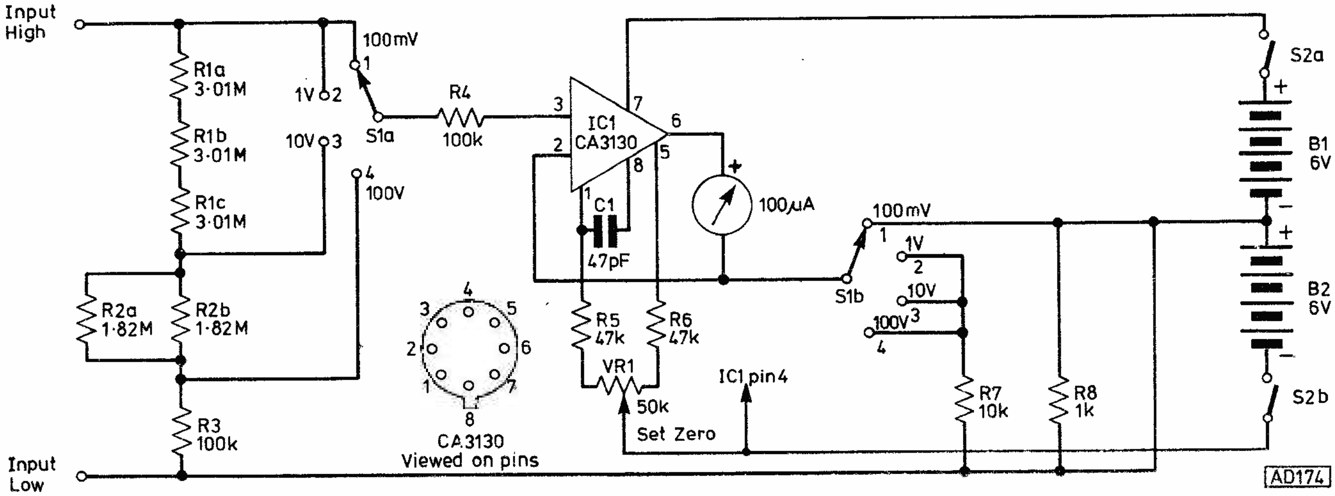




Figs. 1 and 2 (left) Showing, respectively, an op.amp. configuration providing an overall gain of 1, and a method to quantify the microammeter current in a similar circuit; also Fig. 3: (below) The dividing arrangement and the series-connected resistors which form the attenuator







▲ **Fig. 4: The main circuit diagram of the voltmeter. Note the polarity of the (dual) battery supply rails**

This is the basis for a multi-range d.c. voltmeter. For a 1V range R will be 10kΩ. If R is 1kΩ f.s.d. is 0·1V. When we come to the 10V and 100V ranges we cannot just increase R to 100kΩ and hence apply 10V to the op.amp. input, as the supply rails are only ±6V and the op.amp. cannot cope with inputs greater than the supply rails. So the input must be divided by 10 or 100 as appropriate and Fig. 3a shows how this is done. The resistor values are rather inconvenient and Fig. 3b shows how the input attenuator can be built using available resistors.

The complete circuit is shown in Fig. 4. C1 is a compensation capacitor to prevent instability. VR1 provides the means to set the meter current to zero with no input while R4 provides protection against excessive input currents which would flow if a high voltage was applied to the input with the op.amp. supplies turned off.

★ components

Resistors

¼W 5%
47kΩ 2 R5, R6
100kΩ 1 R4
½W 2%
1kΩ 1 R8
10kΩ 1 R7
100kΩ 1 R3
900kΩ R2 (See text)
9MΩ R1 (See text)

Potentiometers

50kΩ lin. 1 VR1

Capacitors

Ceramic 12V
47pF 1 C1

Semiconductors

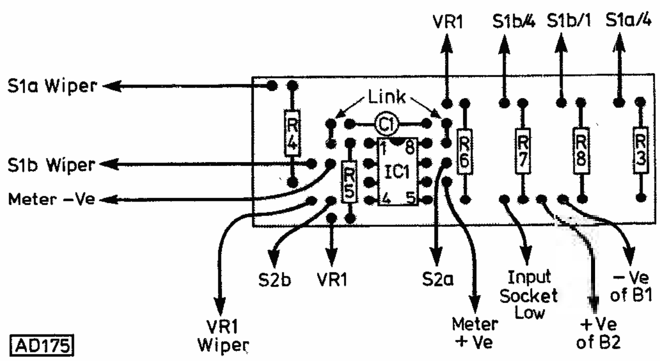
CA3130 1 IC1

Miscellaneous

Meter 100μA 58 × 46mm (1)
2p. 4w. switch (1) S1
dp on-off switch (1) S2
Veroboard 9 tracks × 21 holes, 0·1 inch matrix
Battery holders 4 × HP7 (2)
Input sockets for test leads
Case

Fig. 5: The practical layout on Veroboard; "break track" points are clearly shown, as are lead-outs to meter and switching points

▼



Construction

The main components are mounted on a piece of Veroboard as shown in Fig. 5. This can be either fitted to the back of the meter or into the case. The meter, VR1, both switches and the input sockets are mounted on the front panel of the case, which can be any suitable sized plastic or metal one. The two sets of HP7 batteries are fitted into the case and the instrument is ready for use.

Finally, it is as well to point out that R1 is constructed from three 3·01M resistors wired in series and mounted on S1. These are specialised types from Radio Resistor, but any adequate combination of close tolerance resistors would suffice. ●

'purbeck'

Part 6 (conclusion)

OSCILLOSCOPE

IAN HICKMAN

In the preceding parts, each board has been taken through to the point at which it is basically working, but we still have to perform setting up and calibration.

Until this is done, the instrument is no more than a "look-see box", whereas when calibrated, the amplitude and period (hence frequency) of repetitive waveforms can be read off directly from the graticule.

Before starting the setting up, finish off any tidying up still remaining, e.g. connect up the on/off switch if this was left earlier as suggested in Part 2.

Also, prepare the graticule and bezel if you are making these items yourself. The graticule is already printed accurately on the special front panel overlay available from the *PW* editorial offices.

This overlay can be used to provide the legends etc on the front panel if you are making your own casework. If you are using the ready made case by Bazelli then the annotations will be silk screened directly onto the front panel and a bezel and graticule supplied ready made. The bezel may be fabricated from 12·5mm aluminium angle, the four sides being stuck together at the corners with an epoxy adhesive such as Araldite, working on a sheet of graph paper to ensure a square assembly. A rubber band holds it together whilst the epoxy is setting and then, having drilled the fixing holes, it can be sprayed matt black with an aerosol spray can (from any motor accessory shop).

In addition to the support for the front end of the c.r.t. shown in Fig. 3 (the screws which fix this to the front panel also secure the graticule and bezel), the tube and mumetal screen are secured to the case top member with heavy grade p.v.c. tape.

A packing piece of soft wood and hardboard is epoxied to the case top member. The mumetal screen is a simple rolled tube which covers the neck of the tube.

Great care must be taken not to bend the mumetal to the point where it takes a permanent set, as this will greatly reduce its permeability and hence its effectiveness. Neatly lap both ends of the tube with a turn or two or self-adhesive tape to hold the edges together but not overlapping. Then insert several strips of self-adhesive draught excluder foam running the length of the bore, spacing them closely opposite the join. With the join at the top, the closely spaced strips of foam will support the tube, the other merely acting as spacers.

With this simple inexpensive screen there is only a very small amount of trace deflection due to the field of the specified mains transformer and it is only noticeable when displaying low frequency waveforms with frequencies which are a multiple of 50Hz.

The case details are shown in Figs 1 and 2. Enough details and dimensions are given to enable those who want to make their own casework.

Once all the mechanical work is complete, setting up and calibration can begin. Plug in and make sure the trace is horizontal, as described in Part 5. Next, adjust the balance control VR301 on the Y amplifier board.

This control compensates for the offsets in TR301, IC301 and circuit tolerances. It is adjusted so that there is no vertical movement of the trace as the "Variable" gain control VR302 is adjusted (Volts/Div Multiplier S301 in position 4). Now, C7-10 of the

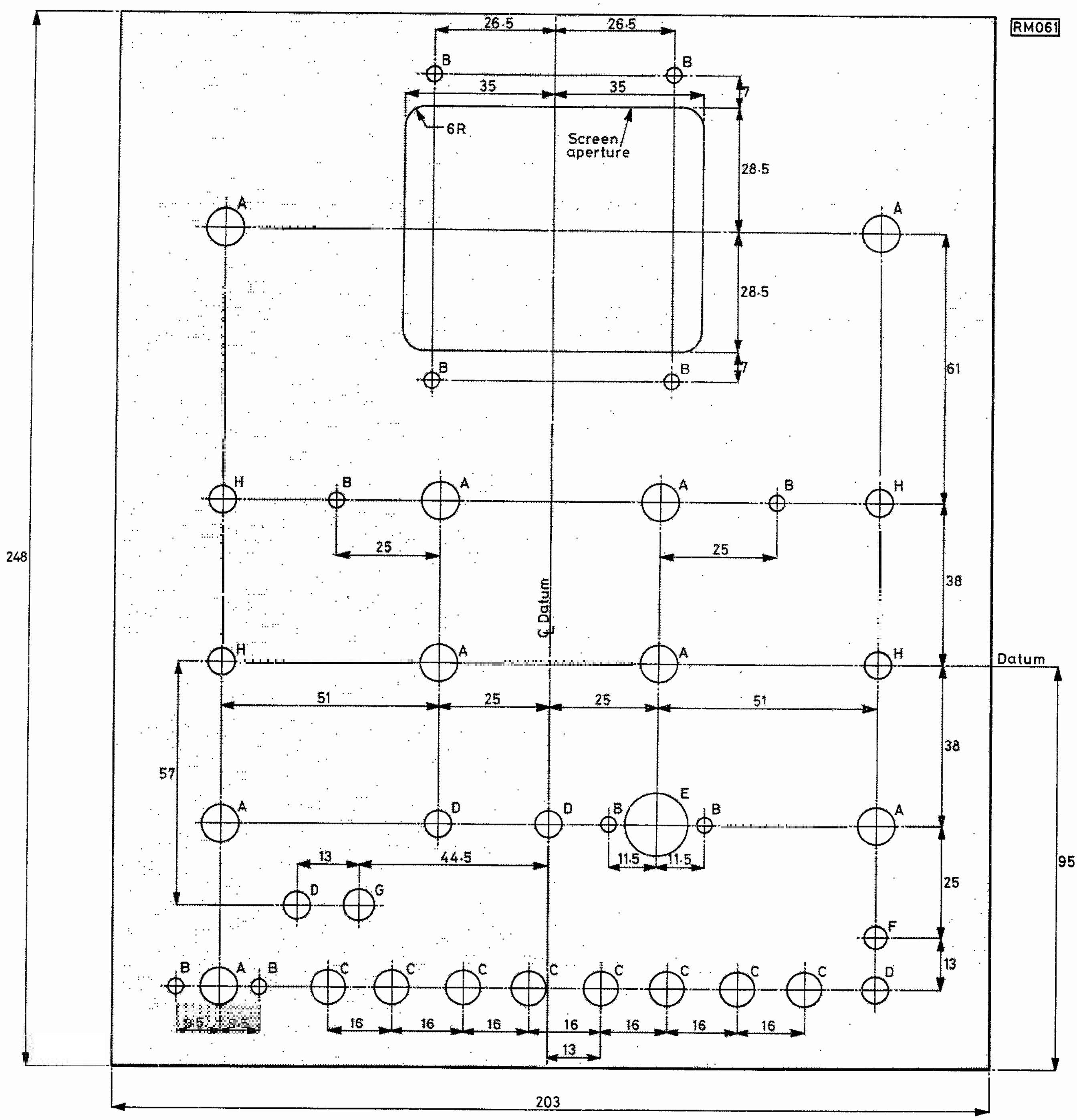


Fig. 1: Front panel drilling diagram. Hole sizes are: A 9·5mm, B 3mm, C 8·3mm, D 6mm, E 15mm, F 5mm, G 7·3mm, H 6.5mm. A transparent overlay is available from the *PW* Editorial Offices to fit this layout and includes an accurate photographically produced graticule. The overlay is designed to be used with the Sifam 15mm collet knobs specified in the collated parts list

Volts/Div switch S3B (input attenuator) should be set up as follows.

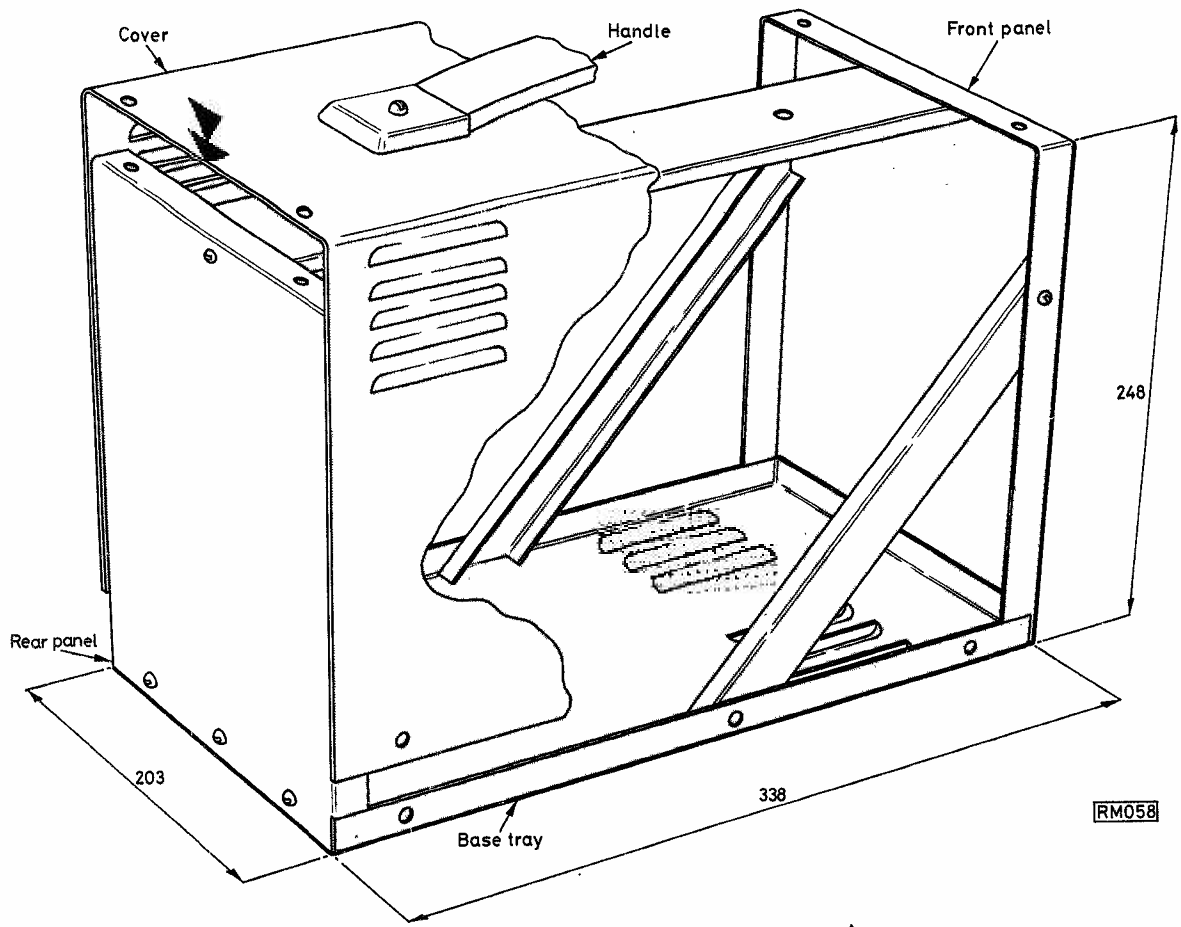
Set S3 to position 2 and connect a squarewave generator, set to 10kHz, to the Y input SKT 1. Adjust C7 for a square leading edge to the waveform, without either a spike or a slow risetime. Adjust C8, 9 and 10 similarly increasing the amplitude of the input squarewave as necessary.

With a 5V-pk to pk. squarewave it should prove possible to set up C10 if "Variable" gain control VR302 is set for maximum gain.

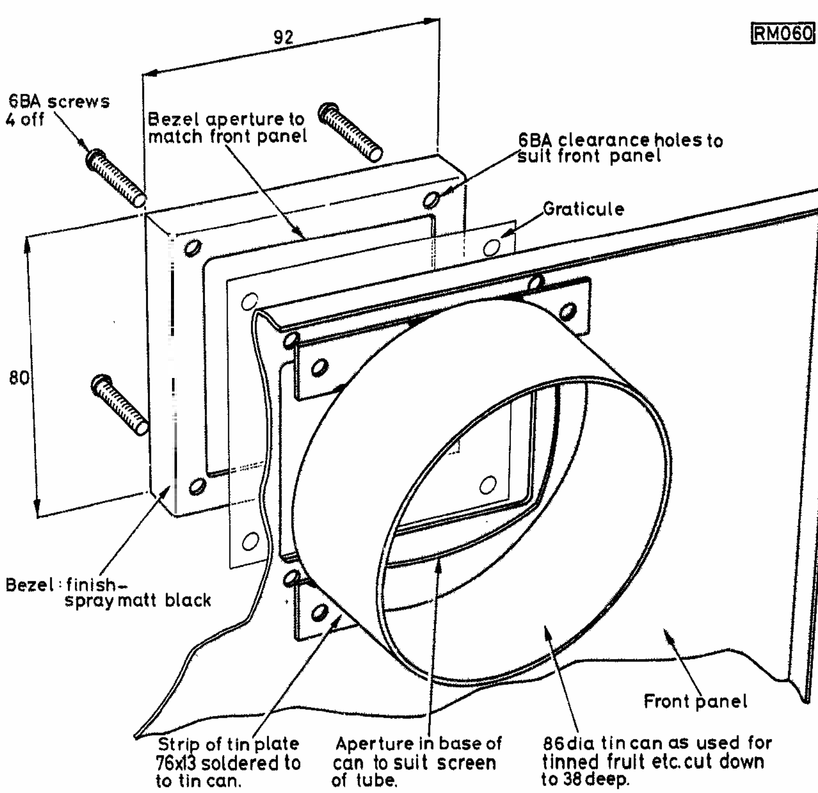
For now, C3 to 6 should be set to mid-travel; their setting up is carried out in conjunction with a 10 to 1 divider passive probe which will be described in a future article.

Next, apply a 10kHz sinewave to the input and set the controls for about 4 divisions of vertical deflection and about 5 complete cycles across the screen. Adjust VR201 (Astigmatism), and VR6 (Focus), alternately until the trace is finely focused both at the tips of the sinewave and on its flanks. As the oscilloscope supplies are fully stabilised, once VR201 has been set up it should not need adjusting again.

To set up the timebase, proceed as follows. Set S4 (Timebase), to position 4; VR3 (TB Variable), fully clockwise (Cal.) and S401 (TB Multiplier), to position



▲
Fig. 2: The basic case construction of the Purbeck. The production cases by Bazelli are made from steel sheet with the front panel markings silk screened



◀
Fig. 3: The method of fitting the c.r.t. to the front panel. The tube retaining ring is made from a suitable fruit tin cut down with two strips of tinplate soldered across as shown. The four 4BA screws pass through the bezel, graticule, front panel and the tube retainer with the nuts and washers behind the retainer strips

Fig. 4: The various mounting brackets and spacers used to hold the p.c.b.s to the case. Two brackets type (c) are required one on each of Board 3 and 4 to hold the controls. Board 1 mounts onto the case bottom and the transformer using brackets type (a) and (d). The two p.c.b. edge connectors are mounted using a pillar at the top and a type (b) bracket at the bottom ▶

1. Set RV407 (X Gain), fully anti-clockwise (Cal.), and adjust VR408 so that the trace length is exactly 10 divisions. Set timebase to position 2 and connect the Cal. Output (Socket 3) to Y Input (Socket 1). Set RV406 so that exactly five complete cycles of 50Hz Cal. squarewave appear on the screen. (The Cal. waveform is not exactly square, the top and bottom being slightly arched.) At position 2 of S401 set RV405 so that exactly 2½ cycles are displayed, 1 cycle at position 3 (RV404) and ½ of a cycle at position 4 (RV403).

Now connect the square wave generator to the Y input instead of the Cal. waveform. Set S401 to position 2 and adjust the frequency of the square wave to show exactly 10 cycles on the screen. Set S401 to position 5 and adjust RV402 to display exactly one cycle. If 1% capacitors have been used for C12-15, the other ranges will be correct, but 1% capacitors are both bulky and expensive. So alternatively, given enough to sort through, capacitors can be selected out from 5% or even 10% types.

In this case, having set up the 1 ms/Div. range (position 2 of S4) proceed as follows. With S401, (TB Multiplier), at position 4 (×1) set the square wave generator to give ten complete cycles on the display. Now set S4 to position 3 and check that the display shows exactly one cycle. If the display shows part of a second cycle as well, C13 is too large and another capacitor should be tried. If slightly less than one cycle is displayed, a small capacitor can be fitted in parallel as required.

WARNING

If you intend to use the Purbeck to service television sets it is **imperative** that you use a 1:1 mains isolating transformer to power the TV, you should not be tempted to remove the earth from the case of the Purbeck under any circumstances. To attempt to use any oscilloscope on a TV chassis, without an earth, could prove fatal as you could end up with the case of the 'scope being at mains potential.

Having got the 100 μs Div range correct, set the square wave generator to display ten cycles, switch S4 to position 4 and proceed as before.

In this way, all the timebase ranges can be set up, provided your squarewave generator goes up to 1MHz. If it only goes to 100kHz, the 100 ns Div range can be set thus: set S4 to position 5 (1μs/Div) and S401 to position 4 (×1). Set the square wave frequency to display exactly one cycle. Now set S4 to position 6 (100 ns/Div) and S401 to position 1 (×10), which gives the same timebase speed. Set C16 to display exactly one cycle.

The only remaining setting up is the adjustment of C309, which is set to provide the maximum bandwidth when the vertical deflection amplitude is one division.

The easiest method is to use a squarewave input and adjust for the fastest risetime which does not result in excessive overshoot—2 to 4% is normally regarded as acceptable.

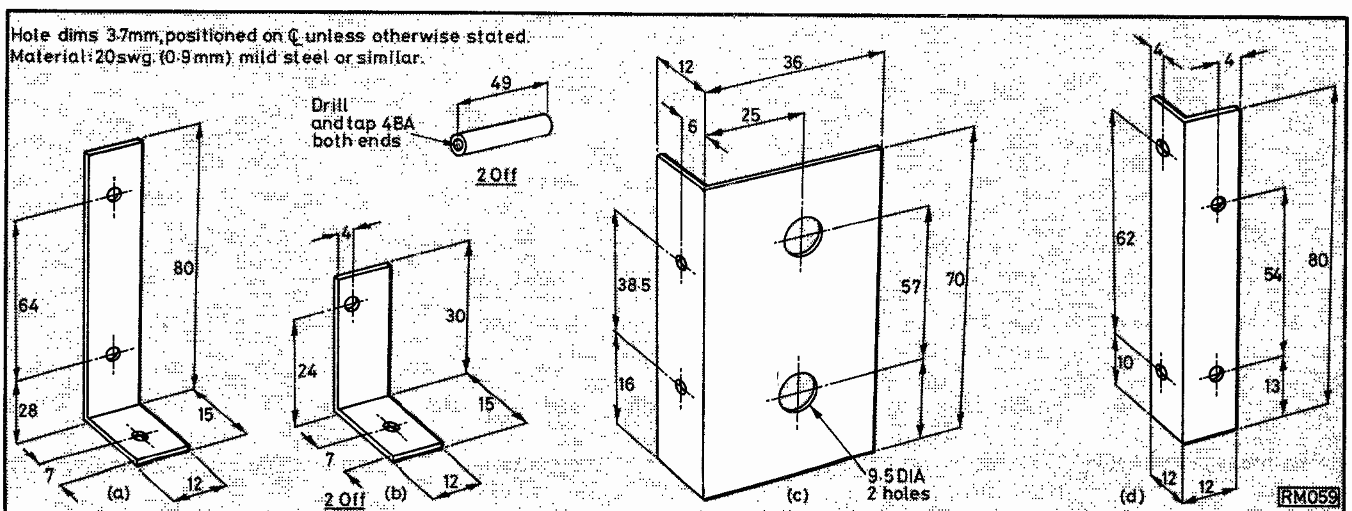
However, the rise and fall times of the squarewave need to be substantially shorter than those of the oscilloscope and this is in itself a fairly tall order.

A suitable squarewave circuit is shown in Fig. 5 and this can be driven from a sine wave oscillator or signal generator at frequencies up to 10MHz, 1 V rms being a suitable drive level.

The output should be connected to the Y input of the oscilloscope by very short leads to avoid ringing. With a 3MHz squarewave applied, adjust C309 for fastest rise and fall times consistent with minimal overshoot.

This completes the setting up and calibrating of the instrument, but there are still some facilities to test. The Cal. waveform at SKT 3 has already been mentioned and now we must check sockets 4-9. First, connect a 1kHz sinewave to 3V peak to peak to SKT 4 (X Input). Set S4 to position 1 (Ext. Input) and check that a horizontal trace is obtained. (VR4, X Shift may be used to centre it). If SKT 4 is also strapped to the Y input, a sloping trace should appear, but note that VR1 (Trig Level) should be turned to one or other end of its travel to prevent the timebase circuit firing. This will prevent Tr403 applying blanking pulses to the c.r.t. grid.

Alternatively the Int. Ext. Trig. switch S6 can be set to Ext. when using an external X input. The external trigger facility is in fact the next item to test. With



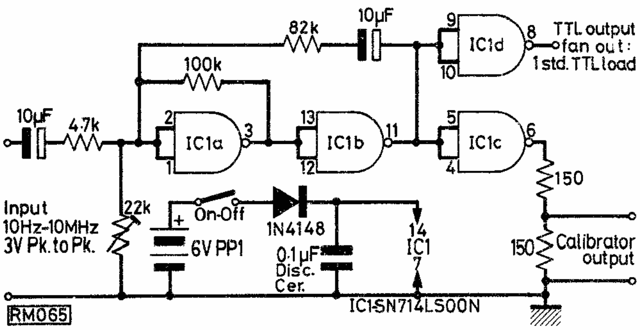


Fig. 5: A suitable squarewave generator used to set up the scope

S6 at Ext., connect a 1kHz sinewave of about 500 mV peak to peak to SKT 5, also to the Y input (SKT 1).

Check that the display triggers normally, but that it free-runs when the sine wave is connected only to the Y input. Check also that when SKT 6 is used instead of SKT 5, triggering is also correct provided 50V peak to peak is applied. Next connect the Y input to SKT, 7 the sweep output and with S6 at Ext. trigger, a sloping line should be seen on the screen. With the Y input connected to SKT 9, (Alternate Gate output), two horizontal traces appear, the distance between them corresponding to about 3·7V as the output switches from "0" to "1" on alternate sweeps.

The Gate output at SKT 8 is more difficult to check, as it sits at logic 0 during the scan and at 1 only during flyback. However, by switching to the fastest time base speed, it should be possible to see, at the left hand end of the trace, the output falling to logic 0, accompanied by some ringing.

Apart from the adjustment of C3-6 in conjunction with a probe, mentioned earlier, the oscilloscope really is now complete as far as construction, setting up and calibration are concerned.

However, before screwing it all up tight, just place the cover in position without any fixing screws and give the instrument a 2 hour soak-test; it can conveniently be left displaying its own Cal waveform.

At the end of two hours, unplug from the mains, remove the cover and feel all the Stabiliser board heat sinks. They should not be too hot to touch comfortably.

If you are already used to using an oscilloscope, you will have observed that the performance of the one you now possess is very creditable by any standards. If not, you will find the *PW* Oscilloscope very easy to use, particularly on account of its stable triggering.

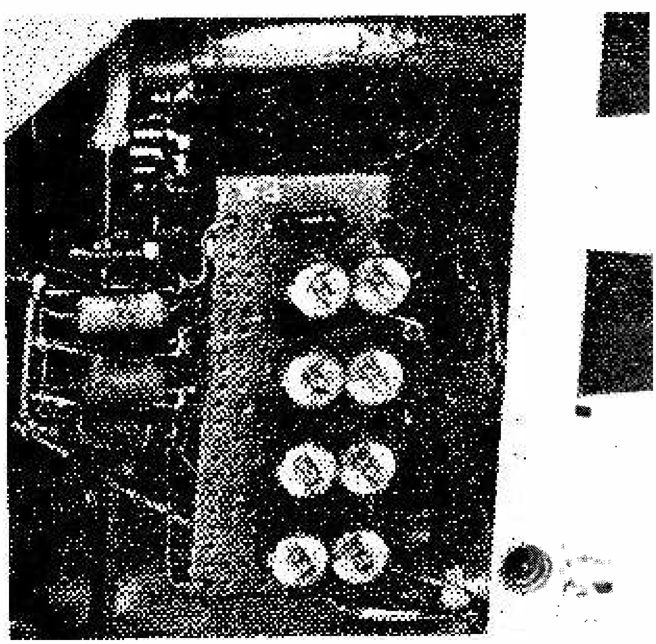
The trigger point can be set so precisely, right up to either tip of the waveform on either the positive or the negative going edge that, although line and frame sync. separator circuits are not built in, in should be simple to trigger from the line sync. pulses in a composite video waveform.

A point worth noting is that with any oscilloscope, there will be certain Y input signal frequencies for which the trigger gate opens just at the same time as the next trigger pulse arrives. The timebase may then fire on that pulse or on the next, possibly resulting in slight jitter of the trace.

If this should be experienced, it is easily prevented by slightly adjusting VR3, TB Speed Variable.

Another point worth noting is the purpose of S2, Beam Finder. When looking for very small a.c. signals riding on a much larger d.c. voltage, e.g. ripple

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.



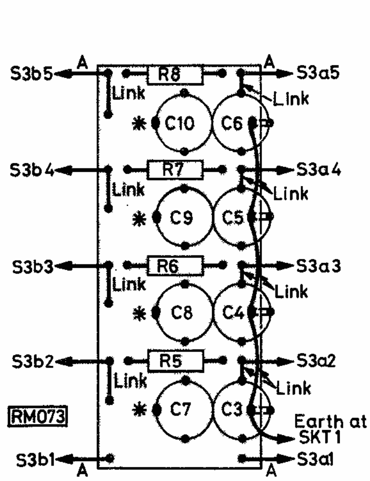
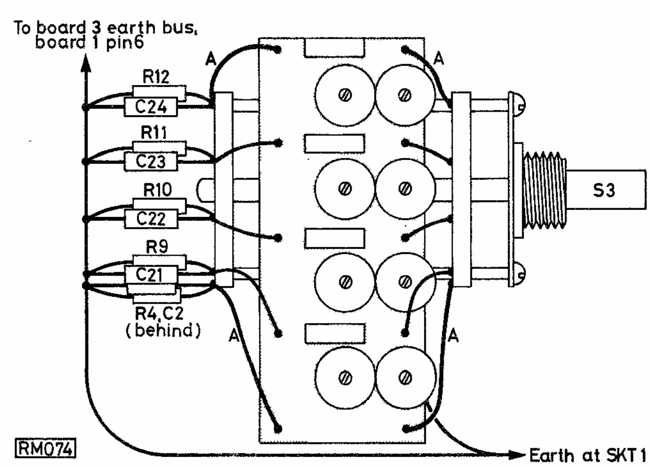


Fig. 6: This photograph shows the mounting and layout of the input attenuator

Fig. 7: Veroboard layout of the input attenuator

Fig. 8: This drawing shows how the input attenuator is mounted onto S3



on a power supply output, it is necessary to use a.c. coupling and a sensitive setting of the Input Range switch. This results in the trace being driven off screen by the large d.c. input and owing to the 0·1 second time constant of the a.c. coupling, many seconds can elapse before the trace reappears.

In these circumstances, pushing the press-button S2 will momentarily ground the "downstream" side of C1, causing it to charge rapidly and restoring the trace to mid-screen.

These and other aspects of driving an oscilloscope are best appreciated by actually using the instrument. Once you are used to using your own 'scope you will wonder how anybody ever manages without one.

Trying to track down a malfunction in even the simplest circuit can be disheartening and downright impossible without a 'scope—it is like fumbling in the dark.

In particular, circuits can suffer from parasitic oscillations, after all even the general purpose BC 107/108/109 family of transistors universally used in a.f. circuits have an f_T of 300 MHz. It only needs an unfortunate wiring run of several inches to turn an a.f. amplifier into an r.f. oscillator! The stage may still work as an a.f. amplifier, but with increased distortion. It is with problems like these, which cannot be diagnosed with an AVO, that an oscilloscope comes into its own.

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.

This concludes the series on constructing the *PW* Purbeck oscilloscope. However it is intended to produce several accessories for use with this instrument and these will appear in future issues.

It is also hoped to publish an article in the next few months which will be based on readers' experiences in building the scope and also articles on using it.

As a final note, please take notice of the various warnings published with the series, they will save you a lot of heartache, money and possibly your life.

Corrections

The X and Y plate connections to the c.r.t. are as follows: X1 pin 10, X2 pin 11, Y1 pin 8, Y2 pin 7.

In Part 5 (August) Fig. 1 IC404 pins 12 and 13 should be interchanged. The wiring diagram Fig. 4 is correct.

The stabilised +150V supply should not be run off-load as R203 will overheat. Changing R203 to a 4W wire-wound type of the same value (10kΩ) will prevent possible failure if the supply is unloaded for any reason.

The transparent front panel overlay is available from the PW Editorial Offices, Westover House, West Quay Road, Poole, Dorset. Price £2·25 including p&p.

PRINTED CIRCUIT BOARDS SERVICE FOR *PW* PROJECTS

It has now been decided, commencing with our issue dated September 1978, to enlarge the facilities for the supply of p.c.b.s to readers by authorising additional suppliers. It is hoped that readers may benefit from being able to purchase boards as part of component kits, thereby reducing the number of separate orders for a project.

For some time, most p.c.b.s published in *Practical Wireless* have been available exclusively from Reader's PCB Services Ltd., P.O. Box 11, Worksop, Notts, who will continue to be a supplier and to whom we would wish to say thank you for helping us to get the service started.

Applications for permission to reproduce boards for resale must be made to the editor in writing.

AM RECEIVERS—
DEVICES & CIRCUITS

Due to pressure on space, Part 2 of this series has been held over until our next issue.

Modernising A VALVED RECEIVER

R. BRETT KNOWLES

It sometimes happens that an existing valved receiver has reached the end of its useful life, but it is desired to update its performance without changing the external appearance. Perhaps it may be a radiogram which is a cherished piece of furniture, or, as considered here, a specialised receiver for which it is difficult to find a replacement.

The London Sailing Project had an old valved receiver which covered the long, medium and trawler (1·6 to 3MHz) bands, operating from the boat's 24 volt d.c. supply by means of a rotary converter. It was decided that the set should be modernised during the winter refit and I undertook to do it. It is hoped that some of the techniques may benefit others.

The original circuit was quite conventional, KTW61 r.f. stage, X65 mixer, two KTW61 i.f. amplifiers, DH63 detector and a.f., 6V6 output and 12AT7 b.f.o., the latter being a plug-in unit with an octal socket in the set to accommodate it. There did not seem any point in disturbing the coil pack and tuning arrangements, which would be necessary if bipolar transistors were to be used, so f.e.t.s were considered. The dual-gate m.o.s.f.e.t. is so very similar to a valve in its peripheral requirements that it looked like the obvious choice, and the first step was to replace the r.f. valve by an RCA 40673, retaining for the moment all the original beyond the r.f. stage. This was not an unqualified success, the stage was unstable on the long wave band; damping the coil concerned cured it, not elegant but a quick solution. Another 40673 was used to replace the hexode part of the mixer, and a 2N3819 replaced the triode oscillator. Fig. 1 shows the circuit, whose only real difference from the original was the change from 250 volts h.t. to 20, even the a.g.c. was compatible, though it was finally removed. The mixer caused no problems and so the next step was to rebuild the i.f. and a.f. stages completely, on printed circuit boards.

The IF and AF Stages

Starting from scratch, or almost so gives a wide choice of possible configurations. The first i.f. transformer was left (Fig. 2) and naturally was designed for high impedance, calling for the f.e.t. again, but only 2N3819 were available, all the dual-gate ones available being used up. Some Transfilters were also on hand and I wanted to use them since they need no tuning and do not drift. By using top-end capacitive coupling I found I could get text-book type coupled circuit response with two of them, but the 2N3819 has too much feedback capacity to allow driving the Transfilter directly, so the cascode was tried, using a BF195 as the upper element. Some a.g.c. was applied by using a common emitter BC107 as the bias element, normally in saturation. When gain is to be reduced, the BC107 is taken out of saturation, which increases the bias on the 2N3819 and applies current feedback at the same time. This allows a wide dynamic range, and the feedback reduces the likelihood of intermodulation as the gain is reduced.

The Transfilters are followed by the conventional bipolar stages with single tuned coupling, to remove the spurious responses. Only the first stage has reverse a.g.c. applied, the last i.f. stage is without a.g.c. since it has to feed the detector with a constant level signal regardless of the overall gain of the system. The two tuned circuits have a high unloaded Q, but operate at a Q of the order of 50, and are stagger-tuned to give a flat overall bandpass of $\pm$3kHz with steep sides.

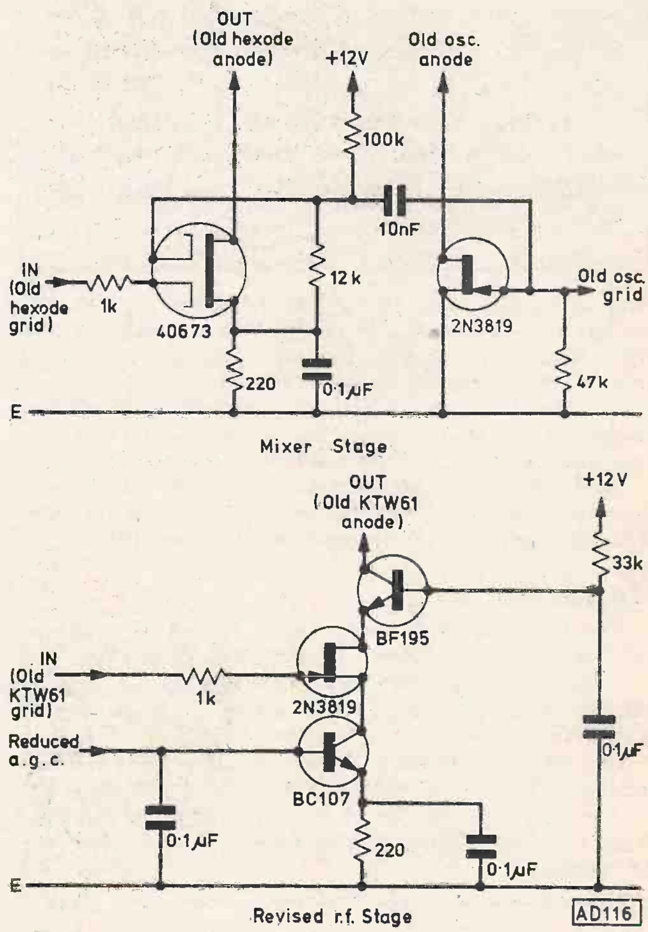


Fig. 1: The mixer stage and the final version of the r.f. stage, using a cascode amplifier

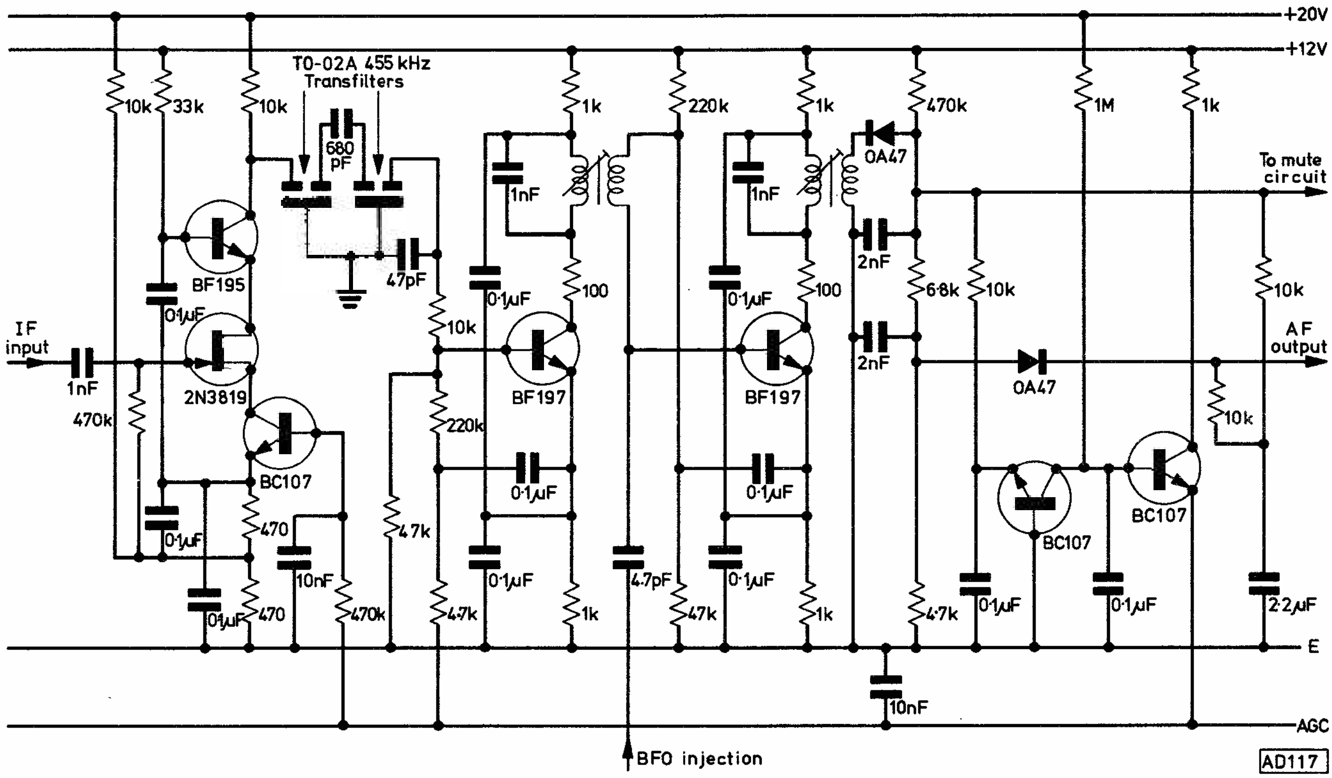


Fig. 2: The i.f. and a.f. amplifier stages

A transistor detector was tried, but the overload performance was not satisfactory, and a simple biased germanium diode with series noise limiter proved the best. Reverse a.g.c. is derived from the diode, amplified by a common base BC107 and emitter follower.

The b.f.o. injection takes place at the base of the last i.f. transistor, at a level below the a.g.c. threshold. The b.f.o. uses another Transfilter and BF195, built into an old octal valve base, and plugged into the original socket.

The a.f. output stage uses a complementary pair of germanium transistors in a conventional circuit. Volume control is by a series resistor at the input to the a.f. amplifier; this prevents reduction to zero volume, a feature required by the users of this receiver.

Muting

The set is used to keep watch on either 2182kHz (calling and distress) or one of the inter-ship channels, for long periods, and it is distracting to have to listen to noise. The co-fitted v.h.f. equipment has muting which cuts off the loudspeaker unless a signal sufficiently far above noise is coming in, and a similar facility was wanted on the m.f. receiver. On v.h.f. f.m., muting presents little problem owing to the reduction in supersonic noise when a signal is being received, but a.m. does not possess this property, and also the noise is due to unwanted external signals rather than thermal noise. The set is designed to receive a.m., not s.s.b., and there is one effect that can be exploited.

The bandwidth of the receiver is 6kHz overall, and in the absence of a carrier, post-detector noise will occupy all this. When a carrier is tuned in to the centre of the pass-band, the noise will increase (assuming no a.g.c. action yet) but it will be due to the carrier beating with 3kHz components and so be only 3kHz wide. This is the phenomenon which allows an operator to tune his set on a carrier only, by the sound of the noise.

The muting switch (Fig. 3) receives four inputs, a.g.c. voltage, detector voltage, rectified 5kHz noise and bistable voltage. The first two act to unmute the receiver, both before and after the a.g.c. threshold is reached, the third mutes the receiver when present, and the last provides a degree of backlash so that the receiver does not pop in and out as the muting threshold is reached. The fraction of a.g.c. voltage fed in determines the threshold. On trial the circuit reliably unmutes to a signal which is too noisy to read at the low threshold end of its range, so there is no possibility of missing a weak signal unintentionally, though of course it can be set to unmute at any wanted level above this.

Power Stabiliser

The boat's supply comes from twelve lead-acid cells, which are charged either from an alternator on the main engine, or by an auxiliary petrol electric set. The input voltage can vary between 22 and 30 according to whether the battery is exhausted or on charge. Since the total consumption of the modified receiver is so low, it is a practical possibility to stabilise the entire supply to it, with the exception of the dial lights (whose consumption exceeds the quiescent current of the remainder).

Two stabilised voltages are required, 20 and 12, and operation down to 22 volts is expected, which allows little to be wasted in the higher voltage stabiliser. An unusual configuration is adopted to

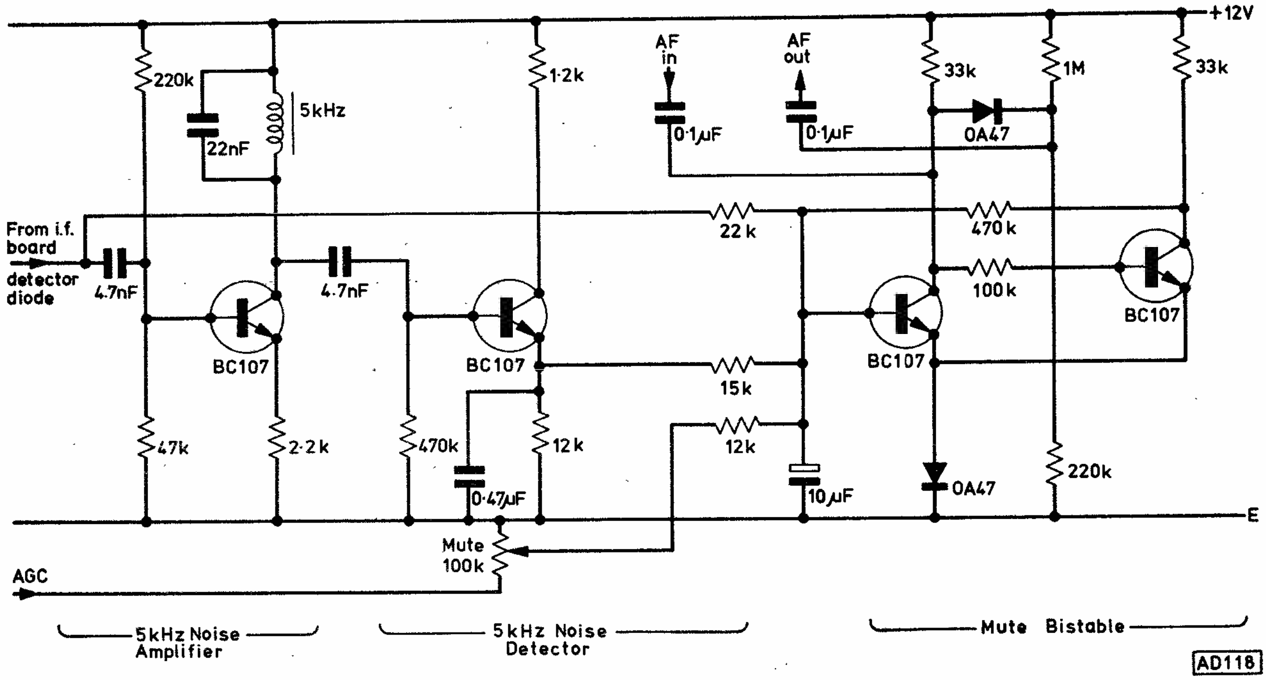


Fig. 3: Circuit diagram of the muting switch

permit this, and also to reduce the ripple caused by charging from an alternator.

The series pass transistor is operated in the common emitter mode rather than the more usual emitter follower, and the reference voltage is derived from the stabilised output instead of the raw input. The dilemma of not starting until there is a reference, and not having a reference until the stabiliser has started is solved by feeding the pass transistor base from the negative line through an f.e.t. and a *pnp* emitter follower.

A junction f.e.t. is, by definition, operating in the depletion mode and needs bias to turn it off; which bias is developed only when the fraction of the output at the base of Tr4 exceeds the reference voltage. Starting current reaches the base of Tr1 from the negative line through the 330 ohm resistor and Tr2 which is itself biased on by the current through the lower 47kΩ resistor and Tr3. Since Tr4 is not yet on there will be no current through the upper 47kΩ resistor and Tr3 will have its gate and source at the same potential. Under these conditions Tr3 conducts, although there is not yet any output voltage. However, since Tr1 is on, output voltage will be rapidly built up, until Tr4 is biased on, when negative bias will be applied between Tr3 gate and source, reducing the current through it and ultimately Tr1, until equilibrium is reached.

The 330 ohm resistor is there to limit the current through Tr2 if the output is prevented from reaching the demanded level, say by excessive load current. If it were not there, under these conditions a forward biased diode (Tr1 base-emitter diode) and a saturated transistor would be in series across the input, and this combination will pass a large indeterminate current. This resistor gives current limiting, at a

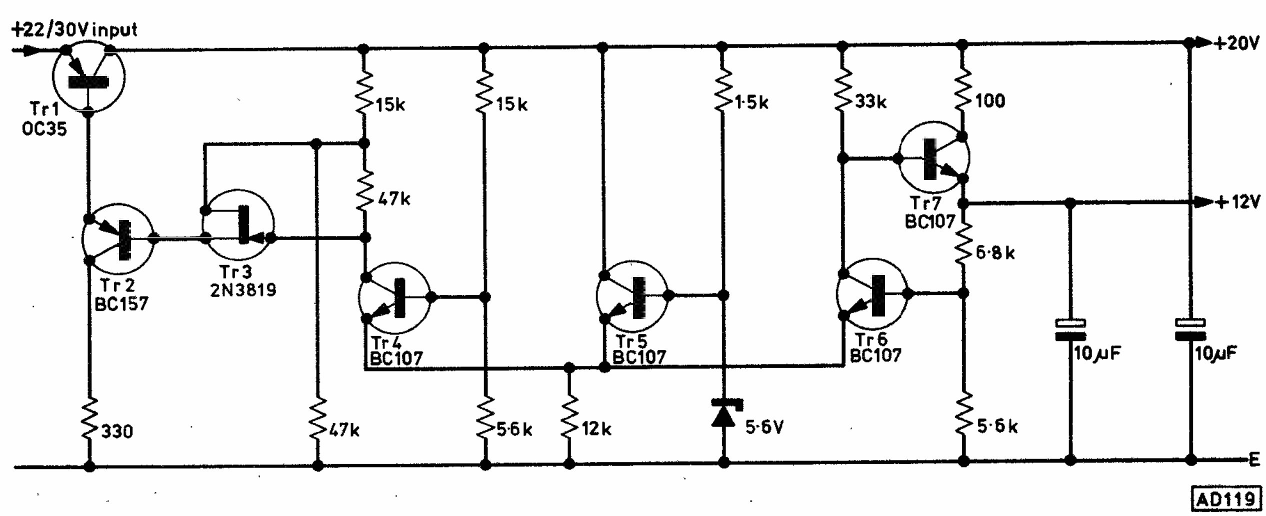
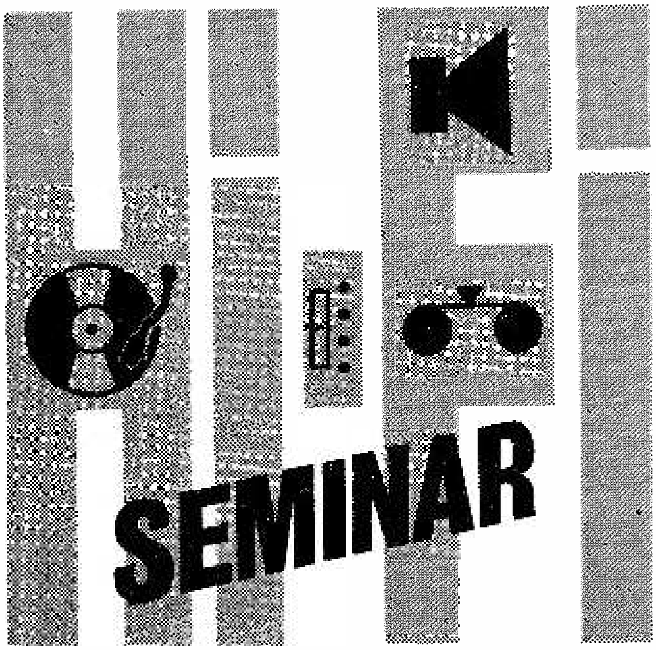


Fig. 4: The dual stabilised power supply

Continued on page 64



Whether it was the counter-attraction of Derby Day or the World Cup which caused the poor attendance at the recent seminar "Considerations for High Fidelity Reproduction" organised by the Society of Electronic and Radio Technicians, is debatable. What is certain is that those who did go along enjoyed a very informative and entertaining time. In fact, several said they could happily have spent the whole day listening to any one of the speakers.

James Moir, in his paper "Loudspeakers" considered that the best of today's designs are sufficiently good to make it very difficult to improve on them, though opinions differ on the most desirable sound distribution pattern. He outlined some of the problems experienced in testing loudspeakers, for instance in differentiating between intermodulation and distortion due to Doppler effect.

Some of the relative merits of valves and transistors when used in audio amplifiers were explored by John Linsley-Hood. He commented upon the apparent preference of listeners for reproduced sound including a controlled amount of distortion, and the fact that this was more easily obtained from valved amplifiers, or from those using the "power MOSFET" devices. Considerable work remained to be done on improving feedback stability margins, as a means of enhancing an amplifier's transient performance.

John Borwick reviewed the various problems involved in obtaining faithful reproduction from the gramophone record, still the most popular medium for home enjoyment of recorded music.

In a paper on Tuners by Angus McKenzie, lavishly illustrated by tape recordings of tests on a number of commercial designs, various shortcomings in performance were explored in depth. Little comfort could be drawn from the fact that the only model which seemed capable of what could be termed good all-round performance was one currently retailing at around £600!

The final paper, on the Technology of Magnetic Tape, by Basil Lane, left us in little doubt that the tape recording field is in a mess, with the proliferation of tape types generally resulting in poorer performance (because of incompatibility between tape and machine) instead of the improvement claimed by manufacturers.

GCA

MODERNISING A VALVED RECEIVER

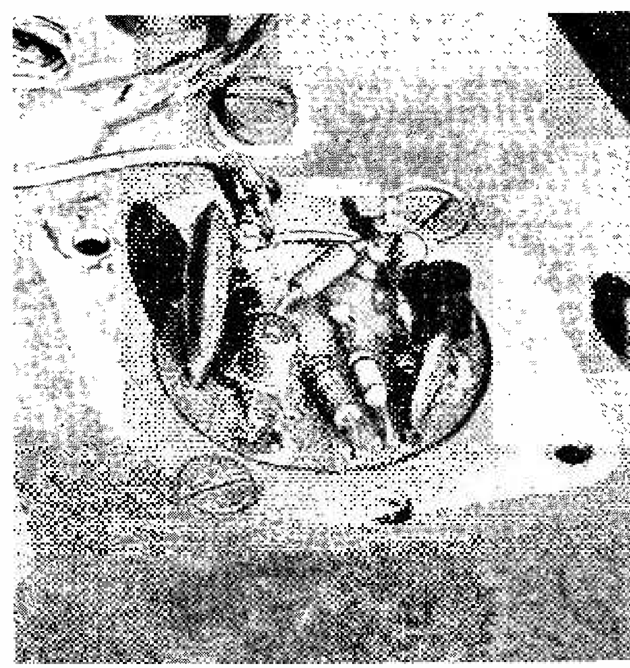
continued from page 62

value set by the h_{FE} of Tr1; a better limiter would be an emitter resistor for Tr1 and a base bypass diode in the conventional circuit. This was not used because it would need a higher differential between input and output voltages than permissible.

The 12 volt stabiliser uses a difference amplifier (Tr5, Tr6) and emitter follower (Tr7), with resistive current limiting, to prevent loss of transistors due to accidental short circuits.

Trials

At this point the set was tried in harbour and showed two faults; insufficient a.g.c. range to cope with transmissions from an adjacent ship, and near instability of the r.f. stage. The dual-gate transistor was at the bottom of both these troubles and it was replaced by the same cascode that was used in the



The replacement circuitry was assembled on small p.c.b.s, each fitted in place of one of the removed valve-holders

Transfilter i.f. stage, but with reduced a.g.c. voltage applied to make the r.f. stage the last to lose its gain as the signal increased. This circuit is shown in Fig. 1 in place of the dual gate. The early experiments were done with the components soldered to the pins of the octal valveholders, but p.c.b.s were later fitted as shown in the photograph.

Now the stage became completely stable without the damping resistors, the dynamic range allowed communication with adjacent ships and so modernisation ended with the set being used on the first trip of the following season.

HOTLINES

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

Silent microphone

Tape recorder buffs are doubtless aware of the problems of noise when a microphone is built in to the recorder itself. This popular trend commonly employs electret microphones and the real problem is the noise generated by the recorder itself things like motor noise and vibrations.

A Japanese company believes it has the answer and is to use a new type of noise-cancelling microphone in its new models, probably starting in the Autumn of this year. Once in-house demands have been met, the microphones will probably be made available to other users.

Many cassette recorders use electret microphones whose diaphragms are some 20—25μm thick and because of this thickness noise, particularly low frequency noise, can be a great problem. Like most problems, the solution has been a compromise often achieved by keeping the amplifier turned down i.e. less sensitive and therefore not so prone to pick up the noise. However, a certain lower sensitivity limit is reached before the practical performance of the unit is degraded. This also has the effect of making the tape noisy on playback.

Using the new noise-cancelling microphone, the Japanese engineers (usually scrupulously accurate in recording details—especially technical ones!) claim that below 500Hz their new microphone has a noise reduction of at least 30dB better than the electret. The secret is the use of a new material which is extremely thin. Two 'pieces' of this are set either side of the microphone. When the low frequency noise enters the microphone housing it hits both very thin diaphragms and induces in them two equal but opposite voltages—and these, of course, cancel. The construction of the complete microphone unit (I dare not start to explain the theory and thinking behind the acoustic design) is such that the low-frequency response is extremely good. A key factor here is the capacitance of the microphone which is some sixty times larger than that of the electret. Sounds a good product.

Magnetic Liquidity

Careful, your loudspeaker's leaking. Not true at the moment but it could be so if the new units from Germany are any indication. The range includes both tweeters and woofers and all stations to Acton etc. The secret is a thing called "Magnetofluid". It is claimed that the magnetic conductivity of the space in which a loudspeaker coil vibrates can be increased by 100-times if one uses this magic jollop. The fluid itself consists of a liquid which has iron oxide particles suspended in it. Higher notes have a greater brilliance than with "ordinary" conventional speakers, according to reports. Ideal for listening to Handel's water music, no doubt.

Power station

Now that lamp dimmers have become everyday items with circuitry appearing regularly in the pages of constructional journals, it's refreshing to know that the manufacturers of things like triacs are not just standing still. The latest device of this type to hit the market should cater for almost anything. It's a silicon-controlled rectifier (s.c.r.) which can handle 3MW (three million watts); up to 2,400V at up to 2,500 amps. A right little glow worm dimmer! I was amused to read the line at the very end of the literature describing this device which gave the price per unit "...in lots of ten". Housed in a hermetically-sealed garage, no doubt.

Super 555

For the power misers among us, keep an eye open for a new i.c. from Exar. It's named the XR-L555 and it is pin-compatible with the popular 555 timer i.c. The difference is that the new i.c. draws only one fifteenth of the power of the older chips. Another useful fact is its ability to keep timing accuracy even when the voltage applied is reduced to a mean 2·7V.

Talking chips

Using electronics to synthesise or generate plain language is something being played with in almost every corner of the world. Simple systems have started to appear but the newest one is quite something—it's a simple p.c.b. with a couple of innocent-looking i.c.s and about half-a-dozen discrete components.

The startling thing about it is that it has a 24-word vocabulary; in four languages—Arabic, English, French and German. The little module requires only two supplies (−5V and −15V), audio filter, amplifier and loudspeaker to make it operate. And the price is only around 150 American dollars.

I can visualise the harrowing scene in years to come of all these sophisticated computers, programmed for every language in the world, having a late evening chat—as they idly roast another human for supper

Shrinking trimmers

I was interested to see the launch recently of a thing called a "Multifunction Trimmer". This is a 16-pin dual in-line i.c.-size package which houses four separate and fully adjustable potentiometers. Adjustment of exact ohmic values is done using a small-bladed screwdriver and the four adjusting slots are easily accessible from the top of the d.i.l. package.

It occurs to me that this would probably be the ideal way for electronic musical instrument enthusiasts (organs come to mind immediately) to adjust the pitch of individual notes. Four of these modules could cover the 13 notes of the scale leaving the remaining three pots for other adjustments. They could also be useful in RC circuits for things like frequency response, or timing circuits, and would take up very little space indeed. Not available on the Amateur market at the time of writing.

Ginsberg

ON THE AIR

AMATEUR BANDS

by Eric Dowdeswell G4AR

As the time for the 1979 World Administrative Radio Conference in Geneva approaches there is bound to be an increasing amount of rumour and speculation on the likely outcome of the conference as far as the amateurs are concerned.

Already I have had letters on the matter, mostly quoting second or third-hand information heard on the bands, but which, if repeated often enough, starts to become "authoritative". As with previous conferences of this nature the only sensible approach is to **ignore all stories and rumours.**

Most national telecommunication authorities will be submitting their own proposals to the conference and some of these may not favour amateur radio. Some will ask for additional bands and facilities on the principle that there is no harm in asking. It is important to remember that the amateur bands are only one comparatively small part of the frequency spectrum to be considered by the conference.

As long ago as October 1976 the International Amateur Radio Union (formed of virtually every national amateur radio society in the world) circulated agreed proposals for the conference to every member society. As these proposals included additional allocations at 10·1, 18·1 and 24MHz, plus another from 160 to 200kHz in Regions 2 and 3, these may well have been the reason for the speculation encountered on the air.

Let us leave it to our own RSGB to keep us in touch with events and subsequent decisions, mainly through GB2RS and *Radio Communication.*

Newcomers to the Column

Regular reader **John Williams** of Braintree, Essex has at last made himself known to us. He took the RAE in May and is all atremble waiting for postman with that lovely bit of paper that says "pass"! He intends to go ahead with the code test for his G4 ticket after a period with his G8. For the time being he is the lucky owner of a 75A1 receiver, with a short wire aerial.

Frank Shaw is near Penrith in Cumbria and has been a *PW* fan for 30 years but has only now got around to joining the RSGB, as BRS38645, and to start listening on the amateur bands. A war-time op, Frank is not too impressed with the code of some of the lads, mainly due, in my humble opinion, to the lack of courtesy of some ops of not adjusting their sending speed to suit the other fellow, always a mark of a good op. Frank has completed a Heathkit SB303 and has a number of half-wave aerials for different bands. He expects to take the RAE next December so here's wishing you well OM.

From Godalming, Surrey, **David Parker** blames the column for setting him on the slippery slope to amateur radio but at the moment "A" level exams are taking up the time. Receiver is an HQ120X with a homebrew a.t.u. and 40ft of wire. David is another hoping to get a ticket following the next RAE, with enthusiasm whetted by joining his local club.

Round the Bands

John Whiting (Fareham, Hants) mentions a good find, VR6TC on Pitcairn, on 20m s.s.b., one country I sought for many years but never worked. **J. Hodgson** (Morpeth, Northumberland) must have been pleased with JT1AN, also 20m s.s.b., while KZ5DK on the same band is a country not heard all that often. Likewise KG4FW in Guantanamo Bay on 15m s.s.b. In Herne Bay, Kent, **D. Waddell** is one of the few readers reporting c.w. loggings these days. For his pains he found goodie JT1KAA in Mongolia, KM6BI on Midway Is. and ZK2AV in Nuie Is. in the Pacific, all on 15m. A knowledge of the code gives any op a decided advantage over the s.s.b.-only types so get down to it and let us have some c.w. logs for a change! Anyone can copy s.s.b.!

Ten metres claimed the attention of **Brian Harrison** in Hastings, Sussex, where he logged J3AAG in Grenada, KV4KV in the Virgin Is. and 7Q7LW in Malawi, all with his AR88 and long wire. **Martin Leizers** of Newport is mothballing his DX160 and 250ft wire for a while, concentrating on his exams. In a last fling he copied CX3TU, HI5MAG, and ZP5EF on 40m s.s.b., J3AH Grenada, KM6FC plus WD9FCC/VQ9 on Chagos Is. on 20m. Nepal in the shape of 9N1MM was collected on the 10m band.

A 2m converter has been added to the FRG-7 of **J. Goodier** who operates in Marple, near Stockport so hopefully some 2m logs will follow soon. In the meantime his s.s.b. log shows J3AH and the elusive VR6TC on Pitcairn. **Dick Smith** found A5JO, ostensibly from Bhutan, from his shack in Porthcawl, Mid-Glam., which is indeed a rare one for the records.

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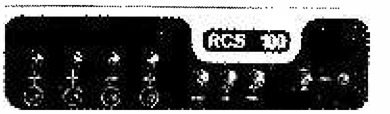

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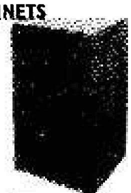

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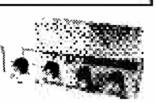

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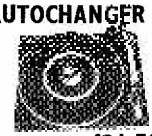

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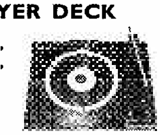

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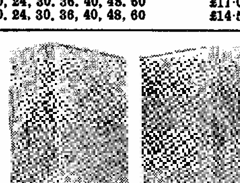

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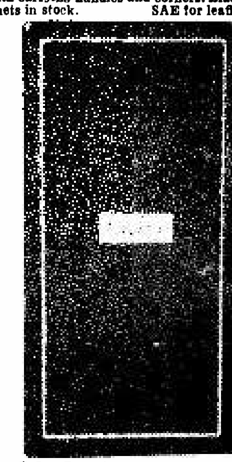

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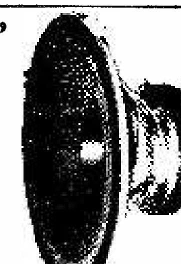

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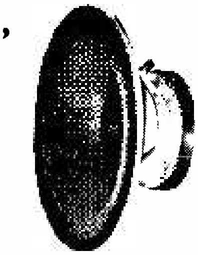

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Let's hope he turns out to be OK but don't be disappointed Dick if he doesn't! The FRG-7 of **Bernard Hughes** BRS25901 must have jumped up and down when he caught VR8O on Tavalu in the Ellis Is. plus another rarity PY0OD in Fernando De Noronha off the coast of Brazil, on 20m s.s.b. After a long wait QSLs from P29FV, 7J1RL and VP8JV have arrived for Bernard.

FG0GD/FS7 and FH8CY (Comoros Is.) were found on c.w. by **Ian Marquis** A9140 in Leigh-on-Sea, Essex, while pottering around 10m, while PY0CA on St. Paul Rock on 80m s.s.b. is no mean catch. **Bill Rendell** of Truro, Cornwall has been concentrating on island stations on the theory that if the island is pretty small there can't be too many amateurs there! His valved Heathkit AR3 and pre-selector found J3AH on Grenada, KC4AAC Anvers Is. in the Antarctic, VK9YL on Cocos-Keeling Is. and VP2VJ on Tortilla, all on 15m s.s.b., to name but a few.

General Notes

Bob Bell in Blyth, Northumberland, is one of a number of readers who comment on the fixed i.f. bandwidth of the FRG-7 and wonders if he can do anything about it. Well, I certainly would not dive inside and start fiddling about with it. Other than selling it and getting something else the only answer is to fit a selective audio filter of some kind between the set and the phones, for use on c.w. This leaves a compromise between s.s.b. and a.m. and, if I had to, I'd fit a good crystal or mechanical filter in the first i.f. stage and let a.m. take care of itself.

Long time reader of *PW* **Len Adlard**, 24 Clements Avenue, Leigh-on-Sea, Essex appeals for any info or manual on the ex-RAF receiver 1392/D. Any costs will be willingly reimbursed and material returned immediately. A reader in Reading, Berks, has an old R1155 receiver he'd like to give to a young listener who could tidy it up a bit. Drop me a line only if you can collect. **S. M. Turner** BRS37620 of Wilmslow in Cheshire has wound himself a helix aerial on a 2in cardboard tube about 24in long. There is 25ft of wire in each half, the centres being taken to an a.t.u. It stands by his set and he compares it favourably with his wire aerials. I suggest that is because it is vertical and provides better pick-up of low angle DX signals.

Brian Smith writes from Barry, Glam. with an interesting experience. He works for British Rail and on boarding one of the engines in the yard noticed that the driver had a copy of Short Wave Magazine in his bag! He turned out to be GW3HDH. Brian has since joined the BR ARS and wonders if there are any other BR types that would like to have info on the society. If so, write to Brian at 15 Courtenay Road, Barry, Glam. A BR net operates on Sundays, 1000hrs on 3730kHz.

Around the Clubs

Newbury and District ARS meet on second Tuesday of the month at the College of Further Education so be there at 1900hrs. Further info from Alan Wood G4EEE, 9 Hillcrest, Tadley, Basingstoke or ring him on Newbury 43501.

Don't forget the **Derby and District ARS** Annual Mobile Rally on Aug 13th from noon onwards at the Lower Bemrose School, Littleover, with talk-in on 2m and 70cm. Normal meetings every Wednesday at 1930hrs at 119 Green Lane, Derby. Hon. Sec. is now Jenny Shardlow G4EYM, 19 Portreath Drive, Darley Abbey, Derby and I'm sure you'll be only too happy to drop her a line for further info.

The Wessex AR Group hope to run GB3WHF to demonstrate amateur radio at the Wimborne Hobbies Fair on Saturday August 5th to the Monday inc. Hopefully, RTTY will be on show as well as v.h.f. and h.f. stations. Details from Sec. Geoff Cole G4EMN, 6 St. Anthonys Road, Bournemouth.

Cheltenham AR Assoc. include morse instruction and a TVI clinic among their multifarious activities. The latter must be a Godsend and could well be copied by other societies. Info on the club's activities from Garth Martin, 88 Tennyson Road, Cheltenham.

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.

Log Extracts

B. Smith:—80m PY2XRA ZL4KF **20m** HI8GAR TJ1BB **10m** LU4MAO ZE6JS

S. Turner:—20m KG6JIU WA4YVG/VQ9 (Chagos Is.)

W. Rendell:—20m FG7TD FM7AQ VE8RCS VK7AE YA2JV **15m** C5ABK CP6HI FY7BC HH2PW HK0WJ HP1SI J3AH KC4AAC TR8ACQ VK9YL VP2MAD VP2VJ YA1AJD

D. Greenhalgh:—20m C5AAR CT3BX FR7BU VP2CDF VR8EH **15m** CT2IA PJ2AAX

I. Marquis:—80m D4CBS (Cape Verde Is.) HB0XAA PJ2AAX PY0CA (St. Paul Rocks) **40m** HH2T PJ2AAX 8P6GO **20m** FR7BE KM6FC VK9YS (Cocos Keeling) WA4YVG / VQ9 (Chagos) YI1BGD **15m** KG4AG VS5XU ZD7JV ZK1DR **10m** C6ANX **FG0GD/FS7 FH8CY** TR8MC

B. Hughes:—20m HH2A TR8LE VP2LLF VP2SQ VR8O PY0OD (Fernando De Noronha) **15m** CP8CB HC2HX ZK1DR **10m** HK4CCX J3AH TR8MC VP8PC YB0GP ZK1DR

R. B. Smith:—80m CT3AB LU2VE **20m** A5JO CO2FRC ZF1MA

J. Goodier:—20m HK1WL J3AH YB5BBH **15m** FY7YF KH6XX **10m** PY6SL VP8HA

M. Liezers:—40m CX3TU HI5MAG ZP5EF **20m** A7XAH (Qatar) FG7TD HL9UD J3AH KM6FC TA1MB VP2SQ WD9FCC/VQ9 **15m** FR7BE 9N1MM

B. Harrison:—20m C31MK VP2KT **15m** P29NPS (New Guinea) YB3AE **10m** EA8QU J3AAG KV4KV 7Q7LW (G3JSU)

D. Waddell:—15m C5AAR **CP7GM** J3AH **JT1KAA KH6DL KM6BI** KS6RJ ZK1DR **ZK2AV** K7BFI/5W1 **6W8FA 8R1J 10m FG0GD/FS7 9L1CA**

J. Hodgson:—40m CO2DC **20m** JT1AN KZ5DK YS2RVE **15m** KG4FW 8R1Q

J. Whiting:—20m VP2KT VR6TC **15m** JR6RC 6W8GT VP2KT FP8AEZ

D. Parker:—20m VK9KE VK8AE

All s.s.b. except those in bold which are c.w.

ON THE AIR

BROADCAST BANDS

MEDIUM WAVE DX

by Charles Molloy G8BUS

Why not cover some Long Wave DX asks **Peter Sommer** (London) who goes on to say that Cambridge Kits do a converter that allows you to use 3·5 to 4·0MHz as a tuneable i.f. and that the results when used with an FRG-7 are pretty good. Well, the long waves are covered in this column and occasionally logs of DX on this band are received from readers. The snag of course is that many receivers, other than domestic types, do not cover the band. Incidentally, the current Cambridge converter, as advertised in *PW* converts the range 100 to 600kHz into 4·1 to 4·6MHz.

Long Wave DXing

First of all a popular misconception should be cleared up. Propagation in the range 150 to 280kHz is by sky wave after dark and in principle is no different from that on the medium waves. The ground wave suffers less attenuation than on the medium waves and all things being equal, it will travel much further. If you are looking for DX then a path of darkness is required, just as for m.w. DX. It is not until you get well below 100kHz that ducting between the D layer and the surface of the earth takes place, allowing long-range propagation during daylight. GBR on 16kHz and possibly the Time Signal and Frequency Standard MSF on 60kHz are examples.

Yes Peter, it is possible to construct a loop to cover the long waves. Use approximately four times the number of turns that you would use for a similar size of m.w. loop and the ordinary formula for calculating inductance does apply. There is no such thing in practice as a pure inductance. All inductors have some self capacitance and designers of tuning coils go to great lengths to keep it as low as possible. When building a loop, for either band, space each turn as far as possible from the next one and do not use very thick wire. For medium wave loops use the recommended ¼ inch spacing though this may have to be reduced when winding a long wave loop.

No need to go to the trouble of building a converter or winding a long wave loop just to try this band. The ordinary domestic portable with internal aerial can produce some DX. Tebessa in Algeria is quite a good signal on 261kHz. Try resolving the jumble on 209kHz by rotating the receiver and making use of the directional properties of the internal aerial. Reykjavik, Kiev and Azilal in Morocco all share 209 while Monte Carlo, Oslo and Baku are together on 218kHz.

Loops

Can a loop be any shape, is a question often asked and the answer is yes, provided that it is symmetrical. The original ship-borne loop was, and still is circular which is not easy for the DXer to construct. A diamond shape is convenient when winding a spiral loop where each turn is smaller than the previous one and two pieces of wood, one vertical and the other horizontal can be used as a support. A triangle has been tried to save space but the usual shape is a square or rectangle. An irregular figure such as the trapezoid, often quoted in school textbooks (I knew that information would be of value some day!) will not do, as there will be a residual signal when there should be a null. *(In fact the very first ship-borne loops were triangles of wire, with the apex hung from a stay—Ed.).*

Peter Sommer asks for my reaction to f.e.t. loop amplifiers. These are intended to isolate the loop from the receiver rather than to provide additional gain. The coupling between the main and link windings must be tight in order to transfer the maximum amount of signal. This means that the input impedance/reactance of the receiver can be reflected into the loop and consequently affect the tuning range and the directional pattern of the loop. The latter would affect the accuracy of any bearings taken with the loop should the DXer want to use his loop for this purpose. The loading of an f.e.t. pre-amp is negligible and as a result it can be connected directly to the main winding and the coupling winding can then be removed or ignored. I have a balanced f.e.t. pre-amp, though I seldom use it as I find the ordinary loop performs satisfactorily when used with receivers such as the CR100, Marconi Mercury and BRT400.

So far as I know, no experimenting has been done by DXers with differing degrees of coupling on the standard loop and this might be an interesting field for the experimenter. The standard 40in loop has a single turn coupler wound beside the 4th turn of the main winding. To increase coupling, try winding 2 or 3 turns instead of a single turn. To decrease coupling either wind the coupler on a separate frame and vary the spacing between the two or, wind a smaller single turn concentric with the main ones.

Ramadan

This year Ramadan starts on August 5th and finishes on September 4th. Its relevance to DXing is that during this period many Arabic-speaking stations are on extended schedule. some indeed remaining on the air all night. Normally, as a result of differing time zones to the east. Middle East stations sign off between 2000 and 2100 which is too early to benefit from the reduction in European QRM that occurs around 2300. Consequently the DXer has to try to catch this type of DX at signing-on time which occurs in the early hours from 0300 onwards. During Ramadan the position is changed and the easier stations from this part of the world, such as Morocco, Algeria, Tunisia. Libya and Egypt will become prominent. Much of the real DX though will now become a lot easier or even possible such as Afghanistan with Kabul on 1280kHz; Iraq with Bagdad on 760 and Babylon on 1035; Jordan with Amman on 800; Lebanon with Beirut on 836; Saudi Arabia with Riyadh 587 and Syria with Homs on 566. This is only a selection and DXers should consult the *World Radio and TV Handbook* for further possible DX.

Receivers

A cry for help from **W. G. Rooks** of Tredegar who has recently purchased a CR100 and wants a copy of the service manual, highlights a problem encountered by many DXers who presumably want to do their own repairs should the occasion arise. It is not a good idea, as pointed out recently by Eric Dowdeswell, to tamper with a receiver that is under guarantee, nor is it sensible to poke around in a mains receiver without some knowledge of how it works. Many DXers though are able to do their own repairs or even to carry out "improvements", and with the older type of ex-WD receiver this may be the only feasible way of getting it to work. A stamped addressed envelope to Brooks, 5 Farrant House, Winstanley Road, London SW11 2EJ will bring a list of reprints of the manuals of many receivers including most ex-WD types.

Logs and News

An Astrad receiver and long wire antenna launched **John Cook** into medium wave DXing when after reading *PW* he managed to pick up WINS on 1010kHz. Since then he has changed to a Grundig Satellit 2000 and m.w. loop. His best catches to date are WOR on 710 and WCBS on 880 both in New York, CJCH Halifax on 920, CFRB Toronto on 1010 and CHUM also in Toronto on 1050. A QSL card from CHUM is on the front cover of last month's *PW*. All were heard between midnight and 0200. Although the winter season is still some distance away it is possible to hear all of these stations at this time of year between 0200 and sunrise. Radio Sweden is currently using 1178kHz between 1530 and midnight daily to relay its international service and this is expected to continue until the end of September. Programmes in English are at 1600, 1830, 2100 and 2300.

SHORT WAVE BROADCASTS

by Charles Molloy G8BUS

The recent comments in this column concerning the SINFO and SIO reporting codes prompted **Bill Iball**, who lives near Wigan, to reply. Bill thinks that the SIO code is useful to give yourself some indication of reception conditions but the full SINFO code ought to be used when reporting to a station and he refers to the old amateur maxim that a report should be as comprehensive as possible.

Reporting to Broadcast Stations

It is really a question of tailoring the report to the particular circumstances, since the type that would be welcomed by a radio amateur could well be inappropriate when writing to some broadcasting stations. A low power local station on the tropical bands may well be interested in learning that his signal has been picked up far outside the service area but this information is unlikely to be of any value to him. What the DXer has to do here is to convince the station that he really did hear it and to do so he must give a comprehensive report on the programme rather than on reception conditions.

International Broadcasters know that they can be heard in their target area. What they require is a continuous picture of reception so that they can change to different frequencies or bands as required, and many of them ask DXers to become reception monitors and to supply regular reports on reception. To finish off a very interesting letter Bill says that much of the fun in DXing is when reception is poor, a sentiment that I fully endorse.

Bandspreading

Some receivers are fitted with bandspread, the two types in use being electrical and mechanical bandspread. The Realistic DX160 for example has electrical bandspread. There are two tuning scales and pointers. The pointer on the main scale is set to a marker point and the bandspread scale then presents a blown-up or magnified portion of the main scale. Tuning is then done by the bandspread control, when it is as easy to tune round say the 49m band as it is to tune round the medium waves on the main scale. Accuracy depends on setting the main pointer correctly, which can be done with the aid of a calibrator or alternatively the bandspread pointer can be set on a known station which is then tuned in by the main scale control which will then be set accurately.

Mechanical Bandspread

I prefer mechanical bandspread, as used on my BRT400 and Eddystone EC10. The main dial on the BRT400 has a scale marked 0 to 30. In addition there is a small window with a scale marked 0 to 100. The pointer on the main scale moves from 0 to 1 as the other scale completes one revolution from 0 to 100. By this means any band is divided into 3000 scale points. To be accurate the bandspread scale must be linked to the spindle of the tuning capacitor without backlash. I keep a logbook which has a "bandspread reading" column. If I want to listen to Radio Australia on 21570kHz I set the bandspread to 1289 (from the logbook), switch on the receiver and if reception is favourable, the station is there. With the aid of my crystal calibrator I have made up a table of bandspread readings against frequency at 50kHz intervals for the main s.w. bands. Using this table I can set the receiver accurately on 50kHz points up to 26MHz on the 11m band. In between these 50kHz points, frequencies can be estimated using bandspread readings as an aid, or by using the calibrator set to 10kHz markers.

Mechanical bandspread can be fitted to most receivers provided that backlash is not serious. Paste a strip of paper onto the glass cover of the main dial, clear of other marks behind it. Cut an annular strip of paper and stick it to the receiver around the main tuning knob. Start with the pointer at the low frequency end of the main scale and mark this 0 on the paper strip. Put a spot of paint on the rim of the tuning knob and mark another 0 this time on the annular scale opposite the paint spot. Rotate the knob and put marks on the annular scale at equal intervals so that it is marked from 0 to 9. When the knob reaches 0 again, mark a 1 on the paper scale in line with the pointer and carry on across the entire scale. If it takes 7 turns of the knob to cover the scale then you will have 70 calibration points and it should be possible to increase this number by marking additional points on the annular scale. This may seem a very makeshift method but it does work. It is interesting to note that some versions of the famous wartime R1155 receiver had a bandspread system which worked on the same principle.

Some years ago I had the pleasure of meeting **Arthur T. Cushen**, the well-known blind DXer from New Zealand. I asked Arthur how he managed to find his way around the short wave bands and he explained that he used medium wave stations as reference points where the pointer covered a m.w. station and one of the short wave bands at the same time. It was then a matter of bandswitching and the appropriate band could be found in a matter of seconds. By counting the number of turns and fractions of a turn of the tuning knob and consulting a list of stations in Braille, Arthur could then find his way around that band without difficulty! Those of us who are not so physically handicapped have very little excuse for not doing at least as well. Arthur is a regular broadcaster and he can be heard over Radio Nederland on the first Thursday of each month in the DX Juke Box programme.

11 Metre Band

The current situation on this band, gleaned from a number of sources is:— 25605kHz IBA Jerusalem; 25630 RFI Paris; 25690 Radio Liberty; 25720 BBC (carrier heard); 25790 Radio RSA (testing); 26040 Voice of America. **Harold Brodribb** of St Leonards-on-Sea supplied the information on Radio Liberty, which comes in at my QTH in the early afternoon at good strength with programming in Russian.

Logs and News

Ron Proudfoot (Newcastle-on-Tyne), who is a regular reader of *PW*, purchased an FRG-7 about a year ago which he has been using with a 30ft vertical aerial. Best DX to date is Voice of Kenya on 4804kHz between 1850 and sign-off at 2006, Kampala Uganda on 5026 at 1900, Radio Reloj Continente in Caracas Venezuela on 5030kHz at 0300 (sign-off at 0500) and KGEI San Francisco on 9615 at 0630 until it was swamped by UN Radio at 0633. Roy mentions hearing American style news in s.s.b. on 5230kHz which may be a point-to-point transmission, probably a feed to be retransmitted on a broadcast channel. **Chris Howles** (Lichfield) used a Vega 206 and 75ft long wire to pull in ELWA Liberia on 4770 at 2000, Radio Senegal 4890 in French at 0600, Radio N'djamena Chad on 4904·5 at 0430, Radio Colosal Colombia 4945 at 0630, Radio Rumbos Venezuela 4970 at 0600 and the CBC Northern Service 9605 at 2300. **Steve Price** (Doncaster) does not regard himself as a DXer as he only possesses a domestic portable but he enjoys listening to overseas stations and to DX programmes. He mentions the Voice of Turkey DX Corner on 9515kHz in the 31m band which can be heard every night. You don't need an expensive receiver to be a DXer Steve —keep tuning.

VHF BANDS

by Ron Ham BRS15744

I never expected to use the famous name of Muhammed Ali in my v.h.f. column, but there he was, full of life, on Ch.R1 on my DXTV monitor, at 1824 on June 13th, during his visit to Moscow. This is just one of the many interesting events which occurred in the early part of the 1978 sporadic-E season.

Sporadic-E

"The sporadic-E season has arrived with a vengeance" says **Frank Luman**, Glasgow, who, like myself has been watching European and Russian television on several occasions. The frequencies most influenced by sporadic-E are 40-80MHz, which is why very strong signals are received in the UK from a host of east-European broadcast stations between 65-73MHz, often rendering the 4m amateur band unusable while the event lasts.

Sporadic-E disturbances occurred on 15 days between May 26th and June 19th, mainly during the afternoons and early evenings but sometimes around 0830. The most intense disturbance occurred on June 3rd and 4th, when signals were affected up to 146MHz. At 1640 on the 3rd, I counted dozens of Continental broadcast, radio-telephone and TV stations between 40 and 73MHz.

"June 3rd was a real sporadic-E event in GM" writes **John Branegan**, GM8OXQ, Saline, Fife, "I heard French and east-European f.m. up to 105MHz at 1702, and one GM had a QSO with an Italian on 2m". The range 40-73MHz was still disturbed at 2145, very late for sporadic-E, and at 0600 on the 4th, frequent bursts of sync pulses were heard on Ch.R1, 49·75MHz. Later, at 1700, **Roy Bannister,** G4GPX, Lancing, Sussex, worked YU2CCY on 15m and learnt that UK TV pictures were being received in Yugoslavia on v.h.f. At 1800 Roy heard strong signals from Bulgaria and Yugoslavia on 2m.

Around this time a multitude of f.m. broadcast signals were pounding in between 65-73MHz and, like Frank Luman, I received pictures on Ch.R1 from Poland. At 1720, Frank, using his S36-A, received the Russian, Ch.R3 sync pulses, 77·25MHz, and the sound channel, 83·75MHz and realising that the disturbance was moving higher, he tried his stereo receiver and found Russian Ch.R5 sync, 93·25MHz, and the sound on 99·75MHz. **Barry Knight,** also in Glasgow, was already receiving this signal using a Pioneer SX450 with only a ribbon dipole. Frank heard a station from Yugoslavia on 98·9MHz followed by Italians on 97·1, 98, and 99·5MHz between 1920 and 1955. Band II went "dead" from 2100 until 2250 then 18 stations from Norway and Sweden were heard". The crowning glory for Frank came at 2300 when he watched a fishing programme on Ch.E4 from Iceland.

A typical example of the deep QSB, a feature of sporadic-E, came at 1320 on June 7th when strong pictures from Czechoslovakia CST-1, Hungary, MTV-1

Budapest, and Austria ORF-FS1 were changing places with each other on Ch.R1 every few minutes. At 0844 on the 14th I received a strong picture from NRK, Norway and at 1644 on the 16th a good picture from RTVE, Cadena, Spain. All with a vertical dipole feeding my JVC 3060 MK-II receiver.

Introduction to V.H.F.

For some time **Ian Rennison**, Horsham, Sussex, has been a Medium Wave DXer and a contributor to Charles Molloy's column so, imagine Ian's surprise when at 1120 on June 8th, he was tuning around his newly acquired Aiwa AF5080A stereo v.h.f. receiver when he heard "Stereo 96", an AFRTS station on 96·9MHz in southern Spain. Between 1030 and noon, with only a temporary ribbon aerial, Ian heard 14 Spanish speaking stations, including "Radio Popular Almeria" on 97·2MHz. The American voice on the AFRTS station was also heard by **Peter Penfold**, West Chiltington, Sussex.

Solar Activity

A period of solar activity began on May 26th with a few small bursts of radio noise at 136MHz and a mild noise storm which turned severe on the 27th. Both **Cmdr Henry Hatfield**, Sevenoaks, and myself recorded several small bursts of noise on the 28th, 29th and 30th, the largest being a 4 minute duration burst at 1311 on the 28th. The period ended on the 31st with a very large burst, associated with a flare, which began at 1145 and lasted for several hours. Solar noise storms were also recorded on May 18th and June 2nd and a few individual bursts on June 3rd, 4th, and 9th.

The 10 Metre Band

John Branegan, **Harold Goble**, G4FDQ, Lancing, **Alan Baker**, G4GNX, Newhaven, Sussex, and myself noted that 10m has been "flat" compared with previous months. Harold, using a KW2000A into a 66ft end-fed aerial with a KW EZEE Match a.t.u. observed short skip conditions on June 4th to 7th and 13th when he worked DK, HB90, an exhibition station, I0 OE, ON, OZ, PA0 and ZS5. On May 21st he was in contact with G4FFE in nearby Worthing when, at 1900, they were called by ZD7PV, and had, like locals, a three-way QSO. On June 3rd, Harold had a "quicky" with G4AGZ in Cornwall who is studying 10m propagation and would appreciate reports. QTHR.

I heard the beacons 5B4CY and ZE2JV on only 9 days between May 19th and June 19th. The strongest was at 1603 on the 10th when the Cyprus beacon was 599, the Tessa beacon 559 and the Bermuda beacon, VP9BA, 579 which has been quite rare. An h.f. blackout followed the solar flare on May 31st and John Branegan reported weak aurora on May 21st-23rd.

The big surprise came between 2200 on June 16th and 0100 on the 17th when fantastically strong signals from 4Z4, K1, VE, and Ws were working into CT, DK, EA, G, and OZ. One Canadian said it was an "exciting opening", so did Alan Baker when he worked VE1BNN, at 2253, his first Canadian on 10m. At 2307, Alan contacted WA2ZWH, New Jersey who was running five watts, and at 0003 he worked N3GB in Maryland. Almost throughout this rare late night opening the Bermuda, VP9BA and Florida, N4RD, beacons were averaging 539/559 and strong signals from CB stations on the north American Continent were pounding into Europe. On both the amateur and citizen's bands local QSOs in Canada and the USA were easily heard in the UK. At 0042, **Barry Ainsworth**, G4GPW, Sompting, Sussex, contacted WB2QYZ and at 0053 K2BU. For a very brief period Alan Baker and myself heard a ZL calling, which was later confirmed by a VE.

Tropospheric Openings

Most of us in Sussex are getting a good signal from the new 70cm beacon, GB3WHA situated at Crowborough. G4BOO, QTHR, is the beacon keeper and would welcome reports. Alan Baker received a 539 signal from the Emley Moor 70cm beacon, GB3EM, at 2317 on May 25th and I heard it at 579 at 0734 on the 28th and 589 at 0717 on the 30th. The Sutton Coldfield beacon, GB3SUT, was audible in the south around 0730 on the last five days in May and on June 3rd, 12th and 13th. **Andrew "Jim" Lyon**, G8LPY, Worthing, Sussex, can now work through the Portsmouth repeater, GB3PH, on 70cm using his Multi U11 into a 48-element multibeam, and at 1846 on June 15th he worked G4GUX through the Berkshire repeater, GB3AW, RB10.

Strong signals were received in the south from the 2m repeaters, GB3BC, KR, and PO during the v.h.f. opening from May 25th to 31st. At 0746 on the 26th, PA0JO worked G stations through GB3LO and at 0028 on the 27th, OZs and other PA0s were working through the London repeater, which, at 0727 carried signals between ON6BK, Ostend, and G8OUA in Nottingham who was using a "Slim Jim" aerial. During the same period Band II was affected and **Guy Stanbury**, Chelmsford heard, several Continental stations, mainly in the mornings, between 88-104 MHz. Early on the 28th, I heard signals through the Yorkshire repeater, GB3NA and received pictures from the Lichfield transmitter of the IBA on 189MHz. During a mild opening from June 10th to 13th, **John Cooper**, G8NGO, Haywards Heath, Sussex, heard signals on 2m from GD and GU and at 1915 on the 11th, G4GNX, worked DK0EN/P on both c.w. and s.s.b. Later, at 2110, **Dermot Cronin**, G4GRO/EI9DC, at the *Royal Sovereign* in the English Channel worked DK0EN/P and GD8EXI and at 2130 he received a strong signal from GI4GVS, but could not hook up with him. During the early morning of the 13th, **Eric Arnold**, G8OUK, Hove, Sussex, heard the Paris repeater on R6 and "Jim" Lyon worked GW3PNH, Newport through the Bristol Channel repeater.

Microwaves

Ern Downer, G8GKV, Worthing, reports that G8BDJ, G8FMJ and himself were portable on Chanctonbury Ring, 779ft a.s.l., on May 21st for the first of the five one-day cumulative contests on 10GHz. Despite the bad weather they exchanged 59 signals with G3JVL, South Hayling, Hants, G8BCO/P, Hogs Back, Surrey, G3KSU/P, St Catherines, I.O.W., and G3IFF/P Portsdown Hill, Hants.

OSCAR-8

"I am managing to get across to USA regularly now on OSCAR-8," writes John Branegan and on May 25th he worked his first Spaniard, EA1TA, via the satellite. At 2310 on the 28th, John had a QSO with

G3ILD in Darlington, Mode J, when the satellite was south of Greenland, but they did not attract any Ws. Having had 5 QSOs with W2BXA, New Jersey, 2 with W9KDR/W1 in Connecticut, 2 with W1CBZ in Maine and 1 with K4EYG in Virginia, John is getting beyond 90% of OSCAR-8A's designed maximum range.

Club News

The Brighton and District Radio Society held their annual meeting on Brighton Race Course on June 7th. Among the 40 or so people present were representatives from the Haywards Heath, Mid-Sussex, and Worthing radio clubs, the Sussex Coast Repeater Group and the Sussex wing of the Air Training Corps. Both 2m talk-in stations, G4GQR and G8OMR were kept busy.

Despite the heat, lack of sleep, and a herd of cattle the Haywards Heath Amateur Radio Club made 263 contacts during the 144MHz Portable contest on May 27/28th and were delighted with their first efforts.

Members of the Sussex Coast Repeater Group displayed pictures of GB3BR at the Mid-Sussex Amateur Radio Society's annual meeting at the Jack and Jill Windmills, Clayton, Sussex, 700ft a.s.l. Among the 30 or so present were **Mick Senior,** G4EFO, who accessed several 70cm repeaters from the site, **Louis Varney,** G5RV, the Club President, and representatives from the Brighton and Worthing Clubs. **Garry Hibbert,** G8HXB/P was active on 2m f.m. during the event.

From Down Under

Anthony Mann, Applecross, Australia heard from **K. Ushigome** of Tokyo that Australian, Ch.0 and New Zealand Ch.1 television has been received by v.h.f. TV DXers in Japan. Anthony has also been in touch with **George Francis,** P29HV, Papua, New Guinea, who recently logged Band I TV DX from South Korea, Philippines, Hawaii, Samoa, and New Zealand in addition to Japanese Band II television around 108MHz, all by transequatorial propagation.

Anthony also enclosed a copy of the Amateur Radio page of the May *Electronics Australia,* where it is reported that on January 11th a contact took place on 70cm between VK6KX/P near Albany, West Australia, and VK3ZBJ in Frankston, Victoria, a distance of 2456km.

On February 17th a two-way contact was established on 13cm (2304MHz) between VK6WG in Albany and VK5QR in Enfield, South Australia, a distance of 1886km. Both of these achievements may well be world records, let's hope so—they certainly deserve it.

Thanks again for your letters and reports and covering such a wide range of subjects.

VHF PERSONALITY

ANTHONY MANN *by RON HAM*

Both Roger Bunney, *Long Distance Television* columnist for our sister magazine *Television* and myself get regular reports about v.h.f. DX from Anthony Mann, a 22-year-old research student from Applecross, Western Australia. His letters contain detailed information about super DX, covering thousands of miles, and a valuable first-hand account of propagation in the southern hemisphere.

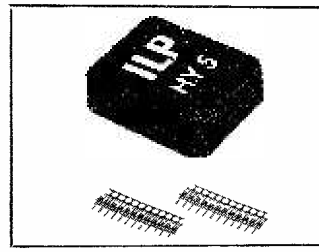
Anthony's interest in radio began in 1968 when he listened to the general short wave bands on a simple regenerative receiver. In 1970 he became an active broadcast DXer using a Trio 9R59DS. His interest in v.h.f. radio and television was suddenly fired in November 1971, by the appearance of a 2000 mile signal on the family TV set.

His equipment, pictured here, is neatly laid out in a space 3m by 2m, and comprises 3 TV receivers, a Trio 9R59DS, 200MHz digital frequency meter and a combination of converters which allows him to tune from 10kHz, to satisfy his interest in v.l.f., to 220MHz. Anthony's best DX to date is, Band I, 5000 miles (Ch.R1 Vladivostok), Band II, 2200 miles (ABDQ3 86-92MHz), and Band III, 1200 miles (Adelaide's 3 Band III TV stations). The TV receivers are fed by individual Yagis for Bands I, II and III, vertical wire aerials are used for v.h.f. and long wire antennae for general purpose listening.

With sunspot activity on the increase, Anthony looks forward to more super DX and in particular to receiving UK TV sound, Ch.B1 down under. ●

15—240 Watts!

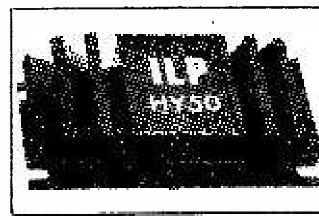
HY5
Preamplifier



The HY5 is a mono hybrid amplifier ideally suited for all applications. All common input functions (mag Cartridge, tuner, etc) are catered for internally. The desired function is achieved either by a multi-way switch or direct connection to the appropriate pins. The internal volume and tone circuits merely require connecting to external potentiometers (not included). The HY5 is compatible with all I.L.P. power amplifiers and power supplies. To ease construction and mounting a P.C. connector is supplied with each pre-amplifier.
FEATURES: Complete pre-amplifier in single pack—Multi-function equalization—Low noise—Low distortion—High overload—Two simply combined for stereo.
APPLICATIONS: Hi-Fi—Mixers—Disco—Guitar and Organ—Public address
SPECIFICATIONS:
INPUTS. Magnetic Pick-up 3mV; Ceramic Pick-up 30mV; Tuner 100mV; Microphone 10mV; Auxiliary 3-100mV; input impedance 4·7kΩ at 1kHz.
OUTPUTS. Tape 100mV; Main output 500mV R.M.S.
ACTIVE TONE CONTROLS. Treble ± 12dB at 10kHz; Bass ± at 100Hz.
DISTORTION. 0·1% at 1kHz. Signal/Noise Ratio 68dB.
OVERLOAD. 38dB on Magnetic Pick-up. SUPPLY VOLTAGE ± 16-50V.
Price £6·27 + 78p VAT P&P free.

HY30
15 Watts into 8Ω

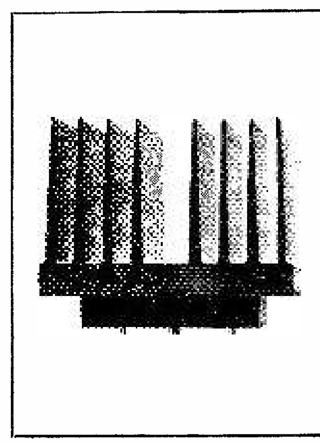
The HY30 is an exciting New kit from I.L.P. It features a virtually indestructible I.C. with short circuit and thermal protection. The kit consists of I.C., heatsink, P.C. board, 4 resistors, 6 capacitors, mounting kit, together with easy to follow construction and operating instructions. This amplifier is ideally suited to the beginner in audio who wishes to use the most up-to-date technology available.
FEATURES: Complete Kit—Low Distortion—Short, Open and Thermal Protection—Easy to Build.
APPLICATIONS: Updating audio equipment—Guitar practice amplifier—Test amplifier—audio oscillator.
SPECIFICATIONS:
OUTPUT POWER 15W R.M.S. into 8Ω: DISTORTION 0·1% at 1·5W.
INPUT SENSITIVITY 500mV. FREQUENCY RESPONSE 10Hz-16kHz—3dB.
SUPPLY VOLTAGE ± 18V.
Price £6·27 + 78p VAT P&P free.



HY50
25 Watts into 8Ω

The HY50 leads I.L.P.'s total integration approach to power amplifier design. The amplifier features an integral heatsink together with the simplicity of no external components. During the past three years the amplifier has been refined to the extent that it must be one of the most reliable and robust High Fidelity modules in the World.
FEATURES: Low Distortion—Integral Heatsink—Only five connections—7 amp output transistors—No external components
APPLICATIONS: Medium Power Hi-Fi systems—Low power disco—Guitar amplifier
SPECIFICATIONS: INPUT SENSITIVITY 500mV
OUTPUT POWER 25W RMS into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·04% at 25W at 1kHz
SIGNAL/NOISE RATIO 75dB FREQUENCY RESPONSE 10Hz-45kHz—3dB.
SUPPLY VOLTAGE ± 25V SIZE 105 50 25mm
Price £8 18 + £1·02 VAT P&P free

HY120
60 Watts into 8Ω

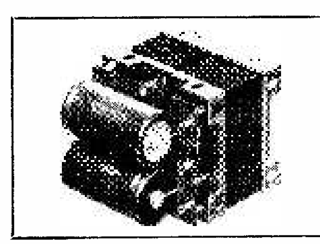


The HY120 is the baby of I.L.P.'s new high power range. Designed to meet the most exacting requirements including load line and thermal protection this amplifier sets a new standard in modular design.
FEATURES: Very low distortion—Integral heatsink—Load line protection—Thermal protection—Five connections—No external components
APPLICATIONS: Hi-Fi—High quality disco—Public address—Monitor amplifier—Guitar and organ
SPECIFICATIONS
INPUT SENSITIVITY 500mV.
OUTPUT POWER 60W RMS into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·04% at 60W at 1kHz
SIGNAL/NOISE RATIO 90dB FREQUENCY RESPONSE 10Hz-45kHz - 3dB SUPPLY VOLTAGE ±35V
SIZE 114 50 85mm
Price £19·01 + £1 52 VAT P&P free.

HY200
120 Watts into 8Ω

The HY200 now improved to give an output of 120 Watts has been designed to stand the most rugged conditions such as disco or group while still retaining true Hi-Fi performance.
FEATURES: Thermal shutdown—Very low distortion—Load line protection—Integral heatsink—No external components
APPLICATIONS: Hi-Fi—Disco—Monitor—Power slave—Industrial—Public Address
SPECIFICATIONS
INPUT SENSITIVITY 500mV
OUTPUT POWER 120W RMS into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·05% at 100W at 1kHz.
SIGNAL/NOISE RATIO 96dB FREQUENCY RESPONSE 10Hz-45kHz - 3dB SUPPLY VOLTAGE ±45V
SIZE 114 50 85mm
Price £27·99 + £2·24 VAT P&P free.

HY400
240 Watts into 4Ω



The HY400 is I.L.P.'s "Big Daddy" of the range producing 240W into 4Ω! It has been designed for high power disco address applications. If the amplifier is to be used at continuous high power levels a cooling fan is recommended. The amplifier includes all the qualities of the rest of the family to lead the market as a true high power hi-fidelity power module.
FEATURES: Thermal shutdown—Very low distortion—Load line protection—No external components.
APPLICATIONS: Public address—Disco—Power slave—Industrial
SPECIFICATIONS
OUTPUT POWER 240W RMS into 4Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·1% at 240W at 1kHz
SIGNAL NOISE RATIO 94dB FREQUENCY RESPONSE 10Hz-45kHz - 3dB SUPPLY VOLTAGE ±45V
INPUT SENSITIVITY 500mV SIZE 114 100 85mm
Price £38·61 + £3·09 VAT P&P free.

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PSU70 suitable for two HY120's £14·58 plus £1·17 VAT. P/P free.
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2N929	0·37	2N3417	0·25	2N4062	0·20	2N5245	0·37	AF106	0·60	BC182L	0·15
2N930	0·37	2N3439	0·85	2N4121	0·27	2N5248	0·44	AF109	0·82	BC183A	0·12
2N1131	0·32	2N3441	0·92	2N4122	0·27	2N5293	0·44	AF114	0·70	BC183LA	0·15
2N1303	0·80	2N3442	1·45	2N4123	0·19	2N5294	0·44	AF115	0·70	AC184	0·12
2N1305	0·80	2N3565	0·25	2N4124	0·19	2N5401	0·44	AF118	0·70	BC184L	0·15
2N1501	0·35	2N3566	0·25	2N4125	0·19	2N5416	1·65	AF124	0·70	BC205	0·17
2N1613	0·30	2N3567	0·25	2N4126	0·19	2N5447	0·16	AF139	0·75	BC212A	0·15
2N1637	0·72	2N3638	0·17	2N4235	1·35	2N5448	0·16	AF200	1·30	BC212LA	0·18
2N1890	0·30	2N3639	0·38	2N4236	1·65	2N5449	0·20	AF201	1·30	BC213B	0·15
2N1893	0·30	2N3644	0·40	2N4237	1·65	2N5457	0·35	AF239	0·70	BC213LA	0·17
2N1991	1·10	2N3662	0·25	2N4240	1·70	2N5458	0·35	AF240	1·25	BC214	0·17
2N2193	0·50	2N3663	0·29	2N4250	0·26	2N5555	0·65	AF279	0·88	BC214L	0·18
2N2194	0·42	2N3702	0·14	2N4266	0·32	2N6109	0·55	AF280	0·95	BC237B	0·15
2N2217	0·55	2N3703	0·14	2N4284	0·38	2N6122	0·44	ASY28	1·30	BC238B	0·13
2N2218	0·35	2N3704	0·14	2N4286	0·32	2N6123	0·48	ASY55	0·70	BC239C	0·17
2N2219	0·38	2N3705	0·14	2N4287	0·22	2N6124	0·45	BC107	0·16	BC256A	0·29
2N2221	0·25	2N3706	0·14	2N4288	0·22	2N6125	0·47	BC108	0·16	BC257A	0·18
2N2222	0·25	2N3707	0·14	2N4292	0·27	2N6283	0·50	BC109	0·16	BC258B	0·24
2N2270	0·49	2N3708	0·12	2N4302	0·31	2S702	3·30	BC113	0·22	BC259B	0·19
2N2368	0·27	2N3709	0·12	2N4303	0·33	2S703	3·95	BC114	0·22	BC261A	0·25
2N2369	0·27	2N3710	0·12	2N4342	0·60	40232	0·60	BC115	0·22	BC262B	0·26
2N2483	0·30	2N3711	0·12	2N4401	0·20	40311	0·55	BC116	0·21	BC263B	0·26
2N2613	0·90	2N3712	1·39	2N4402	0·20	40316	0·95	BC118	0·22	BC264B	0·65
2N2646	0·80	2N3714	1·55	2N4403	0·20	40363	1·45	BC135	0·22	BC307B	0·16
2N2848	1·10	2N3716	1·70	2N4822	0·83	40389	0·70	BC136	0·21	BC308B	0·16
2N2904	0·31	2N3794	0·21	2N4870L	0·58	40408	0·82	BC137	0·22	BC309C	0·16
2N2905	0·31	2N3819	0·36	2N4871L	0·51	40440	0·70	BC138	0·44	BC327	0·22
2N2906	0·25	2N3820	0·39	2N4898	1·55	40512	1·70	BC140	0·30	BC328	0·20
2N2907	0·25	2N3821	0·95	2N4901	1·65	40594	0·87	BC141	0·32	BC337	0·20
2N2923	8·17	2N3827	0·27	2N4902	2·20	40595	0·98	BC142	0·32	BC414	0·17
2N2924	0·17	2N3854A	0·30	2N4903	2·75	40673	0·80	BC147	0·13	BC415	0·16
2N2925	0·19	2N3855	0·30			AC126	0·48	BC148	0·15	BC416	0·17
2N3011	0·37	2N3856A	0·19	2N4904	1·85	AC127	0·48	BC149	0·15	BC547A	0·13
2N3020	0·75	2N3858A	0·20	2N4905	2·40	AC128	0·48	BC153	0·30	BC547B	0·13
2N3053	0·25	2N3859A	0·22	2N4920	0·83	AC151	0·43	BC154	0·30	BC548	0·13
2N3054	0·72	2N3860	0·18	2N5086	0·30	AC152	0·54	BC157A	0·15	BC549B	0·14
2N3055	0·75	2N3866	1·98	2N5087	0·30	AC153	0·59	BC158B	0·15	BC558	0·13
2N3108	0·75	2N3901	0·30	2N5088	0·30	AC153K	0·59	BC159B	0·15	BC559	0·15
2N3133	0·50	2N3904	0·18	2N5089	0·30	AC176	0·54	BC160	0·38	BCY54	2·40
2N3242	0·68	2N3905	0·18	2N5129	0·62	AC176K	0·90	BC167B	0·13	BCY56	0·27
2N3250	0·35	2N3906	0·18	2N5130	0·22	AC187	0·59	BC168B	0·13	BCY70	0·21
2N3301	0·45	2N3962	0·95	2N5131	0·22	AC187K	0·65	BC169B	0·13	BCY71	0·26
2N3302	0·39	2N4031	0·55	2N5137	0·22	AC188	0·54	BC170B	0·19	BCY72	0·18
2N3392	0·17	2N4032	0·65	2N5143	0·22	AC188K	0·65	BC171B	0·17	BCY78	0·43
2N3394	0·17	2N4033	0·65	2N5180	0·58	ACY17	1·00	BC172C	0·15	BD121	2·20
2N3397	0·19	2N4036	0·72	2N5190	0·65	ACY22	0·65	BC173C	0·17	BD131	0·55

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CA3002	3·30	CA3068	3·80	LM360N	3·00	LM1305N	1·52	LM78224CZ	0·30	SN76033N	2·35
CA3005	2·50	CA3070	1·90	LM370N	3·30	LM1307N	1·22	MC1035P	1·90	SN76110N	1·30
CA3006	4·60	CA3071	1·90	LM371H	2·35	LM1310N	2·10	MC1327P	1·70	SN76115N	1·65
CA3007	4·15	CA3072	1·90	LM350K	6·45	LM1351N	1·30	MC1330P	1·10	SN76116N	1·80
CA3008	2·55	CA3075	1·70	LM373N	3·35	LM1458N	0·45	MC1352P	1·20	SN76131N	1·30
CA3012	1·65	CA3076	2·12	LM374N	3·35	LM1496N	1·97	MC1433G	3·65	SN76226N	1·68
CA3013	1·85	CA3080	1·85	LM377N	1·80	LM1800N	1·94	MC1435G	2·20	SN76227N	1·30
CA3014	2·20	CA3080A	2·10	LM378N	2·40	LM1812N	6·20	MC1439G	1·75	SN76228N	1·55
CA3018	0·75	CA3086	0·50	LM379S	4·25	LM1820N	1·16	MC1440G	1·65	SN76531N	0·82
CA3018A	1·10	CA3088F	1·87	LM380N8	0·96	LM1828N	1·90	MC1456G	2·15	SN70532N	1·55
CA3020	2·20	CA3089E	2·90	LM380N14	1·08	LM1830N	1·90	MC1463R	3·90	SN76533N	1·30
CA3020A	2·50	CA3090Q	4·40	LM381AN	2·70	LM1841N	1·90	MC1468L	3·85	SN76544N	1·60
CA3021	2·40	CA3130	1·06	LM381N	1·69	LM1845N	1·50	MC1469R	3·10	SN76545N	1·80
CA3022	2·20	CA3140	1·04	LM382N	1·32	LM1848N	1·98	MC1488L	4·25	SN76546N	1·58
CA3023	2·20	LOBST1	2·25	LM384N	1·55	LM1850N	1·90	MC1495L	5·50	SN76550-2	0·38
CA3026	0·80	LM114H	2·75	LM386N	0·85	LM1889N	4·90	MC1529G	7·10	SN76552-2	0·57
CA3028A	0·90	LM301AH	0·50	LM387N	1·10	LM2907N-8	1·80	MC4024P	2·20	SN76570N	1·80
CA3028B	1·25	LM301·8	0·30	LM388N	1·00	LM2987N-8	1·80	MM5314	4·60	SN76620AN	0·99
CA3029	0·75	LM304	2·60	LM389N	1·00	LM3301N	0·60	MM5316	4·60	SN76650N	1·20
CA3029A	0·90	LM307N	0·50	LM555CN	0·33	LM3302N	0·55	MM5320	4·20	SN76660N	0·66
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CA3030A	2·20	LM308N	0·45	LM701B	2·99	LM3900N	0·68	NE556	0·65	SL610C	2·75
CA3033	3·70	LM309KC	1·95	LM701C	2·99	LM3905N	1·15	NE560	4·50	SL611C	2·75
CA3034	2·75	LM317K	3·35	LM702C	0·81	LM3909N	0·78	NE561	4·50	SL612C	2·75
CA3035	1·95	LM318N	2·15	LM703LN	1·15	LM3911N	1·10	NE562	4·50	SL620C	3·85
CA3036	1·21	LM320T5	2·15	LM709	0·70	LM4250CN	1·30	NF565	1·39	SL621C	3·75
CA3038	2·90	LM320T12	2·15	LM709-8	0·50	LM78L05CH	0·85	NE566	1·75	SL623C	6·25
CA3038A	4·10	LM320T15	2·15	LM709-14	0·49	LM78L12CH	0·85	NE567	1·90	SL640C	4·40
CA3039	0·77	LM320T24	2·15	LM710	0·67	LM78L15CH	0·85	NE558N	1·98	SL641C	4·40
CA3040	3·75	LM320MP5	1·15	LM710-14	0·64	LM78L24CH	0·85	NE571N	4·95	SL701C	2·50
CA3041	1·65	LM320MP12	1·15	LM711CN	0·72	LM7805KC	1·75	SAS560	2·70	TAA263	1·35
CA3042	1·65	LM320MP15	1·15	LM723C	0·75	LM7812KC	1·75	SAS570	2·70	TAA300	3·70
CA3043	2·20	LM320MP24	1·15	LM723C-14	0·45	LM7815KC	1·75	SAS580	2·40	TAA320A	1·15
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CA3049	1·98	LM340T24	0·88	LM748-8	0·50			SN76012ND	1·30	TAA570	2·20
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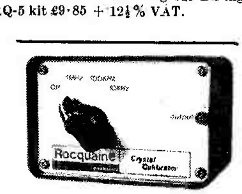

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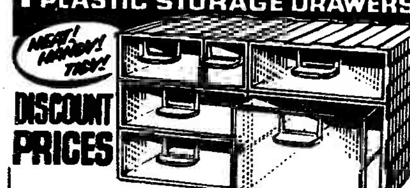

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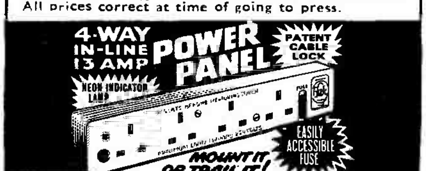

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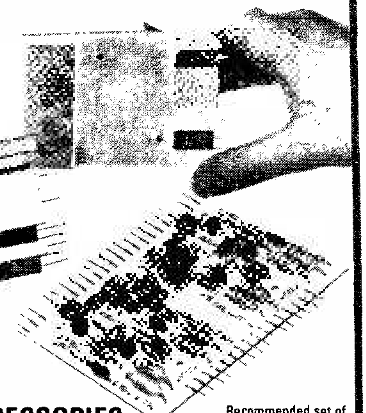

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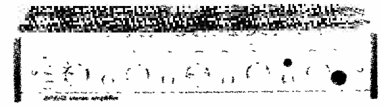

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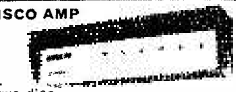

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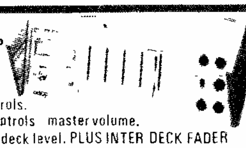

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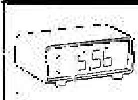

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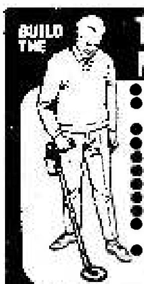

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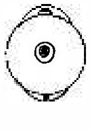

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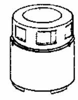

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POLYESTER CAPACITORS: Axial lead type. (Values are in μf). **400V:** 0·001, 0·0015, 0·0022, 0·0033 **8p**; 0·0047, 0·0068, 0·01, 0·015, 0·018 **9p**; 0·022, 0·033, **10p**; 0·047, 0·068, **14p**; 0·1, **15p**; 0·15 0·22, **22p**; 0·33, 0·47 **39p**; 0·68 **45p**. **160V:** 0·039, 0·15, 0·22 **11p**; 0·33, 0·47 **19p**; 0·68, 1·0 **22p**; 1·5 **29p**; 2·2 **32p**; 4·7 **36p**.
DUBILIER: 1000V: 0·01, 0·015 **16p**; 0·022 **18p**; 0·047 **16p**; 0·1 **34p**; 0·47 **53p**; 1·0 **155p**.

POLYESTER RADIAL LEAD (Values in μf). 250V: 0·01, 0·015, 0·022, 0·027 **5p**; 0·033, 0·047, 0·068, 0·1 **7p**; 0·15 **8p**; 0·22, 0·33 **10p**; 0·47 **14p**; 0·68 **18p**; 1·0 **22p**; 1·5 **29p** 2·2 **31p**

FEED THROUGH CAPACITORS 1000pF/350V **8p**

ELECTROLYTIC CAPACITORS: Axial lead type (Values are in μF). **250v:** 100 **65p**; **63v:** 0·47, 1·0, 1·5, 2·2, 2·5, 3·3, 4·7, 6·8, 8, 10, 15, 22 **8p**; 47, 32, 50, **11p**; 63, 100, **27p**; **50V:** 1·0, **7p**; 50, 100, 220, **25p**; 470, **50p**; 1000, **62p**; 2200, **68p**; **40V:** 22, 33μF, **9p**; 100, **12p**; 3300, **62p**; 4700, **64p**; **35V:** 10, 33, **7p**; 330, 470, **32p**; 1000, **49p**; **25V:** 10, 22, 47, **6p**; 80, 100, 160, **8p**; 220, 250, **13p**; 470, 640, **25p**; 1000, **27p**; 1500, **30p**; 2200, **41p**; 3300, **58p**; 4700, **64p**; **16V:** 10, 40, 47, 68, **7p**; 100, 125, **8p**; 470, **16p**; 1000, 1500, **20p**; 2200, **34p**; **10V:** 4, 100, **6p**; 640 **10p**; 1000, **14p**.
TAG-END TYPE: 70V: 2000, **98p**; 4700, **121p**; **50V:** 10,000 **245p**; 3000 **75p**; **40V:** 2500, **65p**; 15,000, **450p**; **25V:** 4700, **48p**; 2000, **37p**; **40V:** 2000+2000, **95p**.

TANTALUM BEAD CAPACITORS
35V: 0·1μF, 0·22, 0·33, 0·47, 0·68, 1·0, 2·2μF, 3·3, 4·7, 6·8. **25V:** 1·5, 10. **20V:** 1·5μF **13p** each. **10V:** 22μF, 33, **6V:** 22μF, 47, 68, **3V:** 100μF **20p** each.
10V: 100μF **30p**. **16V:** 47, 100μF **40p**

MYLAR FILM CAPACITORS
100V: 0·001, 0·002, 0·005, 0·01μF **5p**
0·015, 0·02, 0·03, 0·04, 0·05, 0·056μF **7p**
0·1μF, 0·15, 0·2 **9p**. **50V:** 0·47μF **11p**

CERAMIC CAPACITORS 50V.
Range: 0·5pF to 10nF **3p**
15nF, 22nF, 33nF, 47nF. **4p**. 100nF **6p**

POLYSTYRENE CAPACITORS:
10pF to 1nF. **8p**. 1·5nF to 47nF. **10p**.

POTENTIOMETERS (AB or EGEN)
Carbon Track, 0·25W Log & 0·5W Linear values

500Ω, 1K & 2K (LIN ONLY) Single	27p
5KΩ–2MΩ single gang	27p
5KΩ–2MΩ single gang D/P switch	60p
5KΩ–2MΩ dual gang stereo	70p

SLIDER POTENTIOMETERS
0·25W log and linear values 60mm track

5KΩ–500KΩ single gang	70p
10KΩ–500KΩ Dual gang	80p
Self-Stick graduated Alum. Bezels	22p

PRESET POTENTIOMETERS

0·1W 50Ω–2·2M Mini. Vert. & Horiz.	8p
0·25W 100Ω–3·3MΩ Horiz. } larger	10p
0·25W 250Ω–4·7MΩ Vert. }	10p

SILVER MICA (pF)
3·3, 4·7, 6·8, 10, 12, 18, 22, 27, 33, 47, 50, 68, 75, 82, 85, 100, 120, 150, 200, 250 **9p** each.
300, 330, 360, 390, 600 & 820pF **18p** each.
1000, 2200pF **20p** each.

CRYSTALS

100KHz	365p
1MHz	323p
1·6MHz	395p
3·2768MHz	380p
8·08333MHz	225p
Holder	85p

RESISTORS–Erie make 5% carbon Miniature High Stability, Low Noise

RANGE		Val.	1–99	100+
0·25W	2·2Ω–4·7M	E24	1·5p	1p
0·5W	2·2Ω–4·7M	E12	2p	1·5p
1W	2·2Ω–10M	E12	5p	4p
2% Metal Film	10Ω–1M	E12	6p	4p
1% 0·5W	5Ω–1M	E24	10p	8p

JACKSONS VARIABLE CAPS.

Dielectric 100/300pF	105p
500pF	125p
6:1 Ball Drive 4511/DAF	107p*
Dial Drive 4103 6:1/36:1	520p
Drum 54mm	30p*
0-1-365pF	245p
00 2 365pF	275p
0 2 365pF with slow motion Drive	325p
00 208/176	285p
,, ,, with slow motion drive	325p
C804–5pF; 10; 15; 25; 50pF	175p*
100, 150pF	215p*
'L' 3x310pF	428p
00-3x25pF	386p

HEAT SINKS*

TO92	9p
TO5	12p
TO18	12p
TO220	22p
TO3	22p
TO66	22p
TO5 85°C	20p
Silicon Grease 5ml. Tub	48p
20ml. Syringe	125p
Insulation Kit for TO3, TO66 or TO220	3p Kit

EARPHONES

Magnetic 2·5mm	18p
3·5mm	18p
Crystal	33p

FIGARO GAS and SMOKE DETECTORS*
Types: 109, 308, 812 or 813 **415p each**
Sockets for above **25p**

CERAMIC TRIMMER CAPACITORS
2–7pF; 4–15pF; 6–25pF; 8–30pF **20p**

S-DEC	295p*
T-DEC	399p*
U-DEC 'A'	425p*
U-DEC 'B'	699p*

MINIATURE TYPE:
2·5–6pF; 3–10pF; 3–30pF; 10–40pF **22p**
5–25pF; 65pF; 88pF **30p**

COMPRESSION
3–40pF; 10–80pF **22p**
25–200pF **33p**
100–500pF 1250pF **45p**

PANEL METER*
59mm × 46mm
0-100/A **410p**

AUDIBLE Warning
Buzzers 6V or 12V **65p***

TRANSFORMERS* (Mains Prim. 220-240V)

6-0-6V 100mA	90p
9-0-9V 75mA	95p
12-0-12V 100mA	98p
0-12 0-12V 150mA	140p
0-15 0-15V ·2A	260p+
2×4·5V 0·6A	260p+
12-0-12V 0·5A	260p+
0-12 0-12 0·5A	280p+
15-0-15V 0·5A	260p+
24-0-24V 0·5A	280p+
9-0-9V 1A	275p+
12-0-12V 1A	275p+
0-12 0-12V 1A	295p+
30-24-20-15-12-0 1A Multi tappings	360p+
30-24-20-15-12-0 2A multi tap	445p+
15-0-15V 1A	275p+
18-0-18V 1A	295p+
30-0-30V 1A	315p+
20-0-20 2A	340p+
6-0-6V 1·5A	345p+
0-18 0-18V 1·5A	379p+
9-0-9V 2A	315p+
12-0-12V 2A	320p+
30-25-20-0-20-25-30 2A	497p+
0-6 0-6V 6VA	240p
"Purbeck" Transformer 7559 250-0-250; 12·9-0-12·9; 6·3V	625p
(p & p add 75p)	
LT44	42p
LT700 Min. O/P Pri. 1·2K, Sec. 3·2Ω	42p
MOT Min. O/P Pri 1·2K. Sec. 8Ω	38p

(Please add 48p p&p charge to all prices marked +, above our normal postal charge.)

DENCO COILS
Dual Purpose 'DP' VALVE TYPE
Range 1-5 B,Y,R,W **86p**
6-7 B,Y, R, **75p**
1-5 Green **92p**
'T' Type (Trns. tuning) Rng. 1-5 B, Y, R, W, **92p**

B9A Valve Base	25p
RDT2	92p
RFC 5 chokes	91p
RFC 7(19mH)	96p
IFT 13/14/15/16 17	85p
IFT 18/1·6 or 465	99p
TOC1	86p
MW 5FR	82p
MW/LW 5FR	103p

TRANSISTORS

	p
AC107*	23
AC117*	35
AC125*	19
AC126*	19
AC127*	18
AC128*	18
AC141*	24
AC141K*	38
AC142*	24
AC142K*	38
AC176*	18
AC187*	20
AC188*	20
ACY17	35
ACY18	40
ACY19	40
ACY20	40
ACY21	35
ACY22	40
ACY28	40
ACY39	78
ACY40	48
ACY41	39
ACY44	39
AD149*	60
AD161*	42
AD162*	42
AF106	70
AF114*	25
AF115*	25
AF116*	25
AF117*	25
AF118*	55
AF121*	48
AF124*	55
AF125*	35
AF126	55
AF127*	35
AF139*	35
AF178*	70
AF180*	70
AF186*	50
AF239*	42
AFZ11	128
AFZ12	126
ASY26*	40
ASY27*	45
ASY50*	95
ASY76*	95
BC107*	9
BC107B*	10
BC108*	9
BC108B*	12
BC108C*	12
BC109	9
BC109B*	12
BC109C*	12
BC113	17
BC114	19
BC115	19
BC116	19
BC117	15
BC118	19
BC119*	26
BC134	19
BC135	20
BC136	18
BC137	20
BC140*	28
BC142*	25
BC143*	25
BC147	7
BC147B	10
BC148	7
BC148B	10
BC148C	10
BC149	8
BC149C	10
BC153	14
BC154	14
BC157	10
BC158	11
BC159	11
BC160*	27

	p
BC167A	11
BC168C	12
BC169C	10
BC170	17
BC171	11
BC172	10
BC173	12
BC177*	15
BC178*	14
BC179*	14
BC182	9
BC183	9
BC184	9
BC182L	10
BC183L	10
BC184L	10
BC186	21
BC187*	28
BC212	9
BC212L	10
BC213	9
BC213L	11
BC214	9
BC214K	14
BC214L	10
BC307B	14
BC308	13
BC327	15
BC328	13
BC338	12
BC441*	30
BC461*	30
BC547	11
BC548	11
BC549C	11
BC557	13
BC558	12
BC559	20
BCY30*	57
BCY34*	75
BCY39*	80
BCY40*	78
BCY42	48
BCY43	75
BCY58	22
BCY59*	22
BCY70*	15
BCY71*	15
BCY72*	16
BCY78*	20
BCZ10	145
BCZ11	145
BD112	95
BD115*	62
BD121	95
BD123	98
BD124*	115
BD131*	38
BD132*	38
BD133*	43
BD135*	36
BD136*	37
BD137*	36
BD138*	36
BD139*	36
BD140*	36
BD142*	59
BD144*	198
BD145*	198
BD181*	85
BD205*	110
BD222	60
BD378*	65
BD434	42
BD517*	65
BD695A*	75
BD696A*	75
BDY11	220
BDY17*	195
BDY60*	110
BDY61*	165
BF115*	22
BF154*	23
BF158	29
BF160	30

	p
BF161	60
BF167	25
BF173*	25
BF177*	24
BF178*	25
BF179*	30
BF180*	20
BF181*	30
BF182*	30
BF183*	30
BF184*	30
BF194	10
BF195	10
BF196	10
BF197	10
BF198	18
BF199	18
BF200*	28
BF224A	18
BF244	24
BF244B	30
BF256*	50
BF257*	26
BF258*	26
BF259*	30
BF336	30
BF394	22
BF594	40
BF595	38
BFR39	25
BFR40	25
BFR41	28
BFR79	28
BFR80	28
BFR81	28
BFR98	105
BFX29*	26
BFX84*	24
BFX85*	24
BFX86*	28
BFX87*	23
BFX88*	24
BFY18*	50
BFY50*	20
BFY51*	20
BFY52*	20
BFY53*	28
BFY55*	45
BFY64*	40
BFY71*	20
BLY83*	850
BSX20*	18
BSX26*	75
BSX29*	45
BSX78*	55
BSY95A	25
BU105*	140
BU205	190
BU208	228
E421	96
MD8001	158
ME1120	25
ME4102	10
ME6002	14
MJ400*	90
MJ491*	160
MJ2955*	99
MJE340*	45
MJE370*	55
MJE371*	60
MJE520*	45
MJE521*	65
MJE2955*	115
MJE3055*	80
MPF102	30
MPF103	36
MPF104	36
MPF105	36
MPF106	50
MPF107	50
MPS3904	40
MPSA05	24
MPSA06	24

	p
MPSA55	24
MPSA56	24
MPSA70	34
MPSU02	58
MPSU05	48
MPSU06	54
MPSU52	65
MPSU55	53
MPSU56	56
MPU131*	39
OC23*	150
OC25*	120
OC26*	150
OC28*	99
OC29*	160
OC35*	80
OC36*	99
OC41*	48
OC42*	32
OC43*	55
OC44*	31
OC45*	20
OC46*	28
OC70*	19
OC71*	25
OC72*	30
OC74*	45
OC75*	45
OC76*	36
OC77*	76
OC79*	76
OC81D*	28
OC82D*	48
OC83*	48
OC84*	44
OC122*	48
OC123*	48
OC139*	85
OC140*	85
OC141*	85
OC170*	40
OC171*	40
OC200*	48
OC201*	75
OC202	85
OC203*	85
OC204*	85
SJE5039*	95
TIP29	43
TIP29A	44
TIP29B	56
TIP29C	60
TIP30	47
TIP30A	47
TIP30B	64
TIP30C	65
TIP31*	40
TIP31A*	40
TIP31B*	40
TIP31C*	65
TIP32*	45
TIP32A*	49
TIP32B*	70
TIP32C*	70
TIP33*	80
TIP33A*	80
TIP33B*	100
TIP33C*	105
TIP34*	85
TIP34A*	85
TIP34B*	110
TIP34C*	110
TIP35*	219
TIP35A*	225
TIP35B*	240
TIP35C*	270
TIP36*	280
TIP36A*	265
TIP36B*	300
TIP36C*	325
TIP41A*	63
TIP41B*	73
TIP42A*	64
TIP42B*	82
TIP2955*	63

	p
TIP3055*	52
TIS43	36
TIS44	45
TIS45	45
TIS46	45
TIS47	50
TIS48	50
TIS49	50
TIS50	47
TIS60	45
TIS62	45
TIS74	47
TIS90	18
TIS91	22
ZTX107	11
ZTX108	11
ZTX109	11
ZTX212	28
ZTX300	13
ZTX301	16
ZTX302	18
ZTX303	21
ZTX304	24
ZTX311	17
ZTX314	24
ZTX320	30
ZTX326	40
ZTX341	20
ZTX500	13
ZTX501	14
ZTX502	19
ZTX503	15
ZTX504	25
ZTX531	25
ZTX550	25
40250*	85
40251*	97
40311*	50
40313*	125
40315*	55
40316*	85
40317*	52
40319*	71
40320*	56
40323*	60
40324*	85
40326*	52
40327*	62
40347*	80
40348*	101
40360*	43
40361*	45
40362*	48
40406*	65
40407*	50
40408*	75
40411*	285
40412*	63
40467*	95
40594*	80
40595*	90
40603*	65
40636*	125
40673*	68
2N697*	21
2N698*	39
2N699*	39
2N706A*	19
2N707*	50
2N708*	19
2N914*	32
2N916*	27
2N918*	30
2N920*	51
2N1131*	22
2N1132*	22
2N1303*	50
2N1304*	50
2N1305*	28
2N1306*	35
2N1307*	50
2N1308*	46
2N1613*	23
2N1670*	150
2N1671B*	195

	p
2N2160*	105
2N2217*	48
2N2218A*	31
2N2219A*	22
2N2220A*	26
2N2221A	23
2N2222A*	20
2N2303*	45
2N2368*	21
2N2369A*	15
2N2483*	28
2N2484*	30
2N2646*	48
2N2784	55
2N2904*	22
2N2905A*	20
2N2906*	18
2N2907*	20
2N2907A*	22
2N2926G	10
2N3011*	24
2N3053*	20
2N3054*	49
2N3055*	55
2N3108	39
2N3442*	131
2N3563	20
2N3614*	169
2N3615*	135
2N3663*	24
2N3702	10
2N3703	11
2N3704	10
2N3705	11
2N3706	10
2N3707	10
2N3708	10
2N3709	10
2N3710	18
2N3711	10
2N3772*	170
2N3773*	288
2N3819	22
2N3820	32
2N3823*	65
2N3824*	70
2N3866*	90
2N3903	18
2N3904	18
2N3905	18
2N3906	17
2N4037*	52
2N4041*	80
2N4058*	17
2N4061	17
2N4062	13
2N4064*	120
2N4069	45
2N4236	145
2N4286	20
2N4289	20
2N4427*	75
2N4859	65
2N4922*	55
2N5135	42
2N5136	42
2N5138	20
2N5172	24
2N5179	60
2N5180	60
2N5191	65
2N5305	24
2N5457	32
2N5458	32
2N5459	32
2N5485	32
2N5642*	750
2N5777	56
2N6027	40
2N6109	45
3N128	85
3N140	85

Matched Pair 10p extra

LINEAR IC'S

702	75
709C 8 pin	35
723* 14 pin	45
741* 8 pin	22
747C 14 pin	70
748C 8 pin	36
753 8 pin	150
810	159
AY-1-0212	580
AY-1-1313A	660
AY-1-1320	632
AY-1-5050	241
AY-1-5051	145
AY-1-6721/6	195
AY-3-8500*	450
AY-3-8550*	595
AY-3-8710*	850
AY-5-1224A*	260
AY-5-1230*	450
AY-5-1315	560
AY-5-1317A	630
AY-5-3500*	510
AY-5-3507*	415
AY-5-4007	650
CA3011*	82
CA3014*	137
CA3018*	68
CA3020	170
CA3023	170
CA3028A*	80
CA3035	240
CA3036	110
CA3043	190
CA3045	140
CA3046	71
CA3048	200
CA3075	175
CA3080E*	80
CA3081	190
CA3089E	210
CA3090AQ	390
CA3123	200
CA3130*	85
CA3140	92
ICL7106*	975
ICL7107*	975
ICL8038CC*	370

ICM7205*	1150
LM300H	170
LM301A	30
LM304	240
LM308T	110
LM318H	205
LM318S	195
LM324A	79
LM339	80
LM348	120
LM379	375
LM380	95
LM381N	145
LM381AN	248
LM382	125
LM3900*	60
LM3909N*	70
LM3911*	125
LM732	125
M252AA*	750
M253AA*	795
MC663	275
MC724*	175
MC1303	88
MC1304P	260
MC1310P	175
MC1312PQ	195
MC1458P*	55
MC1495	395
MC1496L	92
MC1710CG	79
MC3340P	150
MC3360P	120
MC3401	70
MEM780	205
MFC4000B	85
MFC6040*	97
MK50362*	650
MK50398*	635
NE350	190
NE543K	210
NE544	185
NE555*	29
NE556DB*	60
NE560*	325
NE561*	395
NE562B*	410
NE565A*	120

NE566*	160
NE567V*	170
NE571	450
RAM2102-2*	170
RC4136D	120
ROM2513*	700
SG3402*	295
SL403D	250
SL437A	560
SN72710*	43
SN72733*	125
SN76003N	211
SN76013N	140
SN76013ND	120
SN76023N	140
SN76023ND	120
SN76033N	211
SN76115N	215
SN76227N	115
TAA550	50
TAA621AX1	228
TAA661A	155
TAA960	300
TAD100	150
TAD110	170
TBA120S	70
TBA540	215
TBA540Q	220
TBA550Q	330
TBA641-A12/BX1 or BX11	250
TBA651	160
TBA800	90
TBA810S	105
TBA820	70
TBA920Q	260
TCA270Q	220
TCA270SQ	220
TDA1022	595
TDA2020	320
TLO81CP*	52
TLO82CP*	96
TLO84CP*	130
UAA170	198
ZN414	105
ZN424E	130
ZN425E*	375

TTL 74* (TEXAS)

7400	13
7401	13
7402	14
7403	14
7404	14
7405	18
7406	38
7407	38
7408	17
7409	17
7410	15
7411	20
7412	17
7413	30
7414	51
7416	30
7417	30
7420	16
7421	29
7422	24
7423	27
7425	27
7426	36
7427	27
7428	35
7430	17
7432	25
7433	40
7437	30
7438	33
7440	17
7441	74
7442	68
7443	115
7444	112
7445	94
7446	94
7447	82
7448	56
7450	17
7451	17
7453	17
7454	17
7460	17
7470	28
7472	25
7473	32

7474	27
7475	38
7476	36
7480	48
7481	86
7482	69
7483	72
7484	95
7485	106
7486	31
7489	210
7490	33
7491	75
7492	38
7493	32
7494	78
7495	65
7496	57
7497	189
74100	119
74104	62
74105	62
74107	29
74109	64
74110	54
74111	68
74112	88
74116	198
74118	83
74119	119
74120	115
74121	25
74122	46
74123	48
74125	38
74126	57
74128	74
74132	73
74141	56
74142	269
74143	314
74144	314
74145	65
74147	175
74148	109
74150	99
74151	64

74153	64
74154	96
74155	53
74156	80
74157	67
74159	210
74160	82
74161	92
74162	92
74163	92
74164	105
74165	105
74166	161
74167	20
74170	230
74172	625
74173	170
74174	87
74175	87
74176	75
74177	78
74180	85
74181	165
74182	160
74184	135
74185	135
74188	275
74190	115
74191	105
74192	105
74193	105
74194	105
74195	95
74196	99
74197	85
74198	150

74LS47	90
73	96
74	41
75	49
83	115
90	60
96	116
107	107
132	95
139	85
151	96
153	76
155	96
156	96
157	76
158	96
160	128
161	98
162	138
163	113
164	114
174	106
175	110
181	318
190	140
191	140
192	130
193	130
196	100

Complete LS range available

74LS*

74LS00	18
01	18
02	20
04	20
10	20
13	38
14	75
27	28
42	75

CMOS*

4000	15
4001	17
4002	17
4006	105
4007	18
4008	87
4009	50
4010	50
4011	18

4012	18
4013	42
4014	86
4015	89
4016	45
4017	89
4018	89
4019	48
4020	99
4021	91
4022	88
4023	20
4024	66
4025	19
4026	180
4027	45
4028	81
4029	99
4030	58
4031	205
4032	100
4033	145
4034	196
4035	111
4036	325
4037	100
4038	108
4039	320
4040	105
4041	80
4042	75
4043	94
4044	88
4045	145
4046	128
4047	87
4048	58
4049	48
4050	48
4051	72
4052	73
4053	72
4054	110
4055	128
4057	2570
4059	480
4060	99
4063	110

4066	58
4067	380
4068	22
4069	20
4070	32
4071	21
4072	21
4073	21
4075	23
4076	85
4077	40
4078	21
4081	20
4082	21
4085	74
4086	73
4089	150
4093	85
4094	190
4096	105
4097	372
4098	110
4099	145
4160	109
4161	109
4162	109
4163	109
4174	110
4175	99
4194	108
4408	720
4409	720
4410	720
4412F	1650
4412V	1380
4415F	795
4415V	795
4419	280
4422	545
4433	1225
4435	825
4440	1275
4450	295
4451	295
4452	
4490F	695
4490V	525
4501	99

4502	120
4503	69
4506	51
4507	55
4508	298
4510	99
4511	150
4512	98
4513	206
4514	265
4515	299
4516	125
4517	382
4518	102
4519	55
4520	108
4521	268
4522	199
4527	152
4528	99
4529	165
4530	85
4531	165
4532	127
4534	788
4536	380
4538	160
4539	110
4541	150
4543	175
4549	396
4553	449
4554	152
4556	78
4557	451
4558	117
4559	388
4560	208
4561	65
4562	533
4566	159
4568	299
4569	359
4572	25
4580	604
4581	409
4585	101

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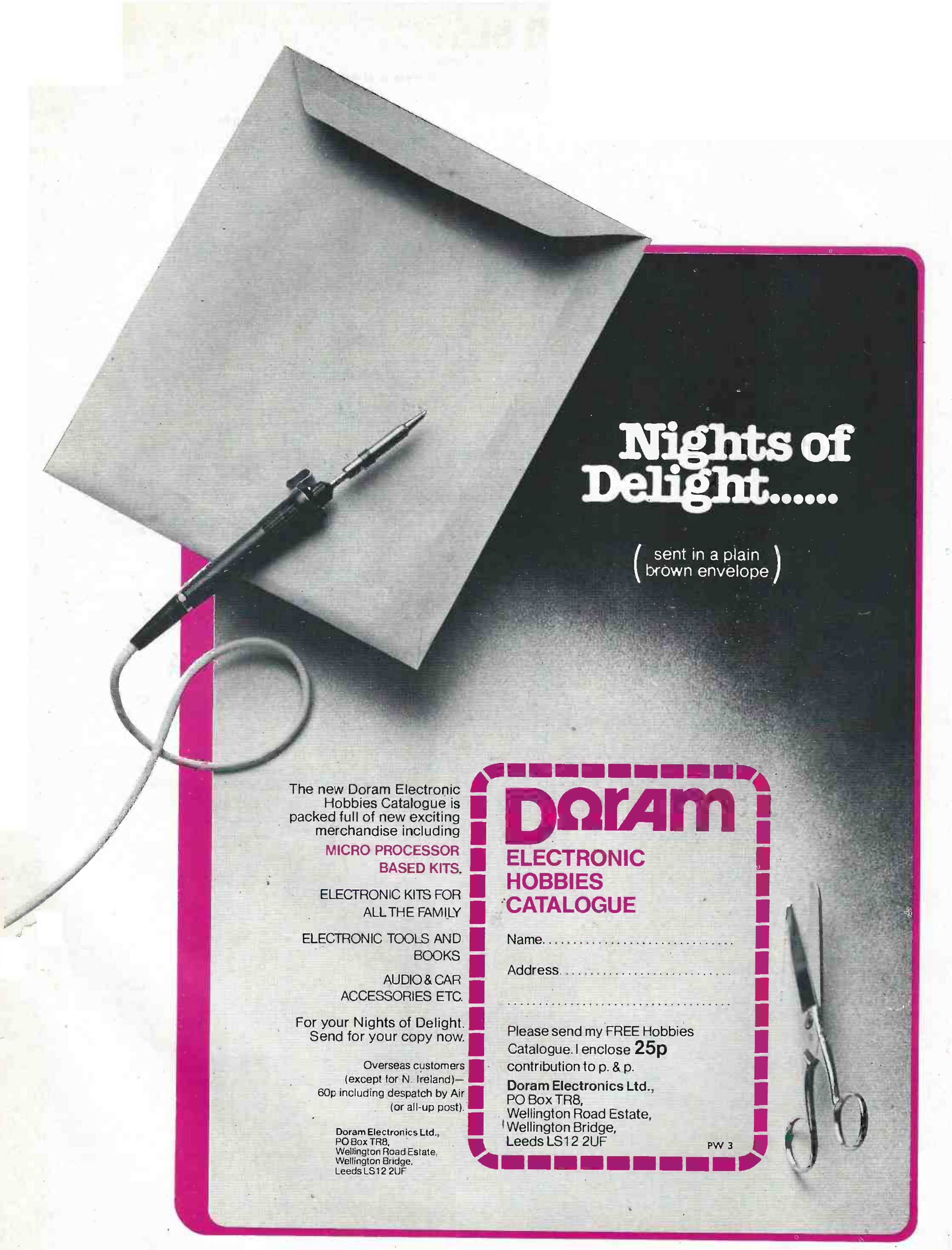

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