PRACTICAL WIRELESS

DECEMBER 1975

35p

EXTRA SIMPLE HOME PROJECTS No.3

8-PAGE SUPPLEMENT INSIDE

PW 'Easybuild'

STEREO DISCO SYSTEM PART 1 (100+100W)

also:

2m FM TRANSMITTER

STABILISED POWER SUPPLY

CHROMASONIC electronics

Dept. 1. 56, Fortis Green Road,
Muswell Hill, London, N10 3HN.
telephone: 01-883 3705

C-MOS

mix prices

	1-24	25-99	100up
CD4000AE	19p *	17p *	14p *
CD4001AE	19p *	17p *	14p *
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CD4006AE	£1.59 *	£1.33 *	£1.06 *
CD4007AE	23p *	19p*	15p *
CD4008AE	£1.75 *	£1.46 *	£1.17 *
CD4009AE	Use	CD4049*	
CD4010AE	Use	CD4050*	
CD4011AE	19p *	17p*	14p *
CD4012AE	19p *	17p*	14p *
CD4013AE	59p *	50p*	46p *
CD4014AE	£1.75 *	£1.46 *	£1.17 *
CD4015AE	£1.75 *	£1.46 *	£1.17 *
CD4016AE	55p *	48p*	44p *
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CD4018AE	£1.89 *	£1.56 *	£1.25 *
CD4019AE	80p *	66p*	53p *
CD4020AE	£1.97 *	£1.64 *	£1.31 *
CD4021AE	£1.75 *	£1.46 *	£1.17p *
CD4023AE	19p *	17p*	14p *
CD4022AE	£1.83 *	£1.53 *	£1.22 *
CD4024AE	£1.26 *	£1.05 *	84p *
CD4025AE	19p *	17p*	14p *
CD4026AE	£2.79 *	£2.33 *	£1.86 *
CD4027AE	98p *	82p*	65p *
CD4028AE	£1.53 *	£1.28 *	£1.02 *
CD4029AE	£1.89 *	£1.56 *	£1.15 *
CD4030AE	71p *	59p*	47p *
CD4035AE	£1.75 *	£1.46 *	£1.17 *
CD4040AE	£2.01 *	£1.69 *	£1.34 *
CD4042AE	£1.49 *	£1.24 *	99p *
CD4046AE	£2.15 *	£1.79 *	£1.44 *
CD4049AE	69p *	58p*	46p *
CD4050AE	69p *	58p*	46p *
CD4051AE	£2.78 *	£2.32 *	£1.85 *
CD4052AE	£2.78 *	£2.32 *	£1.85 *
CD4056AE	£2.12 *	£1.76 *	£1.41 *
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CD4069AE	28p *	24p*	19p *
CD4070AE	28p *	24p*	19p *
CD4071AE	28p *	24p*	19p *
CD4077AE	71p *	59p*	47p *
CD4081AE	28p *	24p*	19p *
CD4082AE	28p *	24p*	19p *
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CD4511AE	£2.36 *	£1.79 *	£1.44 *
CD4528AE	£1.30 *	£1.08 *	87p *

I.C. SOCKETS

Pin Sockets, pins in strips of 100. Just snip off what you need. 65p per strip *

Dual in line

8 pin 13p.	24 pin 26p.	TO5
14 pin 15p	28 pin 30p.	8 pin 31p.
16 pin 15p	36 pin 39p.	10pin 35p.

FREE CIRCUITS

Our 8 Page A4 Audio I.C. Booklet is supplied FREE with purchases of Linear I.C.'s worth £1. or more (35p. if sold alone) Contains circuits and pin connections

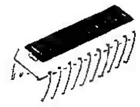
- 15 Amplifiers 250 mW to 20 watts
- 5 Audio Pre-Amplifiers
- 1 Tape Pre-Amplifier
- 1 Power Driver
- 1 Instrument Amplifier (Bifet)
- 1 General Purpose Mini Amplifier
- 1 D.C. Controlled Gain Control
- 1 Micro-mini radio (2 I.C's)

PHOTO-DARLINGTON

Vceo 25v 2N5777
Vcbo 25v
Vebo 8v
Il 250 mA
Pd 200 mW
Hfe 2500

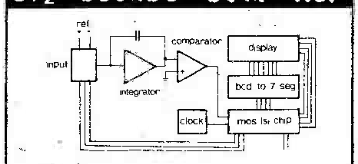
35p.

LINE-O-LIGHT



NEW LED Linear Cursors each device contains 10 light emitting diodes in a 20 pin dual-in-line package. Ideal for solid state analogue meters or dials Type 101 RED £2.26.* Complete with leaflet.

3½ DECADE DVM I.C.



This state-of-the-art MOS LSI chip contains all the logic necessary for a 3½ decade, dual slope integrating, automatic polarity detecting DVM Supplied with free data and circuit booklet. AY-5-3507

OUR PRICE ONLY £6.59.*

(Data and Circuit Booklets alone 20p.)

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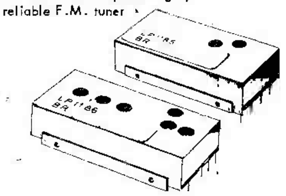
MULLARD MODULES

Still make the simplest, highly reliable F.M. tuner



LP1186	Varactor front end	£5.38
LP1185	I.F. Strip	£6.22
LP1400	Multiplex decoder	£5.62

74 TTL

mix prices

	1-24	25-99	100+
7400	14p*	12p *	10p *
7401	14p*	12p *	10p *
7402	14p*	12p *	10p *
7403	15p*	12½p*	10p *
7404	16p*	13p *	11p *
7408	16p*	13p*	11p *
7409	16p*	13p*	11p *
7410	16p*	13p*	11p *
7413	29p*	24p*	20p *
7417	27p*	22½p*	20p *
7420	16p*	13p*	11p *
7427	27p*	22½p*	18p *
7430	16p*	13p *	11p *
7432	27p*	22½p*	18p *
7437	27p*	22½p*	18p *
7441	75p*	62p*	50p *
7442	65p*	55p*	43p *
7445	85p*	71p*	57p *
7447	81p*	75p*	65p *
7448	75p*	62p*	50p *
7447A	95p*	83p*	67p *
7470	30p*	25p*	20p *
7472	25p*	21p*	17p *
7473	30p*	25p*	20p *
7474	32p*	26p*	21p *
7475	47p*	39p*	31p *
7476	32p*	26p*	21p *
7482	75p*	62p*	50p *
7485	£1.30 *	£1.09 *	87p *
7486	32p*	26p*	21p *
7489	£2.92 *	£2.80 *	£2.10 *
7490	49p*	40p*	32p *
7491	65p*	55p*	45p *
7492	57p*	46p*	36p *
7493	45p*	40p*	32p *
7495	67p*	55p*	45p *
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74107	35p*	28p*	22p *
74121	34p*	23p*	23p *
74122	47p*	39p*	31p *
74141	78p*	63p*	53p *
74145	68p*	58p*	48p *
74154	£1.62 *	£1.48 *	86p *
74174	£1.00 *	83p*	67p *
74180	£1.06 *	88p*	71p *
74181	£3.20 *	£2.50 *	£1.90 *
74192	£1.35 *	£1.14.*	90p *
74193	£1.35 *	£1.14 *	90p *
74196	£1.64 *	£1.34 *	99p *

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555 (TO-99)T	81p *
556 (14 pin dip)	£1.29 *
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709 (8 pin dip)	38p
709 (TO-99)	45p
709 (14 pin dip)	39p
710 (8 pin dip)	39p
710 (TO-99)	45p
710 (14 pin dip)	44p
711 (TO-99)	51p
711 (14 pin dip)	44p
720 (A.M.Radio)	£1.76
723 (TO-99)	£1.09
723 (14 pin dip	74p
741 (8 pin dip	36p
741 (TO-99)	43p
741 (14 pin dip)	36p
747 (14 pin dip)	£1.04
748 (8 pin dip)	42p
748 (TO-99)	46p
748 (14 pin dip)	49p
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75491	88p *
75492	£1.10 *
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78L12WC (TO-92)	60p *
78L15WC (TO-92)	60p *
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78L12AWC (TBA625B)	90p *
78L15AWC (TBA625C)	90p *
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78M15HC	£1.35 *
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7812KC (TO-3)	£2.09 *
7815KC (TO-3)	£2.09 *
7818KC (TO-3)	£2.09 *
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7815UC (TO-220)	£1.72 *
7818UC (TO-220)	£1.72 *
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AY-5-3507	£6.59 *
AY-5-4007	£7.94 *
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CA3045	£1.69
CA3046	88p
CA3053	59p
CA3065	£1.60
CA3075	£1.64
CA3078	£1.26
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CA3081	£1.86
CA3082	£1.86
CA3089E (TDA1200)	£2.43
CA3097E	£1.67 *
CA3123E	£1.76
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CA3401E (LM3900)	68p
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L037T1 (TO-3)	£1.46 *
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L130 (SOT-32)	85p *
L131 (SOT-32)	85p *
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LM3015 (8 pin dip)	59p
LM301A T (TO-99)	67p
LM301A S (8 pin dip)	59p
LM307 T (TO-99)	59p
LM307 S (8 pin dip)	57p
LM308 T (TO-99)	£1.96
LM308 S (8 pin dip)	98p
LM308A T (TO-99)	£7.92
LM308A S (8 pin dip)	£6.90
LM309K	£2.34 *
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LM371	£2.08
LM372N	£1.99
LM373N	£2.99
LM377N	£2.71
LM380	£1.25
LM381	£1.85
LM382	£1.66
LM703	68p
LM1820	£1.03

LM2111	£1.12
LM3900	69p
LM3909	66p *
MC1303L	£1.84
MC1306P	80p
MC1310P	£2.39
MC1312	£2.42
MC1314	£4.13
MC1315	£4.62
MC1327	£1.12
MC1330P	83p
MC1339P	£1.52
MC1350	64p
MC1351	88p
MC1352	88p
MC1357	£1.57
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MC1455 (555T)	62p *
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MC1496G	96p
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MFC6030A	79p *
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NE556	£1.29 *
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NE562B	£5.06
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NE565N	£2.63
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SL415A	£2.75
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TAA550	75
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TBA231	£1.02
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TBA520Q	£3.85
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TBA540Q	£3.72
TBA550Q	£5.29
TBA560CQ	£5.29
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TBA625B	£1.03 *
TBA625C	£1.03 *
TBA651	£1.87
TBA720Q	£2.79
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TBA800	£1.11
TBA810S	£1.24
TBA810AS	£1.24
TBA820	86p
TBA920Q	£4.71
TBA990Q	£4.71
TCA270Q	£5.24
TCA760	£2.16
TCA800Q	£7.24
TCA830S	£1.04
TCA940	£2.25
TDA1054	£1.50
TDA1200	£2.43
TDA1405	80p *
TDA1412	80p *
TDA1415	80p *
TDA2010	T.B.A.
TDA2020	T.B.A.
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ZN414	£1.26

ZN414 Leaflet free with devices (10p alone)

MC1310, 2, 4 & 5 Leaflet free with devices (10p alone)

LED DISPLAYS

Litronix Double Digit Displays 0.5" Common Anode; 2 R/H Decimal Points
DL721 ± 1.9
DL727 0.0 to 9.9
Suitable for Clocks, Meters, Instruments, Channel Indicators
Our price £4.75 * each

NEW

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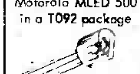
BCD encoded digital switch Reading 0 to 9. Suitable for digital clock alarm setting DVM input Scaling etc.

1 to 9. £1.49 each *

Low cost Red GaAsP Motorola MLED 500 in a TO92 package



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0.33"	Litronix DL 707 Series	✓✓✓✓	all £1.82* each	(Red only)
0.33"	Monsanto MAN 50/70/80/3600	✓✓✓✓	all £1.82* Each	(Red, green, yellow, Orange)
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0.43"	Monsanto MAN 4000 Series	✓✓✓✓	all £2.32* Each	(Red, Green, Yellow, Orange)
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Common Cathode as Common Anode (Red only)

NOTE: MAN 4000 Series pin outs are 14 pin dil the same as MAN 50; 70 and 80 series.

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Red	16p	15p	13p *	27p	24p	22p*	18p	16p	14p *
Green	27p	24p	22p*	33p	30p	27p*	30p	27p	25p *
Orange	27p	24p	22p*	33p	30p	27p*	30p	27p	25p *
Yellow	34p	31p	29p*	35p	32p	29p*	35p	33p	30p *

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6 pin industry standard package
2.5KV isolation £1.00.*

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6-0-6V	100 mA	97p. *	0-9-17 V		-	£1.95 *	£2.27	£2.64 *
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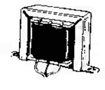
12-0-12V	100 mA	97p *	0-24-30-40-48-60 V		-	£5.18 *	£7.02.	- *
20-0-20V	1 A	£4.55 *	0-19-25-33-40-50 V		£2.70 *	£3.40 *	£4.53	- *
24-0-24V	500 mA	£2.48 *						
28-0-28V	1 A	£6.18 *						



p.p. on transformers 10% of price min. 20p

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Advert No.1A of Series B

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PRACTICAL WIRELESS

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NEWS & COMMENT

CONSTRUCTIONAL

OTHER FEATURES

SPECIAL EXTRA! —8-PAGE SUPPLEMENT — SIMPLE HOME PROJECTS No. 3

READERS—Please note that Studio Electronics of Harlow have gone into liquidation.

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Full labour and material guarantees for 12 months **LOW DEPOSIT CREDIT TERMS**

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LEAK 2060 L/Speakers	£96·95 Ea	£74·95
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ROTEL RX202 Tun/Amp	£124·43	£89·95
ROTEL RX402 Tun/Amp	£169·93	£119·95
ROTEL RT224 Tuner	£72·50	£51·95
ROTEL RT324 Tuner	£92·50	£66·95
WHARFEDALE Denton I L/Spkr	£39·10 Pr	£26·95
WHARFEDALE Denton 2XP L/Spkr	£57·29 Pr	£41·95
WHARFEDALE Linton 3XP L/Spkr	£79·69 Pr	£58·95
FANE Ambassador 35 L/Spkr	£103·00 Pr	£79·95
FANE MARQUESS 30 L/Spkr	£86·75 Pr	£57·50
FANE Mode One Spkr Kit	£29·90 Pr	£21·95
WHARFEDALE Linton II Kit	£33·45 Pr	£24·95

BASF CASSETTES in Snap Pack CARR. FREE

	LH CASSETTES Rec. Price	RSC Price 1	5	10	SUPER SM CASSETTES Rec. Price	RSC Price 1	5	10
C60	98p	65p	3·00	4·99	1·08	80p	3·50	6·75
C90	1·36	90p	3·99	6·99	1·40	1·05	4·75	8·95
C120	1·87	1·20	5·50	9·90	1·94	1·46	6·75	12·95

Also Shure Cartridges, Basf Tape, Koss H/Phones, etc.
Prices of above correct at Oct. 8 1975

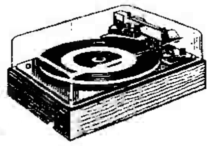
AKAI TAPE UNITS

	Rec. Price	RSC Price
CS30D Spec. Price	£105·95	£69·95
CS34D	£137·50	£99·95
GXC39D	£186·50	£136·95
GXC39	£205·50	£144·95
GXC75D	£258·50	£187·95
GXC310D	£219·50	£159·95
CR81D	£113·00	£79·95
GXR82D	£162·50	£116·95
4000DS MK II	£169·50	£124·95

TURNTABLES

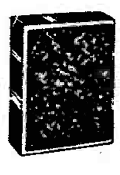
GOLDRING GL75 with G800	£39·95
As above but with Plinth and Cover	£51·95
PIONEER PL12D with Plinth and Cover	£49·95
BSR MP60 with Plinth and Cover plus G850 Goldring Cartridge	£24·95
GARRARD SP25 Mk. 1V with Plinth and Cover plus G850 Cart.	£27·95

PLINTH AND COVER



for Garrard SP25 or BSR MP60
£3·95
Carr. 50p

HI-FI SPEAKER ENCLOSURES



Simulated Teak finish.
Sizes approx.
Carr. 50p. per enc.

ME8 13×9¼×6½in. £4·50
JE8 16×11×9in. £6·95
Both cut for 8in. speaker.
SE10 25×16×9in. £10·25
Cut for 10in. and Tweeter
SE12 25×16×9in. £10·25
Cut for 12in. and Tweeter

DISCO SYSTEM 40 WATT

Consisting of Twin Turntable Console with Pre-amp and built-in Power Output. Sep. vol. controls for each T/table. H/phone monitoring facilities. Sep. Bass and Treble controls. Mic. Vol. control. Neon Mains Indicator. Plus Pair 12" 25w Spkrs. in matching Rexine covered cabinets. carr. £3 **£99·99**

Terms: Dep. £15·99 and 18 fortnightly paymts. £5·38. (Total £112·83)

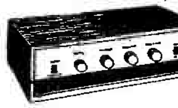
AS ABOVE LESS SPEAKERS
Terms: Dep. £9·00 and 18 fortnightly Payments £4·61 (Total £91·98). **£79·95**

MOBILE DISCO CONSOLE

MIC., JACK, PHONE JACK, MONITOR VOL. CONTROL. MONITOR SELECTOR DECK (1) Vol. Control, DECK (2) Vol. control, Mic. Vol. Control, Treble Control, Bass Control and ON/OFF Switch, Neon Indicator, Twin Turntables. Carr. £3 **£59·95**

Terms: Dep. £7·95 and 18 fortnightly paymts. £3·33 Total £67·89.

RSC G66 MkII 6+6 WATT high quality STEREO AMPLIFIER



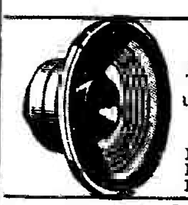
Controls: Bass, Treble, Vol. and Bal. 10 Transistors plus Diodes. Range 20-20,000 c.p.s. Bass Control ± 12db. Treble Control ± 13db. Selector switch for Crystal P.U. or Tape/Radio. 3—15 ohms. Attractive Black and Silver finished metal fascia plate. COMPLETE KIT INC FULLY WIRED PRINTED CIRCUIT and WIRING DIAGRAMS & INSTR Or FACTORY BUILT IN TEAK VENEERED CABINET as illustrated £19·50.
£14·99 Carr 40p

ALL R.S.C. PRICES INCLUDE VAT

POWER (SLAVE) AMPLIFIER 100 WATT

Suitable for use with above or other DISCO-Consoles.
Also for increasing output of lower-powered Amplifiers. **£45·00** Terms: Dep. £5·80 and 8 mthly payments of £5·80 (Total £52·20) carr. £1

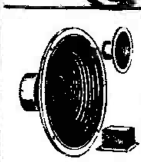
AUDIOTRINE HIGH FIDELITY SPEAKERS



Plasticised Cone surround. "D" or "T" indicates Tweeter Cone providing extended frequency range up to 15,000 Hz. Impedance 3 or 8-15 ohms.
PLEASE STATE CHOICE.
Exceptional performances at low cost.

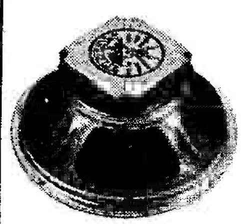
HF808T	8"	10W	£2·95	HF120D	12"	15W	£7·50
HF102D	10"	10W	£3·95	HF126	12"	15W	£9·25
HF120	12"	15W	£6·95	HF126D	12"	15W	£9·95

AUDIOTRINE HI-FI SPEAKER SYSTEM



Consisting of matched 12in. 11,000 Gauss 15 Watt 15 ohm high quality speaker, cross-over unit and tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction. **£7·95** Carr. 45p
OR SENIOR 15 WATT INCLUDING HF123 13,000 GAUSS SPEAKER **£10·25** Carr. 50p

TITAN GROUP/DISCO SPKRS



	Rec. Price	RSC Price
T12/35 12" 35w	£13·00	£10·95
T12/60 12" 60w	£20·00	£14·95
T12/100 12" 100w	£35·00	£27·95
T15/70 15" 70w	£27·00	£19·95
T15/100 15" 100w	£38·50	£27·95
T18/100 18" 100w	£42·50	£29·95

AUDIO FIDELITY FR1 SPKR KIT

Response 30 Hz-15 KHz. Rating 15 watts in sealed cabinet. Imp. 8-15 ohms. 8" Bass Unit with P.V.C. Cone surround for ultra low resonance. Pressure Tweeter. Printed Circuit. Inductive/Capacitive Cross-over. Damping Material, Screws. Terminal Panels.
£13·64 each Carr. Free SPECIAL OFFER **£18·50** Pair Carr. 50p

AUDIO FIDELITY MODEL 80 HIGH FIDELITY SPEAKER

A full range 8in. 10 watt unit for excellent sound quality, in suitable enclosure. Roll P.V.C. cone surround and long throw voice coil to achieve very low fundamental resonance of 30 c.p.s. Tweeter cone is fitted to extend high note response. Frequency range 25 Hz to 15 KHz. Gauss 10,000. Impedance 8-15 Ω. £6·21 ea. **£9·25** pr.
MODEL 83 8" 15w. with parasitic Tweeter. £7·99 ea. **£12·50** pr.
Response 25 Hz to 15 KHz. Gauss 13,000 Imp 8–15 Ω

R.S.C. TRANSFORMERS, L.F. CHOKES & RECTIFIERS

FULLY GUARANTEED. Impregnated and Interleaved where necessary. Primaries 200-250v. 50c/s. Screened

ALL PRICES INCLUDE V.A.T.

MIDGET CLAMPED TYPE

250v. 60mA 6·3v. 2a.	£1·75
250-0-250v. 60mA 6·3v. 2a.	£1·85

FULLY SHROUDED UPRIGHT MOUNTING

250-0-250v. 60mA 6·3v. 2a. 0-5-6·3v. 2a.	£2·60
250-0-250v. 100mA 6·3v. 4a. 0-5-6·3v. 3a.	£4·35
300-0-300v. 130mA 6·3v. 4a. C.T. 6·3v. 1a. for Mullard 510 Amplifier	£5·20
350-0-350v. 100mA 6·3v. 4a. 0-5-6.3v. 3a.	£4·35
350-0-350v. 150mA 6·3v. 4a. 0-5-6·3v. 3a.	£5·20
425-0-425v. 200mA 6·3v. 4a. C.T. 5v. 3a.	£9·85
425-0-425v. 200mA 6·3v. 4a. 6·3v. 4a. 5v. 3a.	£10·00
450-0-450v. 250mA 6·3v. 4a. C.T. 5v. 3a.	£10·45

TOP SHROUDED DROP-THROUGH TYPE

250-250v. 70mA 6·3v. 2a. 0-5-6.3v. 2a.	£2·60
250-0-250v. 100mA 6·3v. 3·5a.	£2·90
250-0-250v. 100mA 6·3v. 2a. 6·3v. 1a.	£3·20
350-0-350v. 80mA 6·3v. 2a. 0-5-6·3v. 2a.	£3·20
250-0-250v. 100mA 6·3v. 4a. 0-5-6·3v. 3a.	£4·35
300-0-300v. 100mA 6·3v. 4a. 0-5-6·3v. 3a.	£4·35
300-0-300v. 130mA 6·3v. 4a. 0-5-6·3v. 1a suitable for Mullard 510 Amp.	£5·20
350-0-350v. 100mA 6·3v. 4a. 0-5-6·3v. 3a	£4·35
350-0-350v. 150mA 6·3v. 4a. 0-5-6·3v. 3a.	£5·20

FILAMENT OR TRANSISTOR POWER PACK
Type: 12v. 1a. £1·10, 6·3v. 1·5a £1·06, 6·3v. 2a. £1·10 6·3v. 3a £1·70, 6·3v. 6a. £2·60, 12v. 3a. or 24v. 1·5a. £2·60 0-9-18v. 1½a. £2·26, 0-12-25-42v. 2a. £3·19

AUTO (STEP UP/STEP DOWN) TRANSFORMERS
0-110/120v. 200-230-250v. 50-80w. £2·90 150 watts £5·20, 250 watts £6·37, 500 watts £9·84

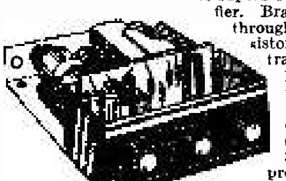
CHARGER TRANSFORMERS
0-9-15v. 1½a. £2·03, 2½a. £2·26, 3a. £2·32, 5a. £2·84, 6a. £3·19, 8a. £3·48

OUTPUT TRANSFORMERS
Standard Pentode 5000 to 3 ohm, or 7000 ohm to 3 ohm £1·12, Push Pull 8 watts EL84 to 3 ohm or 15 ohm £1·68; Push Pull 10-12 watts 6v. 6 to 3 ohm or 15 ohm £2·61; Push Pull 10-12 watts to match 6v. 6 to 3, 5, 8 or 15 ohm £2·72; Push Pull EL84 to 3 or 15 ohm 10-12 watts £2·61; Push Pull Ultra Linear for Mullard 510 etc. £4·35;.

SELENIUM RECTIFIERS
F. W. (Bridged)
All 6/12v. D.C. output. Max. A.C. input 18v.
1a, 45p. 2a, 57p. 3a, 65p. 4a, 95p. 5a, £1.15.

L.F. CHOKES
150mA, 7-10H, 250 Ω £1·28; 100mA, 10H, 200 Ω £1·10; 60mA, 10H, 400 Ω 41p.

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. 85p.

DE LUXE STEREO AMPLIFIER

A.C. mains 200-240 v. Using heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line up: 2 × ECL86 Triode Pentodes. 1 × EZ80 as rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate 'Balance' control fitted at the rear of the chassis. Input sensitivity is approximately 300m/v for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11"w × 4"d. Overall height including valves 5". Ready built & tested to a high standard. **£12·50.** P.&P. 95p.

ALL-PURPOSE POWER SUPPLY UNIT 200/240v. A.C. input. Four switched fully smoothed D.C. outputs giving 6v. and 7½v. and 9v. and 12v. at 1 amp on load. Fitted insulated output terminals and pilot lamp indicator. Hammer finish metal case overall size 6" × 3¾" × 2¼". Ready built and tested. **PRICE £6·35** P. & P. 85p.

VYNAIR & REXINE SPEAKERS & CABINET FABRICS app. 54 in. wide. Our price **£1·80** yd. length. P. & P. 35p per yd. (min. 1 yd.). S.A.E. for samples.

HARVERSON'S SUPER MONO AMPLIFIER

A super quality gram amplifier using a double wound fully isolated mains transformer, rectifier and ECL82 triode pentode valve as audio amplifier and power output stage. Impedance 3 ohms. Output approx. 3·5 watts. Volume and tone controls. Chassis size only 7in. wide × 3in. deep × 6in. high overall. AC mains 200/240v. Supplied absolutely Brand New completely wired and tested with good quality output transformer. P. & P. 85p BARGAIN PRICE **£5·00**

FEW ONLY!

High grade mains transformer with grain orientated lamination. Primary 200/240 Secondary 18·5 volts at 0·6 amps and 4·6 volts at 0·3 amps. Size 2" 1×2½" w× 2" d overall. **£1·40** plus 36p P. & P.

BRAND NEW MULTI-RATIO MAINS TRANSFORMERS. Giving 13 alternatives. Primary: 0-210-240v. Secondary combinations 0–5–10–15–20–25–30–35–40–60v. half wave at 1 amp. or 10–0–10, 20–0–20, 30–0–30v. at 2 amps full wave. Size 3in. long × 3½in. wide × 3in. deep. Price **£2·75** P. & P. 75p.

MAINS TRANSFORMER. For power supplies.
Pri. 200/240v. Sec. 9–0–9 at 500 mA. **£1·35.** P. & P. 35p.
Pri. 200/240v. Sec. 12–0–12 at 1 amp. **£1·50.** P. & P. 55p.
Pri. 200/240v. Sec. 10–0–10 at 2 amp. **£2·20.** P. & P. 70p.

3 VOLT RELAY
100 m/A single pole normally closed. 2 for **60p**+15p P.& P.

GENERAL PURPOSE HIGH STABILITY TRANSISTOR PRE-AMPLIFIER

For P.U. Tape, Mike, Guitar, etc. and suitable for use with valve or transistor equipment. 9-18v. battery or from H.T. line 200/300v. Frequency response 15Hz—25KHz. Gain 26dB. Solid encapsulation size 1½" x 1½" x ½". Brand new complete with instructions. Price **1·50p.** P. & P. 15p.

HANDBOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES

A must for servicemen and home constructors. Including many 1000's of British, U.S.A. European and Japanese transistors. ONLY **40p.** Post 10p.

3 Reference Encyclopedias for Electronic Engineers and Designers, covering between them transistor characteristics, diode and transistor equivalents. Many thousands of up to date European types listed. **Diode Equivalents, £1·00; Transistor Equivalents, £1·20; Transistor Characteristics, £1·40;** P. & P. 15p. All three together, **£3·20**

NEW ISSUE
Thyristor, Triac, Diac etc. encyclopedias **£1·70,** P. & P. 10p

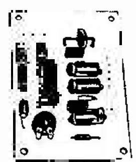
8 pole 3 way 2 bank low loss Yaxley type switches 1½" sections. Standard spindle. 2 switches **75p** + 20p P. & P.

HARVERSONIC MAINS OPERATED SOLID STATE STEREO FM TUNER

Enjoy fabulous stereo radio at this fabulous low introductory price!

Designed and styled to match our 10 + 10 amplifier but will suit any other standard stereo amplifier. The design incorporates the very latest circuitry techniques with high-grain, low noise IF stages. Automatic frequency control to "lock-on" station and prevent drift. IC stereo decoder for maximum stereo separation. L.E.D. for stereo beacon indicator. Nominal output of tuner 100mV. Approximate size 12½" wide × 8" deep by 2½" high. Supplied ready built, fully tested and fully guaranteed (not available in kit form).
Price £27·50 Post and Packing £1·20.

STEREO-DECODER



SIZE 2" x 3" x ½" ready built. Pre-aligned and tested. Sens. 20-560 mV for 9-16V neg. earth operation. Can be fitted to almost any FM VHF radio or tuner. Stereo beacon light can be fitted if required. Full details and instructions (inclusive of hints and tips) supplied. **£6·25** plus 20p. P. & P. Stereo beacon light if required **45p** extra.

SPECIAL BARGAIN OFFER!
Limited number of BSR C129/123 Auto Changer De Luxe with lightweight tubular arm and stereo cartridge. **Brand new. ONLY £12·00** + p. & p. £1·10.

LATEST Hi Sensitivity Uni-directional slim-line condenser microphone as used by many professionals. Very low acoustic feedback. Available hi impedance or low impedance. State which required. **£16·25** plus 35p P. & P

LATEST ACOS GP91/18C mono compatible cartridge with t/o stylus for LP/EP/78. Universal mounting bracket. **£1·75,** P. & P. 18p.

CERAMIC STEREO CARTRIDGE. Universal Mounting brackets and turnover stylus. 70mV per channel output. ONLY **£2·06** + 18p P. and P.

SONOTONE 9TAHC COMPATIBLE STEREO CARTRIDGE T/O stylus Diamond Stereo LP and Sapphire 78. **ONLY £2·62** P. & P. 10p. Also available fitted with twin Diamond T/O stylus for Stereo LP. **£3·18,** P. & P. 18p.

LATEST CRYSTAL T/O STEREO / COMPATIBLE CARTRIDGE for EP/LP/Stereo/78. **£1·98** P. & P. 18p.

LATEST T/O MONO COMPATIBLE CARTRIDGE for playing EP/LP/78 mono or stereo records on mono equipment. Only **£1·75,** P. & P. 18p.

QUALITY RECORD PLAYER AMPLIFIER MK. II
A top quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. wide × 3in. deep × 6in. high. Ready built and tested. PRICE **£6·50,** P. & P. 90p.
ALSO AVAILABLE mounted on board with output transformer and speaker. PRICE **£7·75,** P. & P. £1.

HI-FI LOUDSPEAKER SYSTEM MK II

Beautifully made, simulated teak finish enclosure with atttactive slatted front. Size 16½" high × 10½" wide × 9" deep (approx.). Fitted with E.M.I. Ceramic Magnet 13" × 8" bass unit, H.F. tweeter unit and crossover. **AVAILABLE IN NOMINAL** 4 Ohm, 8 Ohm or 16 Ohm impedance (state which).
OUR PRICE £11·25 each Carr. £1·60.
Cabinet Available Separately £6·25, Carr. £1·20.
Also available in 8 ohms with EMI 13" × 8" bass speaker with parasitic tweeter **£10·00,** Carr. £1·60.

LOUDSPEAKER BARGAINS

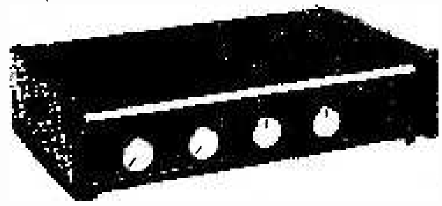
5in. 3 ohm **£1·45,** P. & P. 15p. 7 × 4in. 3 ohm **£1·69,** P. & P. 25p. 10 × 6in. 3 or 15 ohm **£3·50,** P. & P. 35p. E.M.I. 8 × 5in. 3 ohm with high flux magnet **£2·06,** P. & P. 25p. E.M.I. 13½ × 8in. with high flux ceramic magnet with parasitic tweeter 3, 8 or 15 ohm **£4·12,** P. & P. 35p. E.M.I. 13 × 8in. 3, 8 or 15 ohm with inbuilt tweeter and crossover network **£5·50,** P. & P. 35p. E.M.I. tweeter. Approx. 3½". Available 3 or 8 or 15 ohms, **£2·00** + 25p, P. & P.

BRAND NEW. Bakers Loudspeakers at substantial discounts. 12in. 15w. H/D Speakers, 3, 8 or 15 ohms. State which. Current production by well-known British maker. Now with Hiflux ceramic ferrobar magnet assembly **£9·50.** Guitar models: 30w **£8·95,** 35w, **£10·50,** P.&P. 75p.

"POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER
Size 11¾" × 14⅜" × 1⅛" deep. Weight 19oz. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40Hz–20kHz. Can be mounted on ceilings, walls, doors, under tables, etc., and used with or without baffle. Send S.A.E. for full details. Only **£7·68** each. P. & P. 70p.

NOW ALSO AVAILABLE: 8", 10 watts, r.m.s. 20 watt peak 40Hz–20,000Hz. Overall depth 1". Ideal for Hi-Fi or for use in cars. **£5·18** + 50p P. and P.

HARVERSONIC SUPER SOUND 10 + 10 STEREO AMPLIFIER KIT



A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise, level with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridge—instructions included. Output stage for any speakers from 8 to 15 ohms. Compact design, all parts supplied including drilled metalwork high quality ready drilled printed circuit board with component identification clearly marked, smart brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification; Power output: 14 watts r.m.s. per channel into 5 ohms. Frequency response ±3dB 12-30,000 Hz Sensitivity: better than 80mV into 1MΩ. Full power bandwidth: ±3dB 12-15,000 Hz. Bass boost approx. to ±12dB. Treble cut approx. to −16dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1·0 amp. Overall Size 12"w. × 8"d. × 2½"h.

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

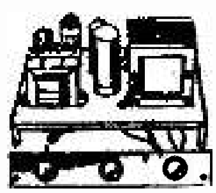
AMPLIFIER KIT	**£15·00**	P. & P. 55p
(Magnetic input components 33p extra)		
POWER PACK KIT	**£5·35**	P. & P. 85p
CABINET	**£5·35**	P. & P. 75p

If all three units purchased the same time total p. & p. £1.
Full after sales service

Also available ready built and tested **£32·50.** Post Free.

Note: The above amplifier is suitable for feeding two mono sources into inputs (e.g. mike, radio, twin record decks, etc. and will then provide mixing and fading facilities for medium powered Hi-Fi Discotheque use, etc.

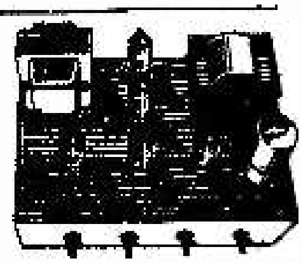
3-VALVE AUDIO AMPLIFIER HA34 MK II



Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½"w. × 4"d. × 4½"h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only **£7·75.** P. & P. 85p.

HSL "FOUR" AMPLIFIER KIT. Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc **£6·50** P. & P. 85p.

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15 Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 25p + SAE (Free with parts)' **All parts sold separately.** ONLY **£12·00** P. & P. £1·25. Also available ready built and tested **£16·50** P. & P. £1·20.

HI-FI STEREO HEADPHONES

Mullard LP 1159 R.F.-I.F. Double Tuned Amplifier Module for nominal 470 KHz. Size approx. 2¾" × 1¼" × ⅝" 7·6 Volt + earth. Brand new pre-aligned. Full specification and connection details supplied. **£2·50** p. & p. 12p.

Prices include VAT at Current Rate

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

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

HARVERSON SURPLUS CO. LTD.

(Dept. P.W.) 170 HIGH ST., MERTON, LONDON, S.W.19 Tel.: 01-540 3985

A few minutes from South Wimbledon Tube Station.

SEND STAMPED ADDRESSED ENVELOPE WITH ALL ENQUIRIES

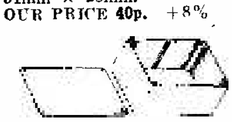
(Please write clearly)

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

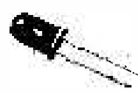
Crescent Quality Components

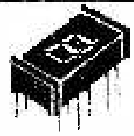
BARGAIN CAPACITOR 2,000MFD at 50v. DC wkg. Size — 2″ × 1¾″ diameter. Tag ended. All new and unused. Our price **35p.** + 25%.

BARGAIN PROJECT BOX
A plastic box with moulded extrusion rails for PC or Chassis panels with metal front plate fitted with four screws (all supplied).
An ideal box to give a small project a professional finish.
SIZE (internal) 81mm × 51mm × 28mm.
OUR PRICE **40p.** +8%



JB11D STEREO JUNCTION BOX
The most popular stereo junction box. Facility for two pairs of headphones and two speakers. 3 position switch selects headphones, loudspeakers or both. A bargain at **£2·50** +25%





LIGHT EMITTING DIODES +8%

	RED	GREEN	YELLOW	AMBER
0·2 inch	17p	27p	29p	27p
0·16 inch	24p	29p	30p	29p
0·125 inch	15p	25p	30p	25p

For orders of 10 and more LEDs 10% discount. (All LEDs supplied with free plastic mounting clip).

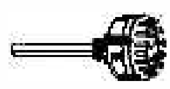
LOW COST SEVEN SEGMENT DISPLAYS ·3 INCH +8%

CR72R	Red	Com. Anode	Left Dec.	£1·35
CR52G	Green	Com. Anode.	Left Dec.	£1·35
CR82Y	Yellow	Com. Anode	Left Dec.	£1·35
CR74R	Red	Com. Cathode	Right Dec.	£1·35
CR54G	Green	Com. Cathode	Right Dec.	£1·35
CR84Y	Yellow	Com. Cathode	Right Dec.	£1·35

For full information on low cost displays please send 15p.

Clock Chip +8%
CT7001 MOS/LSI Digital Clock/Calendar Chip Plus full Circuits and Information leaflet **£4·95**
Circuits and Information Sheet **15p**
Lit 704 Led Display for above **£1·10**
Or 4 for **£4·20**

WAFER SWITCHES
1 Pole 12 Way
2 Pole 2 Way
2 Pole 3 Way
2 Pole 4 Way
2 Pole 6 Way
3 Pole 4 Way
4 Pole 3 Way
27p each +8%



POTENTIOMETERS
All types 1″ and less diameter

Singles		Dual	
5K	Log or	5K	
10K	Lin Less	10K	
25K	Switch	25K	Less
50K	**17p** each	50K	Switch
100K		100K	**53p** each
250K	Double	250K	+25%
500K	Pole	500K	
1M	Switch	1M	
2M	**37p** each	2M	

FERRIC CHLORIDE
Anhydrous ferric chloride in double sealed one pound poly packs.
Our Price **65p** + P/P + VAT @8% per lb.

MAINS TRANSFORMERS
Open Type Double Wound Continuously Rated, two hole fixing clamp with colour coded flying leads, varnish impregnated. Approx. size: 1½″ × 1¼″ × 1¼″ high
Fixing centres: 2⁵/₃₂″.
TR1 20–0–20v 100 m/a
TR2 12–0–12 v 100 m/a
TR3 9–0–9 v 100 m/a
TR4 6–0–6 v 100 m/a
TR5 3–0–3 v 100 m/a
All 240 Volt Primary
Our Price **£1·23** each +8%

ANTEX SOLDERING IRONS AND SPARES
X25 25 watt = **£2·45**
X25 Spare Element = **£1·20**
X25 Spare Bits No. 50, 51, 52 = **44p** each
C240/2 15 watt = **£2·45**
C240/2 Spare Element = **£1·10**
C240/2 Spare Bits No. 2, 3, 6 = **32p** each
ST3. Soldering Iron Stand Suitable for all models = **£1·10**
+ 8% VAT

LOW PRICE TRANSISTORS
BF303B = **15p** TIP42A = **75p**
AC142K = **25p** OC75 = **22p**
BC149B = **15p** AA129 = **6p**
+ 25% VAT

POWER SUPPLY UNITS
PP1 switched 3, 4½, 6, 7½, 9 and 12 volts at 500 m/a, with on/off switch and pilot light. Size: 130mm × 55mm × 75mm. ONLY **£4·00.**
PP2 Switched 6 – 7½ – 9 volt Battery Eliminator. Approx. size 2¾″ × 2¼″ × 3¼″. Ideal for cassette recorders **£3·25**
PP3 Car converter. From 12v Pos. or Neg. to = 6 – 7½ – 9 volt. Easy to fit and transistor regulated **£3·90**
+8%

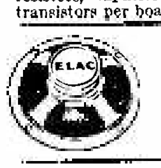
VEROBOARD +8%

	·1	·15	Plain ·15
2½ × 3¾	38p	28p	18p
2½ × 5	41p	41p	20p
3¾ × 3¾	41p	41p	
3¾ × 5	47p	49p	34p
17 × 2½	1·24p	93p	69p
17 × 3¾	1·69p	1·32p	97p
17 × 5	2·16p		1·37p

Pin insertion tool **81p**
Spot face cutter **59p**
Pkt 36 pins (state ·1 or ·15) **30p**

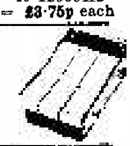
LOUDSPEAKERS +25%
2¼″ 8 ohm **50p**
2¼″ 40 ohm **50p**
2¼″ 80 ohm **50p**
5″ 8 ohm ceramic **£1·25**
6½″ 8 ohm dual cone ceramic **£2·50**
10″ 8 ohm dual cone ceramic **£3·75**
8″ × 5″ 8 ohm Perman't Magnet **£1·60**

BARGAIN BOARDS
Components galore for the experimenter. Ex-Computer boards with resistors, capacitors and useful transistors—at least 4 transistors per board. Five boards **£1** + 8%.



10-INCH 8 OHM DUAL CONE
Manufactured by "ELAC" to a very high standard these loudspeakers are a real bargain
SPEC:—Size = 10″ Dual Cone.
Power = 10 Watts
Frequency = 40-12000Hz
+25% Our Price = **£3·75p** each

MAINS KEYNECTOR
Keynector connects any Electrical Equipment to the mains supply in seconds. Ideal for bench, garage demonstrations, etc. Multi connections can be made (max. load 13A fused).
£3·25p. +8%



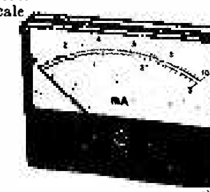
ALUMINIUM BOXES +8%
Metal project boxes give your work a professional finish

	L	W	H	
AB7	2½	5¼	1½	54p
AB8	4	4	1½	68p
AB9	4	2½	1½	54p
AB10	4	5¼	1½	68p
AB11	4	2½	2	54p
AB12	3	2	1	45p
AB13	6	4	2	69p
AB14	7	5	2½	84p
AB15	8	6	3	99p
AB16	10	7	3	£1·35
AB17	10	4½	3	£1·02
AB18	12	5	3	£1·20
AB19	12	8	3	£1·50

ABS PLASTIC BOXES +8%
Handy boxes for construction projects. Moulded extrusion rails for P.C. or chassis panels. Fitted with 1mm front panels.
1005 = 105mm × 73mm × 45mm = **55p**
1006 = 150mm × 75mm × 47mm = **72p**
1007 = 184mm × 124mm × 60mm = **£1·28**
1021 = 106mm × 74mm × 45mm (sloping front) = **55p**

TELESCOPIC AERIAL
Nine section fully swivelling telescopic aerial with 4BA single bolt fixing or two hole fixing bracket.
Fully extended = 43″
Fully closed = 7″
Our Price **50p** + P/P + VAT @ 25%

CLEAR PLASTIC PANEL METERS
Size 59mm × 46mm × 35mm these meters require a 38mm hole for mounting.
ME6 = 0 to 50 micro amp Full Scale
ME7 = 0 to 100 micro amp Full Scale
ME8 = 0 to 500 micro amp Full Scale
ME9 = 0 to 1 m/a Full Scale
ME10 = 0 to 5 m/a Full Scale
ME11 = 0 to 10 m/a FullScale
ME12 = 0 to 50 m/a Full Scale
ME13 = 0 to 100 m/a Full Scale
ME14 = 0 to 500 m/a Full Scale
ME15 = 0 to 1 amp Full Scale
ME16 = 0 to 50 volts
ME17 = 0 to 300 volts A.C. Full Scale
ME18 = "S" Meter
ME19 = "VU" Meter



OUR PRICE **£[illegible]** +8%

IC EXTRACTION TOOL
Saves damage to Valuable IC's
ONLY **40p** + 8% VAT

DECON DALO 33PC ETCH RESIST PEN
The Decon Dalo 33PC in a unique instrument for the professional and amateur electronics engineer, enabling him to prepare in minutes a perfect printed circuit board
OUR PRICE **80p** + 8%

MINIATURE RELAYS
Brand new range of British made Relays. Size 1¼″ × 1″ × ⅞″. All two changeovers with 250v 1·5A contacts and suitable for fitting on ·1m Veroboard.

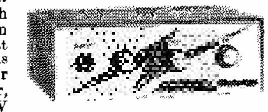
Type	Volts	Current	Ohms
27/A	12v	17M/A	700
21/A	12v	28M/A	430
12/A	6v	33M/A	185

All **£1·30** each –

TWO WAY STEREO ADAPTOR
Stereo jack plug to two stereo line sockets complete with 110 mm of cable. For plugging two stereo inputs into one. A Bargain at **65p.** + 25%

CABLE LESS SOLDERING IRON WAHL."ISO—TIP"
★ Completely Portable
★ Heats in 5 seconds
★ Solders up to 150 joints or more per charge
★ Recharges automatically in its own stand
★ No AC leakage or induced current to damage delicate components
★ Heats to 700 deg. F
★ Fine Tip for delicate and general purpose soldering
★ Only 8″ long and weighs just 6 ozs.
OUR PRICE **£9·75** +8% (spare bits are available)

3 KILOWATTS PSYCHEDELIC LIGHT CONTROL UNIT
Three Channel Bass. Middle, Treble. Each channel has its own sensitivity control. Just connect the input of this unit to the loudspeaker terminals of an amplifier, and connect three 250V up to 1000W lamps to the output terminals of the unit, and you produce a fascinating sound-light display. (All guaranteed).



£18·50 plus 75p P. & P. + 8%

BARGAIN TRANSFORMERS
12-0-12 volt 500m/a
240 volt primary transformer bargain.
approx size = 60mm x 40mm x 50mm
fixing centres = 75mm
Our Price = £1·20 +8%

P.C. ETCHING KIT
This kit contains all that the constructor will need to etch the circuits of his own design
Contents = Plastic etching dish.
Sample copper clad board.
Laminate Cutter.
1 lb Ferric Chloride.
Large Plastic Spoon.
Etch Resist Pen.
Full Etching Instructions.
Complete and Big Kit Value at **£3·75p** +8%

LOW NOISE LOW PRICE CASSETTES +8%
Good quality tape in well made screw type cassettes. Presented in single plastic cases.
C60 = **31p** C90 = **42p** C120 = **53p**
10% Discount on ten or more cassettes of one type

U.K. POSTAGE 50p UNLESS OTHERWISE STATED

VAT—All prices are excluding VAT. Please add to each item the VAT rate indicated.

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CRESCENT CATALOGUE
Price 30p.

RADIO EXCHANGE LTD.

ALL PRICES INCLUDE VAT
We regret we cannot for the time being accept Overseas Orders. Open to U.K. and Ireland residents only.

NEW EDU-KIT MAJOR

Completely Solderless Electronic Construction Kit. Build these projects without soldering iron or solder

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

Components Include: 24 Resistors ● 21 Capacitors ● 10 Transistors ● 3½" Loudspeaker ● Earpiece ● Mica Baseboard ● 3 12-way connectors ● 2 Volume controls ● 2 Slider Switches ● 1 Tuning Condenser ● 3 Knobs ● Ready Wound MW/LW/SW Coils ● Ferrite Rod ● 6½ yards of wire ● 1 Yard of sleeving etc. ● Parts Price List and Plans 55p free with parts.

Total Building Costs £10·30 P & P 65p

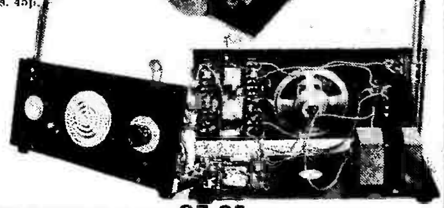
ELECTRONIC CONSTRUCTION KITS

ECK 1

3 Transistor Easy Stage Earpiece Receiver Kit. Full Medium Wave Coverage. Complete with Ready Wound Ferrite Rod Aerial, High Efficiency Air Spaced Tuning Capacitor. Sensitive Crystal Earpiece and Gain Control. Operates from a 9 Volt P.P. 7 Battery (not supplied with kit). This Electronic Construction Kit is a good starter for those interested in kit building and soldering. Parts Price List and Plans free with kit.

Complete kit of Parts **£4·50** P.P. and Ins. 45p.

ECK 2



Self Contained Multi-Band V.H.F. Receiver Kit. 8 Transistors and 3 Diodes. Push/Pull Output. 3" Loudspeaker, Gain Control, Superb 9 section swivel ratchet and retractable chrome plated telescopic aerial. V.H.F. Tuning Capacitor, Resistors, Capacitors, Transistors, etc. Will receive (subject to local reception Conditions) T.V. Sound, Public Service Band, Aircraft, V.H.F. Local Stations, etc. Operates from a 9 Volt P.P.7 Battery (not supplied with kit)

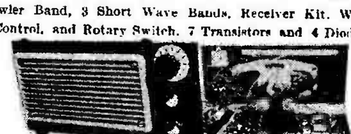
Parts Price List and Plans supplied free with Kit. Complete kit of parts **£7·95** P.P. and Ins 55p.

ECK 3

5 Transistor Medium Wave Receiver Kit. Class "A" Output with 3½" Loudspeaker. Simple to operate with full Medium Wave Coverage. Ready Wound 8" Ferrite Rod Aerial. No external Aerial required. 7 stages, 5 Transistors and 2 Diodes, Tuning Capacitor, Gain Control, etc. Operates from a 4½ Volt Battery (not supplied) Parts Price List and Plans free with kit. Complete kit of parts. **£5·40** P.P. and Ins. 45p.

ECK 4

7 Transistors, 6 tuneable wavebands, MW, LW, Trawler Band, 3 Short Wave Bands. Receiver Kit. With 5" × 3" Loudspeaker. Push/Pull output stage, Gain Control, and Rotary Switch. 7 Transistors and 4 Diodes. 6 section chrome plated telescopic aerial, 8" Sensitive Ready Wound Ferrite Rod Aerial, Tuning Capacitor Resistors, Capacitors, etc. Operates from a 9 Volt P.P.7 Battery (not supplied with kit). Parts Price List and Plans supplied free with kit. Complete kit of parts. **£7·25** P.P. and Ins. 55p.



VHF AIR CONVERTER KIT

Build this Converter Kit and Receive the Aircraft Band by placing it by the side of a radio tuned to Medium Wave or the Long Wave Band and operating as shown in the instructions supplied free with all parts. Uses a Retractable Chrome plated Telescopic Aerial, Gain Control, V. H. F. Tuning Capacitor, Transistor, etc.

All Parts including Case and Plans. **£4·35** P.P. and Ins. 40p.

ROAMER TEN MARK 2

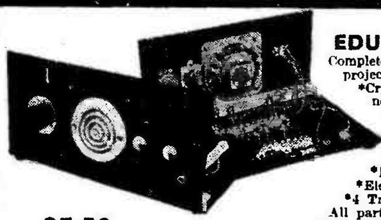
With VHF including aircraft

Now with free earpiece and switched socket. 10 Transistors. Latest 4" 2 watt Ferrite Magnet Loudspeaker. 9 Tuneable Wavebands, MW1, MW2, LW, SW1, SW2, SW3, Trawler Band, VHF and Local Stations also Aircraft Band. Built in Ferrite Rod Aerial for MW/LW. Chrome plated 6 section Telescopic Aerial, can be angled and rotated for peak short wave and VHF listening. Push Pull output using 600mW Transistors. Car Aerial and Tape Record Sockets. 10 Transistors plus 3 Diodes. Ganged Tuning Condenser with VHF section. Separate coil for Aircraft Band. Volume on/off. Wave Change and tone Controls. Attractive Case in black with silver blocking Size 9" × 7" × 4". Easy to follow instructions and diagrams. Parts price list and plans 50p free with parts.

Total building costs **£11·87** P.P. and Ins. 65p.

RADIO EXCHANGE LTD.

EDU-KIT JUNIOR



Completely Solderless Electronic Construction Kit. Build these projects without Soldering Iron or Solder.

- *Crystal Radio Medium Wave Coverage:—No Battery necessary.
- *One Transistor Radio.
- *2 Transistor Regenerative Radio.
- *3 Transistor Earpiece Radio Medium Wave Coverage.
- *4 Transistor Medium Wave Loudspeaker Radio.
- *Electronic Noise Generator.
- *Electronic Metronome.
- *4 Transistor Push/Pull Amplifier.

All parts including Loudspeaker, Earpiece, MW Ferrite Rod Aerial, Capacitors, Resistors, Transistors, etc., plus Parts Price List and Plans free with kit. Complete kit of parts

£7·50 P.P. and Ins. 45p.

TO RADIO EXCHANGE LTD., 61A HIGH STREET, BEDFORD MK40 1SA. Tel: 0234 52367. REG NO. 788372

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

I enclose £.................... for ....

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Address ....

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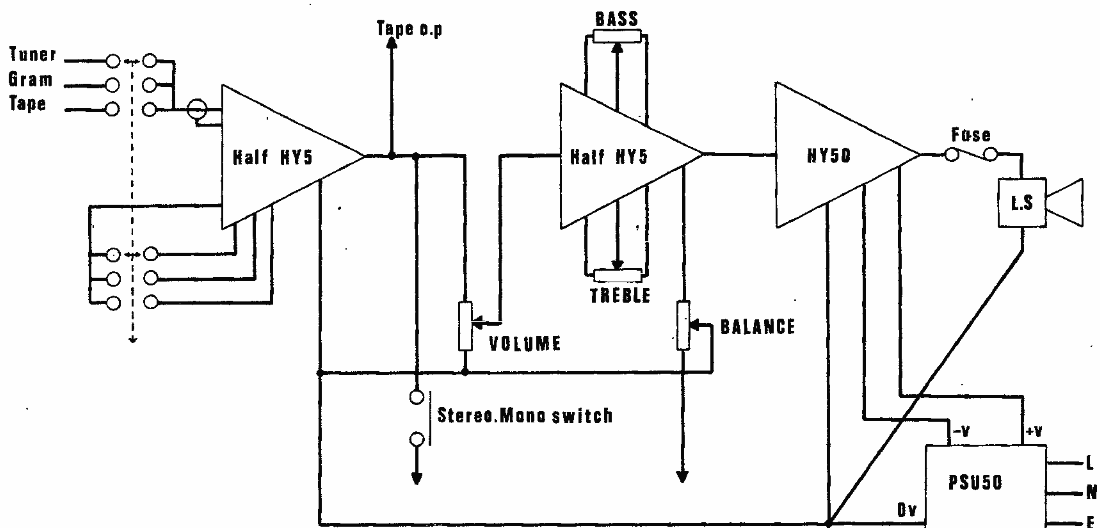
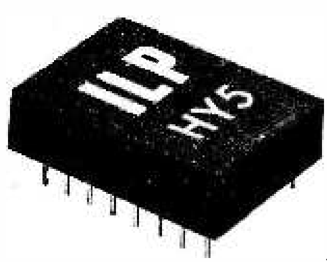
PW 12

I.L.P. (Electronics) Ltd

SHEER SIMPLICITY!



MONO ELECTRICAL CIRCUIT DIAGRAM WITH INTERCONNECTIONS FOR STEREO SHOWN



The HY5 is a complete mono hybrid preamplifier, ideally suited for both mono and stereo applications. Internally the device consists of two high quality amplifiers—the first contains frequency equalisation and gain correction, while the second caters for tone control and balance.

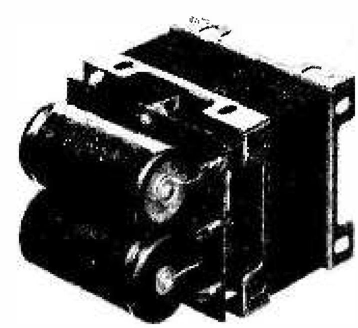
TECHNICAL SPECIFICATION
Inputs: Magnetic Pick-up 3mV RIAA: Ceramic Pick-up 30mV; Microphone 10mV; Tuner 100mV; Auxillary 3–100mV; input/impedance 47kΩ at 1kHz. **Outputs:** Tape 100mV; Main output 0db (0·775V RMS). **Active Tone Controls:** Treble ± 12db at 10kHz; Bass ± 12db at 100Hz. **Distortion:** 0·5% at 1kHz. **Signal/Noise Ratio:** 68db. **Overload Capability:** 40db on most sensitive input. **Supply Voltage:** ± 16–25V.

PRICE £4.75 + £1·19 VAT

The HY50 is a complete solid state hybrid Hi-Fi amplifier incorporating its own high conductivity heatsink hermetically sealed in black epoxy resin. Only five connections are provided, input, output, power lines and earth.

TECHNICAL SPECIFICATION
Output Power: 25W RMS into 8Ω. **Load Impedance:** 4–16Ω. **Input Sensitivity** 0db (0·775V RMS). **Input Impedance:** 47kΩ. **Distortion:** Less than 0·1% at 25W typically 0·05%. **Signal/Noise Ratio:** Better than 75db **Frequency Response:** 10Hz–50kHz ± 3db. **Supply Voltage:** ± 25V. **Size:** 105 x 50 x 25mm.

PRICE £6.20 + £1·55 VAT



The PSU50 incorporates a specially designed transformer and can be used for either mono or stereo systems.

TECHNICAL SPECIFICATIONS
Output voltage: 50V (25-0-25V). **Input Voltage:** 210–240V.
Size: L.70. D.90. H.60mm.

PRICE £6.25 + £1·56 VAT

I.L.P. Electronics Ltd.
Crossland House,
Nackington, Canterbury
Kent CT4 7AD

Tel (0227) 63218

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BI-PAK SEMICONDUCTORS

COMPONENTS

CARBON RESISTOR PAKS

These Paks contain a range of Carbon Resistors, assorted into the following groups:

R1	50	Mixed	100 ohms–820 ohms 1/8th W.	0·60
R2	50	Mixed	1K ohms–8·2 Kohms 1/8th W.	0·60
R3	50	Mixed	10K ohms–82 Kohms 1/8th W.	0·60
R4	50	Mixed	100K ohms–820 Kohms 1/8th W.	0·60
R5	30	Mixed	100 ohms–820 ohms ¼ W.	0·60
R6	30	Mixed	1K ohms–8·2 Kohms ¼ W.	0·60
R7	30	Mixed	10K ohms–82 Kohms ¼ W.	0·60
R8	30	Mixed	100K ohms–820 Kohms ¼ W.	0·60

THESE ARE UNREPEATABLE PRICES

LOW COST CAPACITORS

500	µF	50V Elect	0·09 each
.01	µF	400V	0·03 each

REPANCO CHOKES & COILS

RF Chokes	CH1	2·5mH	0·27
	CH3	7·5mH	0·29
	CH5	1·5mH	0·26
	CH2	5·0mH	0·28
	CH4	10mH	0·31

COILS DRX1 Crystal set 0·29 DRR2 Dual range 0·42

CARBON POTENTIOMETERS

Log and Lin
4·7K, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M.

VC 1	Single Less Switch	0·14
VC 2	Single D.P. Switch	0·26
VC 3	Tandem Less Switch	0·43
VC 4	1K Lin Less Switch	0·14
VC 5	100K Log anti-Log	0·43

HORIZONTAL CARBON PRESETS

0·1 Watt 0·06 each
100, 220, 470, 1K, 2·2K, 4·7K, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M, 4·7M.

REPANCO TRANSFORMERS

240V. Primary. Secondary voltages available from selected tappings 4V, 7V, 8V, 10V, 40V, 50V and 25V-0-25V.

Type	Amps	Price	P & P
MT50/½	½	£1·79	0·45p
MT50/1	1	£2·24	0·48p
MT50/2	2	£3·06	0·60p

COIL FORMERS & CORES

NORMAN ¼" Cores & Formers 0·07p
⅜" Cores & Formers 0·09p

SWITCHES

DP/DT Toggle 0·28p SP/ST Toggle 0·22p

FUSES

1¼" and 20mm, 100mA, 200mA, 250mA, 500mA, 1A, 1·5A, 2A QUICK BLOW ★0·05p each
Anti-serge 20mm only ★0·0p each

VEROBOARDS

VB1 containing approx. 50 sq. ins. various sizes all 0·1 matrix ★0·60p
VB2 containing approx. 50 sq. ins. various sizes all 0·15 matrix ★0·60p

DECON-DALO 33PC Marker

Etch resistant printed circuit marker pen. Full instructions supplied with each pen ★0·92p

BATTERY HOLDERS

Takes 6 H.P. 7s complete with terminal clip and lead ★0·31p each

CABLES

			Per Metre
CP	1	Single lapped screen	★0·08
CP	2	Twin Common Screen	★0·11
CP	3	Stereo Screened	★0·12
CP	4	Four Core Common Screen	★0·21
CP	5	Four Core individually screened	★0·28
CP	6	Microphone Fully Braided Cable	★0·11
CP	7	Three Core Mains Cable	★0·11
CP	8	Twin Oval Mains Cable	★0·08
CP	9	Speaker Cable	★0·06
CP	10	Low Loss Co-Axial	★0·14

INSTRUMENT CASES ★

(In 2 sections, Black Vinyl covered top and sides and bezel)

No.	Length	Width	Height	Price
BV1	8"	× 5¼"	× 2"	★£1·25
BV2	11"	× 6"	× 3"	★£1·62
BV3	6"	× 4¾"	× 1¾"	★0·92
BV4	9"	× 5¼"	× 2½"	★£1·39

ALUMINIUM BOXES ★

No.	Length	Width	Height	Price
BA1	5¼"	× 2¼"	× 1½"	★0·45
BA2	4"	× 4"	× 1½"	★0·45
BA3	4"	× 2½"	× 1½"	★0·45
BA4	5¼"	× 4"	× 1½"	★0·54
BA5	4"	× 2½"	× 2"	★0·45
BA6	3"	× 2"	× 1"	★0·39
BA7	7"	× 5"	× 2½"	★0·79
BA8	8"	× 6"	× 3"	★£1·02
BA9	6"	× 4"	× 2"	★0·65

(Each complete with ½" deep lid & screws)

PLEASE ADD 20p POSTAGE AND PACKING FOR EACH BOX.

COMPONENT PAK

Pak No.	Qty.	Description	Price
C1	200	Resistors mixed values approx. count by weight	0·60
C2	150	Capacitors mixed values approx. count by weight	0·60
C3	50	Precision Resistors mixed values	0·60
C4	75	1/8th width Resistors mixed preferred values	0·60
C5	5	Pieces assorted Ferrite Rods	0·60
C6	2	Tuning Gangs, MW/LW VHF	0·60
C7	1	Pak Wire 50 metres assorted colours	★0·60
C8	10	Reed Switches	0·60
C9	3	Micro Switches	0·60
C10	15	Assorted Pots & Pre-Sets	0·60
C11	5	Jack Sockets 3 × 3·5m, 2 × standard Switch Type	0·60
C12	30	Paper Condensers preferred types mixed values	0·60
C13	20	Electrolytics Trans. types	0·60
C14	1	Pack assorted Hardware—Nuts/Bolts, Grommets, etc.	0·60
C15	5	Mains Slide Switches, 2 Amp	0·60
C16	20	Assorted Tag Strips & Panels	0·60
C17	10	Assorted Control Knobs	0·60
C18	4	Rotary Wave Change Switches	0·60
C19	2	Relays 6-24V Operating	0·60
C20		Sheets Copper Laminate approx. 200 sq. ins.	★0·60

Please add 20p post and packing on all component packs, plus a further 10p on pack nos. C1, C2, C19 & C20.

AVDEL BOND ★

SOLVE THOSE STICKY PROBLEMS!
with

CYANOACRYLATE C2 ADHESIVE

The wonder bond which works in seconds—bond plastic, rubber, transistors, components permanently, immediately

OUR PRICE ONLY 60p
for 2gm phial

BIB HI-FI ACCESSORIES ★

Ref.		Price
B	Stylus and turntable cleaning kit	★31p
J	Tape head cleaning kit	★68p
P	Hi-Fi cleaner	★30p
9	Wire stripper/Cutter	★94p
31	Cassette head cleaner	★58p
32	Tape editing kit	★£1·64
32A	Stylus balance	★£1·24
36A	Record stylus cleaning kit	★32p
42	De Luxe Groov-Kleen	★£1·84
43	Record care kit	★£2·68
45	Auto changer groove cleaner	★98p
46	Spirit level	★68p
56	Hi-Fi stereo hints & tips	★38p
60	Chrome finish as above	★£1·72

ANTEX EQUIPMENT ★

SOLDERING IRONS

X25. 25 watt	★£2·45
Model G. 18 watt	★£2·70
CCN 240. 15 watt	★£2·90
SK2. Soldering Kit	★£3·90

BITS AND ELEMENTS

Bit No.	
102 for model CN240 3/32"	★42p
104 for model CN240 3/16"	★42p
1100 for model CCN240 3/32"	★42p
1101 for model CCN240 3/8"	★42p
1102 for model CCN240 ¼"	★42p
1020 for model G240 3/32"	★42p
1021 for model G240 1/8"	★42p
1022 for model G240 3/16"	★42p
50 for model X25 3/32"	★44p
51 for model X25 1/8"	★44p
52 for model X25 3/16"	★44p

ELEMENTS

Model ECN 240	£1·10★
Model EG 240	£1·35★
Model ECCN 240	£1·55★
Model EX 25	£1·20★

SOLDERING IRON STAND

ST3 Suitable for all models	★£1·10
Antex heat shunt	10p

PLUGS

			Price
PS	1	D.I.N. 2 Pin (Speaker)	0·10
PS	2	D.I.N. 3 Pin	0·11
PS	3	D.I.N. 4 Pin	0·14
PS	4	D.I.N. 5 Pin 180°	0·15
PS	5	D.I.N. 5 Pin 240°	0·15
PS	6	D.I.N. 6 Pin	0·16
PS	7	D.I.N. 7 Pin	0·17
PS	8	Jack 2·5mm Screened	0·17
PS	9	Jack 3·5mm Plastic	0·11
PS	10	Jack 3·5mm Screened	0·17
PS	11	Jack ¼" Plastic	0·14
PS	12	Jack ¼" Screened	0·20
PS	13	Jack Stereo Screened	0·33
PS	14	Phono	0·09
PS	15	Car Aerial	0·14
PS	16	Co-Axial	0·14

INLINE SOCKETS

PS 21	D.I.N. 2 Pin (Speaker)	0·13
PS 22	D.I.N. 3 Pin	0·19
PS 23	D.I.N. 5 Pin 180°	0·19
PS 24	D.I.N. 5 Pin 240°	0·19
PS 25	Jack 2·5mm Plastic	0·15
PS 26	Jack 3·5mm Plastic	0·15
PS 27	Jack ¼" Plastic	0·28
PS 28	Jack ¼" Screened	0·32
PS 29	Jack Stereo Plastic	0·28
PS 30	Jack Stereo Screened	0·35
PS 31	Phono Screened	0·17
PS 32	Car Aerial	0·20
PS 33	Co-Axial	0·20

SOCKETS

PS 35	D.I.N. 2 Pin (Speaker)	0·07
PS 36	D.I.N. 3 Pin	0·09
PS 37	D.I.N. 5 Pin 180°	0·09
PS 38	D.I.N. 5 Pin 240°	0·10
PS 39	Jack 2·5mm Switched	0·11
PS 40	Jack 3·5mm Switched	0·11
PS 41	Jack ¼" Switched	0·19
PS 42	Jack Stereo Switched	0·28
PS 43	Phono Single	0·07
PS 44	Phono Double	0·09
PS 46	Co-Axial Surface	0·09
PS 47	Co-Axial Flush	0·19

P.C.B. KIT ★

PROFESSIONAL D.I.Y. PRINTED CIRCUIT KIT PRICE £7·80

Containing 6 sheets of 6" × 4" single sided laminate, a generous supply of etchant powder, etching dish, etchant measure, tweezers, etch resistant marking pen, high quality pump drill with spares, cutting knife with spare blades, 6" metal ruler, plus full easy to follow instructions.

LOW-NOISE CASSETTES ★

C60	★33p
C90	★44p
C120	★56p

2 × quality marker pens, specifically .... line etchant resistant circuits on copper laminate. Complete with full instructions.
★£1·53 per pair

AUDIO LEADS

S221	5 pin DIN plug to 4 phono plugs length 1·5m	£1·08
S222	5 pin DIN plug to 5 pin DIN socket length 1·5m	68p
S237	5 pin DIN plug to 5 pin DIN plug mirror image length 1·5m	£1·20
S238	2 pin DIN plug to 2 pin DIN socket length 5m	68p
S268	5 pin DIN plug to 3 pin DIN plug 1 & 4 and 3 & 5 length 1·5m	£1·00
S270	2 pin DIN plug to 2 pin DIN socket length 10m	80p
S271	5 pin DIN plug to 2 phono plugs connected to pins 3 & 5 length 1·5m	70p
S275	5 pin DIN plug to 2 phono sockets connected to pins 3 & 5 length 23cm	68p
S318	5 pin DIN socket to 2 phono plugs connected to pin 3 & 5 length 23cm	68p
S404	Coiled stereo headphones extension cord extends to 7m	£1·40
S217	3 pin DIN plug to 3 pin DIN plug length 1·5m	80p
S219	5 pin DIN plug to 5 pin DIN plug length 1·5m	80p
S474	3·5mm Jack to 3·5mm Jack length 1·5m	68p
S600	5 pin DIN plug to 3·5mm Jack connected to pins 3 & 5 length 1·5m	80p
S700	5 pin DIN plug to 3·5 Jack connected to pins 1 & 4 length 1·5m	80p

CROSSOVER NETWORK

K4007 1/P Impedance 8 ohms. Insertion Loss 3dB. Crossover Frequency 3 KHz. PRICE £1·12

H/PHONE JUNC. BOX

H1012 (3-way-stereo) Enables change-over from loud-speaker to headphone listening. Also has a centre position for both outputs PRICE £1·73

ALL PRICES EX
PLEASE ADD VAT ITEMS EXCEPT THOSE MARKED
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HANDBOOKS

TRANSISTOR DATA BOOK
DTE 1 227 Pages packed with information on European Transistors. Full specification including outlines. Price # £2·95 each

TRANSISTOR EQUIVALENT BOOK
BPE 75 256 Pages of cross references and equivalents for European, American and Japanese Transistors. This is the most comprehensive equivalents book on the market today and has an introduction in 13 languages. Price # £2·68 each

DIODE EQUIVALENT BOOK
DE 74 144 Pages of cross references and equivalents for European, American and Japanese Diodes, Zeners, Thyristors, Triacs, Diacs and L.E.D.'s. Price # £1·98 each

MULLARD DATA BOOK 1974/75
MDB 74 The latest edition of this popular handbook contains information on Semi-conductors, Integrated Circuits, Television Picture Tubes, Valves, Capacitors and Resistors. Included in the 161 informative pages are 21 pages on Semiconductor Comparables. Price # £0·40 each

TTL DATA BOOK
DIC 75 Now complete Data book of 74 series TTL (7400-74132). Covering 13 main manufacturers in the U.S.A. and Europe, this book gives full data as well as equivalents. Price # £3·74

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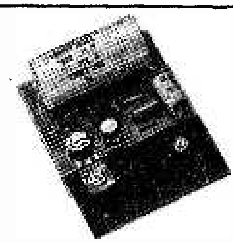
AL 60

50w. PEAK (25w. R.M.S.) **ONLY £3·95**

● Max Heat Sink temp 90°C. ● Frequency Response 20Hz to 100K Hz. ● Distortion better than 0·1 at 1KHz. ● Supply voltage 15-50 volts. ● Thermal Feedback. ● Latest Design Improvements. ● Load—3, 4, 5 or 16 ohms. ● Signal to noise ratio 80dB. ● Overall size 63mm x 105mm x 13mm.
Especially designed to a strict specification. Only the finest components have been used and the latest solid state circuitry incorporated in this powerful little amplifier which should satisfy the most critical A.F. enthusiast.



STABILISED POWER MODULE SPM80

SPM80 is especially designed to power 2 of the AL60 Amplifiers, up to 15 watt (r.m.s.) per channel simultaneously. This module embodies the latest components and circuit techniques incorporating complete short circuit protection. With the addition of the Mains Transformer BMT80, the unit will provide outputs of up to 1·5 amps at 35 volts. Size: 63mm x 105mm x 30mm.
These units enable you to build Audio Systems of the highest quality at a hitherto unobtainable price. Also ideal for many other applications including:—Disco Systems. Public Address Intercom Units, etc. Handbook available 10p. **PRICE £3·00**

TRANSFORMER ER BMT80 £2·60

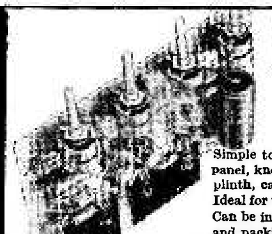
STEREO PRE-AMPLIFIER TYPE PA100

Built to a specification and NOT a price, and yet still the greatest value on the market, the PA100 stereo pre-amplifier has been conceived from the latest circuit techniques. Designed for use with the AL60 power amplifier system, this quality made unit incorporates no less than eight silicon planar transistors, two of these are specially selected low noise NPN devices for use in the input stages.
Three switched stereo inputs, and rumble and scratch filters are featûres of the PA100 which also has a STEREO/MONO switch, volume, balance and continuously variable bass and treble controls. **PRICE £13·20**

MK 60 AUDIO KIT
Comprising: 2 × AL60, 1 × SPM80, 1 × BTM80, 1 × PA100, 1 front panel, 1 kit of parts to include on-off switch, neon indicator, stereo headphone sockets plus instruction booklets.
COMPLETE PRICE: £27·55 plus 45p postage

TEAK 60 AUDIO KIT
Comprising: Teak veneered cabinet size 16¾" × 11½" × 3¾", other parts include aluminium chassis, heatsink and front panel bracket, plus back panel and appropriate sockets, etc.
KIT PRICE: £9·20 plus 45p postage

CLUDE VAT
AT 25% TO ALL
★ ADD 8%
⁂ NO VAT
add 20p overseas
Minimum order 75p



STEREO 30 COMPLETE AUDIO CHASSIS

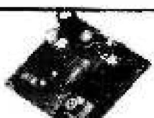
7 + 7 WATTS R.M.S.

The Stereo 30 comprises a complete stereo pre-amplifier, power amplifiers and power supply. This with only the addition of a transformer or overwind, will produce a high quality audio unit suitable for use with a wide range of inputs, i.e. high quality ceramic pickup, stereo tuner, stereo tape deck, etc.
Simple to install, capable of producing really first class results, this unit is supplied with full instructions, black front panel, knobs, mains switch, fuse and fuse holder and universal mounting bracket, enabling it to be installed in a record plinth, cabinets of your own construction or the cabinet available.
Ideal for the beginner or advanced constructor who requires Hi-Fi performance with a minimum of installation difficulty. Can be installed in 30 mins.) **PRICE: £15·75** plus 45p postage and packing. **TRANSFORMER: £2·45** plus 45p postage and packing. **TEAK CASE: £3·65** plus 45p postage and packing.

SATISFACTION GUARANTEED
OR YOUR MONEY RETURNED

SPEAKERS

E M.I. LEK 350 Loudspeakers Enclosure Kit in teak veneer, including speakers.
Rec. Retail Price £45·50 per pair. **OUR SPECIAL PRICE £27·75 per pair — P. & P. £3**



AL10/AL20/AL30

The AL10, AL20 and AL30 units are similar in their appearance and in their general specification. However, careful selection of the plastic power devices has resulted in a range of output powers from 3 to 10 watts R.M.S.
The versatility of their design makes them ideal for use in record players, tape recorders, stereo amplifiers and cassette and cartridge tape players in the car and at home. AL10 **£2·30**, AL20 **£2·65**, AL30 **£2·95**.

M.P.A.30

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

Used in the construction are 4 low noise, high gain, silicon transistors. It is provided with a standard DIN input socket for ease of connection.

Supplied with full, easy to follow instructions. **PRICE £2·65**

STORAGE/CARRYCASES ★

RECORD CASES
7 in E.P. 18¾ in x 7 in x 8 in (50 records) **★£2·48**
12 in L.P. 13¾in x 7⅝ in x 12¾ in (50 records) **★£3·30**

CASSETTE CASES
Holds 15. 10 in x 3¾ in x 5 in. Lock and handle. **★£1·50**

8-TRACK CARTRIDGE CASES
Holds 14. 13 in x 5 in x 6 in. Lock and handle **★£2·20**
Holds 24. 13⅜ in x 8 in x 5⅜ in Lock and handle **★£3·20**

CARTRIDGES

ACOS		
GP91-1SC	200mV at 1·2cms/sec	£1·11
GP93-1	280mV at 1cm/sec	£1·43
GP96-1	100mV at 1cm/sec	£2·31
TTC		
J-2005	Crystal/Hi Output	97p
J-2010C	Crystal/Hi Output Compatible	£1·11
J-2006S	Stereo/Hi Output	£1·52
J-2105	Ceramic/Med. Output	£1·81
J-2203	Magnetic 5mV/5cm/sec. including stylus	£4·78
J-22038	Replacement stylus for above	£2·88
AT-55	Audio-technica magnetic cartridge 4mV/5cm/sec	£3·06

DYNAMIC MIC'PHONE

TYPE B1223. 200 ohms impedance. Complete with stand, on/off switch and 2·5mm and 3·5mm plugs. Suitable for cassette tape recorders. **PRICE £1·67**

JUST OUT!
STEREO FM TUNER
WRITE *NOW* FOR FULL DETAILS

RECORD PLAYBACK TAPE HEADS

Individual prices of these are:
2 track record playback heads **75p** each.
4 track record playback heads **£1·10** each.
Erase heads are also available separately—
2 track **50p**—4 track **85p**.
MV metal mounting shields **60p** each.
2 track heads already fixed on heavy mounting plate with shield **£1.85**. ALL PLUS 25% VAT

DRILL CONTROLLER

Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. **£2·50** plus 45p post & VAT Made up model also available.

NEED A SPECIAL SWITCH

Double Leaf Contact. Very slight pressure closes both contacts **12p** each. Plastic pushrod suitable for operating. **10p** each, 10 for **68p**.

1 R.P.M. MOTOR+GEAR BOX

Made by the famous Chamberlain & Hookham Ltd. These could be made to drive clock or similar. Really robust reliable unit.
Price **£1·50** + 30p Post & VAT

MINIATURE WAFER SWITCHES

2 pole, 2 way—4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole 6 way—1 pole, 12 way. All at **38p** + 15p post & VAT each.

MULTI-SPEED MOTOR

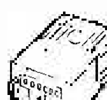
Six speeds are available 500, 850 and 1,100 r.p.m. and 8,000, 12.000 and 15,500 r.p.m. Shaft is ¼ in. diameter and approximately 1 in. long. 230/240v. Its speed may be further controlled with the use of our Thyristor controller. Very powerful and useful motor size approx. 2 in. dia. × 5 in. long. Price **£1·40**+45p post & VAT.

SLIDE SWITCHES

Slide Switch. 2-pole changeover panel mounting by two 6B.A. screws. Size approx. 1in. × ⅜in rated 250V lamp. **15p**+7p post & VAT.

SubMiniatureSlideSwitch. DPDT 19mm (¾in approx.) between fixing centres. **28p**+9p post & VAT each or 10 for **£1·90**. SP Change over spring return 250V 1 amp. **25p**+8p post & VAT.

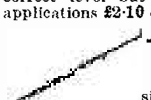
6 DIGIT COUNTER



Resettable. 440 ohm coil up to 25 impulses per second. Ex-equipment but guaranteed perfect, **£3·30**+40p Post & VAT each.
7 digit counter as specified for telephone charge calculator **93p**.

PRESSURE SWITCH

Containing a 15 amp change over switch operated by a diaphragm which in turn is operated by air pressure through a small metal tube. The operating pressure is adjustable but is set to operate in approx. 10in. of water. These are quite low pressure devices and can in fact be operated simply by blowing into the inlet tube. Original use was for washing machine to turn off water when tub has reached correct level but no doubt has many other applications **£2·10** each+25p post & VAT.



TELESCOPIC AERIAL

for portable, car radio or transmitter. Chrome plated—six sections, extends from 7¼ to 47in. **50p**+15p Post & VAT. KNUCKLED MODEL FOR F.M. **80p**+17p Post & VAT.

LIGHT DIMMER KIT

For dimming up to 250w without heat sink or 750w with heat sink. This comprises quadrac variable control potentiometer, condenser, resistors, tag strip for mounting and data. Price **£1·95**+30p Post & VAT.

RELAY BARGAIN

Type 600 relay, 2 changeover one open and one closed contact. Twin 500 ohm coils make this suitable or closing off DC 6v, DC 12v, DC 24v or AC mains using resistor and rectifier. **40p** each. Resistor and rectifier **20p** extra..
and Post VAT 20p.

TERMS

CASH DISCOUNTS

25% on order over £500, 20% over £100, 15% £50, 10% £30.

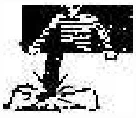
SMALL ORDERS

Please add 30p if order under £5.

LARGE ORDERS

Deduct discounts as follows: £30-£50 deduce 10%; £60-£100 deduce 15%; £100-£499 deduce 20%; over £500 deduce 25%.

SWITCH TRIGGER MATS



So thin is undetectable under carpet but will switch on with slightest pressure. For burglar alarms, shop doors, etc.
24in × 18in **£1·90**. Post & VAT 30p.
13in × 9in **£1·50**. Post & VAT 25p

SMITHS CENTRAL HEATING CONTROLLER

Push button gives 10 variations as follows:—(1) continuous hot water and continuous central heating (2) continuous hot water but central heating off at night (3) continuous hot water but central heating on only for 2 periods during the day (4) hot water and central heating both on but day time only (5) hot water all day but central heating only for 2 periods during the day (6) hot water and central heating on for 2 periods during the day time only—then for summer time use with central heating off (7) hot water continuous (8) hot water day time only (9) hot water twice daily (10) everything off. A handsome looking unit with 24 hour movement and the switches and other parts necessary to select the desired programme of heating. Supplied complete with wiring diagram. Originally sold, we believe, at over £15—we offer these, while stocks last, at **£6·95 each, VAT & Postage 85p each.**

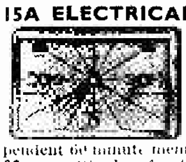
WALL THERMOSTATS (SMITHS)

Wall mounting and in a handsome plastic case. (Cream and beige). Adjustable by slider (lockable) and may be set to control temperatures from around freezing through to 50°C. The slide panel is engraved and indicates (frost), (warm), (very warm), etc. The thermostat will control heaters, etc., up to 15 amp at normal mains voltage and is ideal for living room, bedroom and greenhouse, etc. Price **£1·95. VAT & Postage 30p.** Don't miss this.

AUDIO AMPLIFIER

Part of the famous Reditune background music system, secondhand, but believed in good order. However, no guarantee; we are selling for spares value only. These are 6 valve amplifiers, the output valves are 2 × EL 84 in push/pull, complete with mains transformer, rectifier and ample smoothing equipment. The mains transformer alone, today would cost at least **£4**. Size is 9½" × 5½" × 4½". Price only **£2·00** + postage and VAT £1·50.

15A ELECTRICAL PROGRAMMER



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

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, 31, 39 metre bands—Kit contains chassis front panel and all the parts, **£1·50**—crystal earphone **55p. VAT & Postage 75p.**

THIS MONTH'S SNIP

Smiths 24 hr. timer heart, really the "Autoset" without its plastic case. This is a 24 hr. twice on, twice off, clock switch which will repeat until reprogrammed. Switches rated at 15 amps. Limited supplies—£3.95 VAT & post 55p. each.

12 VOLT 1½ AMP POWER PACK

This comprises double-wound 230/240V mains transformer with full wave rectifier and 2000 mfd smoothing. Price £3·75 plus VAT and Post £1.

Heavy Duty Mains Power Pack. Output voltage adjustable from 15-40V in steps—maximum load 250W—that is from 6 amp at 40V to 15 amp at 15V. This really is a high power heavy duty unit with dozens of workshop uses. Output voltage adjustment is very quick—simply interchange push on leads. Silicon rectifiers and smoothing by 3·000mF. Price **£10·50** plus £25 VAT & post.

TANGENTIAL HEATER UNIT

This heater unit is most efficient, and quiet running. Is as fitted in Hoover and blower heaters costing £15 and more. Comprises motor, impeller. 2kW element and 1kW element allowing switching 1, 2 and 3kW and with thermal safety cut-out. Can be fitted into any metal line case or cabinet. Only needs control switch. **£5·82** plus VAT & post £1. 2kW Model as above except 2kW **£4·25** plus VAT & post 75p. Don't miss this. Control Switch **44p.** P. & P. 40p.

INSTANT START FLUORESCENT LIGHTING BARGAINS

Starterless control gear, complete with tube ends and tube clips for window lighting, signs, fascias. etc. 4 ft. 40 w. **£1·90**; 5 ft. 65w. **£2·00**; 5 ft. 80w. **£2·20**; 6 ft. 80w. **£2·45**; and for pairs as follows:—twin 2 ft. 20w. **£2·55**; twin 3 ft. 30w. **£3·55**; twin 4 ft. 40w. **£3·25**; twin 5 ft. 65w. **£3·25**; twin 5 ft. 80w. **£3·95**; twin 8 ft. 125w. **£5·75**. These are about one half of maker's current prices and can't be repeated once stocks are cleared. Please add 30p per piece to cover postage or carriage and 8% VAT.

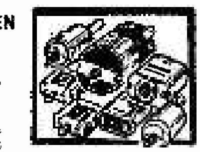
MAINS TRANSFORMERS

All standard 230-250 volt primaries.

		£ p
1v	1 amp (special)	1·75
2·4v	5 amp ..	·85
6·3v	2 amp ..	1·25
6·3v	3 amp ..	1·75
9v	1 amp ..	·95
9v	3·5 amp ..	2·50
12v	1½ amp ..	1·50
12v	1 amp ..	1·00
6·5v-0·6 5v	1 amp ..	1·50
18v	1 amp ..	1·50
24v	2 amp ..	2·25
24v	3 amp ..	3·50
12·0-12v	50mA ..	1·20
6·0-6v	50mA ..	1·20
8·0-8v	½ amp ..	1·50
18·0-18v	2 amps ..	3·50
25v	1½ amp ..	1·95
50v 2 amp & 6·3v ..	1 amp ..	4·50
60v 5 amp & 5v ..	1 amp ..	7·50
27v	8 amp ..	4·50
30v	37 amp ..	22·00
80v tapped 75v & 70v	4 amp ..	5·50
230v-60mA & 6·3v ..	1·5 amps	1·75
275-0·275v at 90mA & 6·4v	3 amps ..	2·25
EHT Transformer 5000v 23mA	(intermittent)	5·50
Charger Transformers		
6v and 12v	2 amps ..	1·50
6v and 12v	3 amps ..	2·25
6v and 12v	5 amps ..	3·50

Add 30p per piece to cover postage and VAT 25%.

ONLY £1·50 FOR SEVEN ELECTRIC MOTORS



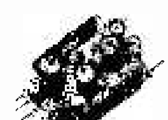
7 powerful batt. motors as used in racing cars & power models. Output & types vary for use in hundreds of different projects—Tools, toys, models. etc. All brand new reversible & for 1½-12v. batts. Wiring diag. inc. VAT & Post 40p. FREE plan for min. power station.

BLACK LIGHT

As used in discotheques and for stage effects, etc. Virtually no white light appears until the rays impinge on luminous paint or white shirts, etc. We offer 9" 6w tubes complete with starter, choke, lamp-holders and starter-holder. Price **£2·75**+30p **post.** Tubes only **£2. Post & VAT 50p.**

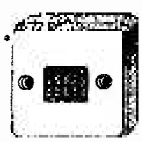
MULLARD AUDIO AMPLIFIERS

All in module form, each ready built complete with heat sinks and connection tags, data supplied.



Model 1153 500mW power output **£1·10**+40p post & VAT.
Model 1172 1W. power output **£1·35**+45p post & VAT.
Model EP9000 4 watt power output **£2·40**+50p post & VAT.
EP 9001 twin channel or stereo pre amp. **£2·50**+50p post & VAT..

LIGHT SWITCH



Automatically switches on lights at dusk and off at dawn. Can also be used where light and dark is a convienent way to stop and start an operation. Requires only a pair of wires to the normal switch. In bakelite box, normal switch-plate size. 1 amp model **£3·75.**
VAT and Postage 50p.

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Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9 and others. Kit comprises: main transformer rectifier, smoothing and load resistor condensers and instructions. Real snip at only **£1·50. VAT & Postage 60p.**

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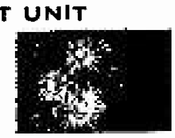
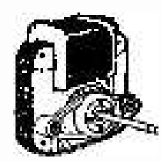


Add colour or white light to your amplifier. Will operate 1, 2 or 3 lamps (maximum 450w). Unit in Box all ready to work. **£7·95** plus 95p VAT and postage.



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Precision made —as used in record decks and tapes recorders—ideal also for extractor fans, blower, heaters, etc. New and perfect. Snip at **95p**+VAT & Postage 20p. Postage 20p for first one then 10p for each one ordered.
1" stackmotor **£1·25**+VAT & postage 25p. 1½" stackmotor **£1·50**+VAT & Postage 30p.

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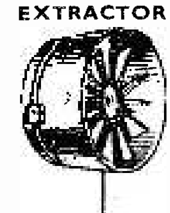

Cleans the air at the rate of 10,000 cubic ft. per hour. Suitable for kitchens, bathrooms, factories, changing rooms, etc., it's so quiet it can hardly be heard. Compact, 5¼" casing with 5¼" fan blades. Kit comprises motor, fan blades sheet steel casing, pull switch, mains connector and fixing brackets. **£4·25 VAT & Postage £1·50.**

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In moulded case forming a 2 pin 5A mains plug.
2 metre output lead with 4-way multiplug giving 2·1 and 2·5 mm sockets and 3·5 mm plugs.
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2″ and 4″ PANEL METERS

2″		4″	
SIZE: 60mm Wide x 45mm High x 40mm Deep.		SIZE: 110mm Wide × 82mm High × 43mm Deep.	
Movement	I.R. Ohms	Movement	I.R. Ohms
0–50 micro A.	1250	0–50 micro A.	1400
0-100 micro A.	580	0–100 micro A.	730
0–500 micro A.	170	0–500 micro A.	200
0–1 mA	170	0–1 mA	200
0–5 mA	170	0–5 mA	200
0-10 mA	6	0–10 mA	6
0–50 mA	0·5	0–50 mA •	0·5
0–100 mA	0·5	0–100 mA	0·5
0-500 mA	0·5	0–500 mA	0·5
0–1 AMT	0·5	0–1 AMP	0·5
0–2 AMP	0·5	0–2 AMP	0·5
0–25 Volt	15K	0–25 Volt	15K
0–50 Volt	50K	0–50 Volt	50K
0–300 Volt	300K	0–300 Volt	300K
"g" Meter	170	"g" Meter	200
VU Meter	5250	VU Meter	5250

VU Meters are complete with detectors. Modern wide view.
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¼ watt CARBON FILM RESISTORS

¼ watt at 70°C E 12 range 10 Ω—1M Ω 5% tol above 470 K Ω 10% tol at 95p per 100. plus 25% VAT

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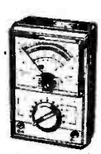
Special Offer



Compact General Purpose Mini Multimeter.
Input Resistance 1000 ohms per volt
Ranges:
AC Volts 0–15, 50, 250, 1000 V
DC Volts 0–10, 50, 250, 1000 V
DC Current 0–1 mA 0–100mA
Resistance 0–150K ohms
Size 60 × 24 × 90 mm
Complete with Batteries, Test Prods, Instructions. Special price £3·35 Post 30p. plus 8% VAT

C1001 MULTIMETER

Input Resistance 20,000 ohms per volt
Overload protection
150 μA movement, clear scale
Ranges—AC Volts 0–10, 50, 250, 1000V
DC Volts 0–5, 25, 125, 500, 2500V
DC Current 0–50 mA
Resistance 0–60 Kohms, 0–6 Mohms
Decibels −20 to +22 dB.
Carrying Case, Test Prods and Batteries included.
Size: 11·5 × 8·3 × 2·7 cm.
Price £9·85. Post 20p. plus 8% VAT

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ADD 8% VAT ON ALL TRANSFORMER PRICES

CASED TRANSFORMERS

Housed in smart resin-coated steel cases, with 3-core power cable and outlet socket, fused primary winding. Isolation types are fitted with 3-pin outlet sockets, and are available with 110 volt or 240 volt output. (Please state). Auto types are fitted with 2-pin flat style sockets up to 500 VA. 3-pin sockets from 750 to 3000 VA. See Auto and Isolation sections for prices.

SAFETY ISOLATING

Prim. 120/240V. Sec. 120/240V. Centre Tap with Screen.

VA (watts)	Ref No.	Price Cased £	Price Plugs 2 Pin + 1 Earth	Price Open £	Post £
60	149	8·60	0·88	4·37	0·56
100	150	9·40	0·88	4·90	0·64
200	151	11·70	0·88	8·14	0·80
250	152	13·15	0·88	9·80	0·88
350	153	15·75	0·88	11·88	0·95
500	154	17·50	0·88	13·62	1·13
750	155	27·35	1·10	20·59	O.A.
1000	156	35·65	1·10	29·15	O.A.
1500	157	42·25	1·10	33·37	O.A.
2000	158	49·95	2·64	37·10	O.A.
3000	159	73·50	2·64	58·55	O.A.

12 & 24 Volts Prim. 200–240V.

Amps 12V	Amps 24V	Ref. No.	Price £	Post £
0·3	0·15	242	1·58	0·34
0·5	0·25	111	1·38	0·34
1	0·5	213	1·74	0·47
2	1	71	2·30	0·47
4	2	18	2·96	0·56
6	3	70	4·18	0·56
8	4	108	4·56	0·64
10	5	72	5·20	0·72
12	6	116	5·51	0·72
16	8	17	7·00	0·80
20	10	115	10·42	0·88
30	15	187	13·25	1·01
40	20	232	14·85	O.A.
60	30	226	16·83	O.A.

30 Volts

Prim. 200–240V. Sec. 12, 15, 20, 24, 30V.

Amps	Ref. No.	Price £	Post £
0·5	112	1·90	0·47
1	79	2·40	0·56
2	3	3·50	0·56
3	20	4·50	0·64
4	21	5·15	0·72
5	51	6·40	0·72
6	117	7·16	0·88
8	88	9·55	0·95
10	89	9·67	0·95

AUTO TRANSFORMERS

VA Watts	Ref. No.	Price Cased £	Price Plugs 2 & 3 pin	Price Open £	Post £
Tapped at 115, 220, 240 Volts					
20	113	4·10	0·20	1·71	0·47
Tapped at 115, 200, 220, 240 Volts					
150	4	6·65	0·20	4·12	0·56
200	65	7·30	0·20	4·95	0·64
300	66	8·25	0·20	5·81	0·72
500	67	11·25	0·20	8·85	0·88
750	83	14·10	0·85	10·80	0·95
1000	84	17·50	0·85	13·68	1·13
1500	93	22·15	0·85	18·31	O.A.
2000	95	33·40	1·60	24·25	O.A.
3000	73	48·20	2·10	35·10	O.A.

50 Volts

Prim. 200–240V.
Sec. 19, 25, 33, 40, 50V.

Amps	Ref. No.	Price £	Post £
0·5	102	2·58	0·47
1	103	3·48	0·56
2	104	5·03	0·64
3	105	5·81	0·72
4	106	7·58	0·88
6	107	12·30	0·95
8	118	13·20	1·13
10	119	17·02	O.A.

60 Volts

Prim. 230–240V.
Sec. 24, 30, 40, 48, 60V.

Amps	Ref. No.	Price £	Post £
0·5	124	2·30	0·56
1	126	3·41	0·56
2	127	5·09	0·72
3	125	7·52	0·80
4	123	8·75	0·95
5	40	9·75	0·95
6	120	11·20	1·01
8	121	15·00	1·19
10	122	18·20	O.A.
12	189	18·50	O.A.

MINIATURE AND EQUIPMENT

Prim. 240V with screen.

Volts Sec. 1	Volts Sec. 2	Milliamps Sec. 1	Milliamps Sec. 2	Ref. No.	Price £	Post £
3–0–3	—	200	—	238	1·50	0·25
0–6	0–6	500	500	234	1·38	0·25
0–6	0–6	1000	1000	212	1·90	0·47
9–0–9	—	100	—	13	1·40	0·25
0–9	0–9	330	330	235	1·50	0·25
0–8–9	0–8–9	500	500	207	1·93	0·34
0–8–9	0–8–9	1000	1000	208	2·75	0·47
15–0–15	—	40	—	240	1·35	0·25
0–15	0–15	200	200	236	1·38	0·25
20–0–20	—	30	—	241	1·35	0·25
0–20	0–20	150	150	237	1·38	0·25
0–15–20	0–15–20	500	500	205	2·73	0·56
0–20	0–20	300	300	214	1·93	0·47
0–20	—	3500	NO SCREEN	1116	3·30	0·64
20–12–0–12–20	—	700 (D/C)	—	221	2·20	0·47
0–15–20	0–15–20	1000	1000	206	3·50	0·56
0–15–27	0–15–27	500	500	203	3·00	0·56
0–15–27	0–15–27	1000	1000	204	3·85	0·56

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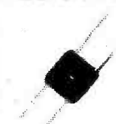
100 P.I.V. 25p	100 P.I.V. 40p	200 P.I.V. 59p	100 P.I.V. 70p
200 P.I.V. 28p	200 P.I.V. 45p	400 P.I.V. 65p	200 P.I.V. 80p
600 P.I.V. 30p	400 P.I.V. 50p	600 P.I.V. 75p	400 P.I.V. 90p



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MINIATURE NEONS

6mm dia., 12mm length leads length approx. 20mm. Recommended ballast resistor 150K ohms for 240 Volt operation Price: Packet of 10 for 60p. Postage 15p. plus 8% VAT

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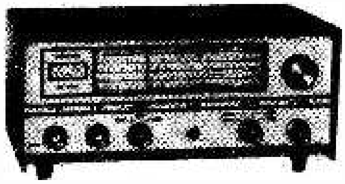

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It tunes from 540 metres medium through to 10 metres with no gaps. Covers shipping, coastguard and distress frequencies, all six amateur bands 160-10 metres, International broadcast, Met. stations etc. etc. giving world-wide reception. Exclusive features include Air-spaced CODAR-COIL Hi-"Q" Aerial input, illuminated Meter and Slide Rule Scale, Two Speed vernier tuning. Switched B.F.O. for CW/SSB signals. Separate output for Tape recorder.
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★ IMPORTANT NOTE

This fine receiver is not a mass produced item, but each set is hand built to your order, individually checked and air tested. Please allow for this when ordering—your delivery date will be shown on your receipt, sent by return.

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This new CODAR A.T.U. tunes 1.5-30Mhz and is designed to match random length single wire aerials from a few feet of indoor aerial to long outdoor wires to the receiver.
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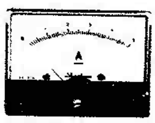
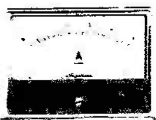


50uA	£4.20	10V DC	£4.05
100uA	£4.15	20V DC	£4.05
200uA	£4.10	25V DC	£4.05
500uA	£4.05	50V DC	£4.05
50-0-50uA	£4.15	300V DC	£4.05
100-0-100uA	£4.10	15V AC	£4.15
1mA	£4.05	300V AC	£4.15
5mA	£4.05	VU Meter	£4.95
10mA	£4.05		
50mA	£4.05		
100mA	£4.05		
500mA	£4.05		
1A DC	£4.05		
5A DC	£4.05		
10A DC	£4.05		
5V DC	£4.05		

CLEAR PLASTIC MODEL SW100
Size: 100 x 80mm



50uA	£5.05	150V AC	£4.90
100uA	£4.95	300V AC	£4.90
500uA	£4.75	VU Meter	£6.25
50-0-50uA	£4.95		
100-0-100uA	£4.90		
1mA	£4.75		
1A DC	£4.75		
5A DC	£4.75		
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50V DC	£4.75		
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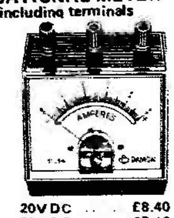
Size: 100 x 90 x 150mm including terminals

A range of high quality moving coil instruments ideal for school experiments and other bench applications. 3" mirror scale. The meter movement is easily accessible to demonstrate internal working.



50uA	£9.35	20V DC	£8.40
100uA	£8.70	50V DC	£8.40
50-0-50uA	£8.70	300V DC	£8.40
1mA	£8.40	500mA/5A DC	£9.50
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1A DC	£8.40	5V/15V DC	£9.50
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5V DC	£8.40		
10V DC	£8.40		
15V DC	£8.40		

CLEAR PLASTIC MODEL SD460
Size: 59 x 46mm

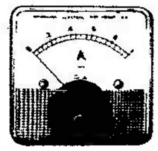
50uA	£3.85	5V DC	£3.65
100uA	£3.80	10V DC	£3.65
200uA	£3.75	20V DC	£3.65
500uA	£3.70	50V DC	£3.65
50-0-50uA	£3.80	300V DC	£3.65
100-0-100uA	£3.75	15V AC	£3.80
1mA	£3.65	300V AC	£3.80
5mA	£3.65	VU Meter	£4.65
10mA	£3.65		
50mA	£3.65		
100mA	£3.65		
500mA	£3.65		
1A DC	£3.65		
5A DC	£3.65		
10A DC	£3.65		

*Items with asterisk are Moving Iron type, all others are Moving Coil

CLEAR PLASTIC MODEL SD830
Size: 110 x 83mm

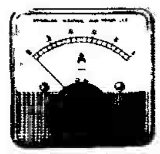
50uA	£4.75	10V DC	£4.50
100uA	£4.65	20V DC	£4.50
200uA	£4.60	50V DC	£4.50
500uA	£4.55	300V DC	£4.50
50-0-50uA	£4.65	15V DC	£4.60
100-0-100uA	£4.60	300V AC	£4.60
1mA	£4.50	VU Meter	£5.60
5mA	£4.50		
10mA	£4.60		
50mA	£4.50		
100mA	£4.50		
500mA	£4.50		
1A DC	£4.50		
5A DC	£4.60		
10A DC	£4.50		
5V DC	£4.50		

CLEAR PLASTIC MODEL MR 45P
Size: 50 x 50mm



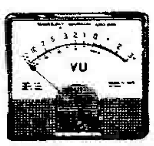
50uA	£3.55	15V AC	£3.40
100uA	£3.50	300V AC	£3.40
200uA	£3.45	5 Meter 1mA	£3.75
500uA	£3.30	VU Meter	£4.30
50-0-50uA	£3.50	1A AC	£3.25*
100-0-100uA	£3.45	5A AC	£3.25*
500-0-500uA	£3.25	10A AC	£3.25*
1mA	£3.25	20A AC	£3.25*
5mA	£3.25	30A AC	£3.25*
10mA	£3.25		
50mA	£3.25		
100mA	£3.25		
500mA	£3.25		
1A DC	£3.25		
5A DC	£3.25		
10V DC	£3.25		
20V DC	£3.25		
50V DC	£3.25		
300V DC	£3.25		

CLEAR PLASTIC MODEL MR 38P
Size: 42 x 42mm



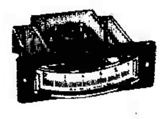
50uA	£3.45	10V DC	£3.05
100uA	£3.40	15V DC	£3.05
200uA	£3.30	20V DC	£3.05
500uA	£3.10	50V DC	£3.05
50-0-50uA	£3.40	100V DC	£3.05
100-0-100uA	£3.30	150V DC	£3.10
500-0-500uA	£3.05	300V DC	£3.10
1mA	£3.05	500V DC	£3.15
1-0-1mA	£3.05	750V DC	£3.15
2mA	£3.05	15V AC	£3.15
5mA	£3.05	50V AC	£3.15
10mA	£3.05	150V AC	£3.15
20mA	£3.05	300V AC	£3.15
50mA	£3.05	500V AC	£3.30
100mA	£3.05	5 Meter 1mA	£3.50
150mA	£3.05	VU Meter	£4.10
200mA	£3.05		
300mA	£3.05		
500mA	£3.05		
750mA	£3.05		
1A DC	£3.05		
2A DC	£3.05		
5A DC	£3.05		
10A DC	£3.05		
3V DC	£3.05		

CLEAR PLASTIC MODEL MR 85P
Size: 120 x 110mm



50uA	£6.00	50V DC	£5.75
100uA	£5.95	150V DC	£5.75
200uA	£5.90	300V DC	£5.75
500uA	£5.80	15V AC	£5.85
50-0-50uA	£5.95	300V AC	£5.85
100-0-100uA	£5.90	5 Meter 1mA	£6.65
500-0-500uA	£6.65	VU Meter	£7.10
1mA	£5.75	1A AC	£5.75*
1-0-1mA	£5.75	5A AC	£5.75*
5mA	£5.75	10A AC	£5.75*
10mA	£5.75	20A AC	£5.75*
50mA	£5.75	30A AC	£5.75*
100mA	£5.75		
500mA	£5.75		
1A DC	£5.75		
5A DC	£5.75		
15A DC	£5.75		
30A DC	£5.95		
10V DC	£5.75		
20V DC	£5.75		

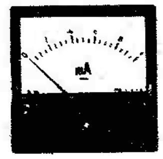
EDGWISE MODEL PE70
Size: 90 x 34mm



50uA	£4.55
100uA	£4.50
200uA	£4.45
500uA	£4.30
50-0-50uA	£4.50
100-0-100uA	£4.45
1mA	£4.25
10V DC	£4.25
300V DC	£4.35
VU Meter	£5.50

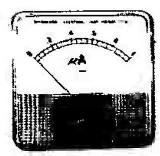
POSTAGE / PACKING & INSURANCE 15p

BAKELITE MODEL S80 Enlarged Window
Size: 80 x 80mm



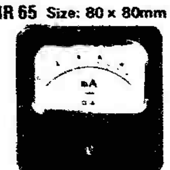
50uA	£4.95
100uA	£4.90
500uA	£4.60
50-0-50uA	£4.80
100-0-100uA	£4.85
1mA	£4.60
1A DC	£4.60
5A DC	£4.60
20V DC	£4.60
50V DC	£4.60
300V DC	£4.60
300V AC	£4.75
VU Meter	£5.95

CLEAR PLASTIC MODEL MR 52P
Size: 60 x 60mm



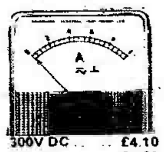
50uA	£4.10	5 Meter 1mA	£4.20
100uA	£3.85	VU Meter	£4.85
500uA	£3.70	1A AC	£3.65*
50-0-50uA	£3.85	5A AC	£3.65*
100-0-100uA	£3.70	10A AC	£3.65*
1mA	£3.65	20A AC	£3.65*
5mA	£3.65	30A AC	£3.65*
10mA	£3.65		
50mA	£3.65		
100mA	£3.65		
500mA	£3.65		
1A DC	£3.65		
5A DC	£3.65		
10V DC	£3.65		
20V DC	£3.65		
50V DC	£3.65		
300V DC	£3.65		
15V AC	£3.75		
300V AC	£3.75		

BAKELITE MODEL MR 65
Size: 80 x 80mm



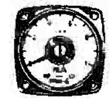
25uA	£5.80	300V DC	£3.95
50uA	£4.40	30V AC	£3.95*
100uA	£4.35	50V AC	£3.95*
500uA	£4.05	150V AC	£3.95*
50-0-50uA	£4.35	300V AC	£3.95*
100-0-100uA	£4.30	500V AC	£3.95*
500-0-500uA	£3.95	VU Meter	£5.20
1mA	£3.95	1A AC	£3.95*
1-0-1mA	£3.95	5A AC	£3.95*
5mA	£3.95	10A AC	£3.95*
10mA	£3.95	20A AC	£3.95*
50mA	£3.95	30A AC	£3.95*
100mA	£3.95	50A AC	£3.95*
500mA	£3.95	500mA AC	£3.95
1A DC	£3.95	50mV DC	£4.15
2A DC	£3.95	100mV DC	£4.15
5A DC	£3.95		
10A DC	£3.95		
15A DC	£3.95		
30A DC	£3.95		
50A DC	£4.20		
5V DC	£3.95		
10V DC	£3.95		
15V DC	£3.95		
20V DC	£3.95		
50V DC	£3.95		
150V DC	£3.95		

CLEAR PLASTIC MODEL MR 65P
Size: 86 x 78mm



50uA	£4.35	300V DC	£4.10
100uA	£4.25	15V DC	£4.20
200uA	£4.20	50V AC	£4.20
500uA	£4.15	150V AC	£4.20
50-0-50uA	£4.25	300V AC	£4.20
100-0-100uA	£4.20	500V AC	£4.30
500-0-500uA	£4.10	5 Meter 1mA	£4.85
1mA	£4.10	VU Meter	£5.20
1-0-1mA	£4.10	1A AC	£4.10*
5mA	£4.10	5A AC	£4.10*
10mA	£4.10	10A AC	£4.10*
50mA	£4.10	20A AC	£4.10*
100mA	£4.10	30A AC	£4.10*
500mA	£4.10	50A AC	£4.10*
1A DC	£4.10	50mA AC	£4.10*
5A DC	£4.10	100mA AC	£4.10*
10A DC	£4.10	200mA AC	£4.10*
15A DC	£4.10	500mA AC	£4.10*
20A DC	£4.20		
30A DC	£4.25		
50A DC	£4.10		
5V DC	£4.10		
10V DC	£4.10		
15V DC	£4.10		
20V DC	£4.10		
50V DC	£4.10		
150V DC	£4.10		

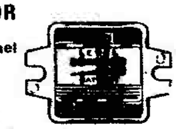
240° Wide Angle 1mA METERS



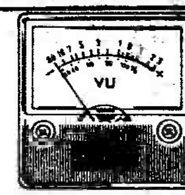
MW1-8, 80 x 80mm
£7.45 P & P Ins. 15p

ALL PRICES INCLUDE VAT

BATTERY/LEVEL PANEL INDICATOR



18mm × 18mm Panel mounting.
OUR PRICE 95p P/P & Ins 15p Discounts for quantity.



VU METER TYPE 3
250 uA Size: 33mm × 20mm.
£1.55 P/P & Ins 15p

REDUCED TO CLEAR

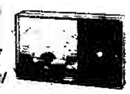
YAMABISHI VARIABLE VOLTAGE TRANSFORMERS
Excellent quality at low cost. Input: 230V 50/60Hz. Output 0–260V.
MODEL S260 BENCH MOUNTING

		P/P & Ins
1A	£7.30	£1.50
2.5A	£10.35	£1.50
5A	£12.95	£1.50
8A	£19.45	£1.50
10A	£23.75	£1.50
12A	£25.90	£1.50
20A	£60.45	£1.50
25A	£64.75	£1.50
40A	£73.40	£1.50

MODEL C7202EN

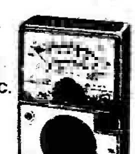
20,000 o.p.v. DC. 10,000 o.p.v. AC Mirror Scale. 5/25/50/250/500/1000/2500 V. DC. 10/50/100/500/1000 V. AC. DC Resistance x10, x1000 (30Ω centre scale) DC Current 50uA/2.5mA/250mA. –20 to +68 dB.
OUR PRICE £7.50 P/P & Ins 30p

U4323 MULTIMETER



20,000opv. Simple unit with audio/IF oscillator. Suitable for general receiver tuning. Ranges: 0.5/2.5/10/50/250/500/1000V DC. 2.5/10/15/250/500/1000V AC. 0.05/0.5/5/50/500mA DC. Resistance: x10, x100, x1,000, x10,000 (50Ω, 500Ω, 5kΩ, 50kΩ centre scale) Battery operated. Size: 160 x 97 x 40mm. Supplied in carrying case complete with test leads.
OUR PRICE £8.60 P/P & Ins 60p

HIOKI 730X



30,000 opv. Overload protection. 6/30/60/300/600/1200V DC. 12/60/120/600/1200V AC. 60/µA/30mA/300mA. 2K/200K/2 Meg Ohm. –10 to +63dB.
OUR PRICE £8.10 P/P & Ins 30p

MODEL C7208FM

30,000 opv DC. 15,000 opv AC. 6/3/15/60/300/600/1200 V. DC. 6/30/120/600/1200 V. AC. DC Resistance x1, x10, x100, x1000 (50Ω centre scale). DC Current 30uA/3/30/600mA. –20 to +63dB.
OUR PRICE £9.65 P/P & Ins 30p

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IT MAKES SENSE TO
TMK 200 MULTIMETER KIT
Build yourself a quality 20000 opv. multimeter and save money. Complete kit with meter scale, movement and rotary range selector ready mounted in cabinet. All parts, batteries, test prods and instructions. Ranges: 0/0.6/6/30/120/600/1200V D.C. 0/6/30/120 600/1200V A.C. Current: 0/0.6/6/60/600mA. Resistance: 0/10/100K/1/10 Meg ohms. Decibels: -20 to +63db. Size: 90 x 150 x 35mm
OUR PRICE £9.65 P/P & Ins 30p
U4324 MULTIMETER
High sensitivity, 20,000opv. Ranges: 0.6/1.2/3/12/30/60/120/600/1200V DC. 3/6/15/60/150/300/600/900V AC. Current: 0.06/0.6/6/60/600mA/3A DC. 0.3/3/30/300mA/3A AC. Resistence: 25/500 ohms/0.5/5/50/500k ohms/5 Mohms. Decibels: -10 to +12dB. Size 167 x 98 x 63mm. Supplied complete with test leads, spare diode and instructions.
OUR PRICE £10.60 P/P & Ins 60p
HIOKI 750X VOLT-OHM-MILLIAMETER
43 ranges: 0-0.3/0.6/1.5/3/6/12/30/60/150/300/600/1,200V DC. 0-3/6/15/30/60/120/300/600/1,200V AC. Current: 0-30/60uA/1.5/3/15/30/150/300 mA/6/12A. Resistence: 0-3/300k/3/30Mohms. Decibels: -10 to +17dB. Output: - 0-3/6/15/30/60/120/300V. Accuracy ± 3% DC, ± 4% AC. Sensitivity: 50,000 opv DC, 5,000 opv AC. 4 inch meter. Built in protection. Size: 57 x 102 x 153mm.
OUR PRICE £12.90 P/P & Ins 60p
U4312 MULTIMETER
extremely sturdy instrument for general electrical use. 667opv. 0/0.3/1.5/7.5/30/60/150/300/600/900V DC & 75mV. 0/0.3/1.5/7.5/30/60/150/300/600/900V AC. 0/300uA/1.5/6/15/150/60/600mA/1/1.5/6A DC. 0/1.5/6/15/60/150/600mA/1.5/6A AC. 0/200/3k/30k ohms. DC accuracy 1%. AC 1.5%. Knife edge pointer, mirror scale. Complete with sturdy metal carrying case, leads and instructions.
OUR PRICE £11.60 P/P & Ins 60p
U4315 MULTIMETER
Sturdy 43-range multimeter for current and voltage in DC AC circuits with freq. 45-20kHz and DC resistance, capacitance, etc. Ranges: DC 50 μA/100μA/0.5μA/1/5/25/100/500/2500; DC 75mV/1V/2.6/5/10/25/100/250/500/1000; AC 0.5 mA/1/5/25/100/500/2500; AC 1V/2.5/5/10/25/100/250/500/1000; DC 300Ω. DC 5kΩ/50/500/5000; -15db +2dB. Complete with steel carrying case and leads, manual.
OUR PRICE £10.80 p/p & Ins. 60p
TMK MODEL TW50K
46 ranges, mirror scale. 50k/V DC 50k/V AC. DC Volts: 0.125/0.25/1.25/2.5/5/10/25/50/125/250/500/1000. AC Volts 1.5/3/5/10/25/50/125/250/500/1000. DC current 25/50uA/2.5/5/25/50/250/500mA/5/10A. Resistence: 10k/100k/1 Meg/10 Meg ohms. -20 to +81.5dB.
OUR PRICE £13.50 P/P & Ins 60p
U4313 MULTIMETER
High sensitivity (20,000 opv on DC and 2,000 opv on AC) and accuracy of 1.5% on DC and 2.5% on AC. Ranges: DC and AC current; 0.6mA/3/15/60/300/1.5A; DC and AC Voltage: 1.5V/3/7.5/15/30/60/150/300/600; DC resistance 1kohm/10/100/1,000. -10 to +12dB. etc. Complete with steel carrying case and leads, manual.
OUR PRICE £14.90 p/p & Ins. 60p
KAMODEN 360 MULTIMETER
High sensitivity. DC 100kohm/V AC 10kohm/V 5" mirror scale, overload protected. Ranges: 0.5/2.5/10/50/250/1000V DC. 5/10/50/250/1000V AC. Current: 0.01mA/0.5/5/50/500mA/10A. Resistance: 0.1/1/10/100 ohms/1/10/100k ohms/10/100M ohms. Decibels -20 to +62dB. Battery operated. Size: 180 x 140 x 80mm. Supplied complete with test leads etc.
OUR PRICE £18.90 P/P & Ins 60p
U4317 MULTIMETER
High sensitivity instrument for field and laboratory work. Knife edge pointer, 86mm. mirror scale. Overload protection. Ranges: 100mV/0.5/2.5/10/25/50/100/250/500/1000 V DC. 0.5/2.5/10/25/50/100/250/500/1000V AC. Current: 50uA/0.5/1/5/10/50/250mA/1/5A DC. 0.25/0.5/1/5/10/50/250mA/1/5A AC. Resistance: 0.5/10/100/200 ohms/1/3/30/300k ohms. Decibels: -5 to +10dB Battery operated. Size: 210 x 115 x 90mm. Supplied in carrying case complete with leads.
OUR PRICE £18.35 P/P & Ins 60p
MODEL AF.105 VOM
50,000 opv. Mirror scale. Meter protection. 0/-3/3/12/60/120/300/600/1200V DC. 0/6/30/120/300/600/1200V DC. 0/30μA/6/60/300 mA/12 Amp. 0/10K/1m/10m/100 Meg Ohms. -20 to +17dB.
OUR PRICE £13.50 P/P & Ins 60p
ALL PRICES INCLUDE VAT
MODEL 500
30,000 opv with overload protection. Mirror scale. 0/0.5/2.5/10/25/100/250/500/1000V DC. 0/2.5/10/25/100/250/500/1000V AC. 0/50uA/5/50/500mA. 12A DC. 0/60k/6 meg/60 megohms.
OUR PRICE £15.05 P/P & Ins 60p
MODEL AS.100D VOM
100,000 opv. Mirror scale. Built-in meter protection. 0/3/12/60/120/300/600/1200V DC. 0/6/30/120/300/600V AC. 0/10μA/6/60/300mA/12 Amp. 0/2K/200K/2M/200 Meg Ohm. - 20 to 17dB.
OUR PRICE £18.90 P/P & Ins 60p
Model HT100B4 MULTIMETER
Overload protected, shock proof circuits. 9.5uA Meter with mirror scale. Sensitivity 100kV. Polarity change switch. Ranges: 0.5/2.5/1/50/250/500/1,000 Volts DC. 2.5/10/50/250/1,000 Volts AC. DC resistence 0-20/200k/2/20 Meg. ohms. DC current: - 10/250uA/2.5/25/250 mA/10A. AC current: -0-10A. -20 to +62dB. Operates from 2 x 1.5V batteries. Size: 180 x 134 x 79mm.
OUR PRICE £21.50 P/P & Ins 60p
KAMODEN HM720B FET VOM
Input impedence 10 Megohms. Ranges: - 0/.25/1/2.5/10/50/1000V DC. 0/2.5/10/50/250/1000V AC. 0/25uA/2.5/25/250 mA DC. 0/5k/50k/500k/5 M 500 Megohms
OUR PRICE £24.30 P/P & Ins 60p
U91 Clamp VOLT AMMETER
For measuring AC voltage and current without breaking circuit. Ranges: 300/600V AC. Current: 10/25/100/250/500A. Accuracy 4%. Size 283 x 94 x 36mm. Complete with carrying case, leads and fuses.
OUR PRICE £15.10 P/P & Ins 60p
U4341 Multimeter & Transistor Tester
27 ranges. 16,700opv. Overload protected. Ranges: 0.3/1.5/6/30/60/150/300/900V DC. 1.5/7.5/30/150/300/750V AC. Current: 0.06/0.6/6/60/600mA DC. 0.3/3/30/300mA AC. Resistance: 0.06/0.6/2/6/20/60/200k ohms/2 Mohms. Battery operated. Supplied complete with probes, leads and steel carrying case. Size: 115 x 215 x 90mm.
OUR PRICE £11.85 P/P & Ins 60p
KAMODEN TT35 TRANSISTOR TESTER
High quality instrument to test reverse leak current and DC current. Amplification factor of NPN, PNP, diodes, transistors, SCR's etc. 4" square clear scale meter. Operates from internal batteries. Complete with instructions, leads carrying handle.
OUR PRICE £18.90 P/P & Ins 60p
SWR METER Model SWR3
Handy SWR meter for transmitter antenna alignment, with built-in field strength meter. Accuracy 5%, Impedence 52' Indicator 100uA DC. Full scale 5 section collapsible antenna. Size 145 x 50 x 60mm.
OUR PRICE £4.55 P/P & Ins 60p
S100TR MULTIMETER TRANSISTOR TESTER
100,000opv. Mirror scale. Overload protection. 0/0.12/0.6/3/12/30/120/600V DC. 0/6/30/120/600V AC. 0/12/600uA/12/300mA/6/12A DC 0/10k/1 Meg/100 Meg. -20 to +50dB. 0.01-0.2 MFD Transistor tester measures Alpha, Beta and ICO. Complete with instructions, batteries and leads.
OUR PRICE £22.65 P/P & Ins 60p
C15 PULSE OSCILLOSCOPE
For display of pulsed and periodic waveforms in electronic circuits. VERT. AMP. Bandwidth: 10MHz. Sensitivity at 100kHz VRMS/mm: 0.1-25; HOR. AMP. Bandwidth: 500kHz. Sensitivity ay 100kHz VRMS/mm: 0.3-25 Preset triggered sweep 1-3000usec. Free running 20-200 kHz in nine ranges. Calibrator pips. 220 x 360 x 430mm. 115-230V AC.
OUR PRICE £47.50 P/P & Ins £1.50
370WTR MULTIMETER
Features AC current ranges. 20,000opv. 0/0.5/2.5/10/50/250/500/1000V DC. 0/2.5/10/50/250/500/1000V AC. 0/50uA/1/10/100 mA/1/10A DC. 0/100mA/1/10A AC. 0/5k/50k/500k/5 Meg/50 Meg. Decibels: -20 to +62dB.
OUR PRICE £21.50 P/P & Ins 60p
KAMODEN 72.200 Multitester
High sensitivity tester. 200,000 opv Overload protected. Mirror scale. Ranges: -0/.06/.3 3/30/120/600/1200V DC. 0/3 12/60/300/11200 V AC. 0/6uA/1.2mA/120mA/600mA/12A DC 0/12A AC. -20 to +63dB. 0/2k/200k/2 Meg/200 Megohms.
OUR PRICE £24.30 P/P & Ins 60p
TE-20D RF SIGNAL GENERATOR
Accurate wide range signal generator covering 120 kHz-500 MHz on 6 bands. Directly calibrated. Variable R.F. attenuator audio output. Xtal socket for calibration. 220/240V a.c. Brand new with instructions Size 140mm x 215mm x 170mm.
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All transistorised compact fully portable. AF sine-wave 18Hz to 220 kHz. AF square wave 18Hz to 100k Hz. Output Square/Sine wave 10V. P-P RF 100kHz to 200MHz. Output 1V maximum. 220/240V AC operation. Complete with instructions and leads.
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Tests PNP or NPN transistors. Audio indication. Operates on two 1.5V batteries. Complete with instructions etc.
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SINCLAIR DM2 DIGITAL MULTIMETER
Will measure AC and DC volts, AC and DC current, and resistance in a total of 20 ranges. The large light emitting diode display will read up to 1999 and automatically indicate polarity. Indication of positive and negative overload is also provided. The instrument is fitted with a combined carrying handle and bench stand and sockets are provided for the connection of an external power supply.
RANGES:
DC VOLTS: 1v. 10, 100v, 1000v.
AC VOLTS: 1v, 10v, 100v, 1000v.
DC CURRENT: 1mA, 10mA, 100mA, 1000mA.
AC CURRENT: 1mA, 10mA, 100mA, 1000mA.
RESISTANCE: 1k, 10k, 100k, 1000k.
OUR PRICE £63.70 P/P & Ins 60p
TRANSISTORISED L.C.R. A.C. BR/8 MEASURING BRIDGE
A new portable bridge offering excellent range and accuracy at low cost. Resistance: 6 ranges: 0.1 ohm-11.1 megohm ± 1% Inductance: 6 ranges: 1 microhenry-111 henries ± 2% Capacity: 6 ranges: 10pf-1110 mfd ± 2% Turns Ratio: 6 ranges: 1:1/1000-1:11100 ± 1% Bridge Voltage at 1,000cps. Operated from 9-volt battery. 100 micro-amp meter indication. Size 7½" x 5" x 2"
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Sine 20cps to 200kHz on 4 bands. Square 20 cps to 30 kHz. Output Impedence 5000 Ohms. 200/250V AC operation. Supplied brand new guaranteed, with instruction manual and leads.
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Six bands. 120kHz-260MHz. Dual output RF terminals. Separate variable audio output. Accuracy ± 2%. Audio output to 8V. Power requirements: 105-125V, 220-240V AC. Size: 193 x 265 x 150mm. Complete with test leads etc.
OUR PRICE £20.45 P/P & Ins 60p
NEW GOLDRING G102 KIT
Belt-drive 2-speed turntable in kit form complete with pick up arm and head shell.
OUR PRICE £21.15 P/P & Ins £1.00
LASKYS a service that makes sense!
EXPORT Personal exports arranged for overseas visitors. Goods specially packed, insured and despatched to all parts of the world at minimum cost exclusive of VAT. Payment by bank transfer, certified cheque, postal order or money order in any currency.
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Software Gobbledegook!

ONE of the most difficult things about publishing technical material is that one is never quite sure for whom one is writing. This is particularly so in the case of a magazine like ours. Our readership covers students, school teachers, laymen, electronics engineers and university professors. In order to avoid talking down or talking up we have to be very careful how we select our words. Regular readers will know that we are always careful to define words of an unusual nature and we always attempt to make our descriptions as simple as possible using plain language.

On the whole, manufacturers of electronic components are only too well aware of the problems the potential user has in working within the specified ratings of his device and are careful to ensure that there is no doubt in the mind of the experimenter or development engineer. We would like to think that this ability has evolved by using practising engineers to write up the original instructions.

We only wish the same could be said of a new range of technical literature that is coming out on a new type of integrated circuit, the MICROPROCESSOR. Publicity material tells us that these devices are God's gift to the electronics industry; anything you can do with combinational logic you can do with a microprocessor, with a saving of space, time and money. Intuitively we believe what we are told but from the reams of descriptive material that are flooding our offices we have yet to find a document which tells us in simple terms exactly what the devices do, how they do it and how we can use them.

At first we thought that the problem was our own ignorance but on making enquiries in the electronics industry we find the complaint is very commonplace. These devices, like the computers they emulate, have brought into our sphere of the electronics business a new type of individual, the SOFTWARE SPECIALIST. It is unfortunate for us that most of the major microprocessor manufacturers seem to have recruited teams of these, so called, "Whizz-Kids" to pass on the facts of how to use and not abuse these exciting new components. In so doing they have now inflicted on us the "Buzz Word" technology in which these Whizz Kids specialise. Being cynics we are not impressed with sophisticated new words because, more often than not, we have found that with a little more thought on the part of the writer a meaningless new word, which needs a glossary of terms to decode, could easily be replaced in descriptive text with a straightforward sentence written in simple English. We accept the fact that eventually one may have to resort to the shorthand of mnemonics and buzz-words when one is totally familiar with the subject but where on earth is the sense in presenting to the newcomer a document in which every fifth word is meaningless?

Come off it microprocessor manufacturers! We admire your technical achievement in developing these potentially revolutionary components but we are not impressed with the way in which you are trying to persuade us to use them. What we want is some well-written literature originated by engineers, for engineers, and this MUST be supplemented by a few simple applications reports. In our experience there is only one way to really get to understand a new component and that is by using it. How on earth do you expect us to start building these systems when you seem hell bent on disguising them behind a forest of "Gobbledegook"?

LIONEL E. HOWES—*Editor*

NEWS...

Disco Decks

THE BSR McDonald BDS80 belt-drive turntables used in the Disco, illustrated on the front cover this month, were kindly supplied by BSR Limited.

Trio Catalogue

B. H. Morris & Company, United Kingdom distributors for Trio high-fidelity equipment, have produced a new, full-colour, illustrated catalogue detailing the Trio range.

Specifications and prices for the complete range of stereo receivers, tuners, amplifiers, turntables, cassette decks, loudspeakers, headphones and high-fidelity systems are included.

Copies of the catalogue, which was designed and printed in Britain, are available free from Trio dealers or direct from *B. H. Morris & Company, Trio House, The Hyde, London NW9 6JP (Telephone 01-205 6441).*

Leak 2000 series speakers

A NEW and improved treble unit is being incorporated in the Leak 2000 series of loudspeakers.

Whilst the current treble unit has a wide and smooth response in the operating range of 4kHz to 20kHz and excellent power handling qualities it is now felt by some that it sounds slightly hard or brash.

The new unit, distinguished by the carefully designed phase-correcting assembly on the front, when compared with its predecessor produces smoother treble but shares the detailed response to beyond 20kHz. The previous traces of hardness however have now been reduced to negligible proportions.

This new driver will be incorporated in the 2030, 2060 and 2075 enclosures in the Leak 2000 range.—*Rank Audio Visual Limited, P.O. Box 70, Great West Road, Brentford, Middx.*

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

Ambience Phones

JAPANESE electronics giant Matsushita Electrical Industrial Co. Ltd. has introduced a new headphone system called "Ambience-phone". It will be sold in Japan this year and is to be available in other countries in 1976.

Listening with conventional headphones, the sound image localises inside the area of the listener's head—unlike the sound from a loudspeaker. Thus the feeling of distance with conventional headphones is nil.

Engineers at Matsushita found that indirect sound is a vital factor in giving a feeling of distance to the acoustic sense of human beings. It was also found that when the feeling of distance was greater, the sound localisation outside the area of the head was realised in a more idealistic manner.

To achieve the desired effect the company uses a delay element called a BBD—bucket brigade device. This device passes a signal charge along its elements from one to the other, rather like a chain of firemen passing buckets of water along from one to the other—hence the name. Passing these charges along takes a finite time from first to last element and thus a delay is introduced.

Further research at Matsushita showed that even in a system where the loudspeaker gives an "even" reproduction of sound, the

middle audio range is heard louder, and the higher sound weaker, due to the characteristics of the human head and hearing system.

The headphones used in the Ambience system are designed in such a way as to automatically modify the middle range sounds making them appear louder and to make the higher sounds weaker. The purpose is to simulate more exactly the characteristics of a loudspeaker system.

Applications for the new system are seen in almost every facet of audio, hi fi, portable radios, tape recorders, stereo receivers etc.

The system was shown this year at the "International Radio and TV Exhibition 1975" in Berlin. Already, some 20 patents have been taken out in Japan, and a further five are being sought in five other countries including Britain.—*D.L.G.*

Audio/Visual Show

"AUDIO/VISUAL in the Midlands" will be held on February 24th, 25th and 26th, 1976 and will feature a wide range of equipment within certain categories encapsulated by the Audio/Visual banner. This new exhibition will be staged in spacious exhibition halls at the National Agricultural Centre, Stoneleigh, Warwickshire. The show will run from 10.00 a.m. till 8.00 p.m. each day with trade visitors only during the morning sessions, the general public being admitted from 2.30 p.m. daily.

The show will be divided into sections covering trade, education, security and equipment of domestic interest. The organisers are aiming to attract specialist audiences in each of these major categories by issuing invitations and directing an advertising campaign towards each sector.

Parking facilities are excellent, and there are plenty of good hotels within easy reach of the exhibition site.

For further information please contact the organisers: *D. L. Ford Exhibitions (1968) Ltd., National Agricultural Centre, Stoneleigh, Warwickshire. Tel: Coventry 21784.*

Short courses

THE Engineering Technology Department of the Inner London Education Authority Paddington College is running the following short courses: "Electronics Practical" from February 25th for six weeks. This is a series of practical evenings for the construction of gadgets, projects etc. "Practical Electronics" will run for five weeks from 28th April, 1976. Students for this should have a basic knowledge of electronics and the course will cover such subjects as latest circuit designs and devices. Some of the devices will be demonstrated including a robot, HiFi unit and an electronic music maker.

Further details of the courses and application forms may be obtained by contacting the course organiser, *G. D. Bishop on 01-402 6221 Ext. 55.*

VHF station for Radio Tees

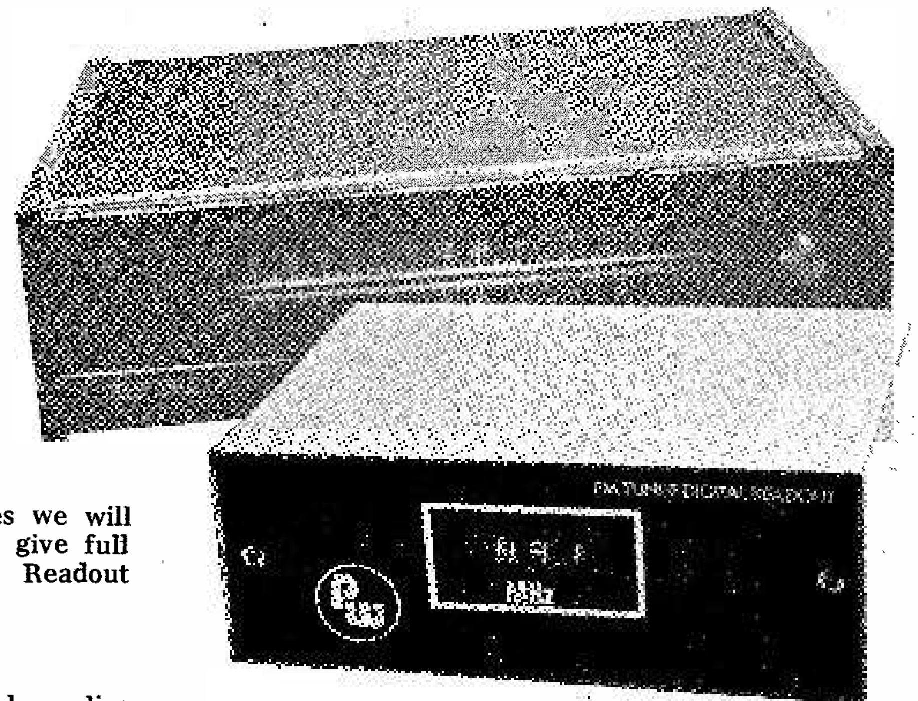
THE Independent Broadcasting Authority's new VHF/FM/Stereo transmitters at Bilsdale are now in operation on 95·0MHz, carrying the programmes of Radio Tees.

Since the opening of Radio Tees on June 24th, 1975, the programmes have been available on 257 metres (1169 kHz) medium-wave. The predicted VHF service area, which covers about 680,000 people, extends from a little north of Hartlepool to about Shildon and Richmond in the west, southwards to a few districts of Ripon and then again northwards along the boundary of the Cleveland Hills to Redcar and including West Hartlepool, Billingham, Middlesbrough, Stockton-on-Tees, Darlington, Thornaby-on-Tees and Northallerton.

Listeners using stereo receivers are advised to use a good VHF roof or loft aerial, reasonably high, if reception is to be completely free of background hiss. It is usually well worthwhile to take extra care over an aerial intended for stereo reception.

DIGITAL READOUT SYSTEM for FM tuners

PART 2 Martin Oliver* & Joe D'Elia†



IN THIS, the second part of the series we will look at the power supply design and give full constructional details of the Digital Readout System for FM Tuners.

POWER SUPPLY CIRCUIT

The circuit shown in Fig. 8 gives regulated supplies of 5V and 13V. The two outputs from the transformer are full wave rectified and smoothed to give DC voltages of 8V and 18V. A voltage regulator, IC16, is used with transistor Tr5 to drop the 18V line to 13V (V2). This IC has an internal reference diode and the output voltage can be adjusted with VR2. The 13V output supplies the prescaler circuit and also the input buffer if there is no convenient supply in the tuner itself.

The 5V output (V1) uses Tr6 and Tr7 as a series regulator from the 8V line. The voltage reference is taken from the 13V supply via R50 and R51. The IC has an internal current limiting circuit and R53 is used as a current sensing resistor.

Adjusting VR2 affects both the output voltages, but the supply for the prescaler is not critical and VR2 is set to give exactly 5V for the TTL logic circuits. Typical currents drawn by the circuits are 0·5A at 5V and 90mA at 13V.

The power supply, prescaler and display circuits are built on 0·1in pitch Veroboard. A Vero DIP board is used for the logic circuits.

POWER SUPPLY BOARD

The power supply should be built first as it can be tested separately and then used to test the other circuits. Fig. 9 shows the layout of the Veroboard containing all the components except Tr7 and the mains transformer. Tr7 is a plastic power transistor mounted on the back panel of the case and connected to the circuit board with flying leads. The layout of this board is not critical and can be changed if

* Formerly Texas Instruments † Texas Instruments

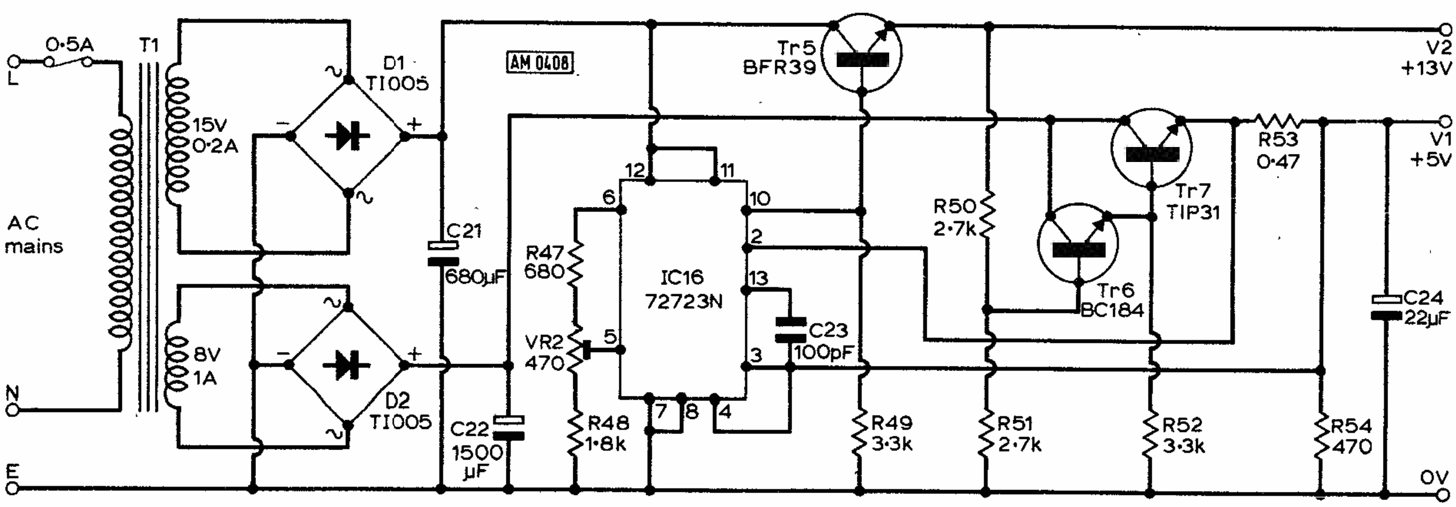


Fig. 8: Circuit diagram of the power supply unit.

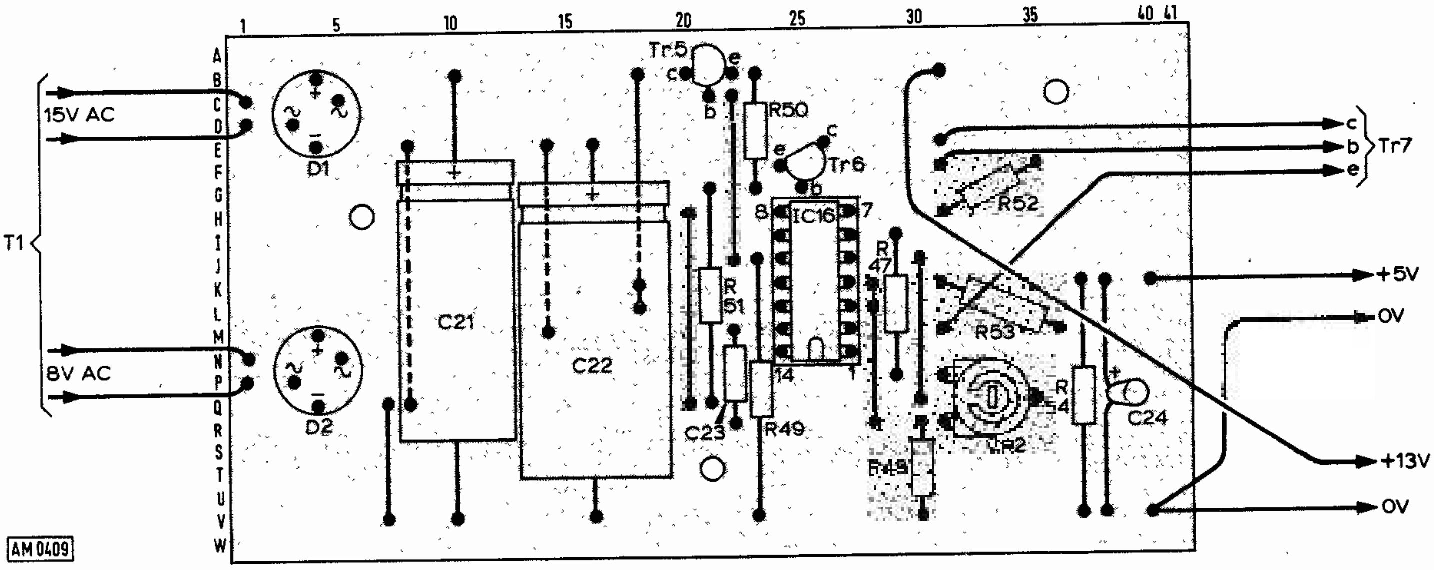


Fig. 9: Component layout on the power supply board. Transistor Tr7 is mounted on a heatsink.

necessary to allow for different sized components. The polarity of the electrolytic capacitors is important and should not be reversed.

When the board has been built and checked it can be tested by connecting the transformer and Tr7. For this initial test Tr7 need not be mounted in the case as, under no-load conditions, it should not get hot. When connecting the transformer to the mains, the usual safety precautions should be observed and connectors to the mains side of T1 should be insulated.

The outputs are checked with a multimeter and the 5V line set by adjusting VR2. With V1 set to 5·0V, V2 should be 13V±1·5V. With this circuit working correctly the rest of the boards can be built.

★ components list

POWER SUPPLY

Resistors

R47	680Ω	R51	2·7kΩ
R48	1·8kΩ	R52	3·3kΩ
R49	3·3kΩ	R53	0·47Ω ½W 5%
R50	2·7kΩ	R54	470Ω

All ¼W 5% except R53
VR2 470Ω miniature preset

Capacitors

C21 680μF 25V elect.
C22 1500μF 16V elect.
C23 100pF polystyrene
C24 22μF 25V elect.

Semiconductors

IC16 SN72723N (Texas)
Tr5 BFR39
Tr6 BC184
Tr7 TIP31
D1, D2 T1005 (2 off)

Miscellaneous

T1 240V primary, 8V 1A + 15V 0·2A secondaries. (Type L743 from SIGA (Electronics) Ltd., Sunderland Road, Sandy, Beds. Price £4·55 including VAT and p & p).
F1 0·5A 20mm fuse and holder.
Case (RS type 3), Veroboard 0·1in pitch, Veroboard DIP board Type 11822, metal for chassis, coaxial cable, heatsink, BNC plug and socket.

DISPLAY BOARD

The seven segment LED displays are mounted on 0·1in pitch Veroboard. Fig. 10 shows the layout. Care should be taken not to overheat the displays when soldering and a very small soldering iron is recommended. This also helps when soldering the input wires as it is very easy to bridge the tracks when a large iron is used.

LOGIC BOARD

Because of the large number of ICs a Vero DIP board is used for the main logic board. This has supply and ground conductor tracks and also solder pads for making connections to the IC pins. Fig. 11 shows the underside of the board. Connections between the ICs are made on the top of the board with insulated wire and connections to ground or 5V are made on the underside of the board.

The component layout is shown in Fig. 12. In the prototype IC sockets were used to make it easy to change devices. These are not essential but they do simplify fault finding.

The position of the wires is not critical, but they should be made as short as possible. The circuit is neater if the wires are all bent at right angles and routed between the ICs. To avoid wiring errors as many different colours as possible should be used.

All components should be soldered in first followed by the ground and 5V connections (under-

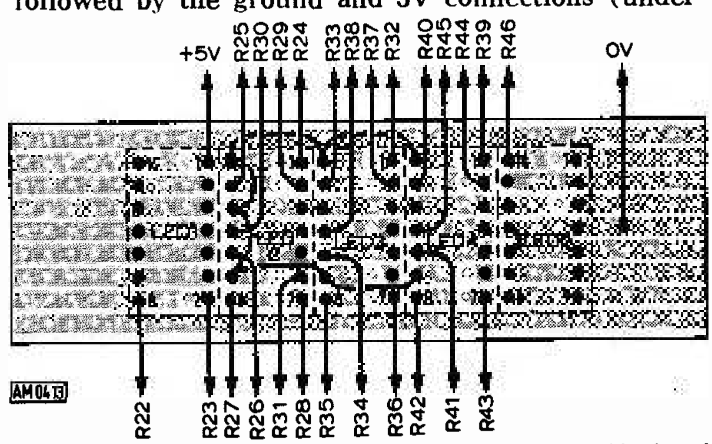


Fig. 10: Component layout on the display panel. The board is viewed from the copper strip side. Note that to achieve close packing of the LEDs some of the breaks in the strips occur between holes. In the prototype 7-way ribbon cable was used to connect the LEDs to the main logic board.

side) and finally the component interconnections. The wiring should then be rechecked as it is very easy to make an error with so many connections. It is a good idea to mark pin 1 of all the ICs on the reverse side of the board before starting the wiring. Fig. 5 shows the pin arrangements for the ICs.

At this stage the data input pins of IC8 to 11 are connected to earth in order to facilitate testing of the board. The final setting of these inputs is determined when this circuit is connected to the tuner.

This board can be tested by connecting the displays and the power supply (V1 and GND). Tr7 must be mounted on the heatsink. With no input the displays should indicate

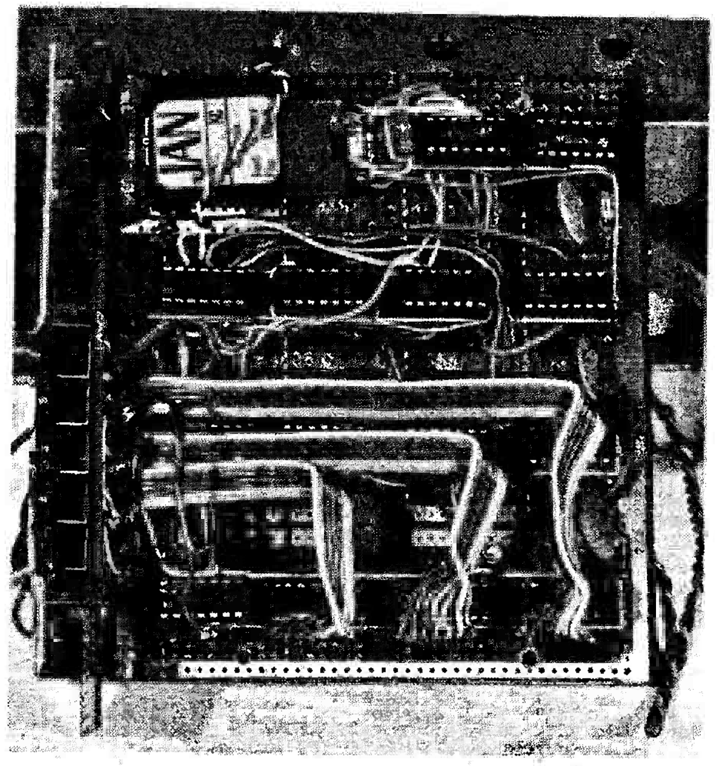
100·0–

Note: V1 must be set to 5V. If it is higher than 5·2V the logic ICs may be damaged.

PRESCALER

The prescaler circuit is also built on Veroboard, the layout is shown in Fig. 13. Because of the high frequency of operation, the components and layout are critical, in particular IC1 and Tr2-4 should be the Texas devices specified. The board can be tested by connecting to the power supply (V2 and GND) and to the logic board.

The two connections to the logic board should be insulated wires twisted together and not more than 150mm (6in) long.



A view of the internal layout of the unit showing the main logic board mounted on one side of the metal tray.

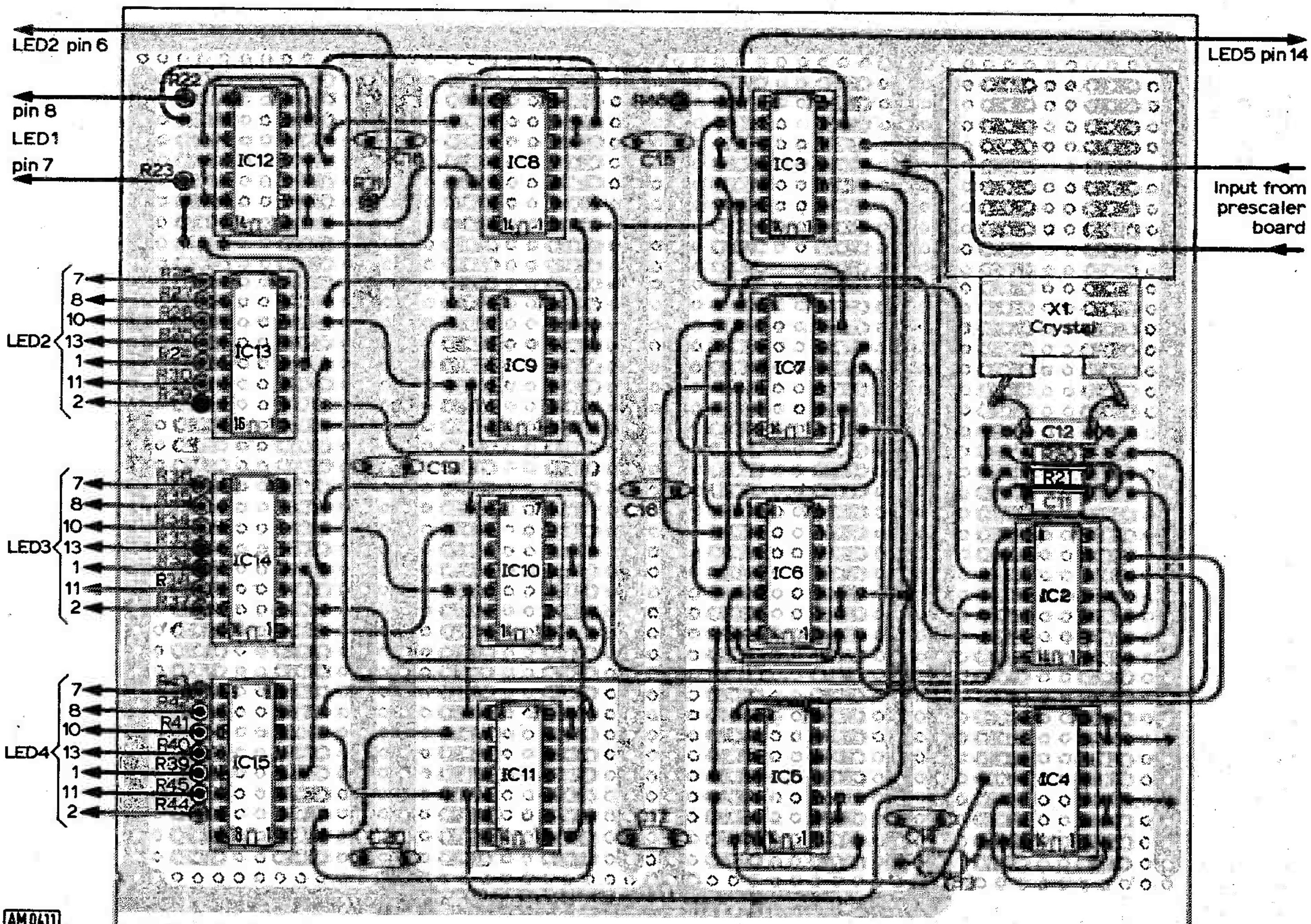
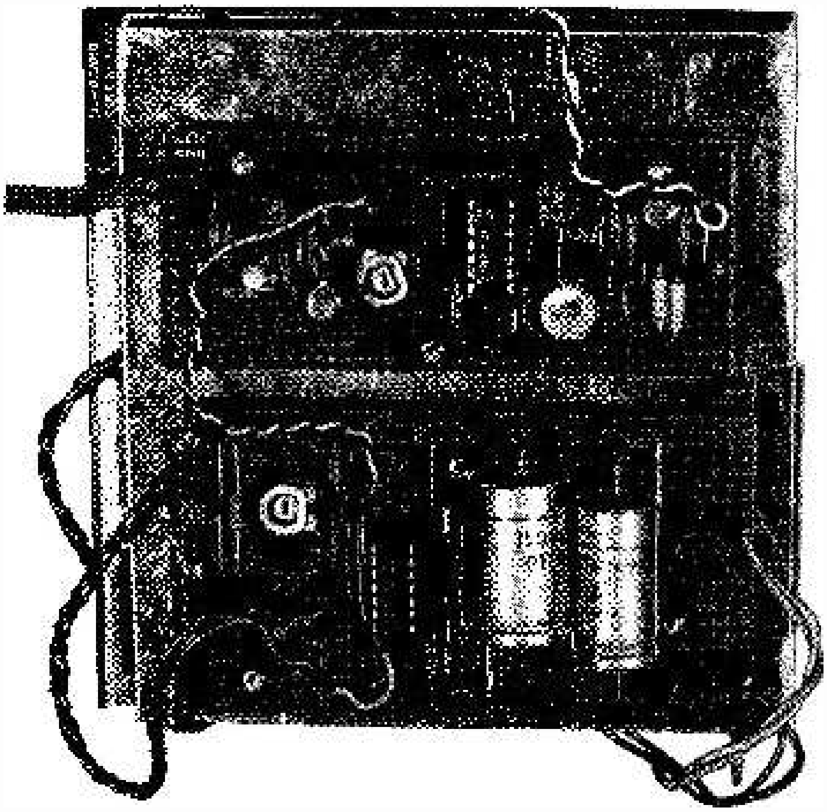


Fig. 11: Layout of the components on the upper side of the Veroboard DIP board. In order to fit into the box the DIP board has to be cut down to the size shown.



The reverse side of the metal tray showing the Veroboard panels holding the power supply and prescaler components.

The display should be set to 110MHz by adjusting C9 which should vary the frequency about this point. VR1 should be set to mid position.

If a high frequency 'scope is available then a signal of between 3 and 5V peak to peak at about 40MHz should be seen at the emitter of Tr4.

INPUT BUFFER

The construction of the input buffer will depend on the tuner. The most important consideration is to mount it as close as possible to the tuner's local oscillator circuitry. Fig. 14 shows the arrangement used with the Heathkit tuner (AJ-1214). The components are mounted on a small printed circuit board which is screwed to the top of the VHF oscillator tuning capacitor, copper side up. Components are soldered to the top of the board and the leads must be kept as short as possible.

Coupling capacitor C1 is formed by the capacitance between the copper of the PCB and the tuning capacitor. The value depends on the thickness of the PCB, the type used in the prototype giving a value of about 1pF.

An earth connection is made by soldering a short length of tinned copper wire to the tuner metalwork as shown in Fig. 14. The 12V supply is taken from the tuner itself.

The output coaxial lead is soldered to the board and passes through a hole drilled in the back of the tuner. 75Ω high frequency coax must be used, and a BNC type connector is soldered to the other end to connect to the display unit.

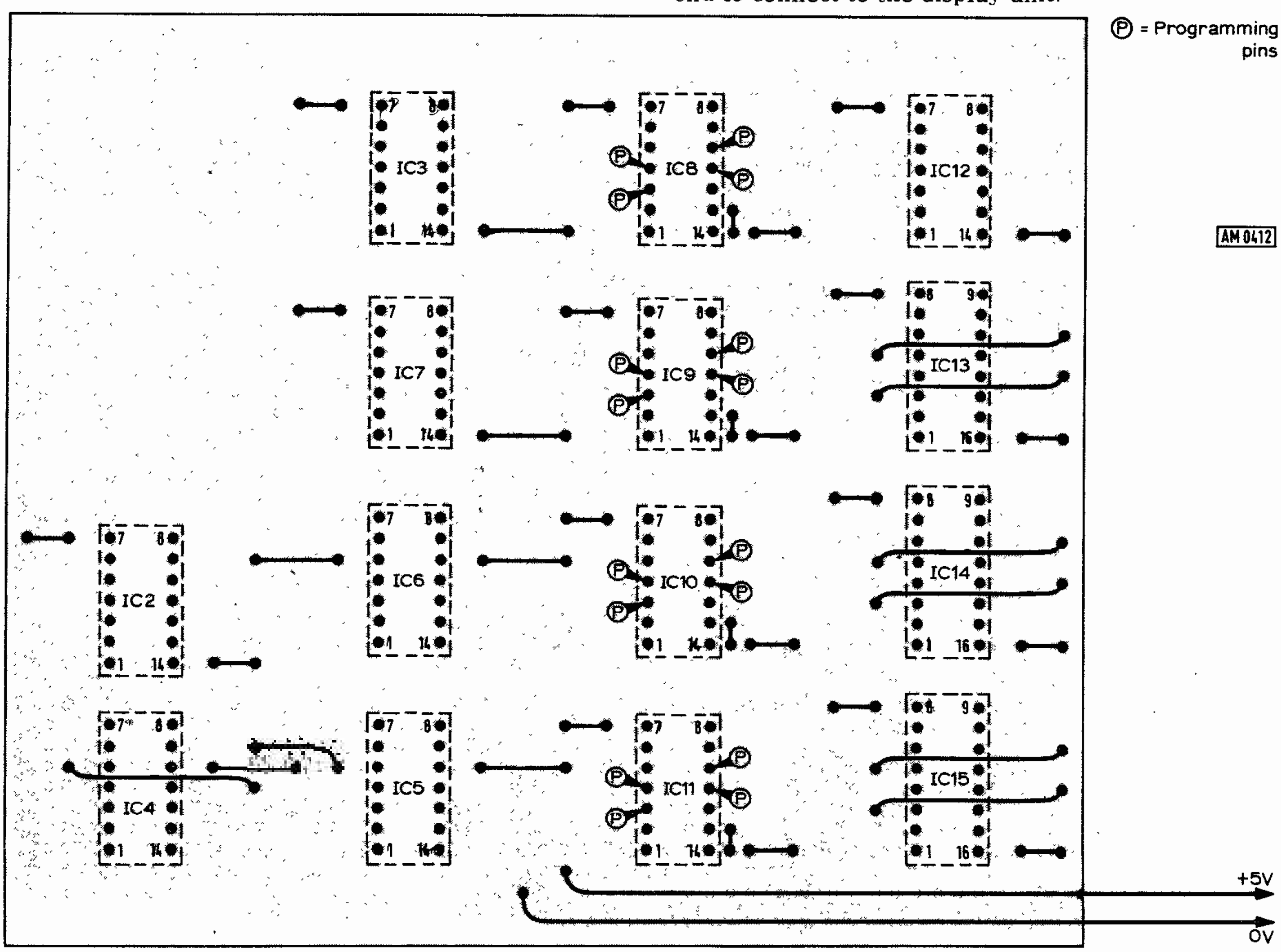


Fig. 12: Underside wiring of the logic board. The programming pins are either connected to 5V or GND lines according to the programming process described in the text.

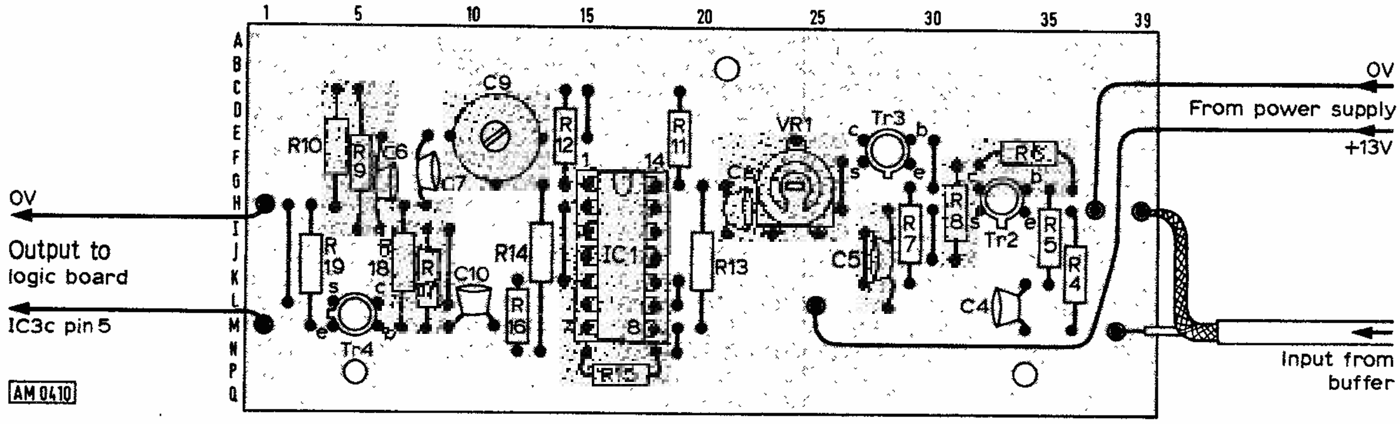


Fig. 13: Layout of the components on the prescaler board.

CHASSIS CONSTRUCTION

The display unit is housed in an RS type 3 case. The four boards are mounted on a metal tray which also shields the prescaler circuit from the logic board. The tray is then screwed to the front panel of the case.

Assembly is quite straightforward as can be seen from the diagrams and photos. The front and back panels are supplied with the case, and the mounting tray is made from 18 s.w.g. aluminium.

Transistor Tr7 is attached to the back panel as shown and the transformer is bolted to the bottom of the case. A fuse holder and coax socket are also mounted on the back panel.

Next make the interconnections between the boards. Wire lengths are not critical but the prescaler output wires should be kept as short as possible. Connections to the transformer and back panel should be long enough to let the circuitry be pulled out for adjustment while it is operating.

SETTING UP

Assuming all the boards are operating correctly and the power supply output voltage has been set, the first adjustment is to set the free running frequency of the prescaler. This is done with the input buffer connected but the tuner switched off. C9 is adjusted until the display reads 109MHz. VR1 is then set to give the correct input level to enable the 733 oscillator to lock over the whole of the range. The optimum level is about 250mV peak to peak at pin 14 of IC1. If the signal is less than this the lock-in range will be reduced, and too much signal will stop the oscillator.

The simplest procedure is to switch on the tuner and set it to about 98MHz. Starting with VR1 set fully clockwise slowly rotate the slider anticlockwise until the display locks to the tuner. When this happens the display becomes steady and will change when the tuner frequency is adjusted.

The tuner frequency is now reduced until the display indicates that lock has been lost, then VR1 is turned further anticlockwise until lock in is again achieved. This process is repeated until the display locks over the whole band. If the circuit will not lock at one end of the band, C9 can be reset so that the free running frequency is offset in that direction.

Note that although the display changes with the tuning control, the frequency displayed will not be correct as the IF offset has not been allowed for.

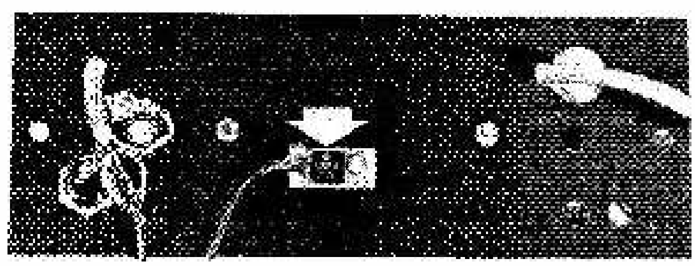
Although in most tuners the local oscillator is higher in frequency than the signal being received this is not always the case. If the display will not lock to the tuner at all in the above procedure then this is probably the reason. For a tuner with the local oscillator frequency lower than the signal, the frequency of the 733 oscillator must be reduced, and a 30pF capacitor should be connected across C9. The above procedure should then be successful if C9 is initially adjusted to give 87MHz instead of 109MHz.

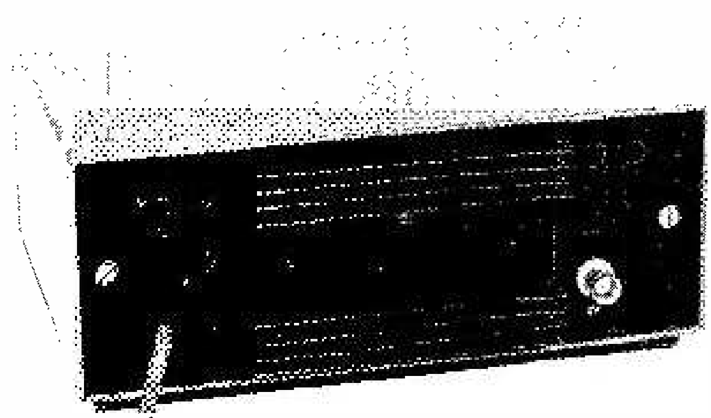
COUNTER PROGRAMMING

When the display locks satisfactorily across the band, the data inputs to the counters can be programmed.

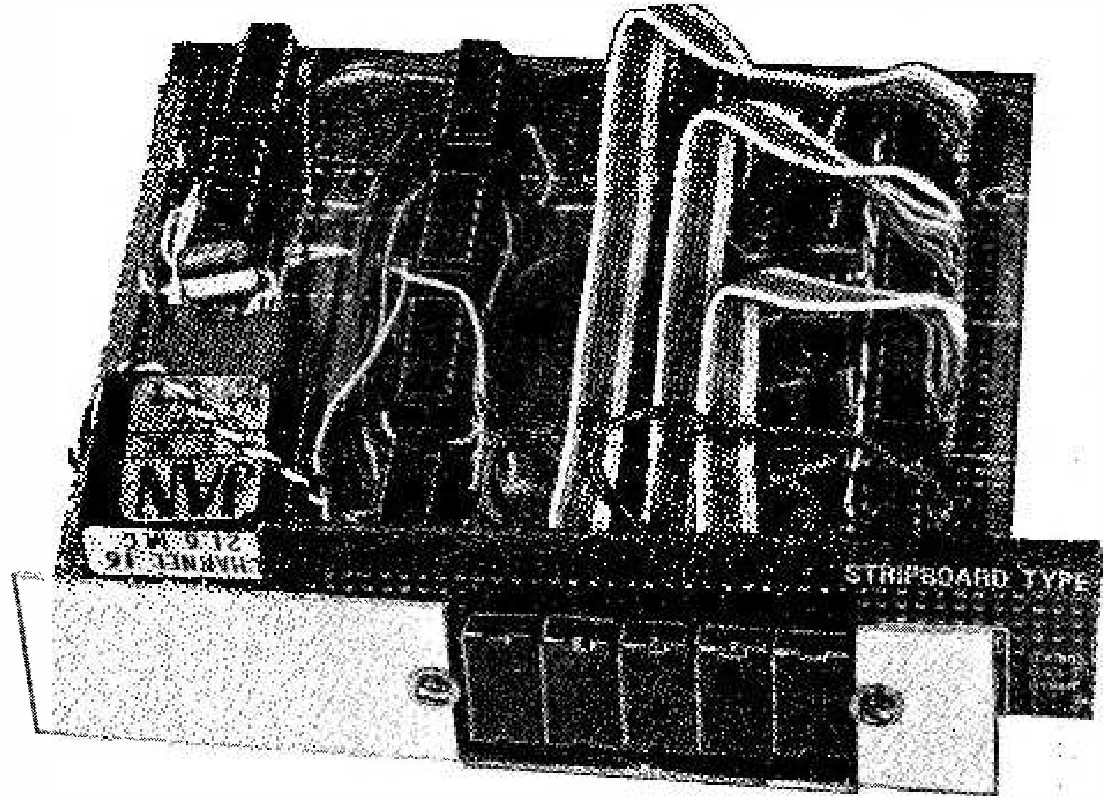
To do this a station of known frequency is accurately tuned in and the resulting displayed frequency is noted. The difference between the displayed and actual frequency is equal to the IF frequency and will be about 10·7MHz.

If the displayed frequency is below the correct value then the IF offset is equal to the IF frequency.





Transistor Tr7 is shown mounted on the inside of the rear panel (top) with the heatsink on the outside (bottom).

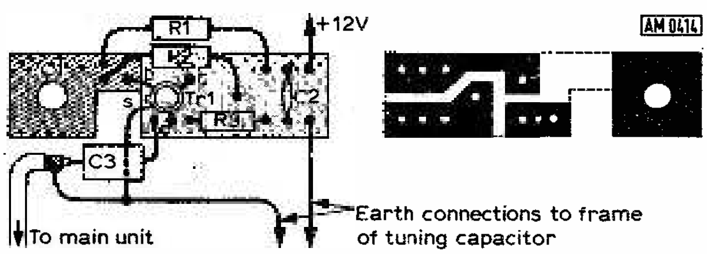


A view of the completed logic board and display board fitted to the metal tray which is simply a piece of aluminium with a single bend cut to take the display board as shown.

If it is above then the IF frequency is subtracted from 100·00MHz to give the offset. In either case the number to be programmed is the IF offset frequency plus 50kHz.

EXAMPLE

Frequency displayed	106·00	=	A
Station tuned in	95·30	=	B
IF frequency (A-B)	10·70	=	C
IF offset (100·00—C)	89·30	=	D



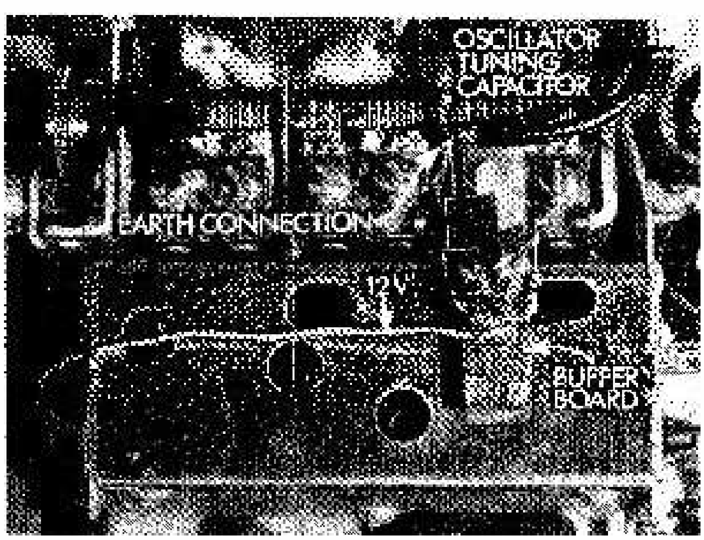


Fig. 14: The buffer board as used with the Heathkit AJ-1214 tuner. This is a small piece of printed circuit board which is screwed on top of the VHF oscillator as shown in the photograph. The shaded area indicates copper both sides of the board.

Number to be programmed (D+0·05) = 89·35MHz

Each digit is converted into binary coded decimal (BCD) according to the following table

	D	C	B	A
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1

For the example above, the inputs to the display counters are as follows

	8	9	3	5
BCD	1000	1001	0011	0101

Those inputs which are to be "0" are connected to GND and those which are to be "1" are connected to 5V.

The circuit should now display the correct frequency for all stations. If the tuning indicator LED1 (+or−) is not quite accurate, the inputs to IC7 can be changed by one or two digits until it works correctly.

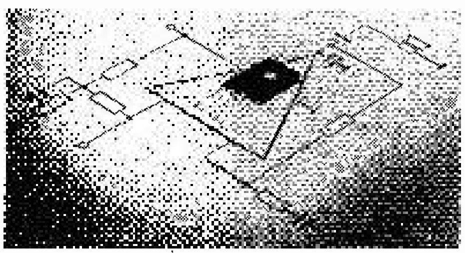
It will probably be noticed that the frequency scale on the tuner is now wrong by up to 1MHz. This is due to the effect of the input buffer changing the local oscillator tuning. This can be cured by adjusting the trimmer on the local oscillator tuned circuit (C317 in the Heathkit tuner) until the stations return to their initial positions on the dial. It is best to choose a known station and mark its position accurately before the input buffer is connected. PW

PRODUCTION LINES

colin riches

TEN-WATT PACKAGE

Texas Instruments have announced the first of a new family of high power audio integrated circuits in a 'plastic power' package similar to the SOT 32 concept used for power transistors.



The new package has a single hole for easy attachment to the currently available standard power transistor heat sink, dramatically simplifying the awkward 'plumbing' required for comparable dual-in-line high power audios. The new format introduced by TI makes it possible to attach the audio I.C. to external metalwork of the equipment to get rid of heat outside the equipment, reducing ambient temperature in the cabinet and increasing reliability. This will be especially useful in applications where space is at a premium, for example in car radios and slim-line stereo equipment. Says Clive Hoggar, TI's Consumer I.C. Marketing Manager, "We've found the dual-in-line configuration inappropriate to the high power audio integrated circuits because of the plumbing you need to get the heat away. We'll be using this all-British 5 pin package for all our new audio circuits".

Designated the SN76008, the new device is capable of delivering 10 watts into a 4Ω speaker, with distortion significantly better than 1% up to 7 watts. The circuit design incorporates on-chip frequency compensation in order to reduce stability problems, requiring only a single external capacitor for complete stability. A key feature of the design is the unique output transistors with greatly improved safe operating area for enhanced reliability under transient and overload conditions, compared with first generation audio integrated circuits.

The device was designed in the U.K. for world markets by TI's Bedford-based design team, the same team who produced the U.K.'s most successful audio integrated circuit—the SN76013 series—over 5 million of which have been shipped since its introduction in 1972. *Texas Instruments Ltd., Manton Lane, Bedford.*

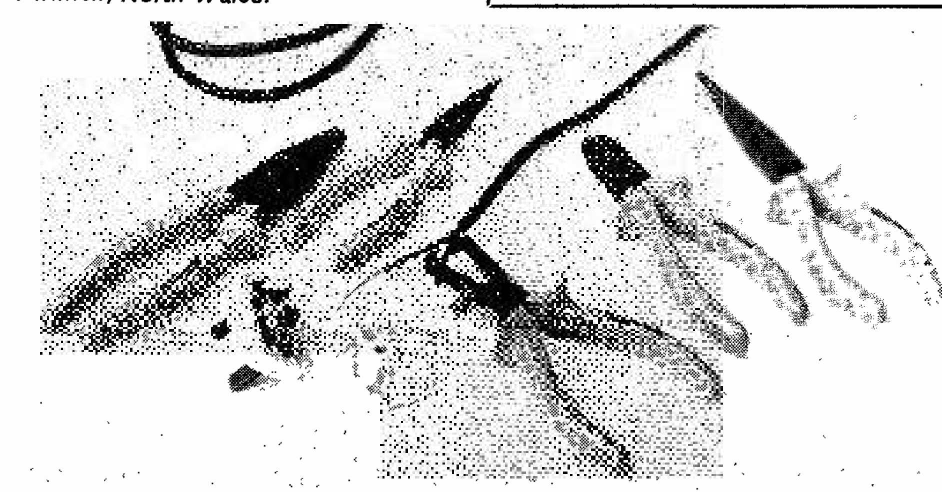
NEW C.K. PLIERS

A new range of hand pliers has been launched by CeKa Works Ltd.

Carrying the company's 'C.K.' trade mark, the new 'Master' range of pliers comprises five individual tools: 7in. Electrician's combination plier, 6in. Telephone plier, 6in. Wire Stripper, 6½in. Side cutter and an 8in. Radio plier. Highly distinctive in appearance, the pliers have all exposed metal surfaces black phosphate anti-corrosion coated, and the handles are covered by a new design of bright yellow P.V.C. insulated safety grips.

The grips, extending the total length of the plier handles, incorporate extra large anti-slip horns, and, with a 'chunky' cross-sectional profile, enable the user to take a really positive hold of the tool.

Retail prices of the C.K. 'Master' range fall between £2·60 for the combination plier and £3·30 for the side cutters.—*Ceka Works Ltd., Gwynedd, Pwllheli, North Wales.*



SFD WITH SM

In case the title mystifies you, it refers to a new cassette tape from Agfa-Gevaert.

SFD cassettes are Super Ferro Dynamic, meaning they have a highly developed ferric-oxide coating, designed to give near absolute performance from recorders.

The ultra-fine iron-oxide consistency of SFD cassette tape is free from dentride particles and is of a very high density with excellent magnetic orientation.

Prices are: SFD C60: £1·08 RRP inc VAT. SFD C90: £1·40 RRP inc. VAT. SFD C120: £1·94½ RRP inc. VAT. *Agfa-Gevaert Limited, 27 Great West Road, Brentford, Middlesex. Tel. 01-560 2131.*

RF POWER TRANSISTORS

Intended for operation at 225MHz, a new pair of transistors introduced by Motorola will produced 13W output and will provide a minimum gain of 9dB with collector efficiencies of 50%. The new transistors are the MRF225 (driver) and the MRF226 (power output) and are designed for use with a 12·5V collector supply.

A v.s.w.r. of up to 20:1 at any phase angle will not damage MRF226. *Motorola Ltd., Semiconductor Products Division, York House, Empire Way, Wembley, Middlesex.*

FREE SOLDERING IRONS

A special Heath offer is aimed at first-time kit builders. The company has long felt that the one tool the first-time kit builder does not have is a soldering iron. Heath's offer gives that constructor a free soldering iron worth £3·50 with his first kit purchase of £30 or over. The offer is being made by sending to Heath and enclosing a voucher obtained from every enquiry catalogue they or their shop send out. Whilst this offer runs, every voucher will have a life of six to eight weeks. Don't forget also that the Heathkit organ is on show at the Tottenham Court Road shop. *Heath (Gloucester) Limited, Gloucester, GL2 6EE.*

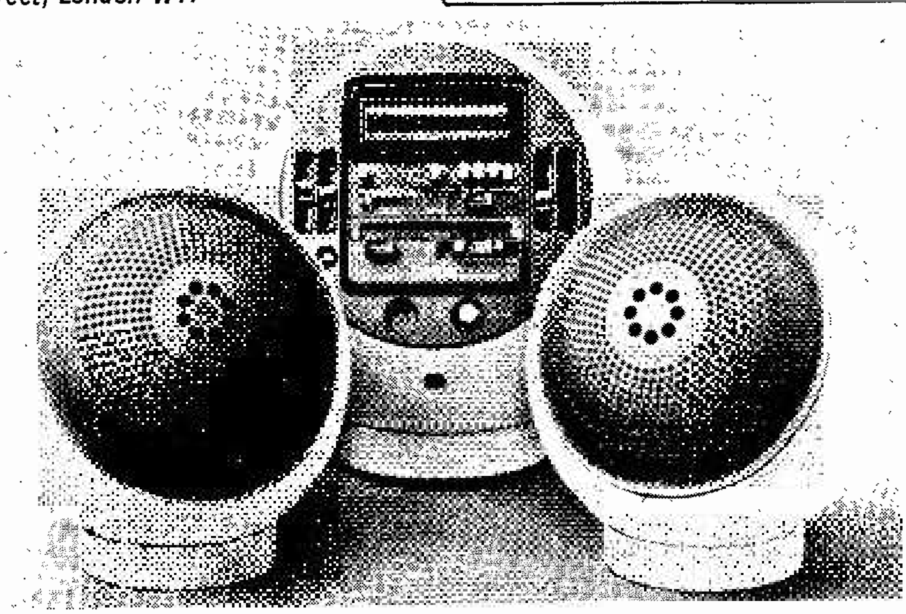
NEW FROM UNI-COM

Uni-Com Electronics Ltd., introduce the Weltron 2004 AM/FM stereo radio combined with a stereo cassette recorder.

This unit will operate on 240 mains or a 12V battery supply. There is a power input socket to accept a supply from a battery in a car with a negative earth chassis. The radio has three wavebands, MW, LW and FM with stereo radio reception. There is a built-in aerial for LW and MW and a telescopic aerial for FM.

The full range of controls include push-button wave change and on/off; finger-tip tuning facility; slider controls for each speaker for stereo balance; fast forward/rewind; cassette eject button; cassette pause and record buttons; microphone volume control and a recording level indicator.

The 2004 weighs only 15 lbs and doubles as a portable unit with a flush fitting carrying handle. Finished in white this unit is also available with 8-track cartridge in place of cassette. Price: £131·50 plus VAT. *36 Clarges Street, London W1.*

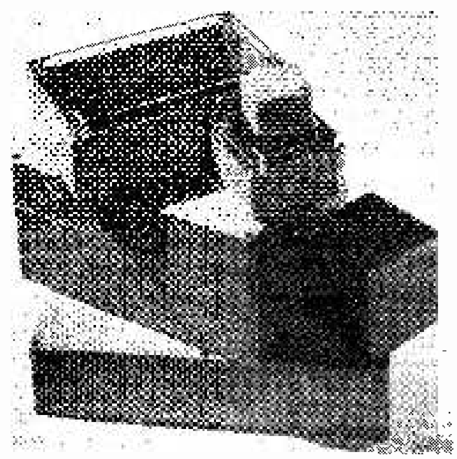


EQUIPMENT HOUSINGS

West Hyde Developments Limited are now offering a range of equipment housings in 28 different sizes.

This range is available ex-stock from Northwood. The fixing screws are inside the cabinet, but outside the enclosure, having the advantage that there are no ugly brackets for mounting.

In addition to the high impact strength of the blue/grey self-extinguishing polycarbonate, it also has a high temperature resistance up to 140°C. The cover retaining screws are captive and made of stainless steel. The insides of the case have pads for mouting chassis etc., with screws provided. The sealing gasket is recessed so giving protection whilst the lid is removed. The gaskets are oil, petrol and water resistant.



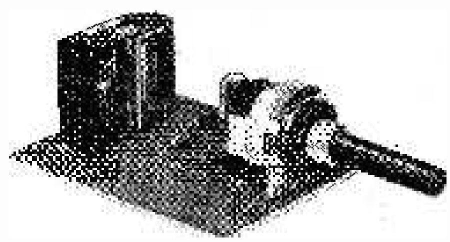
The smallest case is only 35mm x 55mm x 50mm and the largest case is 360mm x 200mm x 150mm and two of the sizes are available with clear covers. (For quantity, all sizes are available with clear covers.) Prices vary from 75p up to £9·00 according to size and quantity. *West Hyde Developments Ltd., Ryefield Crescent, NORTHWOOD, Middlesex, HA6 1NN.*

VARIWIPE

Scientronics announce their new car windscreen wiper delay timer kit—the Variwipe.

It consists of a single Printed Circuit Board, 50mm x 63mm, with a maximum of four connections. It mounts by means of a single hole behind the car's dash.

Variwipe ST version



Variwipe DT version.

Once installed the Variwipe is controlled by a single knob. Turned fully anticlockwise this switches the Variwipe off. Turned clockwise the Variwipe switches on and the wiper gives an immediate wipe. The Variwipe is now set to maximum delay—about 50 seconds. Turning the control clockwise reduces the delay so that, at their fastest, the wipers pause for only a couple of seconds between wipes.

Construction is simple: the instructions give full pictorial layout diagrams and full circuit and installation details.

There are two versions: the "ST" for the older car which uses a single throw control switch (with two wires) for the motor. Price is £4·98 including V.A.T., postage and packing; *The DT version* for those cars which use a changeover switch, which has three wires. Priced at £5·98 including V.A.T., postage and packing, this version is also suitable as a replacement for the ST version.

The Variwipe is covered by the customary one year free parts and labour guarantee, but Scientronics also offer an immediate refund on any kit should the user decide he does not wish to keep it. Scientronics also give a fixed, small charge service on units outside guarantee. *Scientronics, 40 High Street, Somersham, Huntingdon, Cambridgeshire PE17 3JA. Telephone Somersham (048 74) 321*

Elderly digit

To celebrate my 72nd birthday I made a crystal-digital watch with press-button readout which I fitted into a silver pocket-watch case older than myself! It works perfectly, showing hours and minutes on one button and date and seconds on another. It keeps time to a second a day without final adjustment.

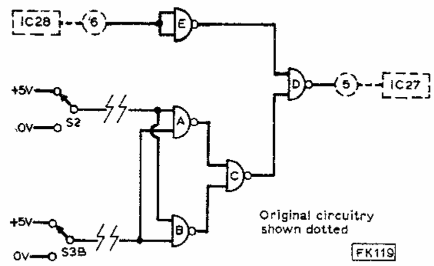
I wonder if I am the first amateur to make one of these watches as well as his own coherer and coils to receive ship's Morse signals in the earliest days of wireless?

The magic of making calculators has now faded with the construction of a CT7001 clock calendar and now this MK5031 watch, which incidentally, had to be fitted into a pocket-watch case because I had to use discrete transistors and a $\frac{1}{8}$in display which can be read easily without a magnifier.—**E. W. Baigent** (High Wycombe)

Armchair Tele-Tennis

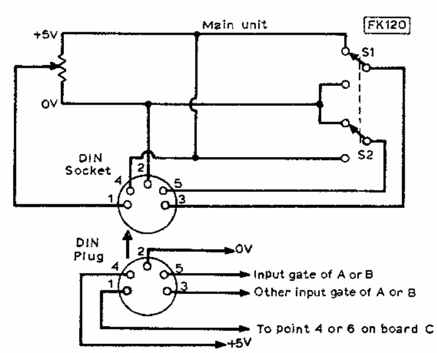
Last year I built a PW Tele-Tennis unit which has proved very popular with the family. However everyone agreed that it would be far better if the unit had remote bat and serve controls. In the original circuit each remote-control box would need a 6-way connecting cable (5V, OV, S2a or S3a, 2 for S2b or S3b and one for bat-control slider). I realised that greater neatness and economy would be achieved if 4-core screened cable could be used connected to 5-pin DIN plugs. I therefore used the following circuitry which I thought might interest you. No extra IC's were needed as sufficient gates were left unused in the original circuit. This circuit allows only one lead to be used in an extension unit for S2 or S3b in addition to the four for 5V, OV, S2a or S3a, and bat-control.

When neither serve button is pressed 1's appear at all inputs of gates A and B. Hence 0's appear



at both C's inputs and a 1 must appear at input 2 of gate D. Therefore pulses from IC28, point 6 on board D, having been inverted by gate E are again inverted by gate D. These reach point 5 just as they would have done in the original circuit.

When a serve button is pressed, a 0 is forced to appear at input 2 of gate D thus preventing a 0 at point 5 (the whole point of the exercise). Gates A and B act as mixers to prevent shorting of the supply rails when one serve button is pressed and the other is not. In this way, common 4-way screened cable may now be used from the main unit to each of, say, two AB7 boxes each housing a bat-control slider and a DPDT push-button switch connected thus:—



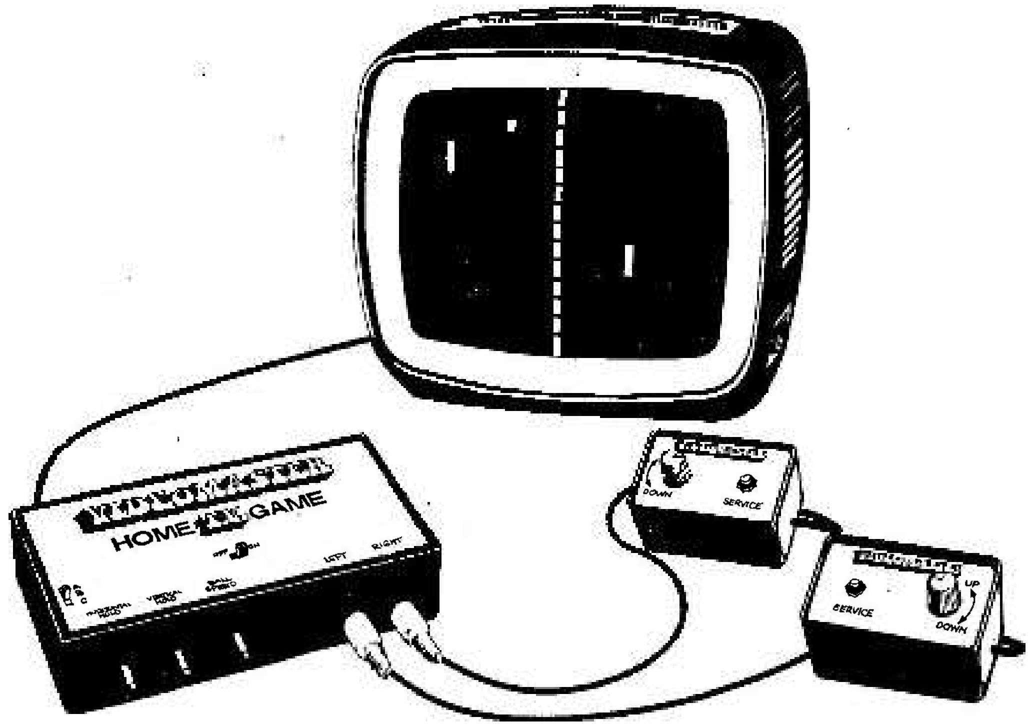
If the original controls on the main unit are to be kept, they must be switched with those on the extension unit through a 6-pole 2-way push-button switch (3 poles for each extension unit, the power rails being permanently connected to the DIN sockets).

This addition has proved very successful and means that we can now play Tele-Tennis from the comfort of our arm-chairs at a reasonable distance from the screen (3m.) while the UHF lead to the TV remains short. Thank you for the excellent Tele-Tennis project.—**Jeremy Lovell** (Winchester).

Take your choice

It's interesting to hear from fellow enthusiasts continued partisanship regarding valves and transistors. It reminds me of the 35mm versus roll film camera controversy which raged some years ago in the correspondence columns of photographic magazines. Surely the simple answer must be to use whatever is most appropriate to the job in hand!

Unquestionably, transistors must be first choice when space is limited and available power restricted. Car radios and portable sets are two obvious examples. Turning to domestic equipment such as table radios and televisions, ample power is available from the mains, and the overall size is likely to be governed by the dimensions of the loudspeakers, record changers, picture tubes, etc., rather than the chassis. In this case the use of easily replaceable valves is surely better from the owner's point of view. There is, for instance, a well known make of unit audio languishing in my workshops for lack of an amplifier module. It has been there for a month already; had it been valved I could have had it repaired long ago. It's significant to note that the same manufacturer has reverted from transistors to the good old PCL82 in the sound output stage of his colour televisions! Speaking of which, my own fully transistorised set blew its line output transistor last week. Not only was the replacement dearer than the equivalent valve, it took a lot longer to fit! Nevertheless, I would hate to have valves in the umpteen portable radios used in my household. You pays your money and you takes your choice! —**Charles Miller** (Uttoxeter).



Videomaster urge all good electronics enthusiasts to play the game

The best thing about the Videomaster Home T.V. Game Mk. III is that the sheer pleasure of building it is immediately followed by the excitement of playing three fascinating games.

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Tele-Tennis—more mods!

I have just read the letters page and am prompted by a letter from A. O'Brien (Sunderland) describing how he has altered his PW Tele-Tennis.

I have altered mine in a similar manner, except, that I now have two extra games, one I call 'Hole-in the wall' and the other 'Squash'.

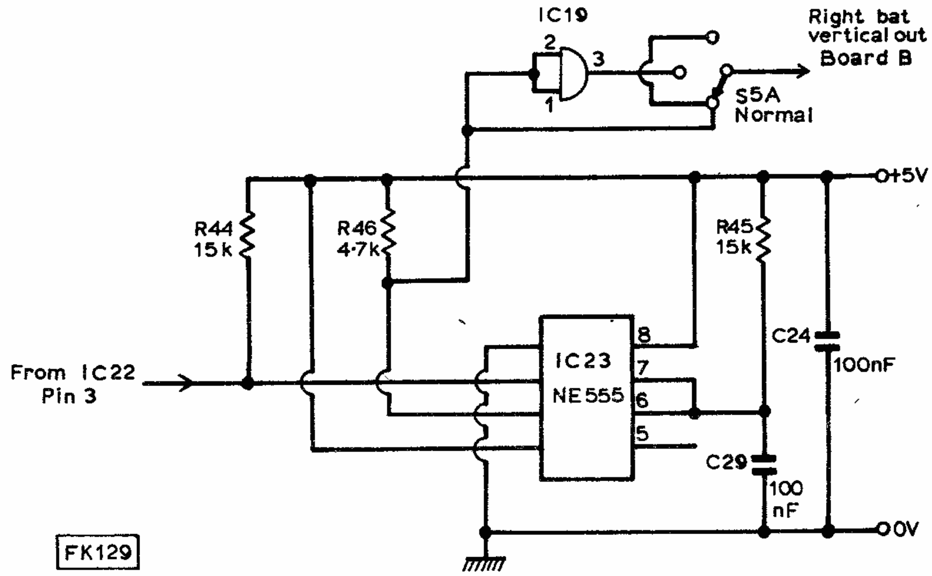
To play 'Hole-in-the-wall' I connected 'Right Bat Vertical Out' from Board C to pins 1 and 2 on ICI9 (SN7400) and to a new switch on the front panel as shown in Fig. 1. The output from pin 3 of ICI9 is also taken to the switch. The output from the switch is connected to pin 9 on board B (Right Bat Vertical In).

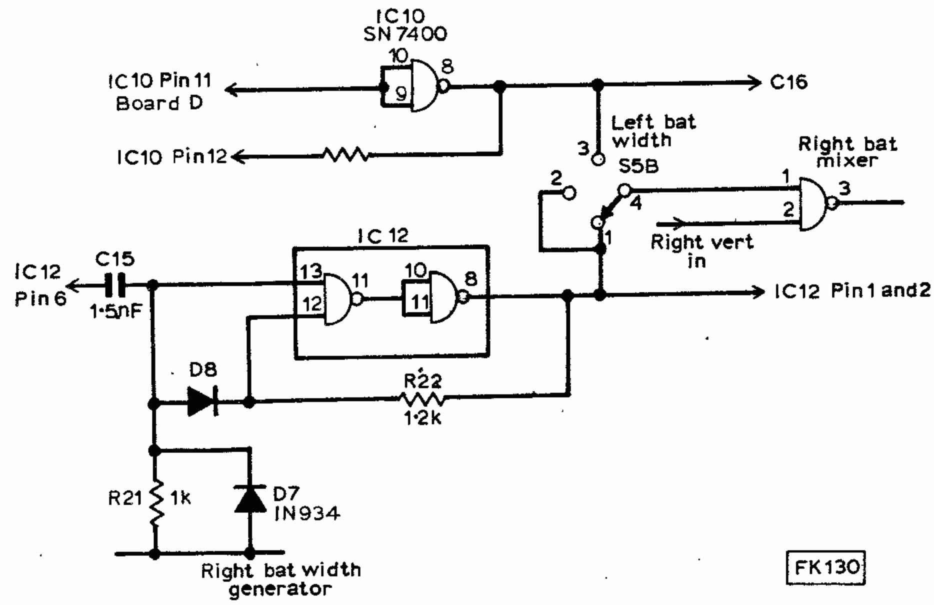
To play Squash though, required a further three sets of contacts. This is because we need to move the right bat from the right base to the left base, to prevent contact between ball and right base from blanking the ball out, and finally to make the ball change direction when it hits the right bat in its new position, Fig. 2.

To make the right bat appear on the left hand side I connected a wire from the link between ICI0 pin 8 to ICI5 pin 4, ie the o/p from the left bat width generator, to the third position of the switch. The o/p from the right bat width generator is connected to the first two connections, this is done by removing the link between ICI2 pins 1 and 2, and ICI5 pin 1, and replacing it with two pins. ICI2 pins 1 and 2 are connected to the first two connections of the switch, the o/p of the switch is connected to the other pin, ie ICI5 pin 1. So in fact what we have done is to use the left bat width generator as our right bat width generator when we are playing 'Squash'. This effectively moves the right bat over to the left hand side without affecting its vertical position.

To prevent the ball from being blanked when it hits the right base, the connection between IC26 pin 12, board D and IC28 pin 1 must have a switch in it. I did this by removing the link between these two points and replacing it with two pins. The pin connected to IC28 pin 1 is connected to the o/p of S5C on the front panel. The other pin is then connected to the first two connections of S5C and the other is left

continued on page 662





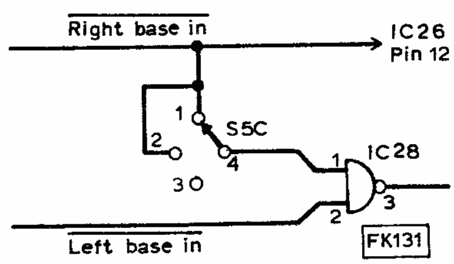
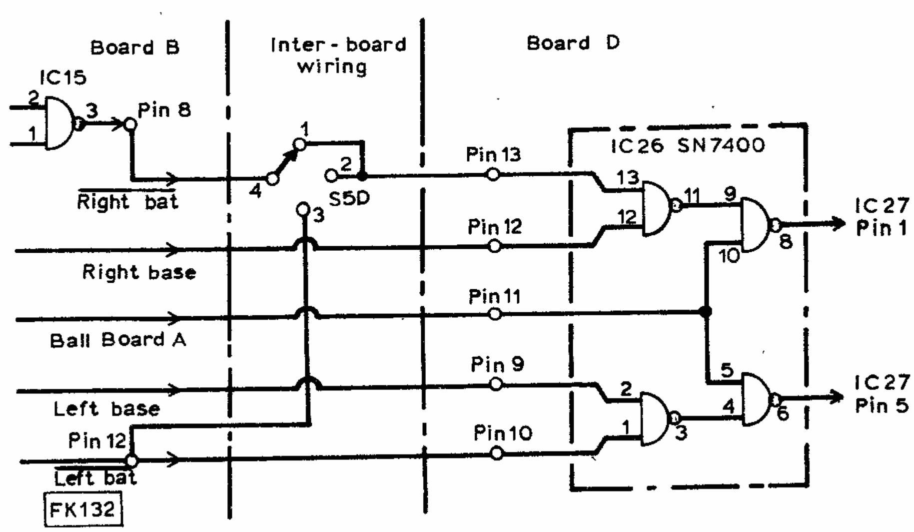
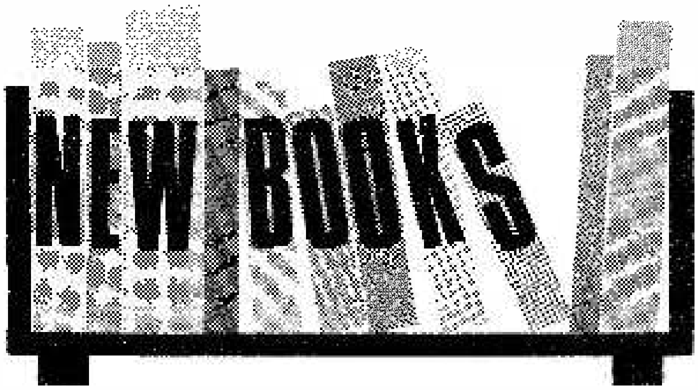


Fig. 1: top, modifications for playing 'Hole-in-the-Wall' while Fig. 2: above, indicates alterations required for 'Squash'. Fig. 3: left, circuit to prevent ball blanking at right base. Fig. 4: below, circuit to get the ball 'bounce' correct with 'Squash'.





ELECTRONICS—AN ELEMENTARY INTRODUCTION FOR BEGINNERS (SI Units)
By L. W. Owers, C.Eng., MIERE
Published by Publication Mailing Services, P.O. Box 6, Crawley, Sussex, RH10 6LH.
119 pages 20·50cms x 15cms.
Price £1·45 (includes post & packing)

A BASIC guide to electronics for those meeting the subject for the first time. It has an essentially non-mathematical approach and where possible, the information is given in diagrammatic form. Where simple formulae and units are mentioned SI units are used.

An easy-to-understand explanation is given of static electricity, the fundamental particles, atoms, energy, waves, the elementary physics of conductors, insulators and semi-conductors, and the laws of current electricity. Types of conductors, resistors, capacitors and inductors and their applications are also dealt with. The concluding chapters are devoted to valves and semiconductor devices and their applications including radio, television, colour TV, etc.

TOWERS' INTERNATIONAL TRANSISTOR SELECTOR
By T. D. Towers
Published by W. Foulsham & Co. Ltd., Yeovil Road, Slough, Bucks., SL1 4JH.
142 pages 29·5cms x 21·5cms.
Price £2·95

THE preface states, quite accurately that, if you deal with transistors—whether as a student, a hobbyist, circuit engineer, buyer, teacher or serviceman—you will often want data on a specific transistor of which you only know the type number. Specifications apart, you may want guidance on a readily available possible substitute. This transistor compendium, a comprehensive tabulation of basic specs. for over 10,000 transistors, offers gen on ratings, characteristics, case details, terminal identifications, applications use, manufacturers and substitution equivalents (both U.S. and European).

More than ten thousand transistors are covered in this compendium which comprises a selection of the more common current and widely used obsolete types.

110 OPERATIONAL AMPLIFIER PROJECTS FOR THE HOME CONSTRUCTOR
By R. M. Marston
Published by Newnes-Butterworths, The Butterworth Group, 88 Kingsway, London, WC2B 6AB.
123 pages 21·75cms x 14cms.
Price £2·80. Limp edition £1·80

IF you have 110 8-pin D.I.L. 741s then this is the book for you! Chapter 1 discusses the basic principles and applications of the 741 Op Amp. Chapter 2 contains 25 AC and DC amplifier projects, Chapter 3, 25 instrumentation projects, Chapter 4, 20 oscillator and multivib. projects and Chapter 5, gives 20 sound generator and alarm projects. The final chapter contains 20 relay-driving switching projects.

INTRODUCING ELECTRONIC SYSTEMS
By Ian R. Sinclair, B.Sc., MIEE, A. Inst. P
Published by Fountain Press, Argus Books Limited, Station Road, Kings Langley, Herts.
103 pages 21·50cms x 14cms.
Price £1·50

AS Mr. Sinclair says in his preface, this is a book for the beginner, and it deals, not with the theory of electronics nor with the nuts and bolts of circuits, but with 'systems'. It describes *how* electronic circuits are used to bring about the results which we see, and not with the details of the circuits which are used. It is as if the author were describing the action of a car—but not showing the construction of each component.

If you have ever wondered how radar works, what was involved in colour television, how electronic calculators can carry out their tasks; this book is meant for you. No previous knowledge of electronics or electricity is assumed but Chapter 7 on analogue computing does need some appreciation of algebraic equations. This is most certainly a book for those with an inquiring mind.

ELECTRONIC MUSICAL INSTRUMENTS
By Norman Crowhurst
Published by Foulsham-Tab Limited, Yeovil Road, Slough, Berks.
118 pages 21·5cms x 14cms.
Price £1·80

THE first chapter of this book discusses the characteristics of orchestral and band instruments—strings, woodwind, brass etc., the types of sound produced and the part played by electronics in the musical world. The amplification of traditional instruments is discussed in Chapter 2 and other chapters are devoted to such items as electronic modifyers, fully electronic instruments, amplifiers and speaker systems, synthesisers, and troubleshooting.

If you contemplate purchasing this book, bear in mind that it was originally written for the U.S. market and some things may seem a bit strange to the English reader.

LETTERS

—continued from page 661

open. See Fig. 3. Now when S5 is switched to its third position the right base signal is removed from IC28 pin 1, so preventing the ball being ball blanked on contact with the right base.

The only thing left to do now is to ensure that the ball will bounce off the right bat when the right bat is on the left hand side of the screen. To do this we have to connect the 'right bat in' to IC26 pin 1 when we are playing squash. Otherwise the signal from IC26 pin 8 will try to change the state of the flip-flop, IC27 A and B to that which causes the ball to travel from right to left across the screen. As the ball will already be travelling in this direction it will pass straight through the bat, and will be blanked out due to its contact with the left base. But by connecting it to IC26 pin 1 and removing it from IC26 pin 13 it will appear as a second left bat signal to IC26 and so the flip-flop will change its state causing the ball to go from left to right.

This is achieved by removing the link wire between pin 8 on board B and pin 13 on board D. A lead is then taken from pin 8 board B to the o/p of S5D and another lead is used to connect pin 13 on board D to the first two connections on S5D. Finally a lead is taken from pin 12 on board B to the third connection of S5D so that in the third switch position right bat is connected to IC26 pin 1. (See Fig. 4).

I hope you will be able to print this letter as I am sure someone else would be interested in modifying an already absorbing project.—**P. J. Morris** (Enfield).

Sorry you can't hear our latest achievements.

Set our sleek new belt drive turntables, the BSR McDonald BDS 80 and BDS 90, in motion and you'll find they are perfectly silent.

So you'll never hear anything but your records.

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A closer look reveals the low-resonance tubular aluminium tonearm floating in a concentric gimbal style mount, carrying the calibrated stylus pressure control.

Another refinement is the counterbalance moving along a rod to give primary weight adjustment while an ultra-fine rotary control gives the final micro-balance.

We could go on, but frankly we feel that all those perfectionists we're out to appeal to will demand to hear just what all this silence can do for their records.

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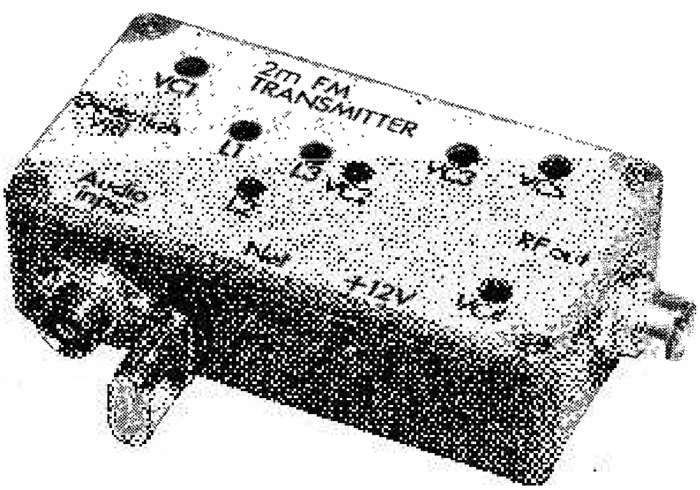
Miniature 2m EQUIPMENT

part 3 : FM transmitter

W. H. Bond F.R.C.S. G3XGP



IN the past the most popular band for local contacts and the means whereby one began to learn about amateur radio, was Top Band. With the increasing proportion of G8+3 callsigns 'two metres' has largely replaced the lower frequency. Readily available and easily modified commercial equipment has resulted in a new group of "black box" operators sufficiently knowledgeable to modify their equipment, erect an aerial and operate a microphone. They don't experience however, the pleasure of making something from scratch, or getting the bugs out of their equipment with the help or other local amateurs. This transmitter is recommeded for bringing back some of the adventure of Top Band, and to give the beginner the same delight that the writer had when he made his first contact.

The transmitter to be described takes advantage of two facts. Firstly, two metrès are remarkably penetrating, bearing in mind that on Top Band 10W was essential to get across town in comfort, while on 2m ½W will do the same job with greater efficiency. The second fact is that AM is expensive, consumes unnecessary power and goes through the front end of the average TV like a hot iron through solder. This transmitter employs FM to which TV sets and high-fi equipment is relatively insensitive, and has the additional advantage that VHF aerials can be physically small, or simple construction and can even be used inside the shack. Furthermore they give considerable gain, for the six-over-six slot used by the writer multiplies the 1W produced by this transmitter by over ten times.

A single watt on VHF gives all the contacts one made on Top Band, and the DX is there, for when tropospheric openings appear the Continent is wide open to the skilled operator. From the constructors point of view, VHF has many advantages. At low powers, transistors and small components can be used as no large power is involved and coils are equally small and easily made. Experience shows that for local working, up to 30 miles, this transmitter is fully the equal of a much more powerful 160m one using ten watts.

This transmitter puts between a half and one watt into the aerial, runs off a 12V battery, is FM, and can be operated with a crystal or VFO. Particular attention has been paid to the spectral purity of the signal and, correctly adjusted, harmonics should be better than 45dB down. The input accepts both crystal and dynamic microphones and the output can be fed into a 50 to 75Ω aerial with a very close match. Furthermore it can be operated into an infinite SWR load, that is short or open circuit, for a brief period without destroying the output transistor, also, being phase modulated converted to frequency modulation, over-deviation is unlikely.

FM can be achieved by two methods, the simplest being the use of a varicap diode across the crystal or VFO. This method calls for little additional circuitry but has the disadvantage of the possibility of overdeviation, that is more than the ±2·5kHz used in this country. Because the capacity variation with voltage is not linear the deviation can be asymmetrical resulting in more power in one set of sidebands. The second method is by the generation of a stable carrier frequency which is then phase modulated and converted into FM by trimming of the AF reponse. Phase modulation causes an increase in deviation not only with amplitude but also with rising AF so that audio amplifier has to have a falling characteristic. The advantages are that overdeviation is almost impossible, deviation is symmetrical and resolution on simple slope detection is a little easier than with pure FM. For these reasons phase modulation was adopted for this transmitter.

Phase modulation calls for a low fundamental frequency if adequate deviation is to be obtained at 144 to 146MHz so 8·0 to 8·1MHz was chosen requiring a ×18 multiplier chain to reach the operating frequency. Conventional transmitters employ bi-polar transistors operating in class C in the multiplier chains, but they have considerable disadvantages. The input impedance is very low, and they are driven by current rather than voltage. This absorbs power from the preceding circuit, so that careful matching into the preceding stage is required if the Q of the stage is to be maintained and the amplification of unwanted harmonics avoided. Though not as efficient, FET's overcome these difficulties, as they operate well in class C for harmonic generation at very low currents and because of the high input impedance, are voltage driven. Therefore the Q is maintained, unwanted harmonics suppressed, but giving selective amplification to the desired frequency.

The output from the multiplier is another FET and runs at 10 to 20mA feeding a conventional driver and power amplifier.

MODULATOR CIRCUIT

A high impedance input is provided by Tr1 and C1 Fig. 1 though not essential, isolates the microphone while R1 and C2 constitute an RF filter, and the gate of Tr1 is earthed by R2. This resistor is not critical and any value over 50kΩ suffices. Tr1 is an impedance changer giving current amplification only,

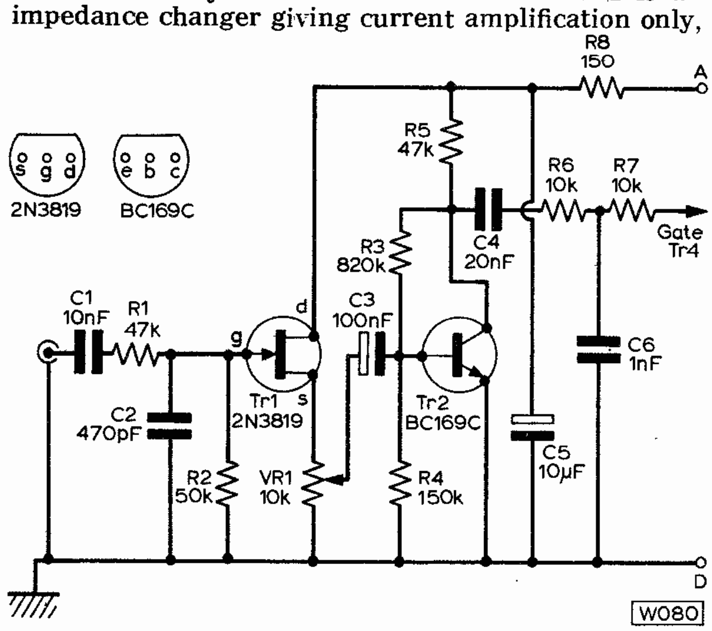


Fig. 1: Circuit of the Modulator section. C5 trims the audio output while R6 and R7 decouples the audio amplifier from the phase modulator.

with a voltage loss of 30% or more. VR1 in the source lead of Tr1 varies the audio output and thus the deviation, source following into the base of Tr2 via C3. Tr2 supplies voltage gain, and by connecting the top of the bias chain to the collector, a measure of feedback is provided, limiting the gain to about 100 times. R8 and C5 decouple the modulator on the power supply side and R7 and C6 keep RF from the output of the modulator. R6 and C4 add the final tailoring to the circuit to provide the required falling characteristic to the audio response. The current consumption of the modulator is about 500µA.

CRYSTAL OSC, VFO AMP AND PHASE MODULATOR

These stages are voltage stabilized by D1 and R13 Fig. 2. The crystal oscillator is the Pierce configuration, the crystal being connected between gate and

★ components list

Resistors

R1	47kΩ	R14	100kΩ
R2	50kΩ	R15	2·7kΩ
R3	820kΩ	R16	100Ω
R4	150kΩ	R17	100kΩ
R5	47kΩ	R18	3·3kΩ
R6	10kΩ	R19	100Ω
R7	10kΩ	R20	2·7kΩ
R8	150Ω	R21	2·2kΩ
R9	47kΩ	R22	100Ω
R10	100kΩ	R23	100kΩ
R11	2·7kΩ	R24	47Ω
R12	2·2kΩ	R25	100Ω
R13	330Ω	VR1	10kΩ vert. preset

All resistors ¼W 5%

Capacitors

C1	10nF	C17	4·7nF
C2	470pF	C18	4·7nF
C3	100nF	C19	10pF
C4	20nF	C20	15pF
C5	10µF (16v)	C21	4·7nF
C6	1nF	C22	4·7nF
C7	100pF	C23	6·8pF
C8	5·6pF	C24	1·8pF
C9	4·7nF	C25	4·7nF
C10	47pF	C26	22pF
C11	4·7nF	C27	4·7nF
C12	4·7nF	C28	33pF
C13	4·7nF	C29	4·7nF
C14	82pF	C30	10pF
C15	4·7nF	C31	33pF
C16	100pF		

Apart from C5, all capacitors are high-K ceramics, Erie ceramicons, or Mullard.
VC1, 3, 4 and 5 5-60pF, plastic insulated Mullard
VC2 2-10pF, plastic insulated Mullard

Semiconductors

Tr1	2N3819	Tr10	2N4427
Tr2	BC169C		
Tr 3, 4, 5, 6, 7, 8	2N3819	D1	9·1 Volt Zener
Tr9	BSX20	D2	1N4000

Inductors

L1 9½ turns stretched to 10mm
L2 6½ turns stretched to 6mm
L3 4½ turns stretched to 5mm
These coils wound on a No. 15 drill, mounted on 4mm formers, using 24SWG enamelled copper wire.
L4 and L5, 5 turns stretched to 8mm, wound on a No. 13 drill using 22SWG enamelled copper wire.
L6 and L7, 5 turns stretched to 10mm, wound on a 6mm drill, using 20SWG tinned copper wire.
RFC1 33µH or higher
RFC2, 3, 5 and 6 2½ turns 22SWG enamelled wire on FX1115 ferrite bead
RFC4 5 turns closewound on a No. 13 drill using 22SWG enamelled wire (if a 2N4427 is used for Tr10, fewer turns may be required).

Miscellaneous

Tr9 heat sink, 10 x 22mm, one end rolled on a 5mm drill. Tr10 heat sink, 12·7 x 14·3mm star shaped type. Screens made from tin-plate 38 x 13mm bent into three sides of a square, and 45 x 13mm bent approximately at the centre. Die-cast box 114 x 64 x 30mm Eddystone or Doram. 1·5mm double sided copper clad fibre-glass board 104 x 49mm. Two coaxial sockets. Three 4mm stand-off bushes. HC6U crystal socket. Two small 1nF feedthrough capacitors. 8·0 to 8·11 MHz crystal.

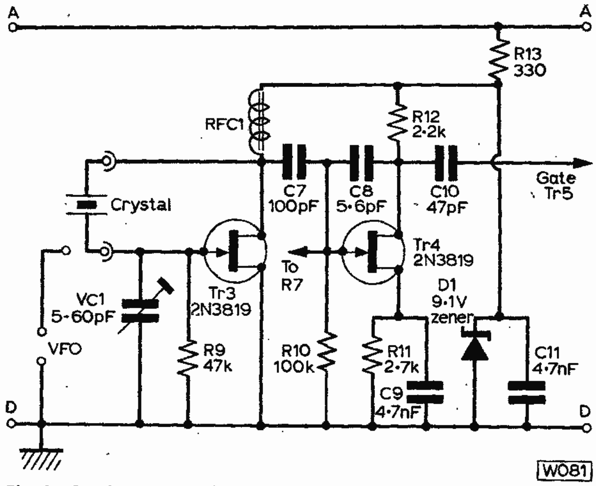


Fig. 2: Crystal oscillator/VFO amplifier, and phase modulator circuit. D1 and C11 are for voltage stabilization.

drain so that removal leaves the gate free for VFO input when Tr3 acts as an amplifier. VC1 is used to pull a crystal to a specific frequency and makes little difference to the VFO. RFC1 blocks the signal from Tr3, passing it via C7 to the gate of Tr4, the phase modulator, whose load is R12. The output goes through C10 to the multiplier chain, and feedback through C8 induces phase modulation, the audio signal being applied to the gate of Tr3, 1V p/p being required by the phase modulator.

MULTIPLIER CHAIN

Transistors Tr5, Tr6 and Tr7, Fig. 3, are tripler, tripler and doubler respectively, with identical circuitry save for the necessary changes in coil and capacitor values required to resonate on the harmonic frequencies. All run quiescent currents of about 500μA, increasing to 1·5mA when RF is applied, thus running in Class AB. Because of the high input impedance of the FETs, the output may be taken from the drain, avoiding the need for taps on the coils, the loading being minimal. This keeps the circuit Q high so that tuning of the coils is fairly critical. The output tuning to the power amplifier is particularly sharp and VC2 requires very careful adjustment for the best results. A small screen is necessary around L4, to avoid feedback to L3 which causes spurious oscillation and reduces the efficiency of the stage. R24 provides a current limiter and voltage feedback to Tr8.

DRIVER AND POWER AMPLIFIER

These stages operate in class C, the input to Tr9, Fig. 4, being tuned by L4, VC2 and C26, the two capacitors providing an impedance match into the base of Tr9, RFC2 being the DC return. The total dissipation of Tr9 with a good multiplier chain and active crystal can rise to 300mW so that a small heat sink is required. Tr10 is of overlay construction, the input impedance is very low and capacitative, while C28 and VC3, tune L5 and provide an impedance match into the base. RFC4 compensates for the input capacity and RFC5 is the DC return. As Tr10 dissipates up to 2½W, an efficient heat sink is required. RFC6 blocks RF so that the collector load becomes the output circuit consisting of VC4, C30, L6, C31, L7 and VC5. The screen around L7 and VC5 considerably reduces the harmonic content of the output and should not be omitted.

CONSTRUCTION

The circuit is constructed on double-sided copper-clad board, Fig. 5. and it is recommended that the components and the instructions be followed precisely. Every earth point is taken to the top side of the board, all leads are made as short as possible, and the longer lead of coils and resistors being made earthy. The coils should be wound on the appropriate drill and then forced on the former after being correctly spaced, finally being held in place with a very light coat of epoxy resin adhesive.

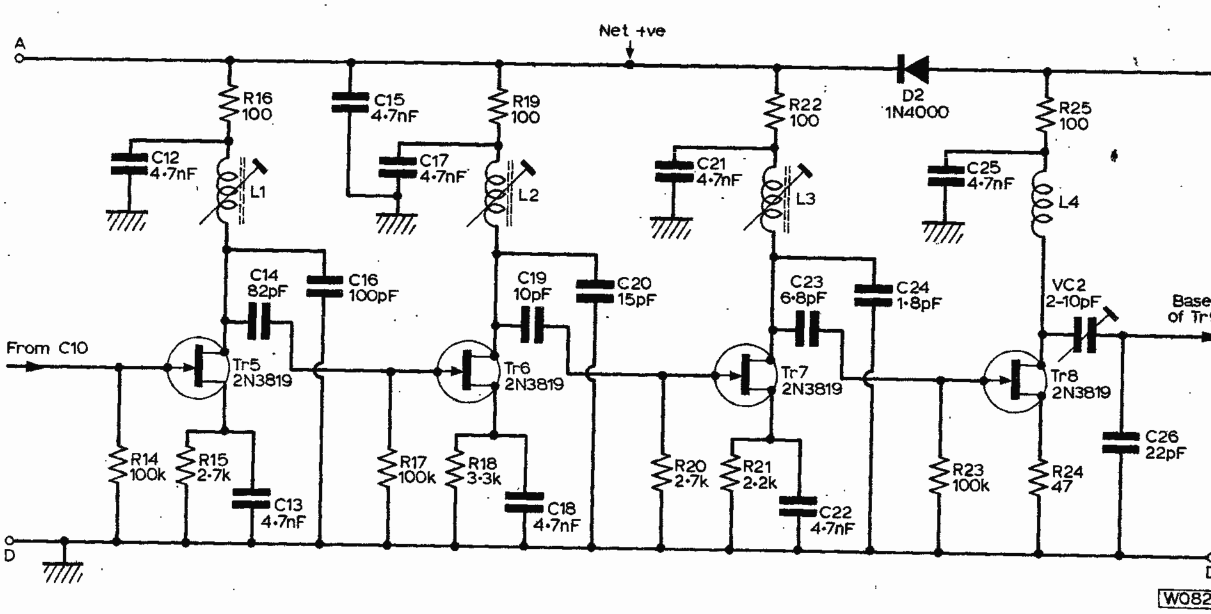


Fig. 3: Diagram of multiplier chain and output to power amplifier. For Netting, power is applied to the junction R19/D2. D2 blocks this supply to the power stages.

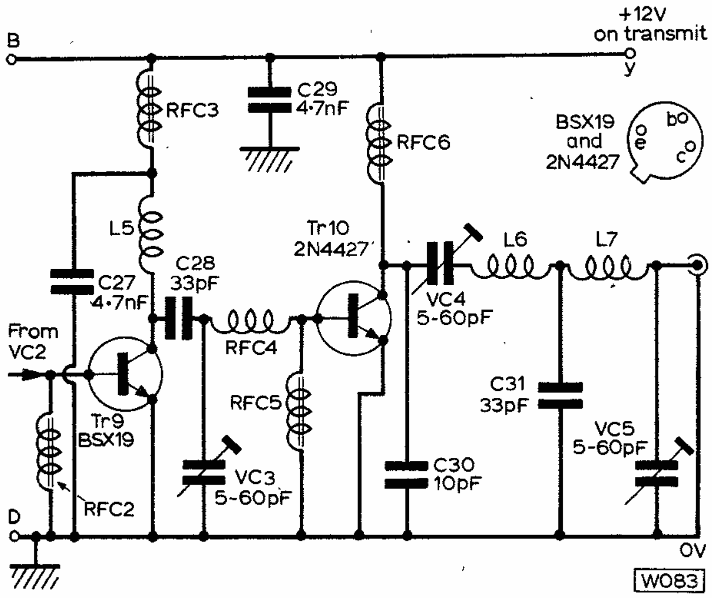


Fig. 4: Circuit of the driver, power amplifier, and output sections. An efficient heat sink is required for Tr10, as up to 2¼W needs to be dissipated.

Coil slugs should be held in place with a dab of wax.

All holes on the topside should be countersunk except for the earth connections, using a suitable drill. Construction is started by clamping the board in the die-cast box and drilling the fixing holes through both. Then assemble the components, Fig. 6, from the long axis outwards, soldering the screens in place at an early stage before too many components accumulate around them. It is also wise to turn the board over, clamp it to the lid of the box and drill through the centre point of the variable capacitors and coils with a No.60 drill. These should be enlarged to 6mm to allow access to the components for final tuning purposes when boxed up. The heatsink for Tr10 is commercial, but that for Tr9 is made by bending a 12mm square of copper or tinplate around a 5mm drill shaft and then forcing it on the transistor.

SETTING UP

As usual, check the board very carefully for solder bridges and a scrub with an old toothbrush is worth while before applying power. It's a wise move now

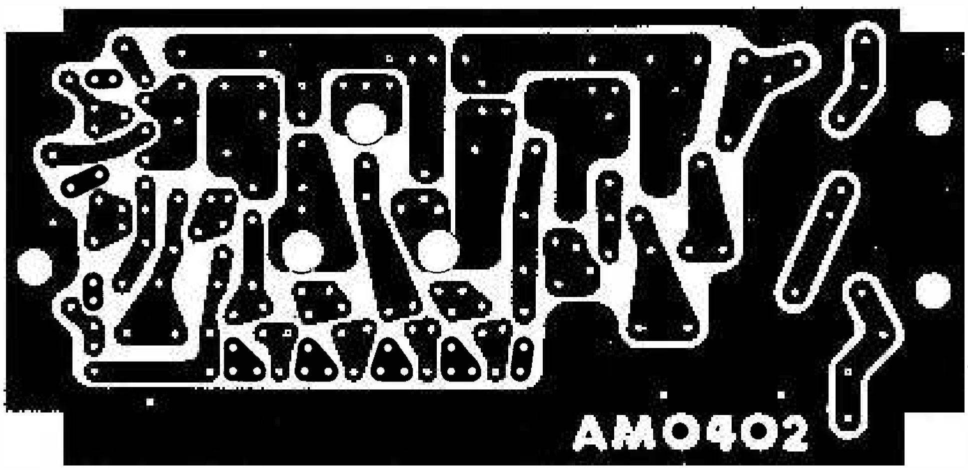


Fig. 5: Foil side view of the PCB shown full size. The holes for the 4mm formers should be bored with a No. 2 drill, while those for the variable capacitors should be made with a 6mm drill.

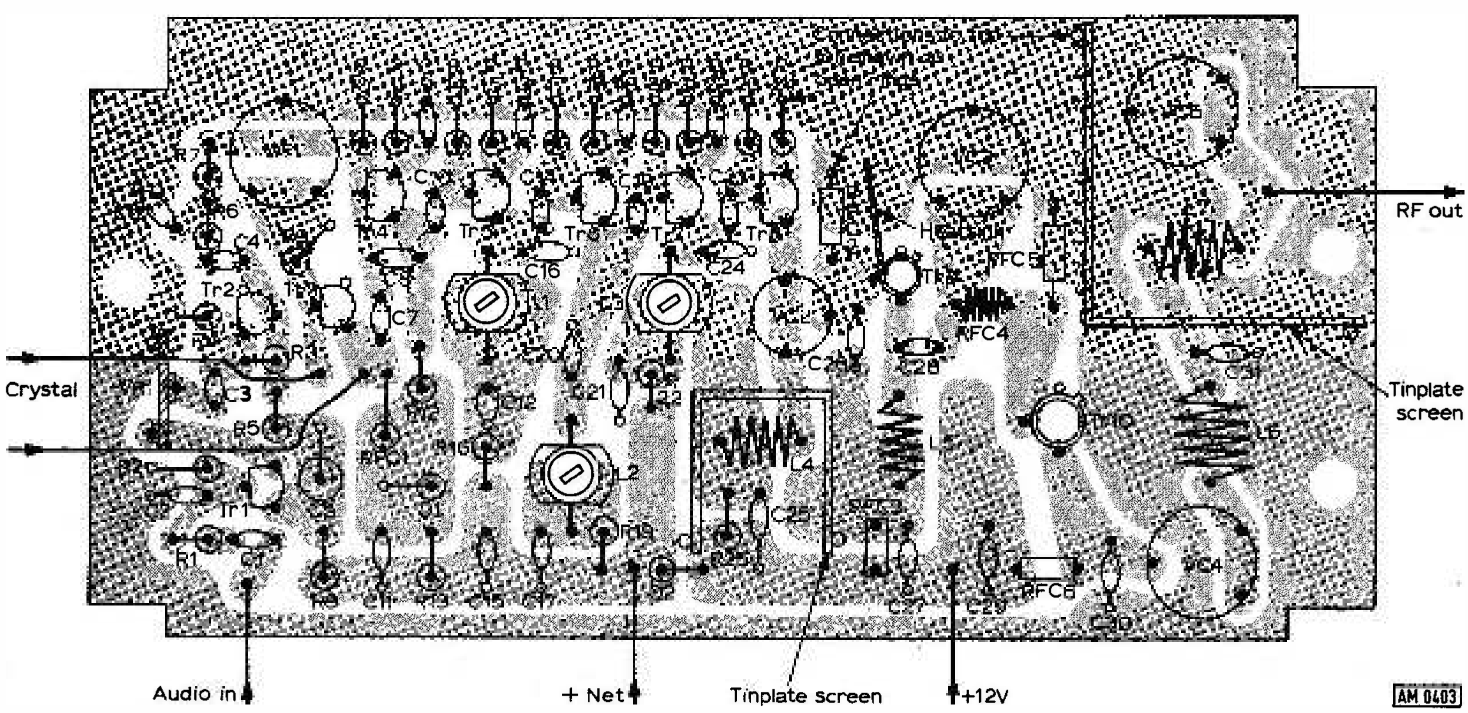
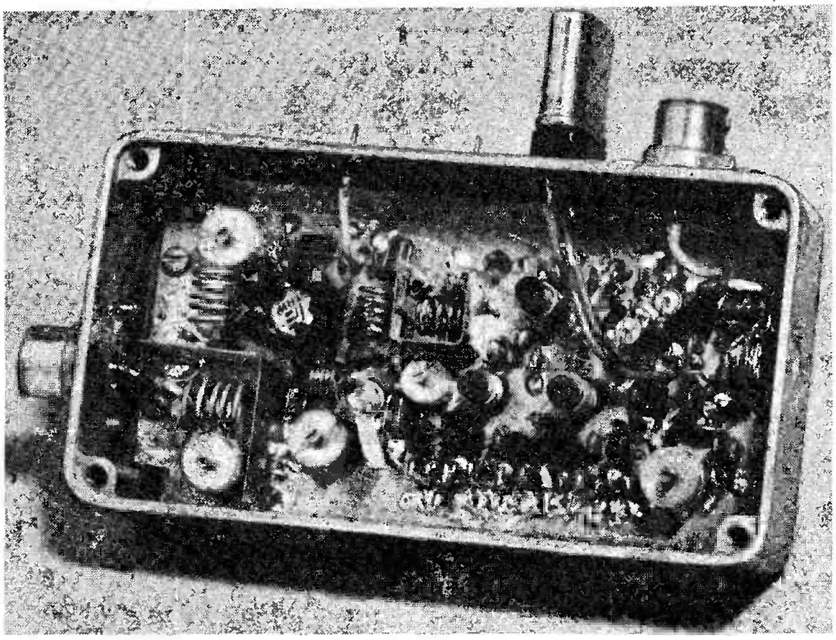


Fig. 6: Component side view of PCB drawn about 1½ times full size. All holes on the earthy side should be countersunk to provide an electrical 'clearance' for the components.



Internal view of the transmitter showing the position of the board, the coaxial sockets, and the crystal. The top of the case should be drilled to provide access to the variable components when the top is in place. See leading photograph.

to get the transmitter working, before fixing it into the case, so temporary connections should be made to input, output and crystal connections. A suitable meter must be connected in the supply line, including a 470Ω resistor to limit current flow should a short exist. Having taken these precautions the output is fed to a 50 to 75Ω screened dummy load through a suitable power meter.

RF SNIFFER

Without a crystal, apply 12V and check that no more than 15mA flows, to the audio stage, oscillator, phase modulator, zener and quiescent multiplier stage. More current indicates a faulty device, or just possibly that Tr8 is oscillating, best revealed by an RF 'sniffer' near L4, and cured by adjusting VC2. If all is well turn to the modulator and using a very high impedance meter, check that the voltage on Tr2 collector is half the supply voltage as measured on the supply side of R19. If higher, increase the value of R4 until the correct reading is reached, and vice versa. For perfection those with an audio generator and oscilloscope can change the value of C6 until there is a 3dB. drop in voltage output at 3kHz compared with 1kHz. This represents the optimum roll off for good frequency modulation, the measurement being made on the gate of Tr4.

Now plug in a crystal and check that there is a rise in current consumption, which, for the sake of the output transistor, should be optimised by adjusting VC4 and VC5. The multiplier chain should now be set up using an absorption wave meter to ensure that the circuits are on the correct harmonic frequency. Alternatively, tune the slugs for maximum output with a sniffer, or for maximum current consumption, as this still puts the circuits on the correct harmonic. VC2 should be adjusted with a sharpened plastic knitting needle, for maximum current consumption. Then adjust VC3 which will reflect on VC2 which will then require readjustment. VC4 and VC5 should now be adjusted, looking for maximum RF output and minimum total current consumption.

It is well worth while repeating all the adjustments for all reflect on one another. The final result should be between 0·75 and 1W into the dummy load for a total current consumption of about 300mA.

If an SWR meter is available the unit may now be connected to an aerial using a crystal on a clear frequency and final adjustments of VC4 and VC5 made to achieve optimum output for minimum SWR. No change in output should be seen when the transmitter is modulated. For those with a good absorption wavemeter, a loop pick-up from the output coil should show that all harmonics and spurii are better than 45dB down on the fundamental, and further improvement on this figure can be made using such a wavemeter by readjustment of the variable capacitors. Once a satisfactory performance has been obtained the unit may be fixed in the die-cast box and all the adjustments repeated until the same figures are obtained.

NOTES

VR1 controls the audio amplification and thus the deviation and without very sophisticated equipment is best set by on-the-air testing. Any crystal between 8·0 and 8·11MHz may be used, although if full coverage of the two metre band is envisaged, a compromise must be reached between output and band coverage. Because the Q of the multiplier chain is high, very careful adjustment of the coils is required. VC2 must be maximised to the centre of the band, but fall off of power is inevitable at the band edges if full coverage is to be achieved. The transmitter, frankly, is happiest when covering 1MHz rather than the whole 2MHz of the band. This proves to be no real disadvantage for all local operating and fits in with the band plan for 2m. The crystal socket may be used as the input for a VFO, as it is high impedance and 2V RMS is more than sufficient. For netting, power is applied to the earlier stages, blocking the supply to the output, but conducting on transmit passing a supply from the power to the earlier stages of the transmitter. PW

HOTLINES ON RECENT DEVELOPMENTS

DIAL-A-COMPUTER

Most people use the telephone in a social sense for talking with a friend located at a distant point. How about ringing up and having a chat with a computer? It hasn't quite reached that stage yet but in the US a company has built a small viewing set which permits one to read out data which has been put into the computer. The subscriber with access to the computer uses a push-button type telephone and the viewing terminal (it's quite small, only weighing about 4·5kg.) which stands next to the telephone completes the system. The user receives a special recognition tone to inform when the telephone is connected to the computer and data can then be entered into the computer using the ordinary numbered push-buttons which would otherwise be used for dialling. Data which is entered comes up on the viewing screen and will remain there until it is erased. The cost isn't too high, either. Initial rental is just $30/month in the US. It will probably be some time before anything like this gets established in the UK.

SAVE IT!

I confess to being impressed with the approach adopted by one large European electronics concern regarding the conservation of energy. Together with the German Federal Government the company has built an experimental house. The usual commercial electricity supply is used for lighting, cooking and the usual appliances such as washing machine, fridge and carpet sweeper, etc. All the energy for household heating, however, is supplied from the ever smiling sun. A mini-computer installed in the house simulates the electrical requirements of a family of four. It also controls the heating system and processes the data collected. The total energy supplied by the sun is 8300kWh per year.

One obvious thing to emerge was that collecting energy from the sun is not difficult, the problem lies in storing that energy. Incident energy from the sun is collected via banks of solar cells which form part (not all) of one side of the roof. This energy is then converted into low-temperature (up to 95°C) heat and is stored by a storage reservoir located in the cellar. But the collection of "free" energy doesn't end with a few solar batteries on the roof—the surrounding ground offers a useful supply also. The earth itself absorbs a certain amount of solar energy and this is collected from a soil heat exchanger and used for heating and cooling (it can work both ways).

For solar battery enthusiasts, the cells occupy an area of some 20 metres by 20 metres and they face south at an angle of 48°. It has been claimed that the solar battery collects between 10,000 and 12,000kW hours of energy per year.

MAKE A DATE

I note with interest that at least one UK importer is handling batteries from elsewhere in Europe for sale in this country. So what's new about that? Well, these batteries have small plastic caps over the terminals which prevents any possibility of shorting during transit and storage. More importantly, they have the date of manufacture printed on them. This allows anyone purchasing one of these batteries to know just how long it's been sitting on a stockist's shelf. Certain other manufacturers of batteries have decided not to follow suit, but if the public were educated to look for a date then this could become a trend.

TREASURE

Treasure tracers of various types have been offered for sale on the British market for some time. Some boast the ability to locate or detect a single coin at anything up to 30cms I note that a French company has developed and built something quite remarkable. A magnetometer is a device which will measure or detect very weak magnetic fields. The French company claim to have built a device which is called a double resonance magnetometer with a resolution of 0·01 gamma. This is something like 100 times more accurate than conventional detectors of magnetism. The company will not sell you one, but its team will travel to any part of the world and use it for you. So if you think you've located treasure and you really want to know, it may well pay you to hire someone to take a magnetic peep for you—saves all that fruitless digging if you're wrong.

ON THE DESK

Talking computers, I see that the age of the desk-top unit is well and truly here. One of the latest desk-top computers weighs 22·5kg. and has a 100mm. cathode ray tube screen which displays 16 lines of 64 characters each. This extremely useful little gadget employs a 48 kilobit MOS ROM (read-only memory), to interpret the high-level language which is fed into it from the self-contained keyboard. It looks just like a modern typewriter with a small television screen. If you're not impressed, the computer houses 25 of the ROM chips described above. To complete the story, the device also has a tape recorder inside it. The tape is used for mass storage of information. The cartridge of tape holds up to 204,000 characters. It's 90km. long and 5mm. wide.

DAB IT ON

Those with future aspiration to get their "A" level in applied crime should remember the golden rule—always wear gloves. Laser holograms are now being employed to compare and sort finger prints. The "dabs" of the suspect are compared with prints on master cards to drastically reduce the number of cards which must be hunted through manually. One system can compare/sort finger prints at the rate of 144,000 per hour and can reduce the number of cards requiring manual searching by up to 80%.

GREEN STUFF!

That green stuff which is so hard to come by these days—money, is in the news and coupled with computers. I hear that one prominent British bank network is to go on-line with a number of automatic tellers. These mechanical/electronic beasties will permit clients/customers (that's you and me) to deposit money (notes and cheques) and withdraw little heaps of cash up to a maximum of around £50 per day. The initial set-up covers some 100 locations in banks, stores, and even factories.

Ginsberg

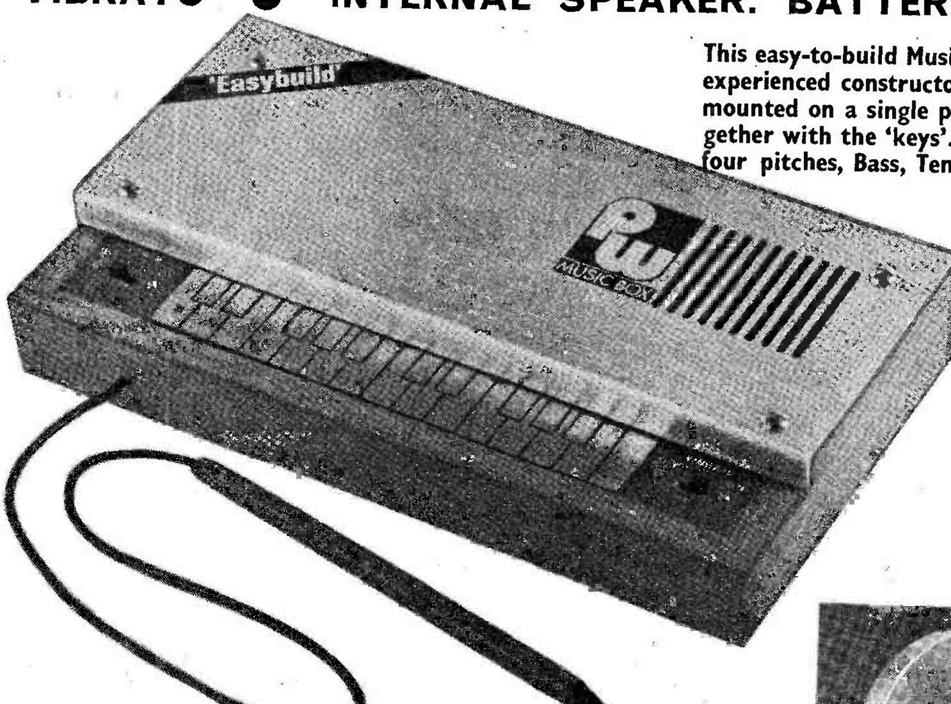
PW 'Easybuild' Music box

IN NEXT MONTH'S PRACTICAL WIRELESS

Make a note of the following features:

● 25 NOTE C-C KEYBOARD ● PRE-SET CONTROL SHIFTS RANGE OVER 4 OCTAVES ● SWITCHED VARIABLE DEPTH VIBRATO ● INTERNAL SPEAKER. BATTERY OPERATED

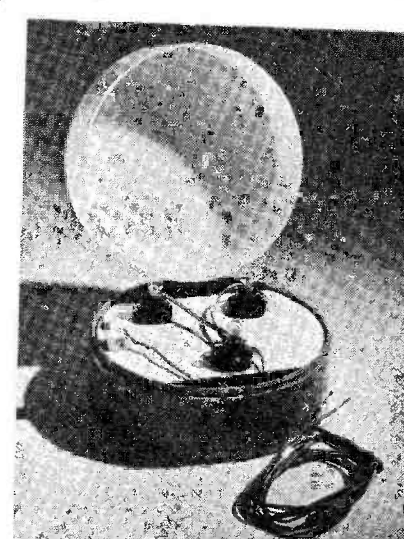
This easy-to-build Music Box is ideal for the less experienced constructor, all components being mounted on a single printed circuit board, together with the 'keys'. Can be tuned to any of four pitches, Bass, Tenor, Alto or Soprano.



DON'T MISS THIS ISSUE!

Emergency Light Unit

This 'luminaire' provides over three hours of emergency lighting in the case of a mains power failure, sufficient for the hall and stairs at home. A readily-available case makes the completed unit an attractive fitment for wall or ceiling.



PLUS ALL THE REGULAR FEATURES ON SALE IN DECEMBER

PW 'Easybuild' STEREO DISCO SYSTEM PART 1

THIS article describes the construction of a versatile stereo disco outfit comprising twin turntables, a five-input mixer and a pair of 100W slave amplifiers. An optional light display unit is also detailed which can be incorporated into the main console.

To ensure that this project can be given a professional finish a custom designed console has been prepared and will be available in kit form to constructors.

SYSTEM PERFORMANCE

The ultimate performance of any system of this nature depends solely on the power amplifier. Attention to design details has resulted in an amplifier offering very high performance and reliability with sustained full power operation. The wide power bandwidth, low distortion and high stability ensure that the audible results are exceptional for this type of high power unit. Switch-on surges, which could damage loudspeakers, are eliminated by a slow switch-on circuit.

The mixer has input facilities for a pair of ceramic cartridges, dynamic microphone, tape recorder, and any auxiliary input in excess of 300mV. The cross-fade control is incorporated to provide a smooth changeover from one turntable to the other, and may also be used to mix the two.

Separate controls for each input allow effective mixing. The microphone input has a degree of bass cut to reduce any "boom" caused by speaking close to a dynamic microphone.

To compensate for the relatively high attenuation of the passive mixer, a high gain pre-amplifier circuit is used incorporating four transistors. Full tone control facilities are provided as well as an effective top cut filter. This is used to reduce record noise and to give a typical bass-heavy "disco sound".

By incorporating the light modulator into the console, advantage can be taken of the high output voltage available from the power amplifiers to drive the switching thyristors from a frequency selective network. Three coloured spot lamps are mounted in the front of the console to effect the display.

MIXER

A circuit diagram of the mixer is shown in Fig. 1.

Provision is made for five inputs on each channel: AUX (300mV), TAPE (150mV), MIC (4mV), PU1 and PU2 (20mV).

To cater for two turntables a pair of ceramic inputs (PU1 and PU2) are provided with independent level controls, VR4 and VR5. Cross fading from one turntable to the other is accomplished by VR6.

A small capacitor, C1, in the microphone input serves to reduce the excessive bass produced when speaking close into a dynamic microphone.

Combination of the various inputs, from their respective level controls and attenuators, is carried out in a "star" network of 120 kilohm resistors feeding directly into the pre-amp input, which is a relatively low impedance.

Consideration of the simple mixing network will confirm the high insertion loss, requiring a sensitive pre-amp. It is as well to note at this point that the input sensitivity of the pre-amplifier is less than 1mV.

*Consultant †W.F.K. Electronics

★ specification

TURNTABLES

Two BSR BDS80 turntables with Sonotone 9TAHC ceramic cartridges

MIXER

Five input with crossfade facility between pickup inputs

Sensitivities to give 800mV from preamplifier (r.m.s.)

PU1, PU2	20mV
MIC	4mV
TAPE	150mV
AUX	300mV

All inputs have independent level controls

PREAMPLIFIER

Baxandall tone controls ±15dB at 50Hz and 12kHz. 800mV maximum output

POWER AMPLIFIER

Power Output per channel	100W continuous into 4Ω
Frequency Response	45Hz to 25kHz ±2dB
Total Harmonic Distortion	0·08%, at 1kHz 50W
Signal-to-noise ratio	90dB rel. 100W unweighted

OVERALL SYSTEM

Frequency Response	45Hz to 22kHz ± 2dB
Signal-to-noise ratio	82dB rel. 100W unweighted

LIGHT MODULATOR (OPTIONAL)

Three channel with crossover frequencies of 3kHz and 7kHz. Up to 1000W per channel.

PRACTICAL WIRELESS

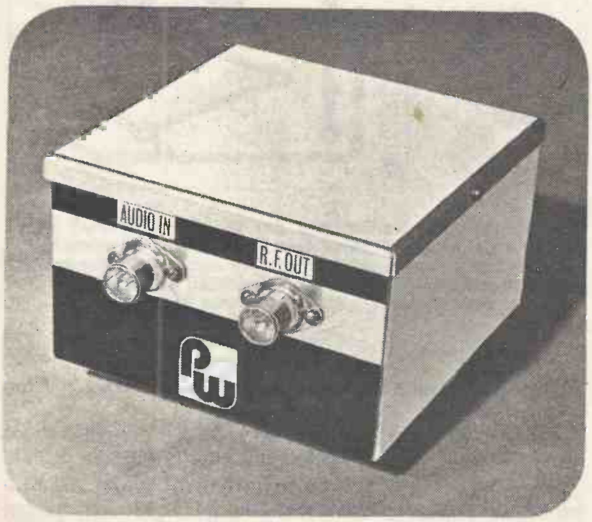
SIMPLE HOME PROJECTS

8 PAGE SUPPLEMENT No.3

DECEMBER 1975

CONTENTS

RADIO-PICKUP LINK



This simple project enables a microphone or record player pickup to be used through a radio that does not have auxiliary input connections. Access to the aerial of the radio is necessary but this is no problem because the output signal of the link can be very loosely coupled to portable radios which do not have external aerial sockets simply by winding one or two turns of wire round the rod of the ferrite aerial.

The device was originally designed to fit inside a turntable and pickup enclosure with a coaxial output socket that could be coupled into any medium wave radio. The prototype system had a low output magnetic cartridge so it was necessary to bring the level up with the pre-amplifier stage of Tr3 before using the resulting signal to modulate the supply voltage feeding the RF oscillator, (Tr1). To allow the variations in the output voltage of different pickups VR1 introduces a controlled amount of negative feedback thus adjusting the gain of the pre-amplifier. The supply to the oscillator is controlled by emitter follower action of Tr2. The quiescent voltage is set by R4 and R5 and this is modulated by the audio signal at the base of Tr2.

Bits and Pieces

R1	470kΩ	R5	1·2kΩ
R2	1kΩ	R6	4·7kΩ
R3	10kΩ	R7	470kΩ
R4	1·2kΩ	R8	100kΩ

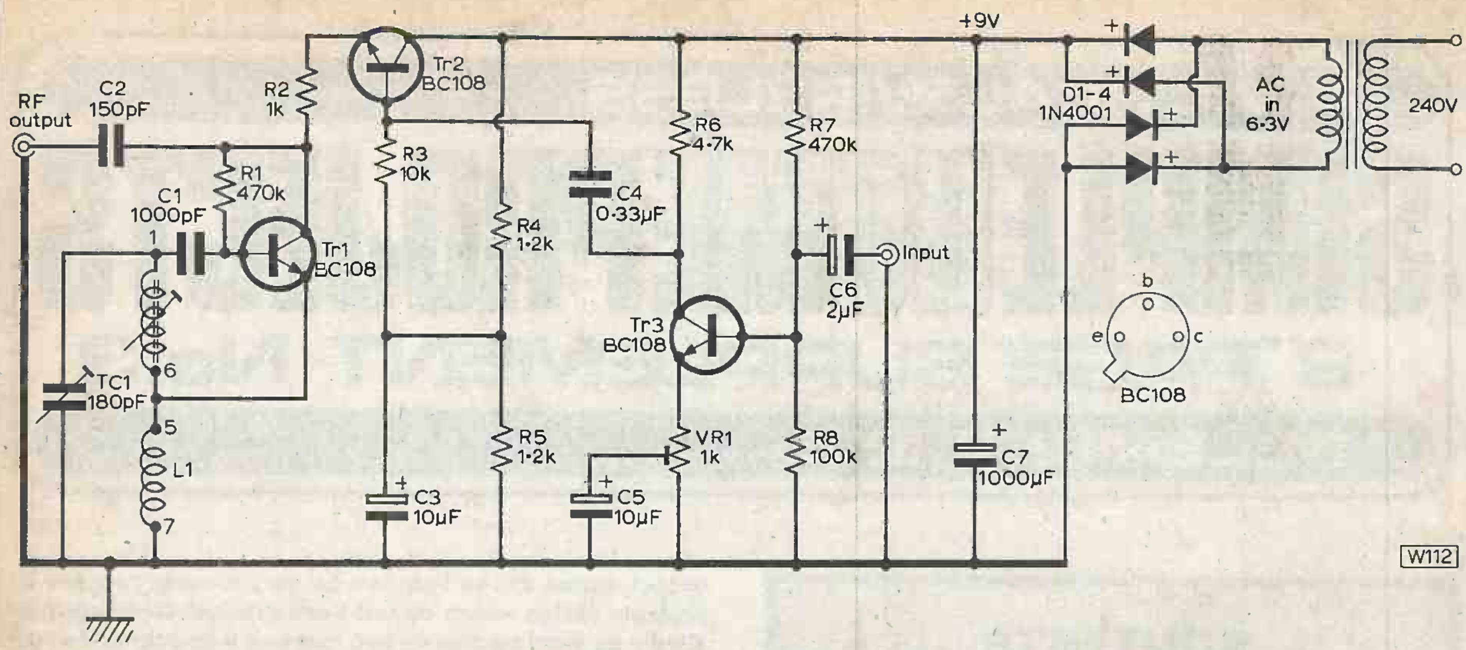
All ¼W 10%

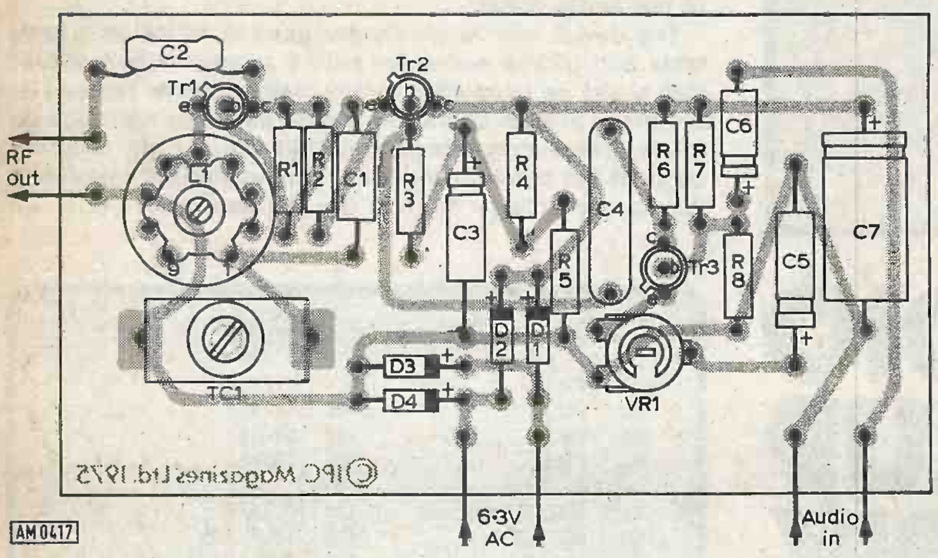
TC1	180pF trimmer	C4	0·33µF
C1	1000pF	C5	10µF 12V
C2	150pF	C6	2µF 12V
C3	10µF 12V	C7	1000µF 18V

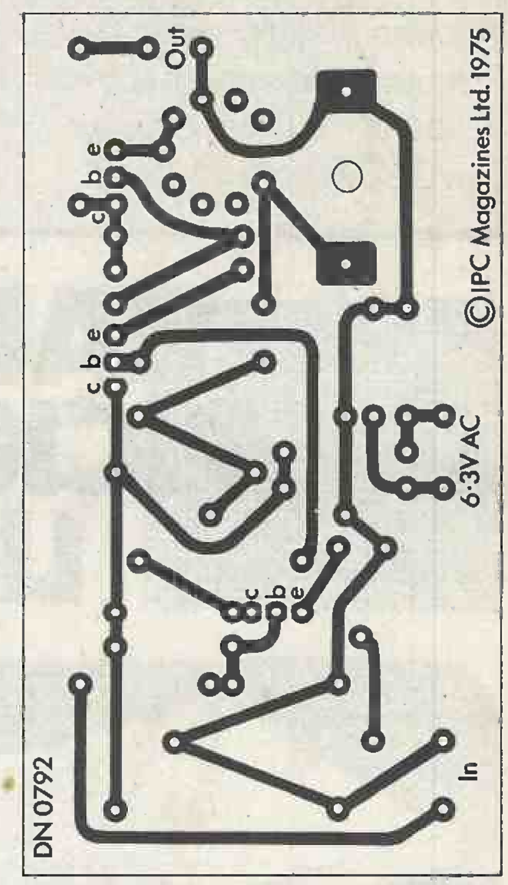
L1 Aerial Coil (Blue) Range T2 transistor type. (Denco)
T1 6·3V heater transformer
D1-D4 1N4001
Tr1/3 BC108
PCB (WKF Electronics)
Coaxial connectors (2) to suit. Metal screening box.

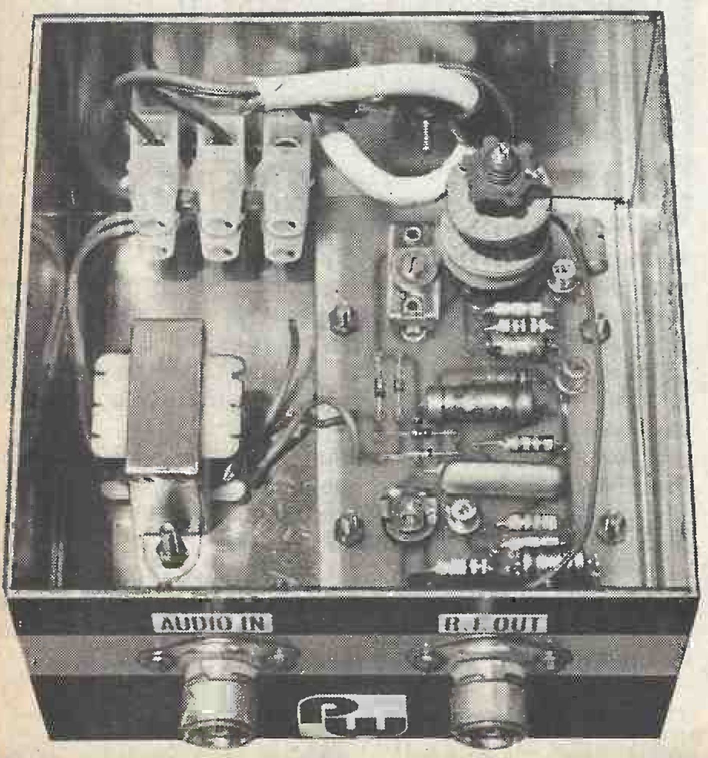
It has been found that the pre-amplifier will accept input signals from low impedance moving coil microphones and some crystal types but the quality associated with the latter leaves a lot to be desired. For those who wish to use the unit with crystal cartridges that have quite high outputs leave out the pre-amplifier circuitry and increase the value of R3 to about 100kΩ, the input from the crystal going between the base of Tr2 and earth.

An ordinary 6·3V heater transformer was used for T1. Current consumption is minimal and a 6V 50mA miniature transformer will do the job just as effectively. Alternatively,









Top, circuit of the Radio-Pickup Link with, below, printed circuit board (actual size) and component layout. In the photograph, left, the 6·3V supply is obtained from a 6-0-6V secondary, using one half only. The coil shown is not the one specified. It was used for later experiments with the Link on other frequencies.

run the unit from a 9V battery by leaving out D1/4 and the transformer.

When built the unit should be housed in an aluminium case which is connected to the earth rail of the circuit. This is to prevent radiation which might interfere with other radio sets within a short range. Input and output connections should be made via screened coaxial cable.

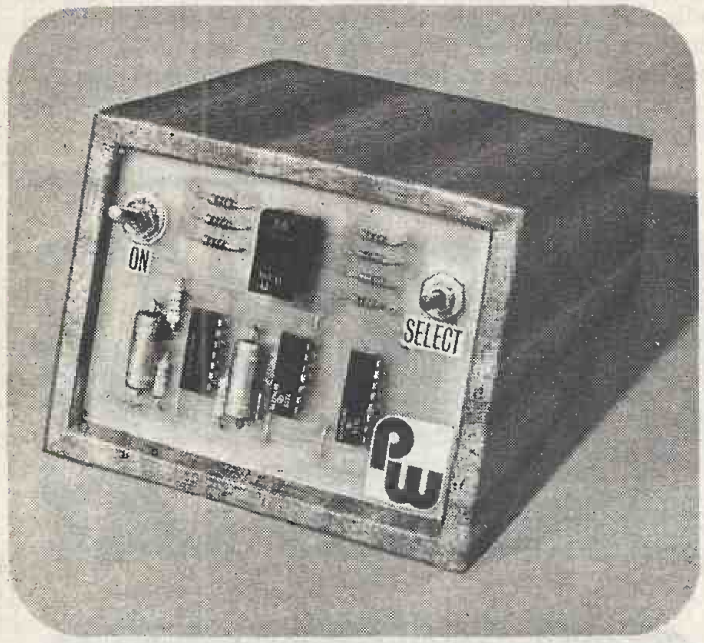
When setting up you should adjust it so that signal is heard on a quiet part of the medium waveband of the radio.

RANDOM NUMBER SELECTOR for games

Bits and Pieces

R1	2·2kΩ	C1	0·22μF
R2	4·7kΩ	C2	0·22μF
R3	4·7kΩ	IC1	SN7410
R4 to R10	100Ω	IC2	SN74177
All ¼W 10%		IC3	SN7447

LED1 MAN3610 or MAN3620 or equivalent common anode display.
S1 push-to-make push button switch
S2 single pole on-off switch
14 pin DIL sockets (3) 16 pin DIL socket (1)
Printed circuit board (WKF Electronics)



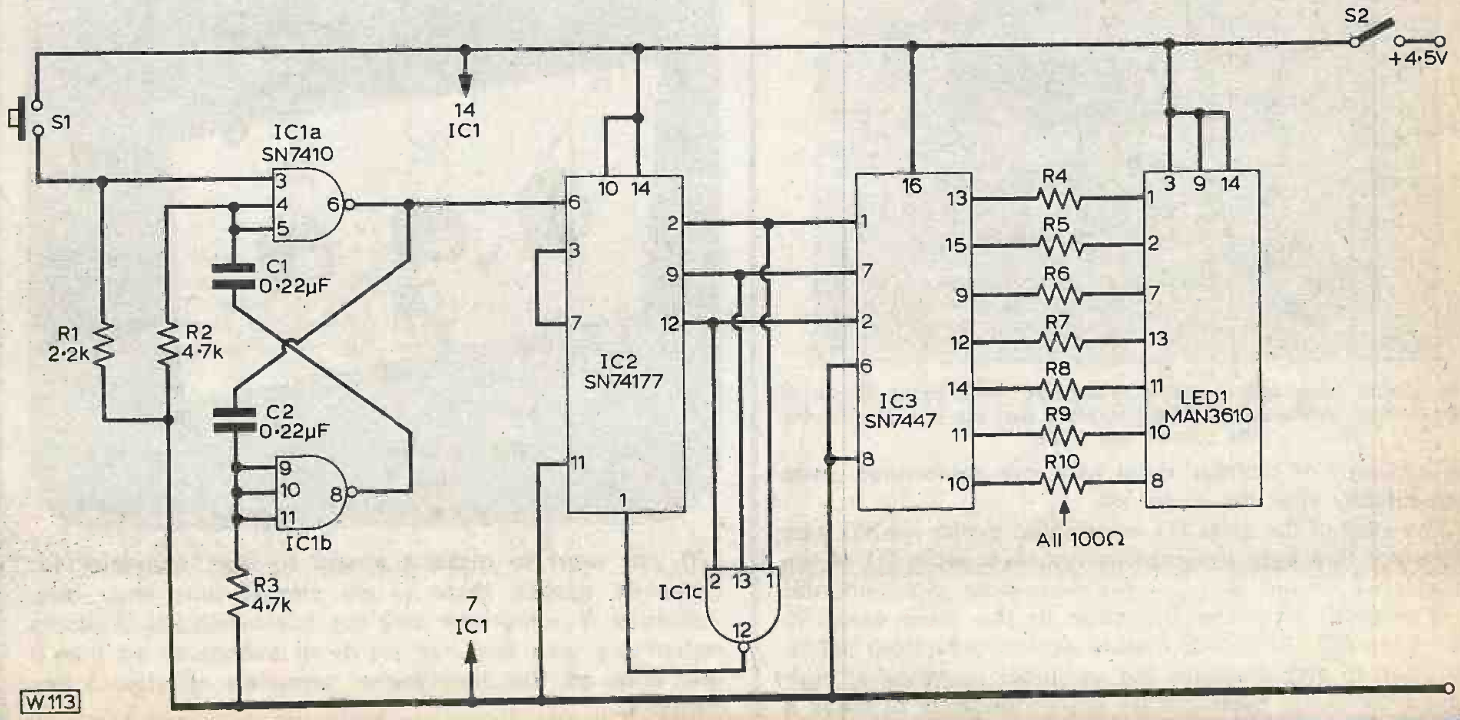
All the components are mounted on one circuit board which forms the front panel. Leads run from the PCB to the internal battery. The cabinet can take any convenient form but the sloping front feature should be retained. The circuit of the Selector is shown below.

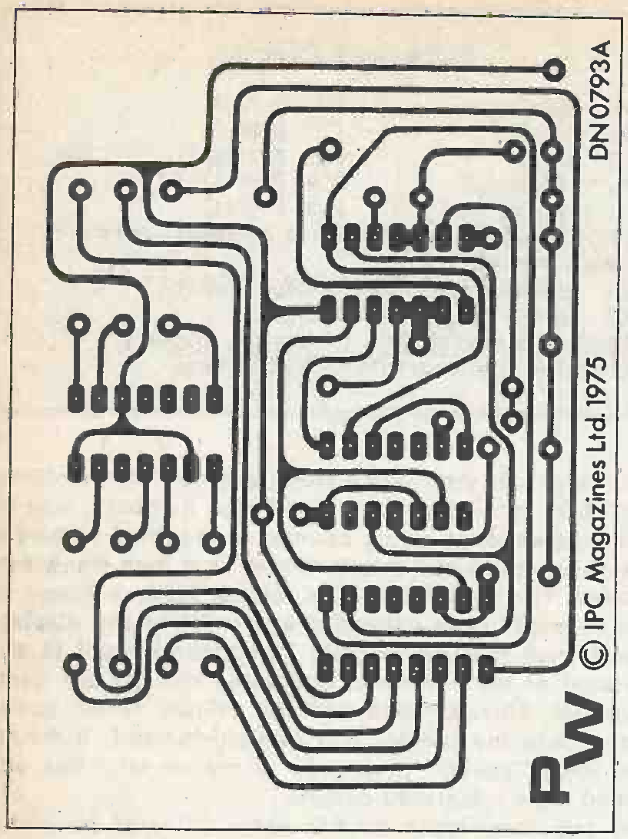
This electronic dice uses a seven-segment light emitting diode LED1 to display the normal dice numbers, one to six. A conventional binary counter is modified to give a scale-of-six count and this is driven by a high frequency oscillator. The output from the counter feeds a binary to seven-segment code converter which drives the display.

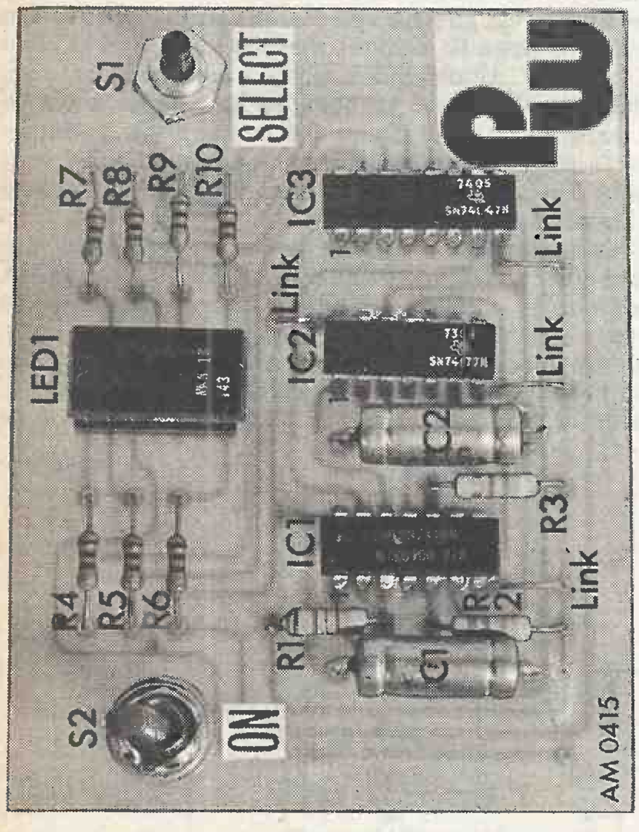
Apart from the few discrete components used to set the speed of the oscillator, integrated circuits are used throughout. This, coupled with the printed circuit board design, make the project very straight-forward. It would be an ideal "starter" project for someone who has not yet used logic integrated circuits.

The two three-input NAND gates (IC1a/b) form the oscillator which operates at a few kilohertz. The frequency is set by C1, C2 and R2 and R3. When the pushbutton switch S1 is open R1 ensures that the logic level at pin 3 of IC1a is "0". Under this condition the oscillator does not function. However, as soon as this pin is taken to logic level "1" (by pressing the button) the oscillator starts to work and makes the binary counter (IC2) start to cycle. The integrated circuit used here is a presettable four stage binary counter.

In this application only three stages are needed to give a count of six so the first stage of the SN74177 is bypassed. Under normal circumstances a binary counter would start counting from 000 to 111 (giving eight codes which would represent the denary numbers zero to seven). For a dice neither zero nor seven are wanted so steps have to be taken to suppress the codes 000 and 111. This is done







Top, circuit board layout shown actual size, with, below, layout of components on the board. Check carefully that the ICs are inserted the correct way round.

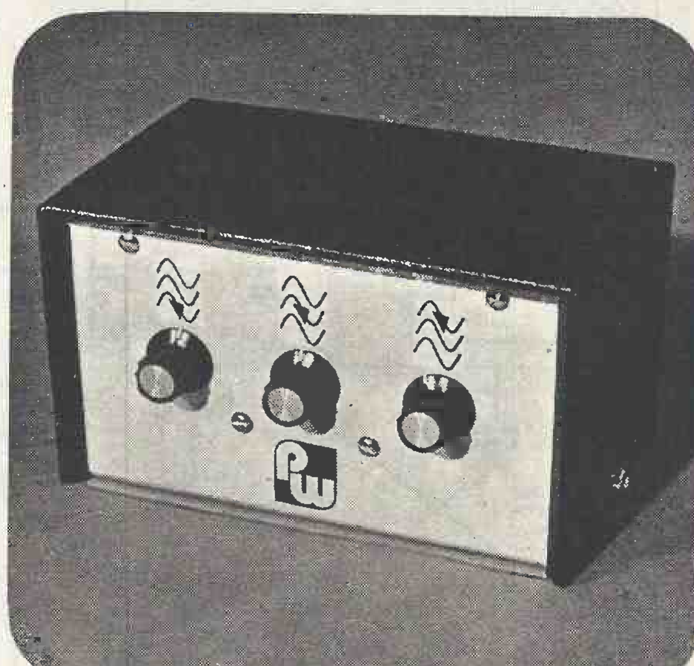
by making the counter reset to a pre-determined code immediately after the count six.

The start of the code 111 is detected by the NAND gate IC1c and this puts a signal on the reset input (1) of the integrated circuit. Being a programmable input counter it is possible to preset the code to the reset value, in this case 001. Thus IC2 counts sequentially from 001 to 110 (one to six). Because the oscillator operates at high speed the count cycle occurs many hundreds of times a second as long as the push button switch is pressed and it is impossible to predict at what number the counter will stop when the finger is removed from the button.

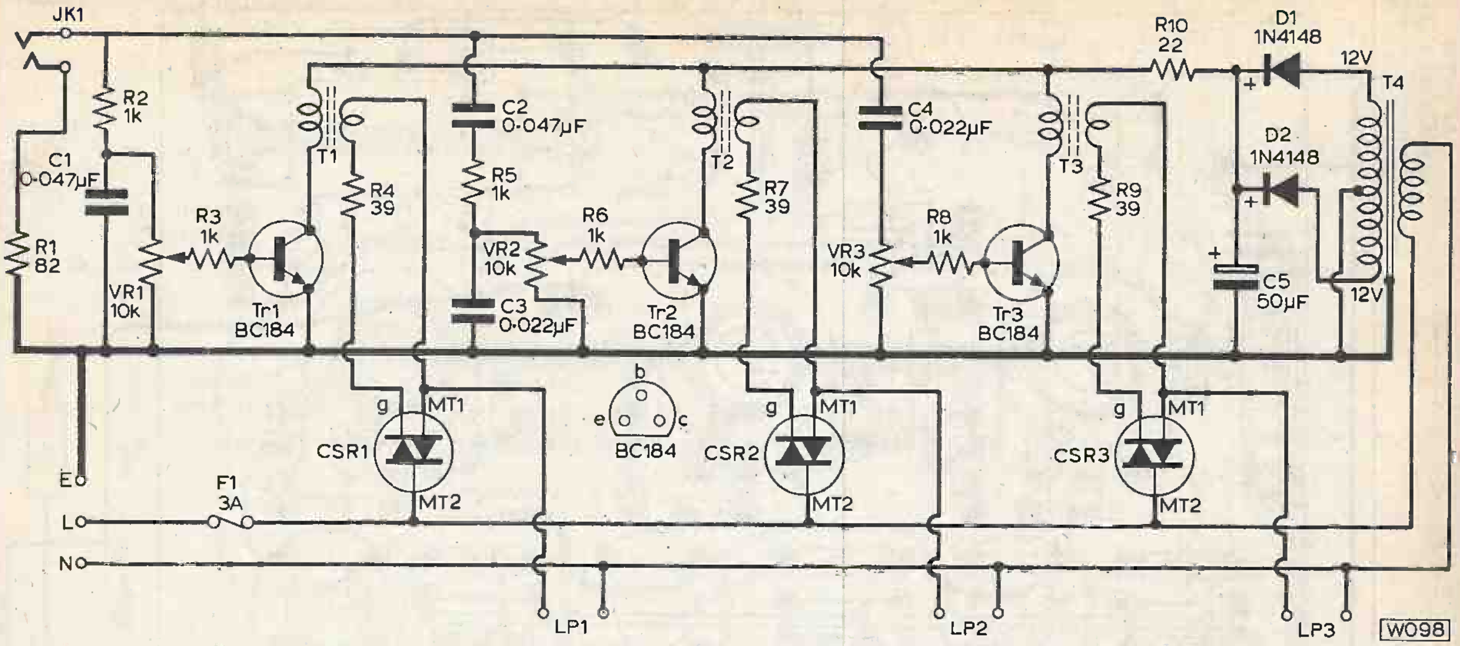
The binary coded numbers produced by IC2 are decoded by IC3 to seven-segment codes which are fed to the respective elements of the seven-segment display. When the button is pressed the LED appears to display the figure eight. This is because the segments are being switched on and off very rapidly as the counter is cycling round the sequence one to six, but as soon as the push-button is released a number between one and six will be displayed on the LED. This number stays until the device is switched off or until the button is pressed again.

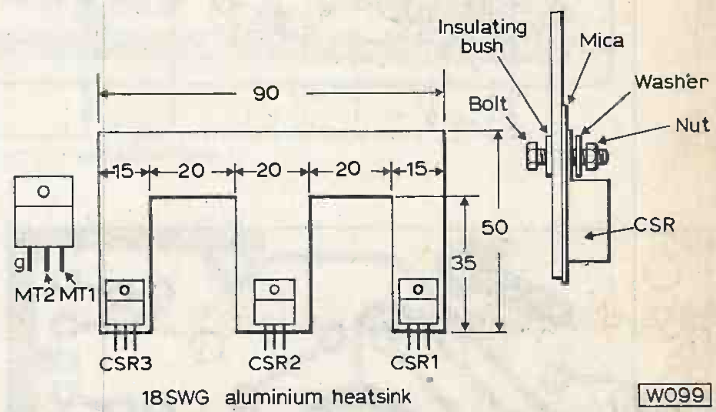
Current consumption by the device is comparatively high being, on average, just over 100mA. Therefore it is suggested that a reasonable capacity battery be used to power it; the prototype used a standard 4·5V flat cycle lamp battery. Space has been left on the printed circuit board for the switch and pushbutton to be mounted on either side of the LED. However these could be mounted in remote positions. The cabinet style can be left to the individual as all the electronic components are mounted on the single board giving the constructor a wide variety of mounting options.

SOUND-TO-LIGHT DISPLAY



If you want to make a sound to light converter for domestic parties there is no simpler one than this. Although it comprises only the basic features it works remarkably well and has plenty of sensitivity so that it will work off the loudspeaker terminals of almost any amplifier.





Top, circuit of the Sound-to-Light Display. Above, details of the aluminium heatsink for the three triacs, dimensions being given in mm. Insulating kit must be used with each triac. Check with ohmmeter that each is isolated from heatsink.

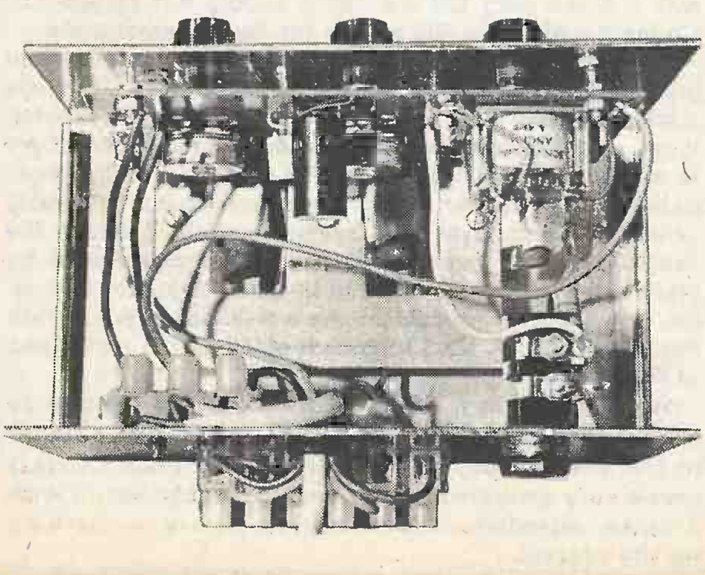
Bits and Pieces

R1	82Ω 1W	R6	1kΩ
R2	1kΩ	R7	39Ω
R3	1kΩ	R8	1kΩ
R4	39Ω	R9	39Ω
R5	1kΩ	R10	22Ω ½W

All ¼W 10% except R1 and R10
VR1/2/3 10kΩ linear, PCB mounting

C1	0·047µF	C3	0·022µF
C2	0·047µF	C4	0·022µF

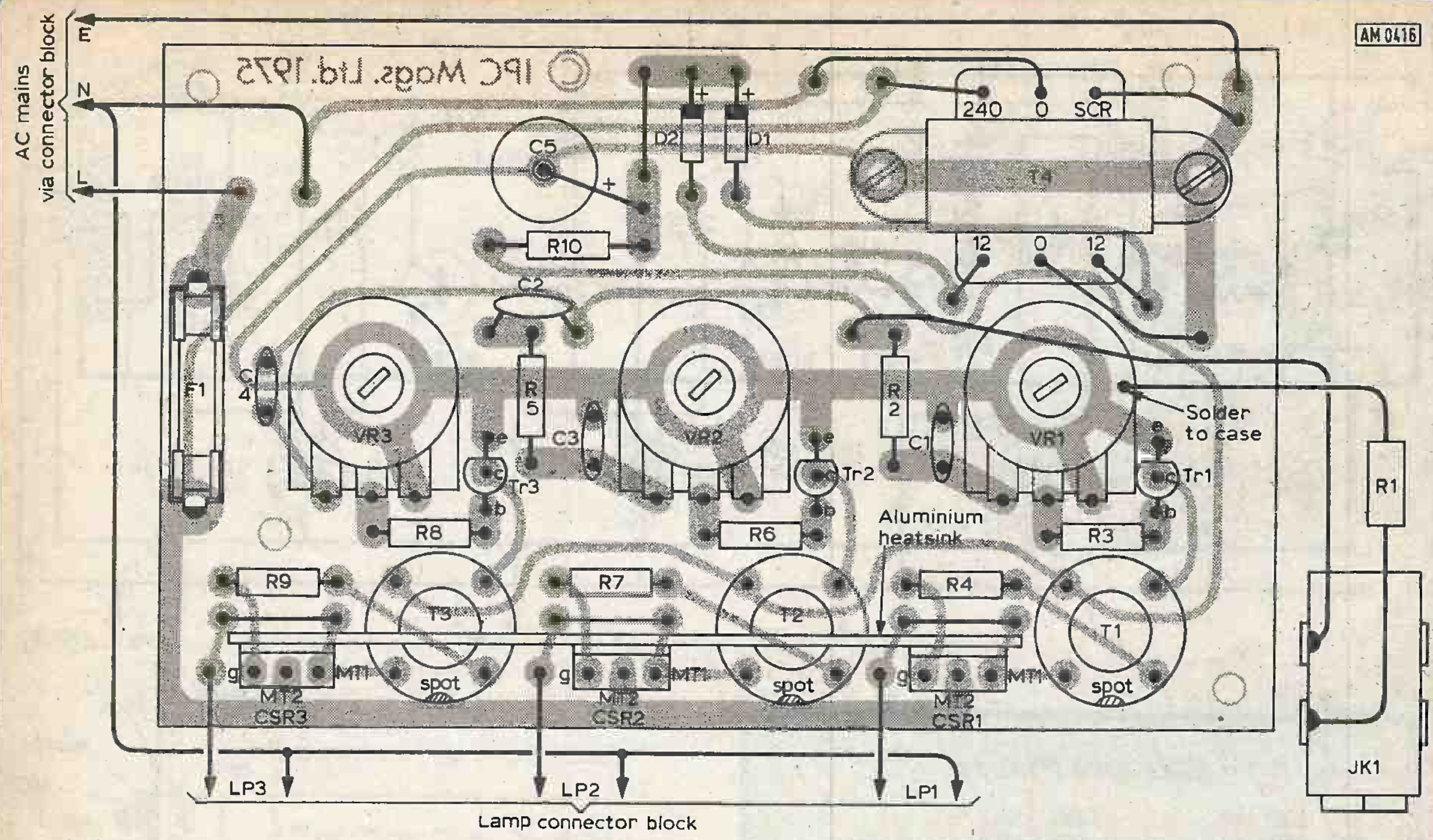
All 250V
C5 50µF 20V
D1/2 1N4148 Tr1/2/3 BC184
T1/2/3 Pulse transformer
T4 Mains transformer 240V primary, 12-0-12V 50mA secondary.
CSR1/2/3 TXAL 228B Triac (400PIV 5A) with insulating kit. Connector blocks 3-way and 6-way. Fuse holder PCB mounting and 3A fuse. Metal for heatsink. JK1 input socket. Metal case 150mm wide, 90mm high and 90mm deep, or similar. LP1/2/3 240V coloured lamps to a maximum of 500W per channel. The pulse transformers, mains transformer and triacs are obtainable from Radio Component Specialists. PCB (WKF Electronics)



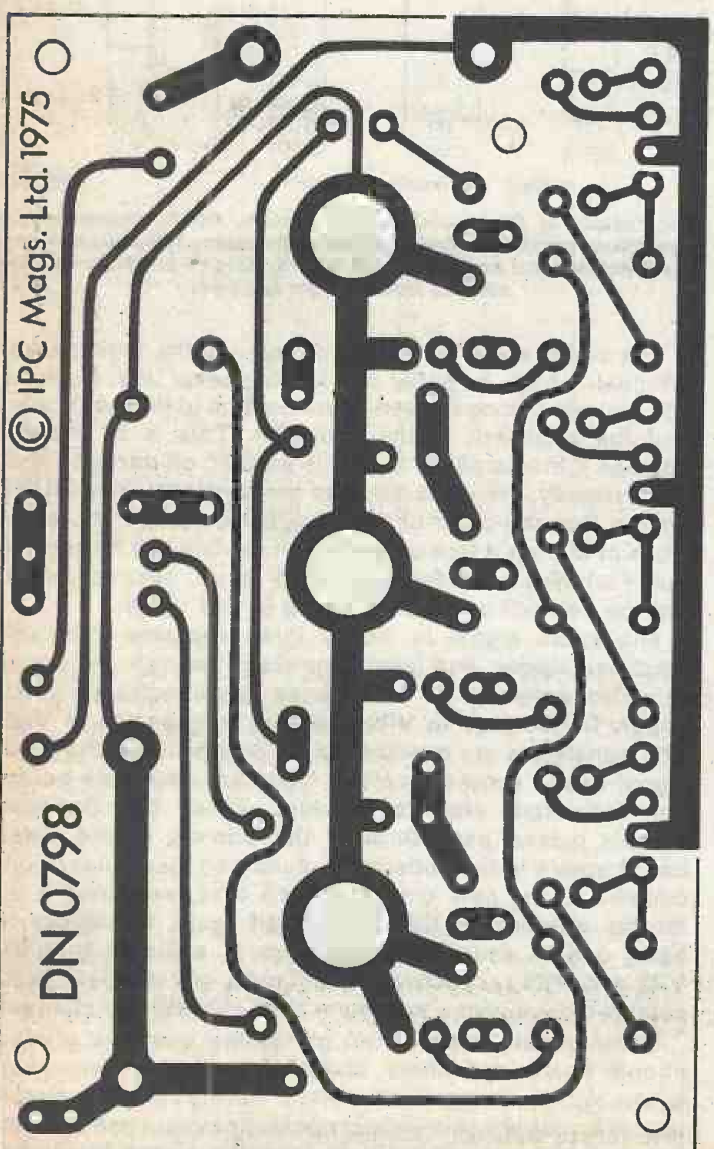
The audio signal is taken from across the loudspeaker terminals of the amplifier and fed to socket JK1. Note the 82Ω resistor linking the earthy connection of the jack socket and the earth rail of the converter. This is to prevent damage if the amplifier output is earthed on one side and, inadvertently, the wires become crossed over. You MUST ensure that the earth of the amplifier corresponds to the earth of the input jack otherwise all signals will be shorted out. Fortunately no damage would result, because of R1, but the unit will not work if wrong in this detail.

The audio signal is fed to three separate transistor amplifier stages and simultaneously through frequency selective networks to pass bass frequencies to VR1, middle frequencies to VR2 and high frequencies to VR3. The transistors are operated without bias hence the input signal has to exceed a certain minimum amplitude before the transistors start to conduct. When this happens current pulses pass through the primary of the pulse transformers in the collector circuits and these pulses are coupled to the gate circuit of each triac, switching it on for the duration of that mains half cycle. Sensitivity to bass, middle and high frequencies is adjusted by VR1, VR2 and VR3 respectively. The lamps are standard 240V coloured ones with a maximum load of 500W per channel.

Construction is simplified by making use of a printed circuit board and there should be no problems with assembly. If the potentiometers having printed circuit tags are unobtainable ordinary potentiometers can be used but use jumper wires to go into the board locations.



The printed circuit board, actual size, is given on the left with the parts layout at the top. Note that the heatsink is fitted at right-angles to the PCB.



When fixing the potentiometers make sure to insert them so that the spindle protrudes on the copper side of the board.

Care should be taken to insert the pulse transformers (T1, T2 and T3) the correct way round, noting the spot, and similarly insert the triacs in the right way. The best way of carrying out the latter stage is to bolt the triacs on to the aluminium heat sink, making sure to use the insulating plastic bush and mica sheet, and then offer up the triac pins to the circuit board so that the triacs are on the side of the heatsink opposite to that which faces the potentiometers. The leads for transistors Tr1 to Tr3 should be carefully formed before they are inserted into their respective holes.

Under no circumstances should the unit be operated without a fuse somewhere in the system. There is provision for a fuse on the circuit board but if difficulty is experienced in getting a suitable fuse holder then operate the unit with a fused plug but the rating should not exceed 3A. Connect a shorting link across the fuse contact pads.

Mains input connections are made to a three-terminal mains connector and the outputs to the three lights are made via similar connectors fixed to the rear of the cabinet. If you use the metal cabinet as specified make sure there is ample separation between the rear side of the front panel and the copper side of the circuit board. Preferably sandwich a thin layer of insulating material between the two, a piece of blank Veroboard or Formica would be ideal. Likewise ensure that the heatsink does not foul on the metalwork of the cabinet. As a final safety precaution the metal cabinet MUST be connected to the earth lead of the mains plug.

When operating, parts of the circuitry are live to mains voltages hence a soldering mistake or a finger in the wrong place when carrying out tests COULD prove very dangerous. If you are in doubt consult with a more experienced constructor before embarking on the project.

12V PA SYSTEM

The output transistors of this amplifier are fitted to the backdrop of the chassis which acts as a heatsink. The arrangement can be seen in the photograph at the right, with the PCB mounted on the bottom of the chassis with spacers.

Bits and Pieces

R1	470kΩ	R6	68kΩ
R2	470kΩ	R7	270Ω
R3	100kΩ	R8	27kΩ
R4	4·7kΩ	R9	680Ω
R5	270Ω		
All ½W 10%			
VR1	10kΩ log	VR2	100Ω min. horiz. preset
C1	16μF	C5	16μF 16V
C2	0·022μF	C6	0·1μF
C3	680pF	C7	100μF 16V
C4	16μF 16V	C8	500μF 16V
D1/2	OA91	LED1	MV5025 or GP
Tr1	BC108	Tr2	BFY51
Tr3	AD161	Tr4	AD162

With mounting kits for Tr3/4

SK1, phono socket. SK2, jack socket. SK3, loudspeaker socket. S1, single pole two way slide switch. S2, single pole on-off slide switch. Cabinet 200 x 125 x 50mm aluminium case or similar. Printed circuit board (WKF Electronics) Four-way tag strip. Suitable re-entrant loudspeakers are available from Radio Component Specialists.

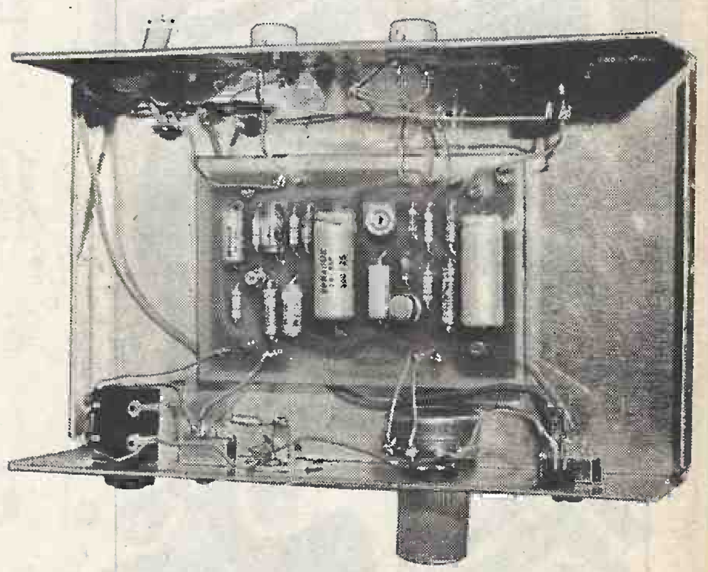
Although this is a Public Address amplifier it is not a very powerful unit by normal public address standards. Nevertheless, when used with a directional re-entrant horn loudspeaker, it is very effective and would be ideal for amplifying the voice of a speaker at an average sized garden fête or it could be used as a mobile amplifier for advertising from a moving car. It provides an output of just over 2 watts RMS into an 8Ω loudspeaker increasing to about 6 watts when used with a 3Ω loudspeaker. Two alternative inputs are provided, one for a 600Ω moving coil microphone and the other for, typically, a cassette tape recorder output. SK2 is the microphone input and, in the case of the prototype, maximum power output was obtained when using a Foster Low Impedance Microphone, type DF100.

Other microphones may be used but they MUST be moving coil (dynamic) types and should be of low impedance. SK1 is the phono input the sensitivity of which is set by the value of R1. A value of 470kΩ is suitable for a Philips cassette tape recorder allowing maximum output when VR1 is set at maximum, without any undue distortion. To obtain higher input sensitivity R1 should be reduced.

No great claims are made for the musical quality of the amplifier except to say that it is more than adequate when used with directional loudspeakers which, in themselves, leave much to be desired as far as frequency response is concerned. An LED is used as an on-off indicator.

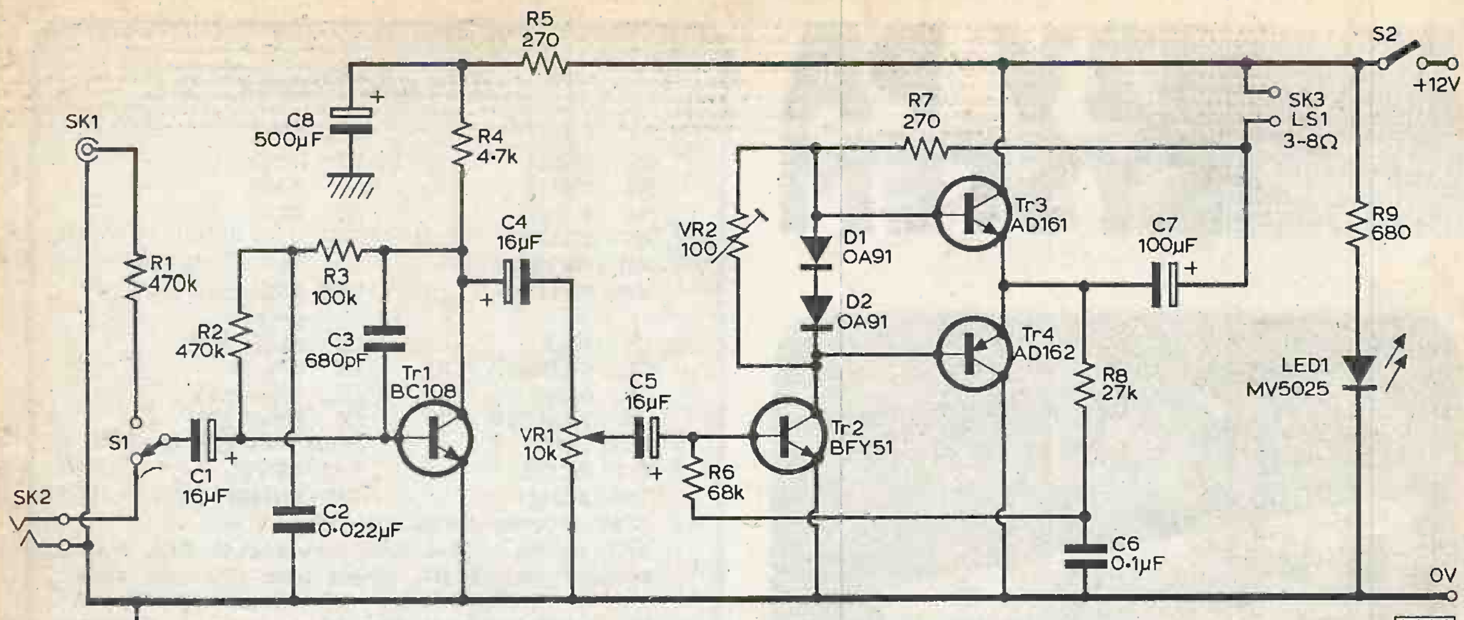
The circuit is straight-forward and conventional. Tr1 serves as a pre-amplifier having fixed gain, the output level of which is manually adjusted by the volume control VR1. C3 is present to reduce the gain of this stage at high frequencies to prevent spurious high frequency oscillations. This component can be varied in value if a more mellow tone is required from the amplifier. Increasing its value to 1500pF gives a more acceptable quality for music but makes speech a little muffled.

Tr2 provides the drive to the complementary output pair which operate in Class B thus lowering power con-



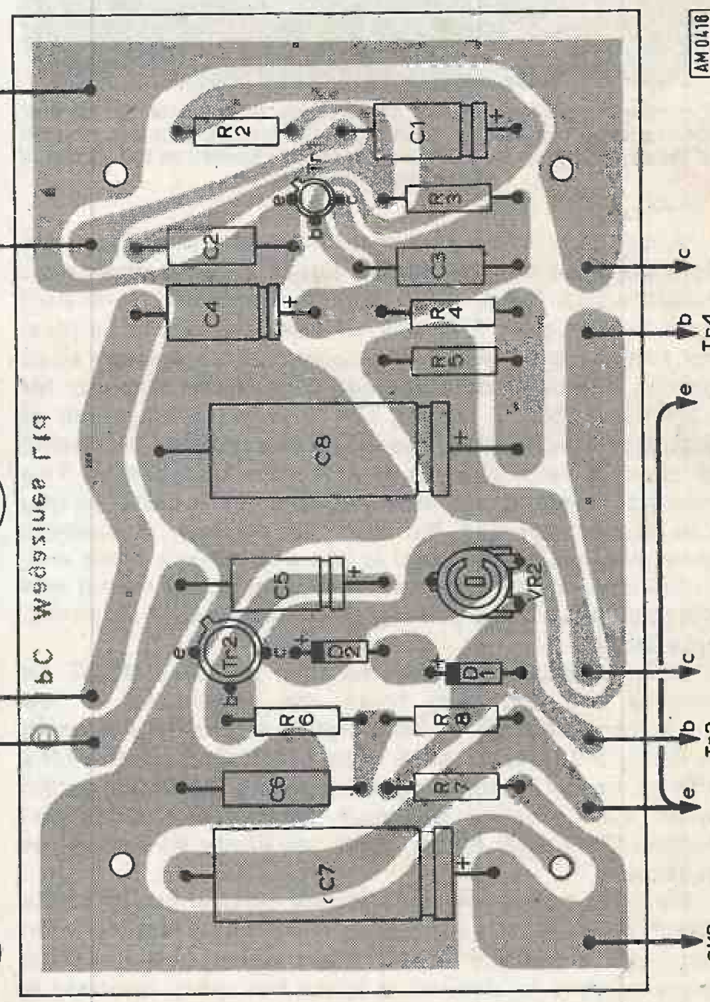
sumption. The quiescent current is set by adjusting VR2 from minimum resistance until the total current consumption is about 35mA under no signal conditions. If you do not have a meter to check the current start with VR2 set to minimum resistance and play some music from a tape through the system with VR1 set about half way. It will sound very distorted, due to crossover distortion in the output stage. Slowly increase the value of VR2 until the distortion JUST disappears, the optimum setting of the control.

There are few problems to be encountered in assembly. Use mica spacers and insulating bushes when mounting Tr3 and Tr4 to the outside of the chassis and drill clearing holes for the leadouts. Ensure that all diodes, transistors and electrolytic capacitors are fitted to the circuit board with the correct polarity. When fixing the circuit board into the cabinet make sure that the spacers used do not short across between the earthed area of the PCB's foil and any other part of the PCB.



Circuit of the PA system. The printed circuit board, below left, is actual size. Below, right, shows the layout and associated wiring.

W114



IMPORTANT NOTE

This circuit can only be used with negative earth vehicles if it is intended to mount the unit under the dashboard. With the same application in mind make sure that the loudspeaker leads do not make contact with the chassis of the vehicle and that the speech coil is isolated from the metal work of the loudspeaker. Remember that the car should be properly suppressed electrically to avoid interference when using the amplifier while moving.

Fully drilled epoxy glassfibre printed circuit boards which have been roller-tinned can be obtained for these projects from:—
W.K.F. Electronics, Welbeck Street, Whitwell, Worksop, Notts., S80 4TW.
Radio-Pickup Link, 12V PA System and Random Number Selector are each 98p plus 10p post and packing. The Sound-to-Light Display is £1·15 plus 10p post and packing.

A.C. AINSLIE* & C. TOMS†

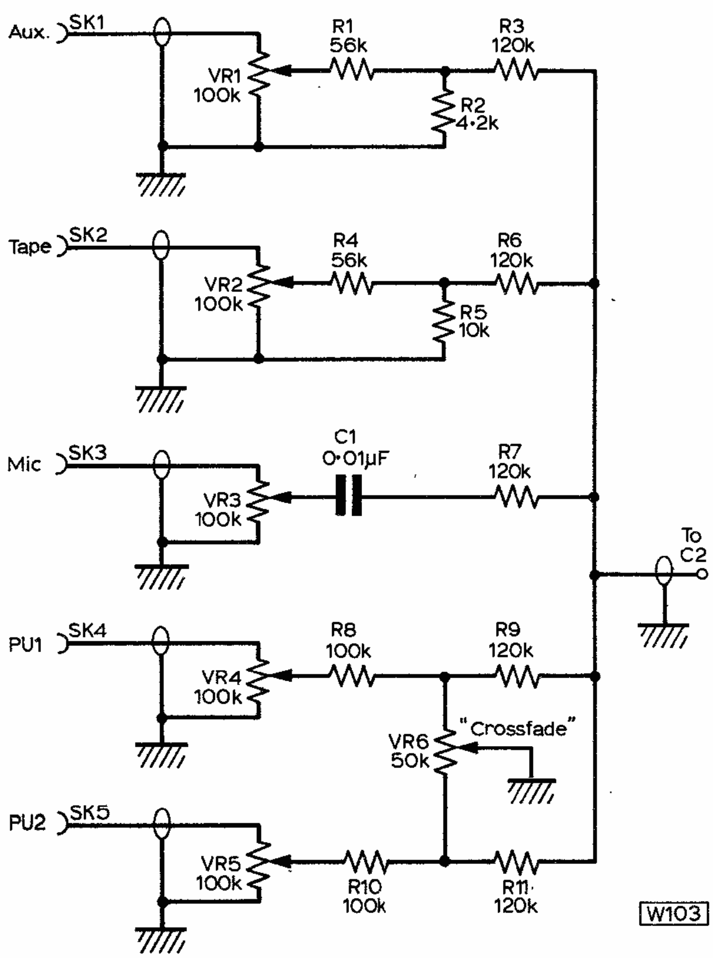


Fig. 1: Circuit diagram of the mixer.

Linear pots are used for the level controls as, feeding into a relatively low impedance, they behave in a semi-logarithmic manner.

PRE-AMPLIFIER

The power amplifier requires 800mV r.m.s. from the pre-amp to deliver full power output. Due to the use of a simple passive mixer of low output the pre-amp is required to have higher gain than usual, and employs four transistors, see Fig. 2.

INPUT STAGE

The input stage Tr1 has a medium input impedance and noise is kept to a minimum by operating at a low collector current and fairly low gain. Negative feedback is provided by R12 and R13, while C3 reduces the collector load to A.C.

Tr2 and Tr3 are a D.C. coupled pair with Tr2 passing only a small collector current, again for minimum noise. Overall negative feedback round the pair is provided by R21 which stabilises the D.C. conditions, giving low D.C. gain to the pair. R20 and C6 apply a measure of positive A.C. feedback to Tr2 emitter, offsetting the effect of the negative feedback at signal frequencies. In effect the A.C. gain is defined by the difference between the positive and negative feedback. R24 and C7 stop any tendency towards high frequency instability.

TONE CONTROL

Tone controls are incorporated into the final stage, Tr4. Bass and treble controls in the familiar Baxandall configuration are connected in the collector-to-base feedback loop of the transistor. This feedback system gives a low collector impedance to Tr4 allowing the tone controls to be varied independently over a wide range. When the treble control is fully advanced, the gain of the final stage increases rapidly with frequency. To curtail this rise above 20kHz a small capacitor (C14) applies high frequency negative feedback.

A "top cut" control is brought into operation by closing S1, connecting C23 across the signal to ground.

Balance and volume controls link the pre-amp to the power amplifier.

SUPPLY REGULATOR

The pre-amp operates from a +30V supply which is derived from the main amplifier supply. Rather than using simple resistance voltage dropping with capacitive decoupling, a single transistor, 30V series stabiliser is used. This provides very effective decoupling of the main supply rail, which, in view of the high power output of the amplifier, is bound to fluctuate considerably under load.

Tr5 acts as the pre-amp supply regulator and is connected as a simple emitter follower with a constant 30V on its base from D1. R33 provides the standing current for the Zener diode as well as base drive forTr5.

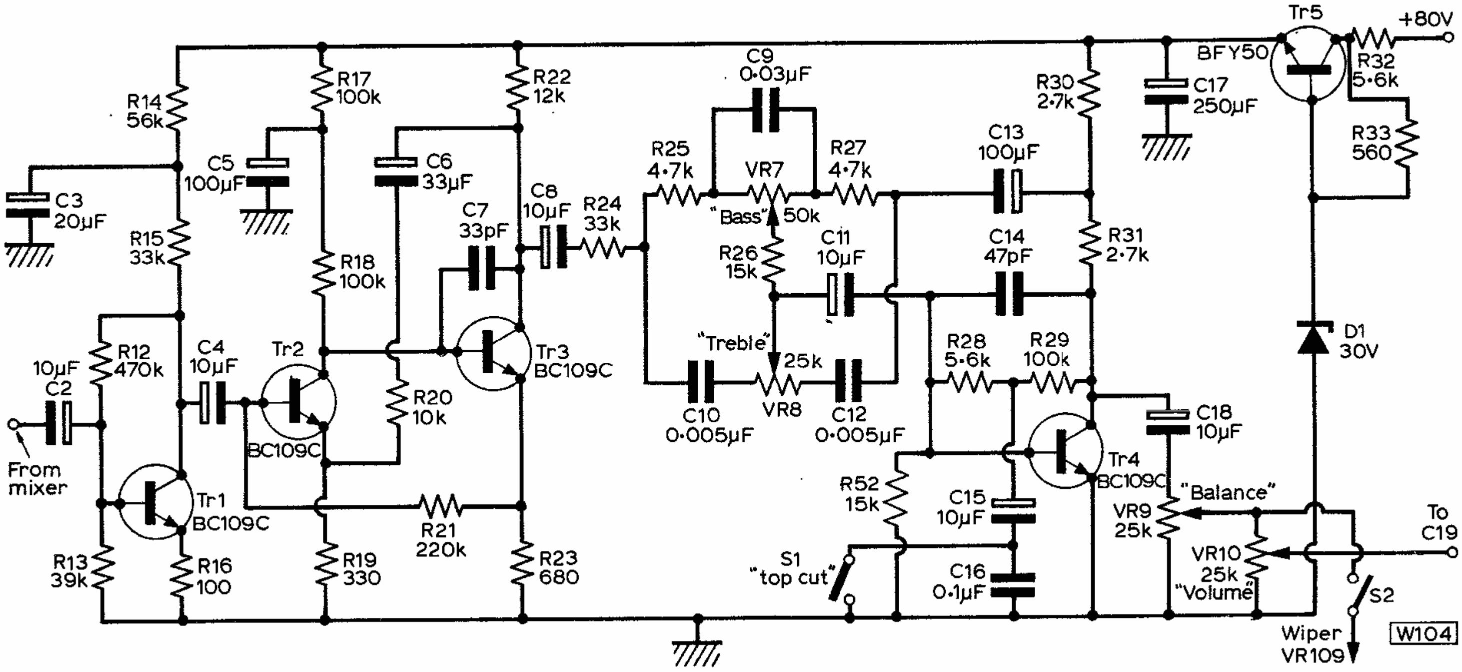


Fig. 2: Circuit diagram of the preamplifier.

POWER AMPLIFIER

The amplifier is a class B design operating from an 80V supply (65V on full load). Feedback round the amplifier gives a constant voltage output so it follows that the output power is dependent on load impedance. Feeding 4 ohms the 20V r.m.s. output develops 100W of load power. Into 8 ohms and 15 ohms the theoretical output would be 50W and 27W respectively, but in practice will be considerably higher as the supply current at full output would not be so great, giving a higher supply voltage. The circuit is shown in Fig. 3.

SLOW SWITCH-ON

A feature of this design is a "slow switch on" circuit which eliminates the output surge that occurs with conventional designs as the output capacitor charges when power is applied.

Transistors Tr9 and Tr10 are connected as a Darlington pair emitter follower in the emitter of the driver, Tr11. Initially on switch-on C22 is discharged and slowly charges to full supply voltage, bringing the emitter of Tr10 up to supply voltage. This slow turn-on of the driver gives a controlled rise to the D.C. voltage across the output capacitor, eliminating surges.

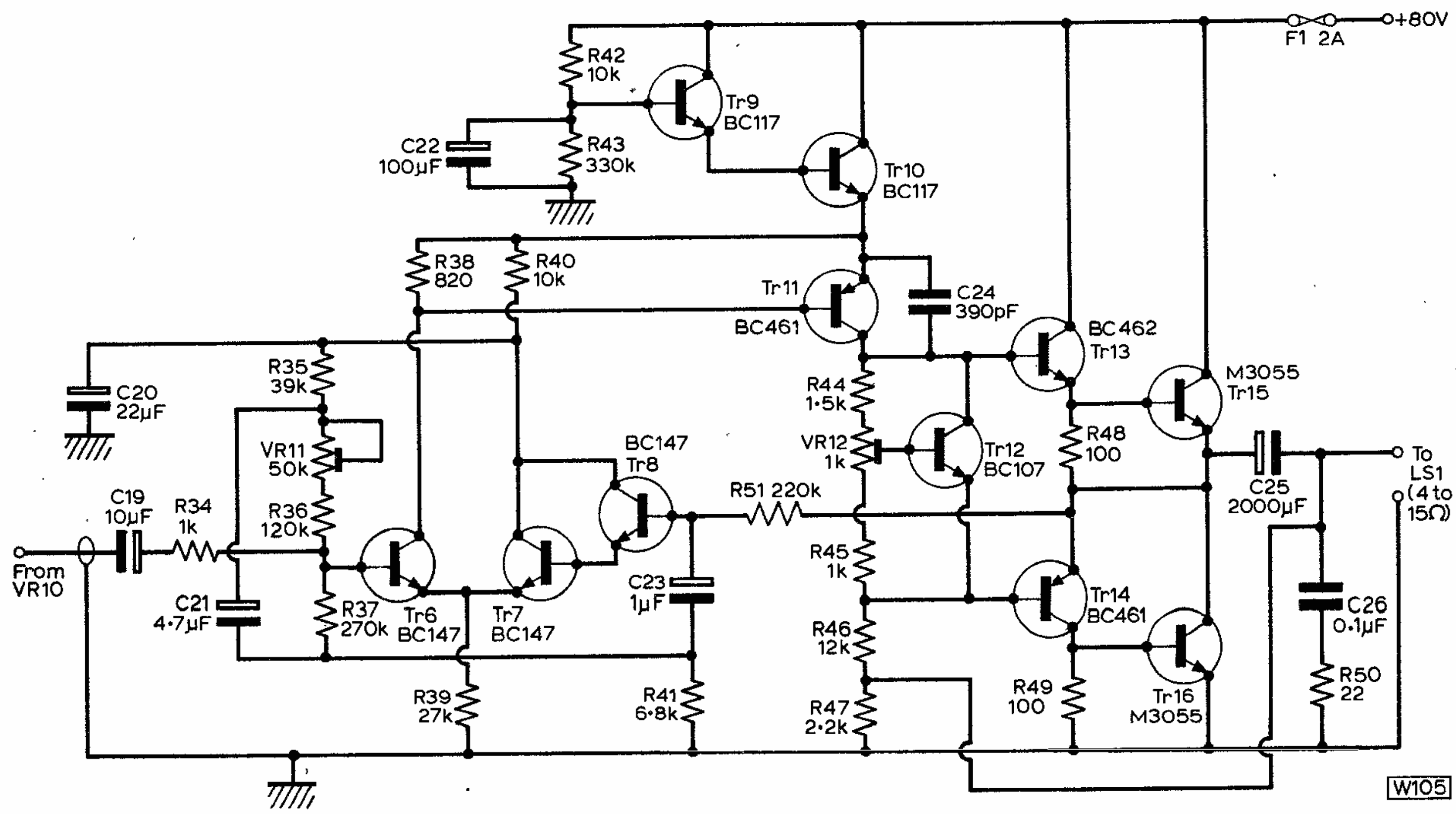


Fig. 3: Circuit diagram of the power amplifier. A 100μF smoothing capacitor (C29) is required between 80V and GND.

The collector load of the driver Tr11 consists of Tr12, R46 and R47; Bootstrapping R47 increases its effective A.C. resistance giving Tr11 high A.C. gain.

BIAS STABILISER

Tr12 acts as bias stabiliser for the quasi-complementary output stage, Tr13/14, Tr15/16. It is connected as a "V_{be} multiplier" whereby the voltage across emitter and collector is a multiple of its V_{be} determined by the setting of VR12. To just turn on the output stage a potential of three V_{be}'s must be applied between Tr13 and Tr14 bases to overcome the V_{be}'s of Tr13, Tr14 and Tr15.

The V_{be} of Tr12 varies with ambient temperature to maintain a constant standing current in the output stage.

The effect of too low a standing current is cross-over distortion, more pronounced at high frequencies as the amplifier runs out of loop gain and feedback is consequently reduced. This amplifier has been designed for a standing current of 10mA in Tr15 with the transistors at working temperatures.

DIFFERENTIAL AMPLIFIER

The front end of the power amplifier is a differential amplifier formed from Tr6 in one side of a "long tailed pair", with Tr7/Tr8 connected as a Darlington pair in the other side. Tr6 base is the non-inverting input, while Tr8 base is the inverting input.

The audio input is fed to Tr6 base while Tr8 receives feedback from the output via R51. The emitter coupling between Tr6 and Tr7 (the common "longtail" connection) completes the A.C. feedback path round the amplifier.

Tr8 collector is decoupled to A.C. by C20 and D.C. feedback from this point to Tr6 base through R35 and R36 serves to stabilise the D.C. conditions of the amplifier overall.

For maximum output power and symmetrical clipping, the no-output D.C. voltage at the positive end of C25 should be one half of the supply voltage; this condition is set by adjustment of VR11.

STABILITY

Apart from the input and output capacitors the amplifier is completely D.C. coupled, and the large feedback factor ensures high stability. C24 shunts Tr11 at high frequencies so that the gain of the

★ components lists

MIXER

Resistors

R1, R101	56kΩ	All ¼W ±5% carbon
R2, R102	4·2kΩ	
R3, R103	120kΩ	
R4, R104	56kΩ	
R5, R105	10kΩ	
R6, R106	120kΩ	
R7, R107	120kΩ	
R8, R108	100kΩ	
R9, R109	120kΩ	
R10, R110	100kΩ	
R11, R111	120kΩ	
VR1-5, VR101-105	100kΩ linear tandem (5 off)	
VR6, VR106	50kΩ linear tandem	

Capacitors

C1, C101 0·01μF 100V ceramic

Sockets

SK1-5, Stereo jack sockets (5 off)

PREAMPLIFIER

Resistors

R12, R112	470kΩ	R23, R123	680Ω
R13, R113	39kΩ	R24, R124	33kΩ
R14, R114	56kΩ	R25, R125	4·7kΩ
R15, R115	33kΩ	R26, R126	15kΩ
R16, R116	100Ω	R27, R127	4·7kΩ
R17, R117	100kΩ	R28, R128	5·6kΩ
R18, R118	100kΩ	R29, R129	100kΩ
R19, R119	330Ω	R30, R130	2·7kΩ
R20, R120	10kΩ	R31, R131	2·7kΩ
R21, R121	220kΩ	R32, R132	5·6kΩ
R22, R122	12kΩ	R33, R133	560Ω
All ¼W ±5% carbon		R52, R152	15kΩ

VR7, VR107 50kΩ linear tandem
VR8, VR108 25kΩ linear tandem
VR9, VR109 25kΩ linear tandem
VR10, VR110 25kΩ log tandem

Capacitors

C2, C102 10μF 25V elect
C3, C103 20μF 25V elect
C4, C104 10μF 25V elect
C5, C105 100μF 25V elect
C6, C106 33μF 25V elect
C7, C107 33pF ceramic
C8, C108 10μF 25V elect
C9, C109 0·03μF 100V polyester
C10, C110 0·005μF miniature polyester
C11, C111 10μF 25V elect
C12, C112 0·005μF miniature polyester
C13, C113 10μF 25V elect
C14, C114 47pF ceramic
C15, C115 10μF 25V elect
C16, C116 0·1μF 100V polyester
C17, C117 250μF 40V elect
C18, C118 10μF 25V elect

Semiconductors

Tr1, Tr101 BC109C
Tr2, Tr102 BC109C
Tr3, Tr103 BC109C
Tr4, Tr104 BC109C
Tr5, Tr105 BFY50
D1, D101 BZX61 30V 1·3W Zener

Miscellaneous

S1 D.P.D.T. miniature toggle
S2 S.P.S.T. miniature toggle

POWER AMPLIFIER

Resistors

R34, R134	1kΩ	R44, R144	1·5kΩ
R35, R135	39kΩ	R45, R145	1kΩ
R36, R136	120kΩ	R46, R146	12kΩ
R37, R137	270kΩ	R47, R147	2·2kΩ
R38, R138	820Ω	R48, R148	100Ω ¼W metal oxide
R39, R139	27kΩ	R49, R149	100Ω ¼W metal oxide
R40, R140	10kΩ ¼W metal oxide	R50, R150	2Ω
		R51, R151	220kΩ
R41, R141	6·8kΩ		
R42, R142	10kΩ ¼W metal oxide		
R43, R143	330kΩ		

All ½W —5% unless otherwise stated

VR11, VR111 50kΩ miniature horiz preset

VR12, VR112 1kΩ miniature horiz preset

Capacitors

C19, C119 10μF 25V elect

C20, C120 22μF 100V elect

C21, C121 4·7μF 63V elect

C22, C122 100μF 100V elect

C23, C123 1μF 100V polyester or tantalum

C24, C124 390pF 160V polystyrene

C25, C125 2000μF 50V elect (840mA A.C. ripple at 50Hz)

C26, C126 0·1μF 100V polyester

C29 100μF 100V

Semiconductors

Tr6, Tr106	BC147	Tr12, Tr112	BC107
Tr7, Tr107	BC147	Tr13, Tr113	BC452 } matched
Tr8, Tr108	BC147	Tr14, Tr114	BC461 } pair
Tr9, Tr109	BC117	Tr15, Tr115	M3055
Tr10, Tr110	BC117	Tr16, Tr116	M3055
Tr11, Tr111	BC461		

Miscellaneous

F1, F101 2A 20mm fuse and p.c.b. clips

Heatsinks for M3055 transistors (R.S. type 180), heatsinks for Tr16, 18 and 19 (R.S. type 154), TO3 insulating kit for Tr20 and 21, terminal pins (10 off), p.c.b. (1 p.c.b. required for each channel)

POWER SUPPLY

Capacitors

C27, C28 1000μF 100V elect (2 off)

Rectifier

D2 200V 6·6A REC92 (R.S. Components)

Transformer

T1 55V 5A low flux leakage transformer (B. B. Atkin)

Miscellaneous

S3 S.P.S.T. on/off illuminated rocker switch

F2 5A 20mm fuse and holder

Note: Component numbers greater than 100 refer to the second channel so two of these components are necessary for stereo system. For mono only one of each will be necessary.

MISCELLANEOUS

BSR McDonald turntables (type MP60 or BDS80) (2 off)

Sonotone 9TAHC stereo ceramic cartridge (2 off)

Mains plug and socket

Woodwork (see cutting list) A complete d.i.y. cabinet kit is available from Birch and Ridley (Cabinet makers) Watson Rd., Worksop, Notts. The cabinet kit is supplied in polished teak veneer. The deck board has a cut out for either the BSR MP60 or BDS80 turntables—please specify when ordering. The price is £26·50 + 8% VAT and £3·20 p.&p. Other deck board cut outs may be specified but a pattern plus an extra £1 must be sent with order.

Fully drilled and silk screen printed mixer and mains panels are available from W.K.F. Electronics, Welbeck St., Whitwell, Worksop, Notts, Prices are £5·00 + 30p p&p and £2·50 + 15p p&p respectively.

Amplifier and Light Modulator components are available from Worksop Electronics, 24 Vessy Rd., Worksop, Notts. Send s.a.e. for price list.

Transformers, inductors and accessories are available from B. B. Atkin Electronics, 1 Windsor Walk, S. Anston, Nr Sheffield, Yorks. S.a.e. for price list.

Printed circuit boards for the amplifier and light modulator are available from W.K.F. Electronics. Prices are £3·40 + 18p p&p (two required for stereo) and £2·70 + 18p p&p respectively.

MP60 type turntables are available from R & TVC, 323 Edgware Road, London W2, price £14 + £1·50 p.&p. BDS80 type turntables are available from Maplin Electronic Supplies, PO Box 3, Rayleigh, Essex price £27·95 (VAT and postage included).

amplifier is reduced well before the output stage cut-off frequency is reached, ensuring good transient response with minimum transient distortion and overshoot.

The Zobel network C26 and R50 is connected across the output to compensate for the inductive nature of a loudspeaker load, further assisting stability.

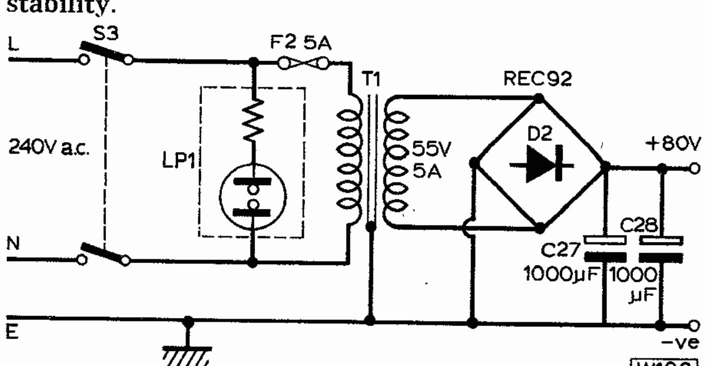


Fig. 4: Circuit diagram of the power supply.

THE POWER SUPPLY

Owing to the very high stability of the power amplifier and the series stabilisation of the pre-amplifier, there was no advantage to be gained by the use of a stabilised power supply. Another factor is that, owing to this very high stability large smoothing capacitors have also been unnecessary.

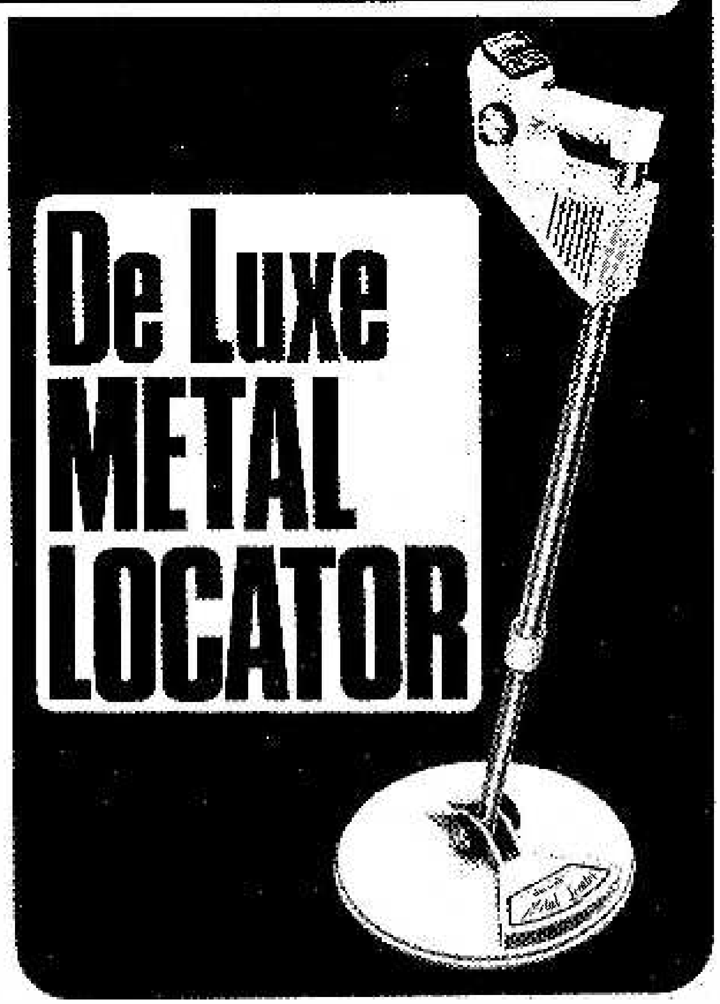
Transformer T1 is a low flux leakage transformer capable of delivering 55V D.C. at 5A. D2 is a full wave bridge rectifier. For full-wave circuits, the average current per rectifier is $0{\cdot}5 \times I_{d.c.}$ Each rectifier should have a V_{rrm} rating in excess of $1{\cdot}4 \times V_{a.c.}$ C27, C28 is a 2,000μF capacitive filter rated at 100 VDC. No additional smoothing was found necessary.

As the $V_{d.c.} = 1{\cdot}41 \times V_{a.c.}$, in this type of circuit and the $I_{d.c.} = 0{\cdot}62 \times I_{a.c.}$ the supply voltage and current are adequate.

In Part 2 next month details of the Light Modulator and construction of the system will be described.

SPECIAL PRODUCT REPORT

HEATHKIT GD-348



THE GD-348 De Luxe Metal Locator is designed to meet the needs of the more sophisticated treasure seeker. This instrument uses the induction balance method of operation and is typically capable of detecting the presence of a small coin at a distance of about 150mm (6in.) in air.

CIRCUIT DESCRIPTION

Transistors Q101, Q102 form an audio relaxation oscillator, Fig. 1, operating at about 500Hz, whose output is applied to the search coil L301 which is tuned to resonate at 100kHz. A modulated RF field thus surrounds the coil. The search coil and the pickup coil, L302, are so designed that there is virtually no magnetic coupling between them. The Null control R301 allows the signal due to the residual coupling to be balanced out in the absence of any metallic object.

When the search coil is passed over a metal object, a current is induced in the object, which sets up its own magnetic field. This field in turn induces a current in the pickup coil which provides the signal used for detection. This signal is passed through an active filter and amplifier formed by transistors Q103, Q104 whose output is detected by diode D101 to recover the 500Hz audio signal.

A fixed-gain amplifier Q201, Q202 raises this signal to a suitable amplitude to operate the level detector Q203. This transistor's bias is adjusted by the Sensitivity control R302 (the second operator control) to be just in saturation when only noise and residual audio are present. As soon as a small audio signal arrives, indicating the proximity of metal, Q203 plus the output amplifier Q204, Q205 amplify it to a level sufficient to drive the built-in loudspeaker or optional headphones. The output also feeds the output meter M301. This is protected by a shunt transistor Q206 which is brought into conduction by very large signals.

CONSTRUCTION

The majority of the circuitry is mounted on two small printed circuit boards, one of which is fitted in the search coil housing and the other in the handle housing. Construction begins with the assembly of these boards, which is straightforward and well documented in the usual Heathkit fashion. Assembly of the rest of the parts mounted in the handle housing similarly presents no headaches. The same, unfortunately, cannot be said of the assembly of the telescopic shaft and the wiring which runs through it, which took well over one third of your reviewer's total assembly time.

The interconnecting wiring requires five cores and Heath get round this by using part of a coiled four-core telephone handset-style lead, plus a single wire which the constructor has to form into a coil and feed down the centre of the four-core cable. Because only a part length of a coiled

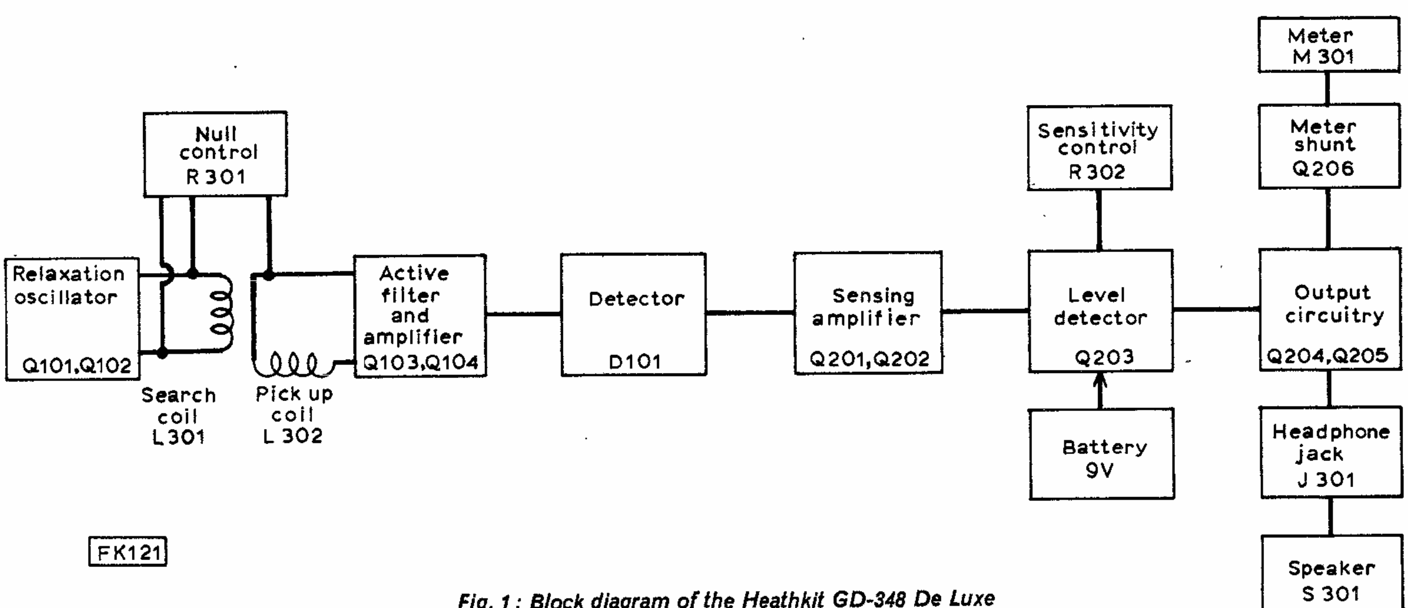


Fig. 1: Block diagram of the Heathkit GD-348 De Luxe Metal Locator.

lead is used, it means that at least one end of the cable will be from the "curly" part. I have never had to try to strip one of these before, but I can assure you that it is not an exercise to be recommended unless you are both patient and dexterous. The same comment applies to the operation of threading the concentric coils of wire safely through the shaft and the various obstacles at each end.

The final stage of construction, assembly of the search coil housing, poses no problems. If initial tests prove satisfactory, the application of waterproof sealant to all the housing joints completes assembly. The whole process, from unpacking the parts to final testing, took your reviewer just six hours.

OPERATION

The two controls, Null and Sensitivity, allow very sensitive adjustment of the instrument, which proved during tests to be capable of detecting the heads of floorboard nails and would even register the presence or absence of carpet over those floorboards. By offsetting the Null control from its optimum position, the locator can differentiate between ferrous and non-ferrous metals; very useful to the treasure hunter.

The whole instrument is powered from a 9V battery which has a life of about 50 hours. The telescopic handle allows the overall height to be adjusted between 710 and 915mm (28 and 36in.). The search coil housing is waterproof and is submersible to a depth of 610mm (24in.). It folds flat against the shaft for transit or storage. The whole instrument weighs 1·6 kg (3½ lbs.)

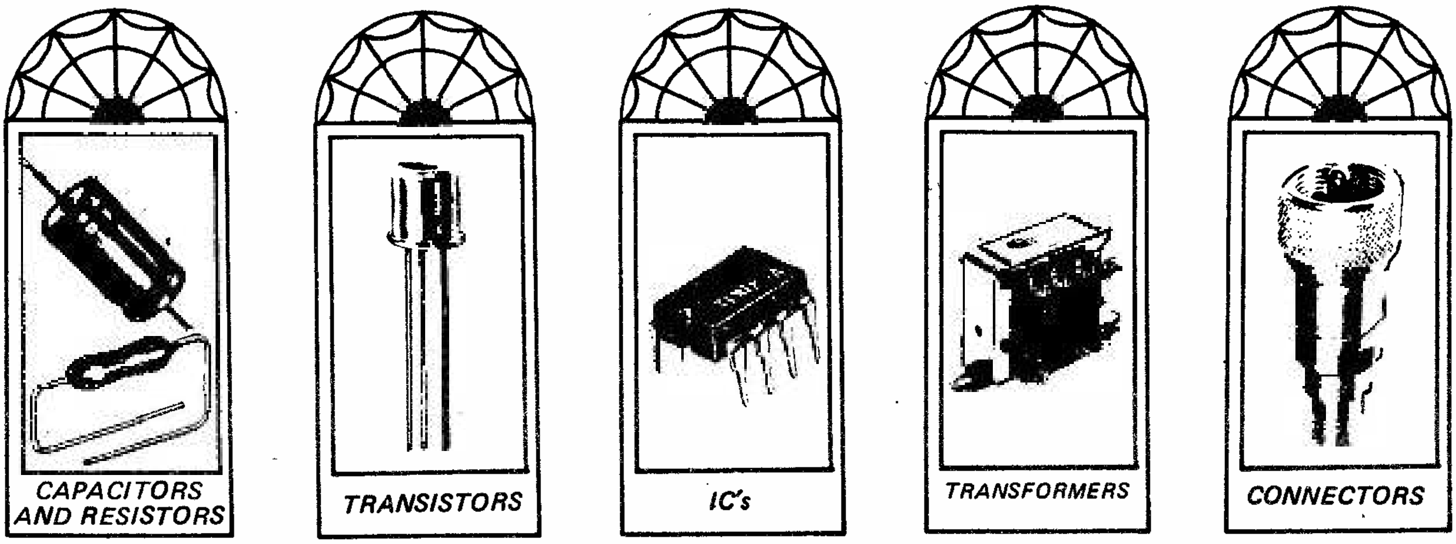
Heath offer two optional accessories. The first, headphones, proved very useful in noisy locations and, indeed, in very quiet ones where the 500Hz tone from the loudspeaker can be a bit shattering, there being no volume control. The second accessory is a zippered plastic carrying case, rather reminiscent of a golfing bag.

Price of the GD-348 kit is £58·20. The headphones, Model GD-396 cost £5·70 and the carrying case, Model GDA-348-1 £5·50. All prices are inclusive of VAT and delivery within the United Kingdom.

Further details are available from Heath (Gloucester) Limited, Bristol Road, Gloucester GL2 6EE (telephone 0452-29451) or from the London Heathkit Centre, 233 Tottenham Court Road, London W.1.

SPECIFICATION

Electrical	
Frequency	Search coil oscillator: 100kHz Audio modulation: approximately 500 Hz
Power Source	9 volt battery (PP6)
Battery Life	50 hours (approximate, under normal operating conditions)
General	
Detection Method	Induction balance circuit
Detector Output	Built-in meter and speaker. Phone jack provided for accessory headphones
Search Coil Diameter	254mm (10in.)
Overall Dimensions	Search coil housing: 265mm (10½in.) Extended height: 915mm (36in.) Collapsed height: 710mm (28in)
Waterproof	Search coil housing submersible to 610mm (24in.)
Net Weight	1·6kg (3½ lbs.)



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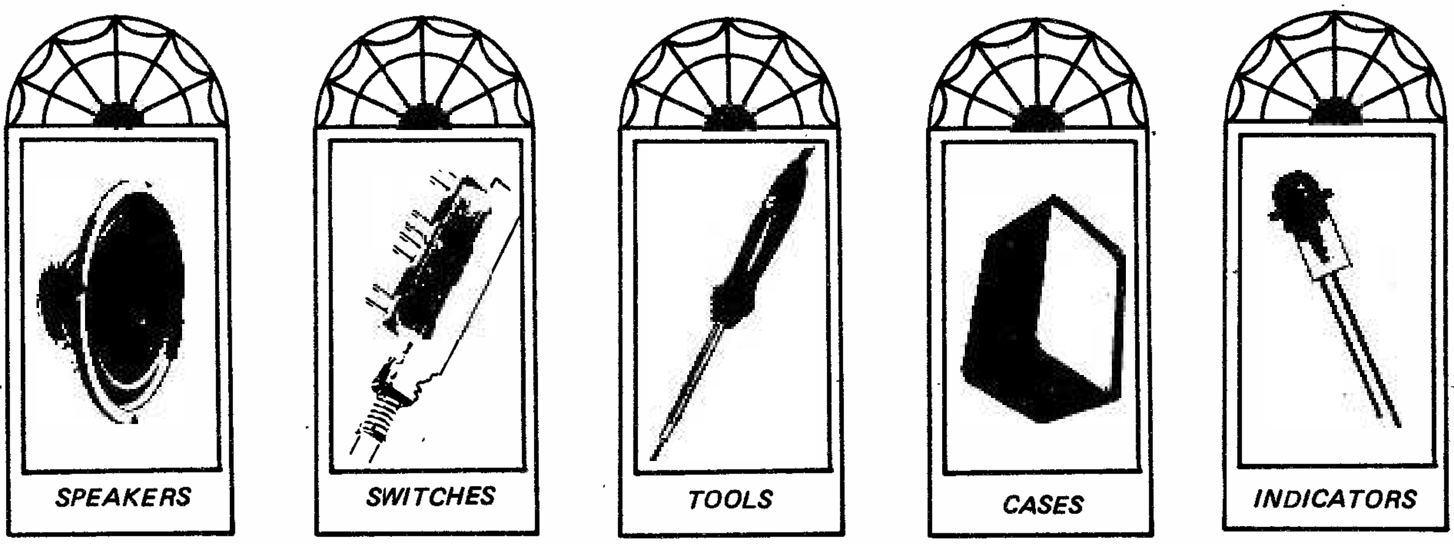

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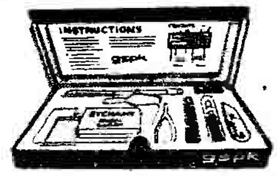

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PART 3

B. BARNARD

TRACKING

While it is a matter more of maintenance than "improvements", I feel that a few words on tracking are not out of place. All the work on the gram side already described will be largely spoiled if the stylus and arm track badly and produce serious harmonic distortion. Budget stereo almost always comes with one of the well-known and quite excellent budget decks. Lateral tracking will have been taken care of in the design so we have no need to worry about that for it is very unlikely to deteriorate with wear and tear. However, there are some other points which should be examined carefully from time to time or sound quality may slowly deteriorate.

The first is that budget decks require to be level, more so than the expensive sophisticated ones. So arm yourself with a spirit level, check that the instrument is level on whatever piece of furniture it stands. This check, by the way, sometimes produces unpleasant surprises! Next check that the cartridge shell is also level, that is, parallel with the turntable. The vertical tracking angle, the angle the stylus arm trails in the groove when playing, is most important. Unfortunately it is almost impossible to measure it so we have to get at it another way.

See that the flat part of the cartridge underside is perfectly parallel with the record surface and this will ensure that the vertical angle is within limits. Some budget decks (the Garrard SP25 is one) have the pickup arm tilting downward towards the record; a small plastic wedge is supplied to fix between the cartridge and the shell to counteract this: make sure there is one fitted and that it is fitted the right way round.

My last point concerns wear and tear on the Garrard deck. The pickup arm rests in a cradle at its pivot end and is held in place by two small screws which go into the metal tube from the underside. After a lot of use these screws can work loose with the result that the arm, and therefore the cartridge, can rock about the arm axis. This will cause the stylus to meet the record groove at some angle very different from 90° which can cause horrible distortion and loss of output on one channel. The arm is easily removed by unscrewing the two large screws which provide pivots for the vertical arm movement, one on each side of the assembly, and gently lifting it out of its cradle. The holding screws for the arm are then easily accessible and can be tightened.

MORE REFINEMENTS

In previous articles I described the various modifications that I have carried out to a budget stereo outfit, costing £80 cash-and-carry, which brought it, in my opinion and that of many visitors who have heard it, into at least the £250 class. I feel more than ever that it can hold its own against many very much more expensive systems in the hi-fi category. I doubt if the cost of the modifications exceeded £20 provided, of course, we ignore completely the hours of planning and labour that went into them. The next step is to upgrade the appearance and functions as much as possible so that what is good, looks good.

Having fitted a tuning meter I cast around for other uses for the meter, to monitor and test certain vital points in the total circuitry. Of the many possibilities that occurred to me, I decided that the resistors in the emitter circuits of the output transistors were the most useful and promising.

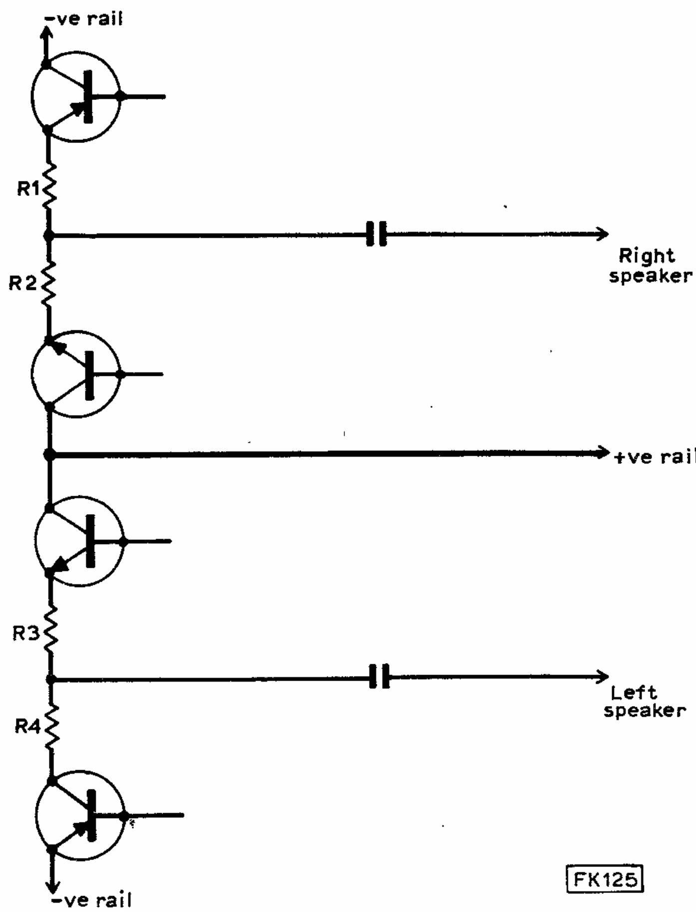


Fig. 1: Typical arrangement of output stage transistors, the test meter being switched across each emitter resistor in turn.

Figure 1 shows a circuit of four output transistors for both left- and right-hand amplifiers and is typical. The currents through R1, 2, 3 and 4 under no-signal conditions are the quiescent conditions and are of the highest importance where crossover distortion is concerned. In addition to this, if a **small** constant amplitude signal is applied to each amplifier in turn, measurement of these currents will monitor the behaviour of each output transistor and check that all are giving the correct and equal AC output. Obviously we cannot keep breaking into the circuit to measure these currents but we can, by some reasonably simple switching, connect the 50mV meter across each resistor in turn.

These emitter resistors are usually between 0·5 and 1·5Ω and in this particular circuit they are 1Ω each which is very fortunate as it means the meter reads directly, volts for milliamps, that is a reading of 15mV means 15mA. If the resistance values are different from this, the calculations to obtain equivalent currents to scale readings are quite simple or one can simply mark on the meter scale a normal reading and work to that. Our tuning meter on the front panel in this way becomes a multi-purpose instrument which carries out useful tests.

SWITCHING THE METER

Two single-pole, 6-way break-before-make switch wafers are required, Fig. 2. Only five positions are required with position 2 blank to give some obvious separation between the functions of "Tune" and "Test". Normally the switch is left in the "Tune" position and it must be remembered that the volume control must be turned to zero before moving the switch to "Test", as a strong signal driving the output stages will probably swing the meter needle off the scale.

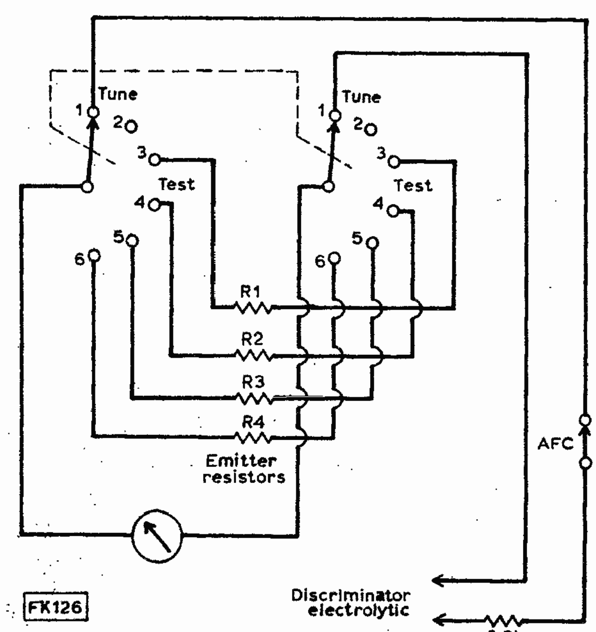
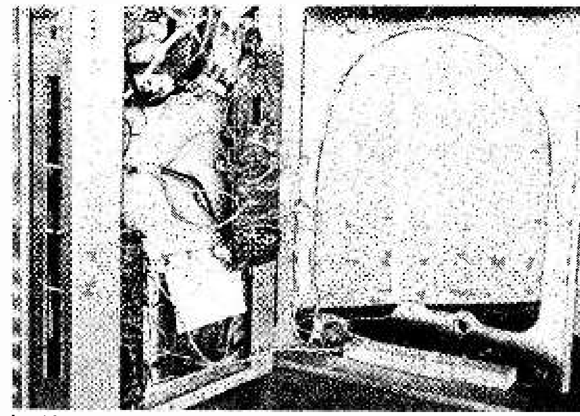


Fig. 2: Switch wiring for test meter measuring the quiescent current of each transistor in the output stage.

Photographs show the meter switch and its wiring. For clarity the playing deck has been removed and only the motor board together with the main body of the instrument is shown. In models like this where the motor board is hinged, there are obvious advantages in mounting the switch as near the hinge line as possible as this reduces the length of the necessary connections and reduces the movement of them



In this view the playing deck has been removed leaving the hinged motor board. The added meter switch and wiring can also be seen.

every time the motor board has to be lifted. The switch has been fitted in the position shown. It is mounted on a small aluminium plate which is screwed to the fancy woodwork that surrounds the playing deck. I had to cut away some of the wood underneath to make room for the switch assembly but this did not spoil the appearance of the cabinet. The leads from the switch are cleated to the back of the motor board and then emerge in loose loops to be soldered to the ends of the respective emitter resistors. The meter leads are cleated to the woodwork close to the switch and then loosely towards the AFC switch and meter. With this arrangement, the leads fall neatly and safely into position when the motor board is lowered as can be seen in the photograph. The small loops going to the power board and the one larger loop of the meter leads are no hazard to the circuit provided the cleating and the soldering are thoroughly sound.

It is essential that the wire used for this work is lightweight and fully flexible. The tags on switch wafers are not usually very strong and if one should break off sometime after the job is done it is an annoying job repairing it. Connect all the wires to the switch before mounting it; making them overlong and establish a colour code for the meter pair and for the four pairs going to the emitter resistors.

I have already found and located one elusive fault that had bothered me for a long time, an intermittent slight reduction of output on one channel which completely upset the stereo image. I thought it must be my imagination but the meter in the "test" position with a constant amplitude signal from my audio generator and the volume control just "on" confirmed the drop was real. With this factual confirmation, it was a matter of twenty minutes or so to find the offending dry joint and put it right. It is worth remembering that with an input signal driving the meter within its scale limits, we are not only monitoring the output circuit behaviour but the drive levels as well.

ILLUMINATION REFINEMENTS

No doubt because of its low price, the dial illumination was sparse and consisted of two 12V pilot lamps edge-lighting the tuning scale, glowing brightly but not very prettily whatever service was in use, and there were no separate lamp indicators to show when "Gram" or "Aux" were in use. I therefore decided to look around the circuit and mechanical arrangements to see if it was possible to fit

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View of the budget stereo system after all the modifications described in this series have been added.

indicator lamps on the panel to light when "Gram" or "Aux" were selected. This really meant searching for spare, unused switch contacts. For good measure I decided to fit a neon mains indicator lamp but this is simple and straightforward.

Luckily spare contacts with 12V DC were ready and waiting for both services. Many models have push-button switches, usually two-pole changeover, requiring only one position, to break the DC supply to the radio section in order to kill it on gram or auxiliary. Figure 3 shows the arrangement showing only the DC contacts concerned.

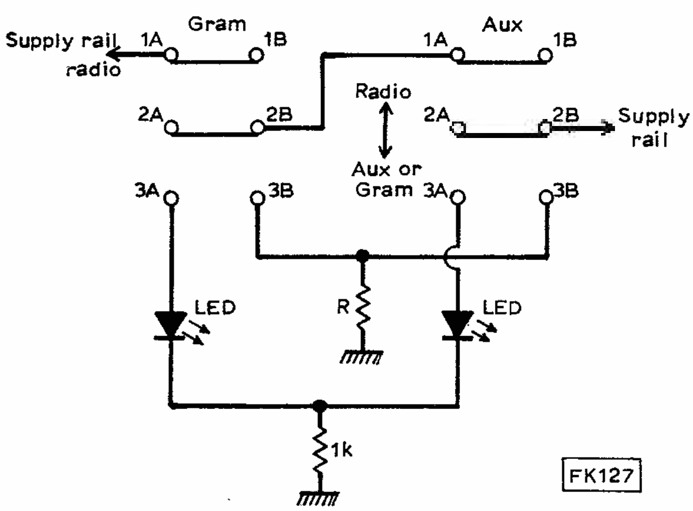

Fig. 3: Additional contacts were found for this switching arrangement for indicating LED's on Aux and Gram.

I decided to use LEDs as they are neat and tidy and I like the even, soft glow. The resistor marked "R" is put in the original design presumably to present a dummy load to the supply when the radio circuits are switched out. As LEDs take up to 50mA it seems sensible to remove "R" when they are fitted. But check with a voltmeter that the supply stays constant and correct on "Radio", "Gram" and "Aux" without "R" in circuit.

HANDLING LED's

There is a space between the facia and the main chassis from which the connecting wires must emerge and a first attempt to connect flexible wires from chassis to the LED wires merely proved that the LED leads are fragile and break off very easily! Eventually I soldered the LED leads to a thin strip of Veroboard, pressing the diode itself closely and safely against the strip. The flex leads can then be connected to the ends of the Veroboard conductors and taken away to the appropriate switch contacts on the main chassis. The LEDs on their respective Veroboard strips can then be safely offered to the panel clips which will have already been fitted to the front panel. For 12V supplies, each LED must be connected through about 1kΩ but in the circuit shown they share the same resistor.

SWITCHED LIGHTING

But the tuning scale light still glows and glows on all services! Hardly daring to hope, I made a further search for spare contacts on the "Gram" and "Aux" switches which would be open when either was selected but would be closed on radio. And I found them. True they had been soldered together in parallel with the contacts feeding DC to the radio chassis so as to share the load but as the radio load was well within the specification of the average push-button switch I decided I could safely separate them.

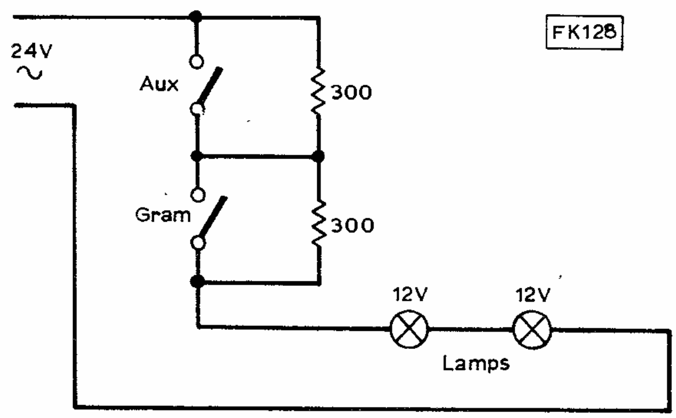

Fig. 4: On Aux or Gram the tuning scale lights are dimmed using this circuit.

The 24V AC for the pilot lamps (the 12V bulbs are in series) was now fed through these contacts so that the scale lamps on "Gram" and "Aux" are extinguished but come back on again as soon as both these buttons are disengaged by the latch action whenever any of the radio buttons is pressed. Unfortunately, edge-illuminated scales look even worse unlit, the scale shows up too clearly in black and white so I had to think again. I decided that the most pleasing arrangement would be if the scale was dimmed on "Gram" and "Aux" but went back to full brilliance on radio. This accounts for the two 300Ω resistors included in Fig. 4 across the switch contacts. They reduce the pilot lamp current when "Gram" or "Aux" is selected and so dim the lamps. The value of these resistors is a matter for experiment depending on the wattage of the lamps and a personal decision as to the degree of "dim-out" that is acceptable.

The colour of the scale illumination was originally a pale pink which I did not find very pleasant and is decided by transparent plastic stuck to the edges of the scale. I changed mine to a dark green by the simple expedient of changing the plastic to one of this colour. PW

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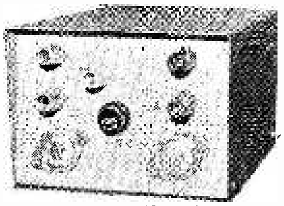

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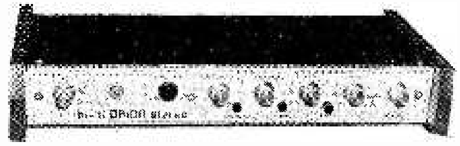

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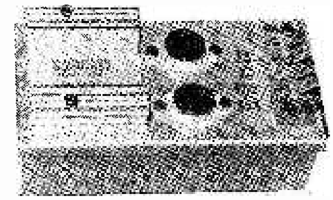

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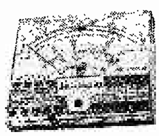

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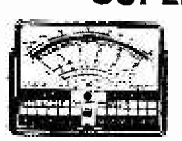

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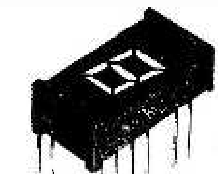

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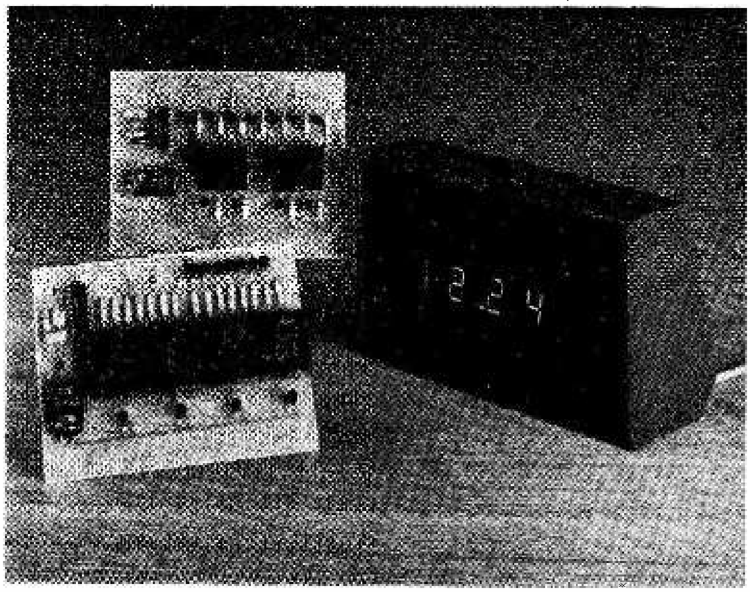

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If one considers a bench supply where sooner or later inadvertent overloads or shorts are almost bound to occur the shunt system has something to recommend it in that it is inherently current limited and therefore short-proof. However, at load currents of more than a few milliamps it becomes very inefficient, since the Zener is called on to carry all the current that the load does not need, and therefore may need to be a high dissipation device.

The series system is the more common, probably because it is far more efficient, since apart from a relatively small loss in the Zener and feed resistor, loss only occurs in the series transistor when it is passing current. The one drawback of the series system is that it is not short-circuit proof (or even resistant), and under fault conditions the transistor can pass a large current with usually disastrous consequences to itself, and probably to the equipment under test.

It is not necessary to have a complicated circuit to achieve the best of the two sorts of regulating systems, and the circuit about to be described is one way of combining the advantages of each system.

The bench supply to be described has a maximum short circuit current of 1A, with the output voltage controllable between 24V and 5V, which should cover most needs except high power amplifiers.

FEEDBACK CONTROL

The simplest way of varying the output voltage is to connect the base of the transistor to a potentiometer placed across the Zener diode in Fig. 2, but this form of control does not give very good regulation at the lower voltages, so a feedback type control will be used, shown in basic form in Fig. 3. Here, the base voltage of TrA, and hence output voltage, is controlled by the voltage drop across RA due largely to the current drawn by TrB, which in turn is a function of its emitter voltage, set by DA, and the fraction of output voltage applied to its base by VRA.

With the slider at the earthy end of VRA, TrB will be cut off, and the only voltage drop across RA will be due to the base current of TrA, and the output voltage will be nearly equal to the collector voltage.

At the other extreme TrB will be turned hard on when the slider is at the positive end of VRA, so that RA and the base of TrA will be almost shorted to DA, giving the minimum output voltage, with intermediates between these extremes.

This feedback action helps to maintain the output voltage set by VRA because if the output voltage drops due to an increasing load, the proportion applied to TrB base also falls, lowering its current demand, so reducing the voltage drop across RA, which therefore increases TrA's base volts, so tending to restore the output to its pre-set value.

If the output tends to rise, the action is reversed. The same effect applies to any ripple left at the output, since this is inverted and fed back to the TrA base so tending to cancel the original variation.

Up to now RB and TrC have been ignored, since they play no part in the proceedings until the current through RB causes a potential difference that exceeds the 'turn-on' voltage of TrC. If RB is, say, 0·5 ohms, a current of 1A through it will cause a base emitter difference of 0·5V across TrC, which will begin to conduct, drawing extra current through RA and diverting it via the load to the negative

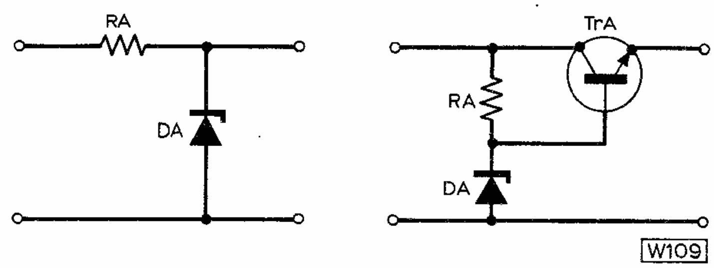


Fig. 1: (left) The simplest shunt stabiliser using a Zener diode. Fig. 2: (right) A simple series stabiliser, which is Fig. 1 with a transistor across the resistor.

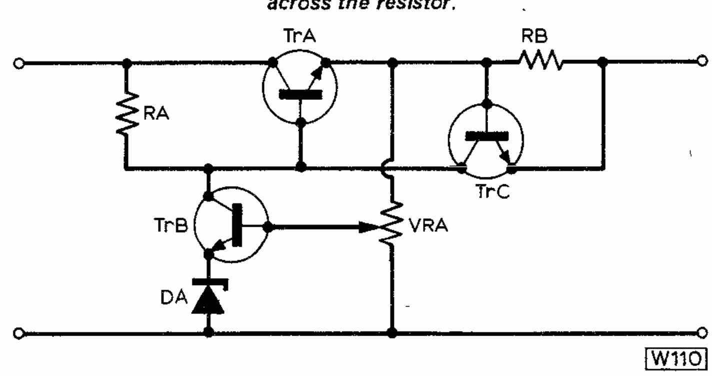


Fig. 3: A more complicated voltage stabiliser using a feedback control system.

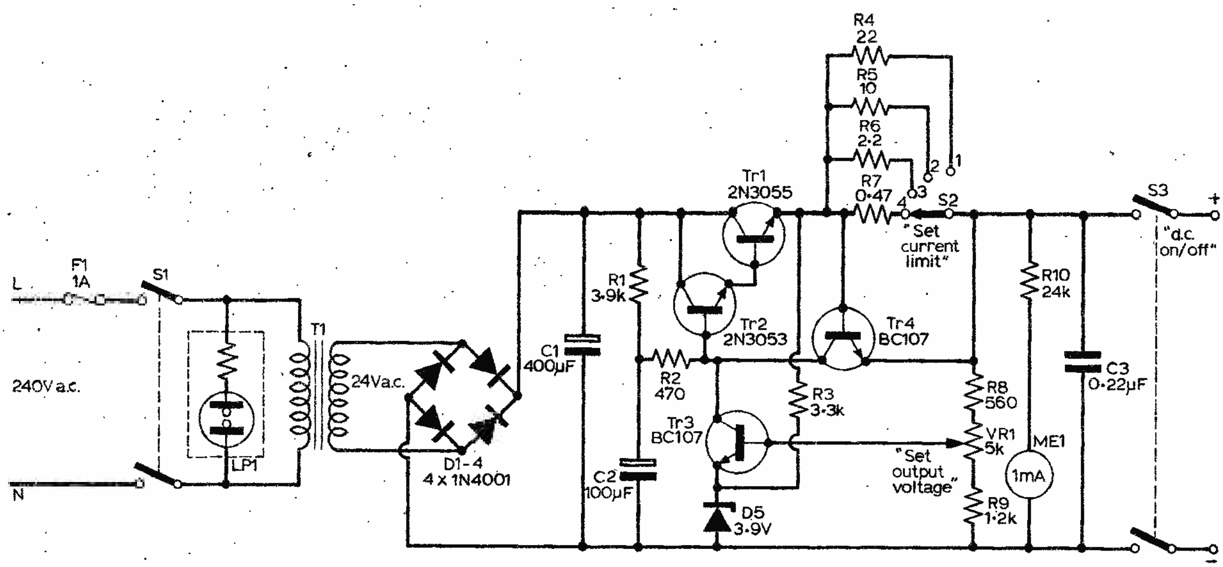


Fig. 4: Complete circuit diagram of the Stabilised Power Supply.

rail. The voltage drop across RA will be increased, lowering the base voltage of TrA, which of course reduces the voltage driving the current through the load such that it will only maintain a maximum current of 1A through any load, even a short circuit.

PRACTICAL CIRCUIT

So, from abstract theorising to a practical circuit (Fig. 4). T1, D1-D4 and C1 perform the obvious conversion of 240V A.C. to about 36V D.C. The main responsibility for smoothing rests on R1, C2 and the series transistors, so C1 need not be as large as might be expected for an unregulated supply, though there is no reason why a larger one could not be used.

To get the extra benefit of the feedback ripple reduction, RA of Fig. 3 has to be split, (into R1 and R2) and C2 connected to the junction rather than at Tr2 base, where it would actually decrease the overall smoothing.

Resistor R1+R2 in total could be as high as 6kΩ but to avoid any risk of Tr3 being starved of current and to ensure that the current taken by Tr2 base is a relatively small fraction of the total current through R1, it should be much less, but this would tend to restore the conditions that Tr2 was added to avoid, so a value of around 4kΩ was chosen.

Obviously the larger the proportion of this that R1 can be, the smaller C2 can be for equivalent smoothing, therefore R2 should be as small as possible. In this case it will be made about ten times the minimum expected base impedance of Tr2, say 470Ω, leaving 3·9kΩ for R1. With C2 at 100µF, this will give a ripple at Tr2 base of less than one per cent of that at its collector.

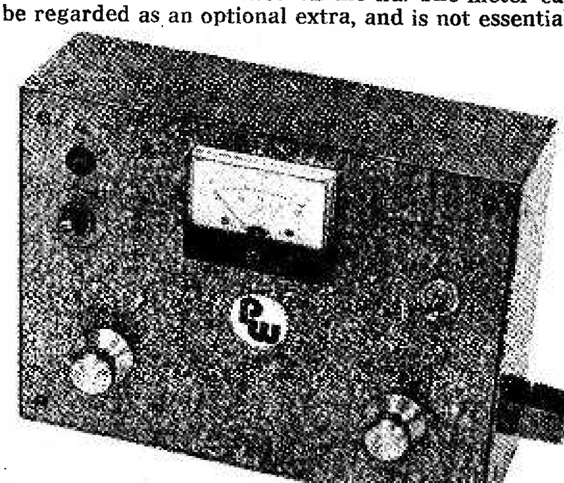
Zener diode D5 needs to be less than the minimum required output voltage, since this, together with the collector to emitter saturation voltage of Tr3, sets the minimum possible output voltage, so, to allow for tolerances, D5 was chosen to be 3·9V. R3 is included as an attempt to keep the variation of current through D5 reasonably stable despite varying output voltages and currents.

The current limit resistors (R4-7) can now be chosen to limit the output current to whatever the constructor feels to be a safe value for a particular purpose, providing that they are never less than 0·47Ω, which gives a maximum current of about 1A. 1Ω will give about 500mA, 5Ω about 100mA and so on. It must be pointed out however, that the 'usable' current before the output voltage pre-set begins to fall significantly is less than the 'short-circuit current.

Capacitor C3 is included to reduce the tendency of amplifiers to oscillate, but constructors should beware of putting any large value capacitor after the output, because while the supply itself can be made to give no more than a safe current, a few hundred microfarad fully charged can easily supply enough current to destroy a transistor which has inadvertently been caused to pass more than its rated current.

CONSTRUCTION

The prototype was made up in an aluminium box with the controls mounted on the lid. The meter can be regarded as an optional extra, and is not essential,



The completed Stabilised Power Supply.

but it does give an indication of overload conditions. S3 is included as a means of switching off the D.C. from a circuit without switching off the power supply, and could also be ignored.

The transformer is mounted on one long side of the box, which becomes the bottom. The output terminals were put at the side partly for preference, but also because the transformer makes it difficult to put them on the front panel in a convenient position.

Transistor Tr1 is bolted to the rear of the box with the leads towards the inside, taking care that it is properly insulated with a mica washer from the case, and if possible, with a smear of heatsink compound or silicone grease on both sides of the mica to aid heat transference. The collector is the case, and connection is best made to this by passing a 6BA screw through the transistor then through the plastic bush which should be pushed through the box from the inside, and then putting a solder tag on before the securing nut. The other end of the transistor is treated in the same way, except that a washer should be substituted for the solder tag.

The other regulator components can be mounted on a piece of Veroboard. It is much easier to drill the 6BA clearance holes and make the breaks in the copper strips at the appropriate points before soldering any components in. It is probably better also to use the Veroboard as a template for drilling the mounting holes in the box rather than measure them out separately, since this should ensure that they line up.

Allowance has been made for four different values of resistor to be selected by S2. As long as the minimum value is not less than 0·47Ω, the other values may be almost any required value. Those shown give nominal values of 1A, 300mA, 80mA and 30mA. Only R7 need be of 1W rating, but small value resistors are not so easily available in carbon film, so 1W wirewound should be used for values less than 10 ohms.

★ components list

Resistors

R1	3·9kΩ
R2	470Ω
R3	3·3kΩ
R4	22Ω
R5	10Ω
R6	2·2Ω 1W wirewound
R7	0·47Ω 1 W wirewound
R8	560Ω
R9	1·2kΩ
R10	24kΩ

All ¼W 5% carbon except R6, R7

VR1	5kΩ linear carbon pot

Capacitors

C1	400μF 40V elect.
C2	100μF 25V elect.
C3	0·22μF polyester

Semiconductors

D1-4	1N4001 (4 off)
D5	3·9V 400mW Zener
Tr1	2N3055
Tr2	2N3053
Tr3	BC107
Tr4	BC107

Miscellaneous

T1	240V AC primary, 24V 1A secondary (Douglas MT79AT)
S1	D.P.D.T. toggle
S2	3 pole 4 way rotary only 1 pole used
S3	D.P.D.T. toggle
ME1	1mA meter
F1	1A fuse and holder
LP1	Mains neon

Metal case, 4mm terminal posts (2 off), insulating set for Tr1, mains cable, knobs, 0·15in pitch Veroboard 24 x 16 holes.

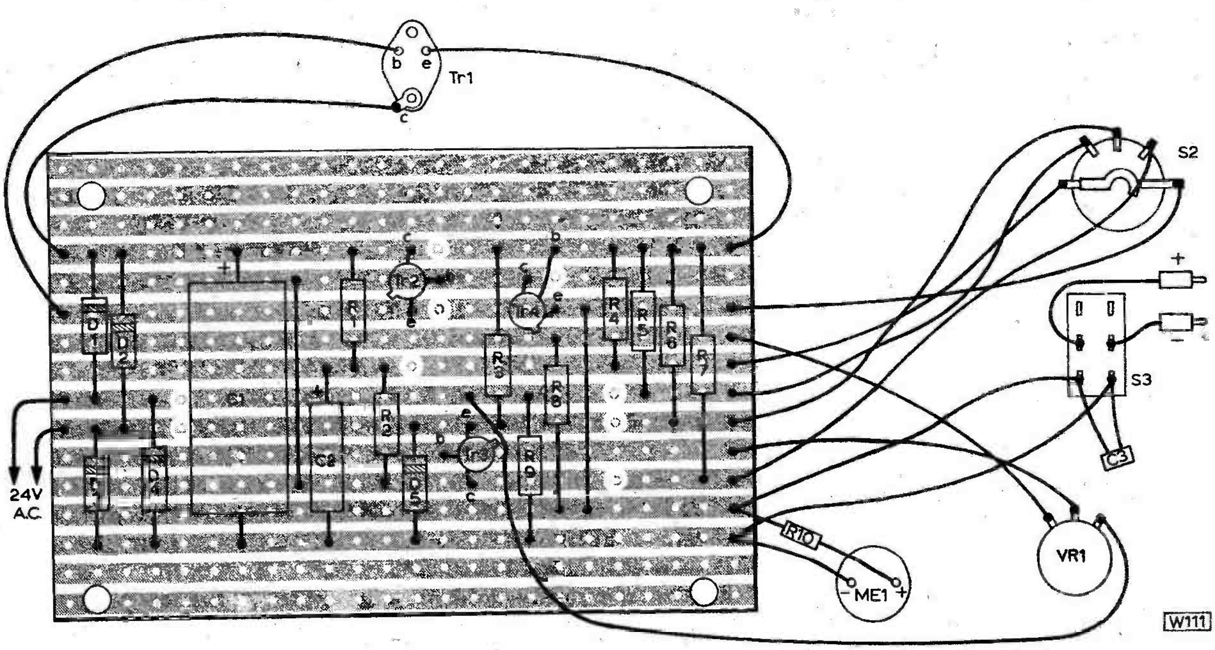


Fig. 5: Layout of the components on the 0·15in pitch Veroboard panel, and connections to the other components. Only one pole of S2 is shown though it is probably easier to use a 3 pole 4 way type.

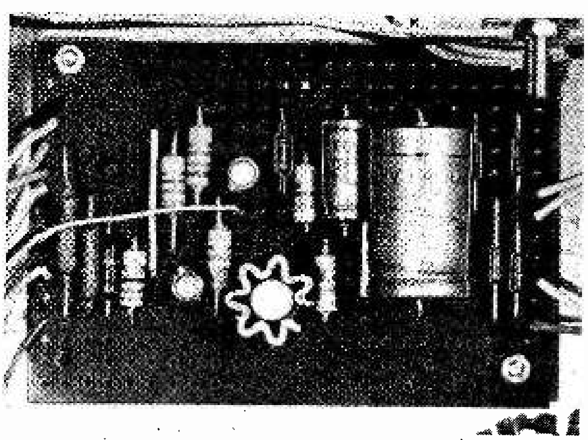
The board should be stood off from the box by insulating spacers—4BA nylon nuts serve the purpose well.

Leave the interconnecting wires long enough from the board to allow them to reach the appropriate points on the front panel when this is removed from the box.

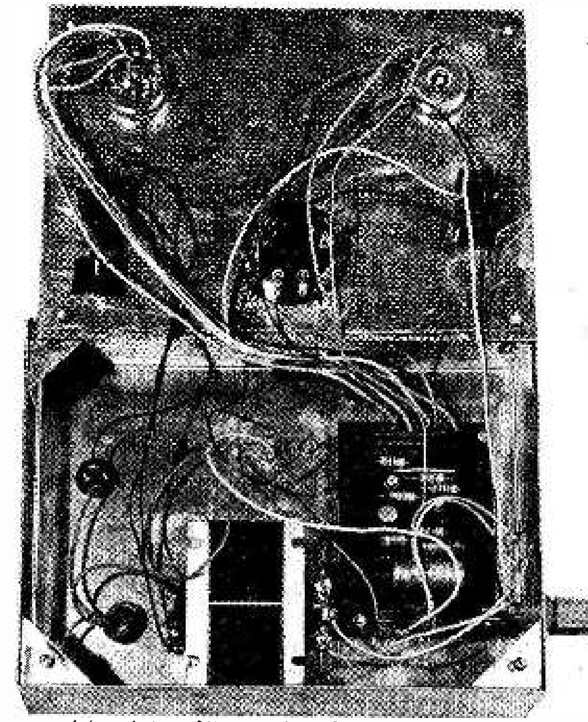
TESTING

It makes sense to do the initial tests before the board is mounted in the box, as it saves the possibility of having to remove it again if anything is amiss. Check carefully that there are no solder splashes or copper whiskers bridging any of the strips. If all seems well, apply mains volts, and with no load applied, check that the output voltage varies in the correct direction as VR1 is rotated. If not re-check the circuit and component placings, then check that the voltage at the slider of VR1 varies as it is rotated. If the output remains high (24-36V) although that at the slider varies, it could be due to a short in Tr1 or Tr2, or open circuit in Tr3, D5, or Tr4. If it is low, then the reverse is probably true, but make sure that there is about 36V at the top of C1 before replacing transistors. When this part of the circuit seems to be working as it should, the next step is to check the current limiting section.

It is prudent to try it with a modest load first, rather than short the output terminals together and



The Veroboard panel showing the heatsink on Tr2.



Internal view of the completed Stabilised Power Supply.

hope that all is well! Set the current limit switch to 300mA, then find a load that will draw about 300mA, say 81Ω, with VR1 set to give 24V out. Check then that with the load applied the output voltage remains at 24V. Remove the load and switch to the 80mA and then 30mA positions, then re-apply the load while monitoring the output voltage. If the current limiting is working correctly, the voltage should drop to around 6V to 9V, and if this is so, the output can then be shorted through a milliameter to see how far it is from the nominal 30mA (or whatever value was aimed at). Each position of S2 can then be checked in the same way, by first choosing a value of load that would exceed the set current limit, but not enough to damage the regulator transistors in event of an error somewhere.

If all is well, the unit can be finally assembled and should then be ready for use by the constructor confident in the knowledge that used intelligently, it can provide a safe source of variable volts for test or experimental purposes. PW

CQ! CQ! CQ! CQ!

ISSUES WANTED

..June and July 1973 issues of P.W.—C. Asnip, 85 Kaye Lane, Almondsbury, Huddersfield, HD5 8XT.

..December and November 1972 issues of Television for Pye 368 chassis details.—L. C. Johnson, 31 Edward Avenue, Jacksdale, Notts.

..the issue of P.W. containing the 7MHz Transceiver.—P. Rooney, 24 Lakeshore Drive, Renmore, Co. Galway, Eire.

..July and August 1974 issues of P.W.—K. Ruiz, 19 Keightley House, Castle Road, Gibraltar.

..P.W. for February, March, June, August, September, October, November and December 1970, also P.W. for September 1973, February, March and July 1971, May, June, July and December 1972.—M. S. Shankaya, P.O. Box 787, Kabwe, Zambia.

..issue of P.W. containing Digitronic Solid State Digital Clock—A. A. Dyksman, 38 Harsley Road, Hartburn, Stockton-on-Tees, Teesside, TS18 5DJ.

..January 1971 issue of P.W.—J. Little, 1 Wellington Court, Wellington Road, Wanstead, London, E.11.

..P.W. for October and December 1973, January 1974.—R. Cole, 54 Thorpe Place, Tattershall, Lincoln.

..Practical Television for August, September and October 1959, November 1955 and December 1956.—A. Cornish, 'Elsinore', Landscore Road, Teignmouth, Devon.

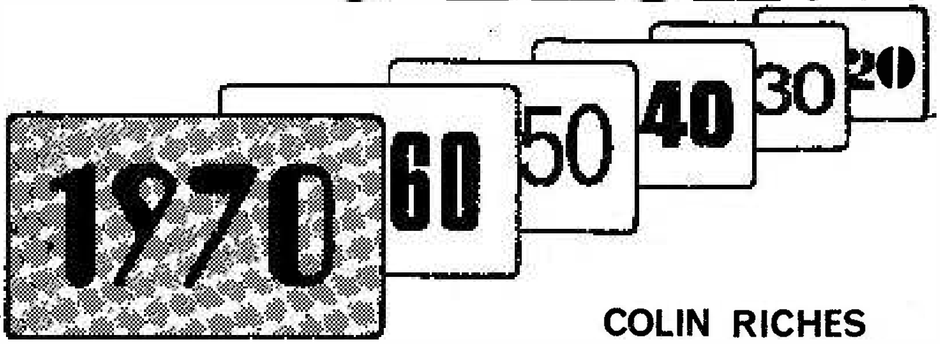
..P.W. June 1965. Also buy or borrow any issues containing information on or mods. to, the R1155.—M. Turner, 13 Churchill Way, Faversham, Kent, ME13 7RF.

..P.W. December 1972 with details of the Reverb Unit.—Kjell Bergkvist, Vretgatan 25, S-781 00 Borlange, Sweden.

..June 1965 issue of P.W. with gen on the Hawaiian Guiter (including blueprint).—N. A. Daniel, 36 Hillcrest Drive, Little Sutton, Wirral, Merseyside, L66 4QD.

..issues of P.W. containing the 10+10W Amplifier (January 1973 onwards).—M. Cole, 4 Eastbourne Street, Lincoln, Lincs.

GOING BACK...



COLIN RICHES

Gamages of Holborn

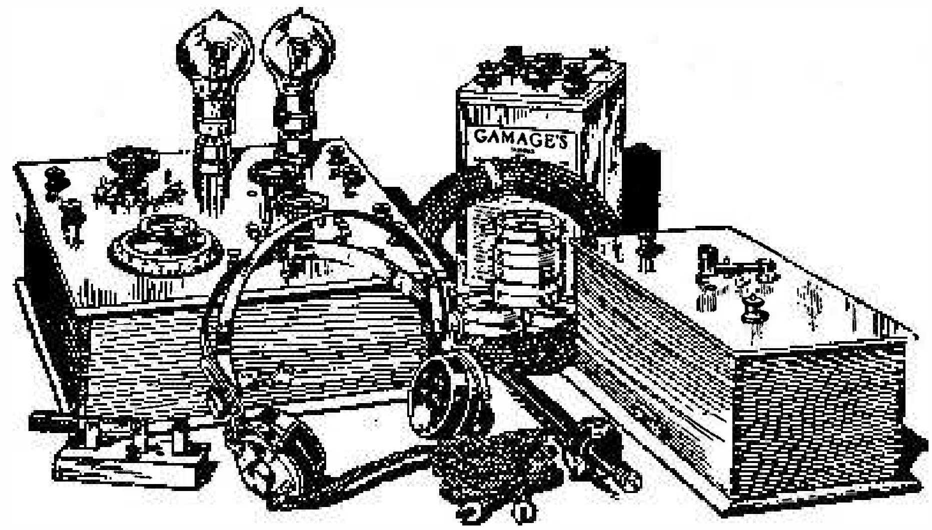
THERE is a name which still brings many memories of the good old days—Gamages of Holborn. How many of you remember the adverts in the popular radio magazines of the early twenties where Gamages used to advertise, "Valve or crystal, complete set or smallest accessory, you cannot go wrong at Gamages. Stocks are so complete, prices for warranted apparatus so keen, and the firm's desire to help the Amateur so genuine, that it would seem almost folly to go elsewhere".

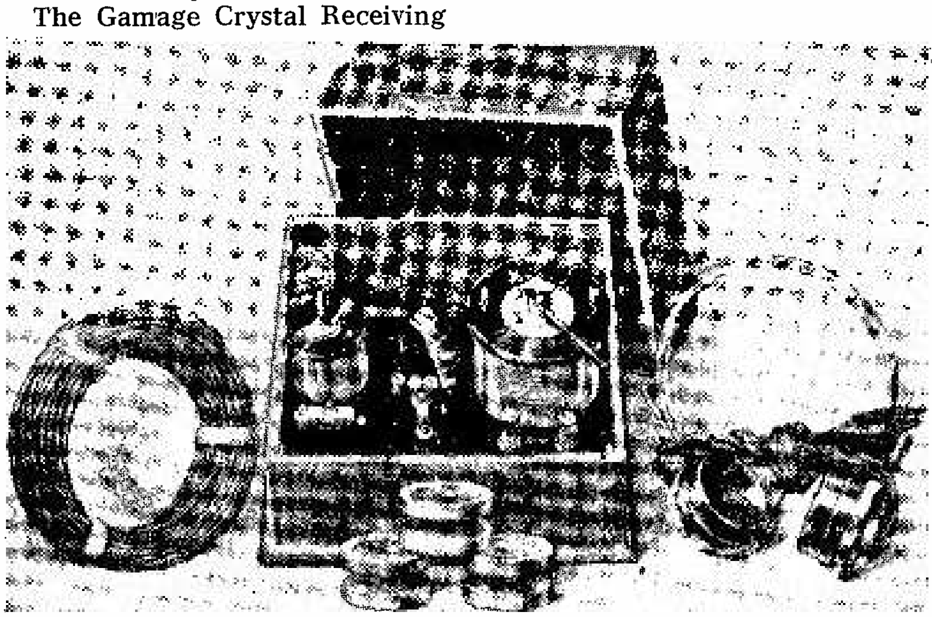
Alas, the site where Gamages of Holborn stood until a couple of years ago is now a great gaping hole filled with men, machinery and dust preparing the area for, I suspect one of those concrete architect's nightmares which abound in such great profusion in London today.

So, with a little bit of imagination and a few pictures, let's try to conjure up a bit of the magic of 1923 by seeing what A. W. Gamage had to sell in March of that year.

The Gamage Crystal Receiving Set, fully licensed by the Post Master General had the Reg. No. 226. The tuning coil was said to be wound with the best quality wire and tapped in four places. This, when used in conjunction with the variable condenser, which was of the 'best possible workmanship', gave a good variation of tuning. The crystal detector, designed to prevent dust from deteriorating the sensitivity of the crystal, contained Gamage's famous 'Permanite' crystal 'which had given such excellent results'. The task of finding a sensitive spot on the crystal was minimised by means of a buzzer. The adverts used to read, 'This set will receive telephony for 30 miles and signals from spark stations, using a wavelength of 300-500 metres for 150-200 miles. Complete in polished mahogany cabinet, with instruments mounted on polished Ebonite, also with phones, aerial wire and the insulators, this set costs £4 19s 6d.'

The 'Sonus' two-valve Broadcast Receiver consisted of one high frequency and one detecting valve. Telephony from broadcasting stations up to 100 miles away could be satisfactorily received on 'telephones' and low frequency amplifying valves could be added to increase the volume of music for the purposes of operating a loudspeaker or several pairs of 'phones. The number of low frequency valves required, depended on the distance of the set from the transmitting station.





Above: the Gamages "Sonus" two-valve receiver.

Left: Gamages Crystal Receiving Set, complete with accessories.

Music and speech were claimed by Gamages to be exceptionally clear on this broadcast receiver, which was designed to work on an 'average' aerial and had a wave range of 300 to 3,000 metres which enabled the owner to receive the well known time signals from Paris. The range of reception of spark transmissions was said to be between 150 and 2,000 miles. Price, complete as shown was £21.

ON THE AIR

AMATEUR BANDS

by Eric Dowdeswell G4AR

A FEW words this month on something that has worried me for some time past. Extracts from readers' logs are published in all good faith but my credulity is rather stretched when someone reports a real bit of weak DX received on a one-transistor receiver and a bit of wet string! I am exaggerating a bit, but not much!

It is obvious to me that this situation arises when a reader sits on the frequency of a powerful European station, logging the DX stations as he works them. The listener no doubt does hear something of the DX too and so he logs it. No trouble with the callsign of the DX because the European is using it! The problem arises when the listener can't hear the DX but logs it nevertheless!

So next time you begin to log a juicy bit of DX ask yourself if you can really hear him well enough to get his callsign, at least, without the assistance of that European, and don't log him if you can't! Self-deception is a futile pastime and brings no satisfaction.

Those of you who live in Surrey should watch out for CATS! The newly-formed Coulsdon Amateur Transmitting Society meets the first Thursday of each month at the 10th Purley Scout Group Hut. This is opposite Rickman Hill on the Chipstead Valley Road, Coulsdon. First in the queue to join ranged from 11 to 72 apparently so that ought to cover most of our readers in Surrey. For more info send an SAE to Nick Moyes G8KMJ, 23 Ellenbridge Way, Sanderstead, Surrey CR2 OEW.

Mark Hill (Birmingham) deserted the HF bands to log some interesting stuff on 2m aided by a halo, all via Oscar 7. Mark who lives at 114 Green Lane, Castle Bromwich, Birmingham would appreciate information on a design for a mobile whip covering the 80 and 160m bands. **Jeremy Hinton** (Newcastle, Staffs) took his Trio 9R59DS on holiday but had to be content with a metal door frame for an aerial! He's swotting for the RAE in December and getting on well with the code. He is very rightly annoyed to find the local radio club night clashes with the RAE course at the local college. Looks like a lack of communication to me!

T. H. Bithell (Chester) for many years an ardent reader of PW plucked up enough courage to drop me a line on his doings. In the last three years he has built up 19 kits by you-know-who and has nine tape recorders! He did at last get round to the Heathkit (I've said it!) HR-10B which led to his interest in this column. He's logged over 2000 stations in a few weeks, mainly on 20 and 80m. However, as I have told him, I hope diplomatically, it's the quality and not the quantity that counts!

Shaun O'Sullivan (Bristol) has just managed to get his 11th 'O' level and has at last turned to amateur radio. About time, too! He's pleased with the PW Microtune plus 80ft of wire. **Martin Kessel** (Stoke) copies SSB the hard way with an old HMV 5-valve superhet plus a 1-valve superregen as the BFO! Oh-er! Concentrates on 20 and 80m but it must be very hard work. **Stephen Terry** (Banbury) stuck to 15m with his FR50B and dipole for that band, an unusual one being VK9XK on Christmas Island, the one in the Indian Ocean if I remember aright. I still have a QSL from him when worked from ST2AR years ago.

Michael Bennett (Slough) spread his effort over 10 to 80m albeit all on SSB. I particularly liked KH6INV on KS6 on 20m and CM6AI on 10m. Regular **Alan Rae** (Glasgow) has done it! Apart from succeeding in his Higher level exams he is madly waving his GM8KRO ticket around. Caught without any gear he persuaded friend GM4DHJ to bring round some 2m gear to make his first QSO from home. Wisely the code is now receiving attention and feelers are out for an HF bands transceiver. Glad you didn't forget us, Alan!

Anent **Peter Walton** A9002 in the last issue he rebukes me because his full QTH is 55 letters long! He'd just quoted the abbreviated form! It's that one that starts at one end of the railway platform and goes on to the other! His 359X, dipole and PR30 preselector worked mainly on 20m. **'Dick' Dickens** writes from 'Steptoe' land, Shepherds Bush, London, about his 'PCR4' being his rebuilt version of the PCR3, preceded by a PW preselector and ATU. The aerial goes out with the washing line! **Peter Allen** A8677 (Taunton) is very happy with his PR30 preselector which has made a great difference to all signals. **Andrew Swiffin** A8603 (Cheadle) is another who cannot be parted from his rig, taking a solid state receiver and loaded whip to GM land.

Log extracts (All SSB)

A. Swiffin:— 20m FP0YY (QSL K9OTB) KG6KD/KB6 KB6BU KC6MW WA8VYV/KL7 VP2MCT 5T5BJ C9MIC

P. Allen:— 80m ZL3GS **20m** 9Y4RH **15m** CE7BDW VP2MCT ZS1EZ ZP5AO ZS4BU JA5EUQ

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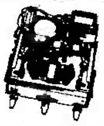

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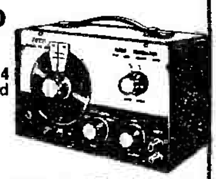

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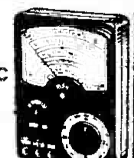

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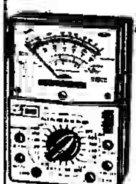

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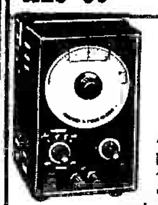

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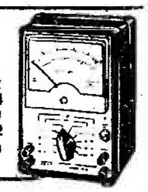

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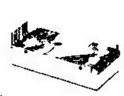

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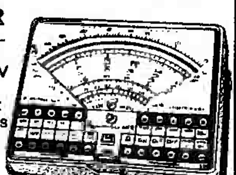

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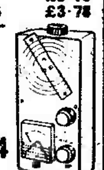

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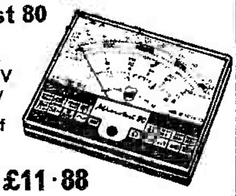

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S. Terry:— 15m TI2PPL VK6KW VK9XK VQ9SG/C (Chagos) ZD7FT ZS3BK 5L2FM 9Y4VT

M. Kessel:— 80m VS6DO **20m** KG4GG KL7HCN KS6ET OA6CM VP2AR ZL1GG

J. Hinton:— 15m C9MAZ M1C 5L7F 9J2AB

M. Hill:— 2m via Oscar 7 DL2BX F1BMP I4CHY OK1MXS ON4UN PA0ZL W2BXA

S. O'Sullivan:— 20m A4XVE OX3OON YS1GMV 3A0GZ 9Y4HM

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MEDIUM WAVE DX

by CHARLES MOLLOY

THE DX season for Asiatics extends from November until February and, during this period, medium wave reception of India, Pakistan, China and parts of the Far East becomes possible in the UK. There are two times of the day to listen for these stations—in the afternoon during the hour before sunset and again between midnight and 0300 GMT when many broadcasters sign-on for the day as local sunrise approaches. The Voice of America outlet at Ban Pachi in Thailand on 1580kHz is often audible between 1600 and 1700 GMT. Hofei in China has been heard recently on 940kHz while Kabul in Afghanistan on 1280kHz is logged regularly until it becomes submerged in European QRM as darkness approaches. The period between midnight and 0300 can be very rewarding. Two Chinese stations, Urumchi on 740kHz and an unknown outlet on 1310kHz, are heard frequently between midnight and 0100. All India Radio signs-on after 0100. Listen for Indore on 650kHz, Jullunder on 710kHz, Rajkot on 1070kHz and Calcutta on 1130kHz. Pakistan is well represented with Quetta on 750kHz, Multan on 1030kHz and Hyderabad on 1010kHz. All of these stations can be heard in the UK with a communications receiver such as the CR100 or the AR88 and a medium wave loop or an outdoor longwire antenna.

Malcolm Laugharne writes from Witney to ask if it is possible to purchase a MW loop aerial. So far as the writer knows this type of aerial is not available commercially and the DXer will have to follow the example of **A. B. G. Hall** (Daventry) who is building a loop for himself. **Steve Howell** (Bristol) wonders if the World Medium Wave Guide is still available. This handy list of medium wave stations is now published as part of the World Radio TV Handbook, which comes out annually, usually in January.

The winter season on the medium waves is now in full swing. Conditions, which are better now than they have been for several years, will continue to improve as we approach the minimum of the current sunspot cycle. North American medium wave stations should become prominent from 2330 until 0300 GMT, when QRM from Eastern Europe starts to build up. North American medium wave stations are allocated callsigns which they use frequently, followed by the name of the city or town where the studios are located, so identification is seldom a problem. Nearly all North Americans are good verifiers and will answer a correct reception report with a QSL card or a letter. Reports should give the date and time of reception along with programme details such as station slogans, commercials, weather reports, announcers' names. Return postage in the form of an International Reply Coupon should always be sent as the DXer is well outside the station's normal coverage area.

The more prominent North Americans heard in the UK include WABC on 770kHz, WCBS on 880kHz, WINS on 1010kHz and WNEW on 1130kHz, all in New York City; WHDH on 850kHz and WBZ on 1030kHz both in Boston, WCAU on 1210 in Philadelphia, WBAL on 1090kHz in Baltimore, KDKA 1020kHz in Pittsburg and WKBW 1520 in Buffalo. Many Canadians can be heard. Search for CBN 640kHz and CJON 930kHz from St. John's in Newfoundland, CHER 950kHz in Sydney N.S. CHNS 960kHz in Halifax, CBA 1070kHz in Moncton and CBI 1140 in Sydney.

SHORT WAVE BROADCASTS

by Derek Bell

THERE'S a pub in Kent that is worthy of a pilgrimage according to **R. I. Macmillan** of Deal. Standing on the bar of this hostelry is a 1934 HMV radio that is in working order and a contestant for this column's "oldest working short wave set" title! Mr. Macmillan (sorry, no other names given) recently repaired this RX and describes it as a five valve straight set. When the dust was removed from the interior, the chassis and all the valve "cans" were found to have been painted matt black by the maker.

Having repaired it R.I. hooked on a six metre longwire and pulled in Voice of Turkey on 31m at 2300 and VOA (Tangiers on 31·8m at 2255 and something described as National Public Radio at 2231. This latter is something of a puzzle to me and I would be interested in more details. The Voice of Turkey logging is in fact the relay of the Turkish home service on 1061kHz transmitting from Diyarbakir with 300 kilowatts. Thus, having shall we say, "knocked out" Dr. Brodribb's set recently featured in the column, its "any advance" on 1934 for the oldest set in use!

Several questions are asked by **Brian Buckley** from County Tyrone, Northern Ireland. First, the transmission times of NHK Radio Japan are listed in WRTV Handbook as 0100 to 0130, 0200 to 0230, 0300 to 0330 and so on with half-hourly gaps for

ON THE AIR

the whole 24 hours on 9585, 15105, 17880, 15195, 9505, 17855 and 5990, the frequencies altering and rotating as the target area is altered. The best times for the UK are generally thought to be from 0600 to 1000 depending on propagation conditions. So the thing to do is to try all the frequencies mentioned above until you strike gold, then write for the QSL to Radio Japan NHK 2-2-1 Jinnan Shibuya-Ku Tokyo, which deals with the second question.

Brian says that he has fitted a socket to his Bush VTR178 to take a TV aerial, presumably the one on his chimney and can pull in Radio Australia, Pekin, Kuwait and WYFR. The Radio Australia service mentioned is the South-East Asia one on 9770 and Brian logs it from 1600 to the sign-off at 1730. I personally feel that the TV aerial would only be effective for the TV bands and that it might be better to use the socket for a long wire provided the aerial input circuitry is not overloaded.

As to the final question Brian I don't think it would be ethical for me to say which sets I use since I see this column as a medium for the exchange of tips, ideas and news and I would not want to influence anyone or perhaps I should say inflict anyone with my personal likes and dislikes.

Bad news is in the air in more ways than one lately. **Anthony Street** from Braintree writes that he heard Radio Canada announce that as from November they were "having to stop the Short Wave Club" but they would merge it with the Mailbag Show. Anthony is another reporter of Voice of Turkey, this time on 11880, the overseas service and is a 250kW station from either Izmir or Erzurum. The QSL address is TRT Turkiye Radyo Televizyon Kurumu, Genel Mudurlugu, Ankara.

For those who have wondered exactly what is put on a QSL card **Paul Cowburn** from Leyland, Lancs, can fill us in. He is the proud possessor of a Radio Nacional de Brasil card and sends the details which, in brief, are that the transmitter power is 250kW and that the aerials are 31, 25 and 19 metre rhombics, situated 55km northwest of Brasilia. The transmitting equipment is made by Brown Boveri of Switzerland and puts out a signal on 9605, 11780 and 15245 at 2200. When not in use for the overseas service the transmitter puts out a domestic service "Avoz da Brazil" Paul gives the address as Radio Nacional de Brasillia, International Service, PO Box 07/0173, Brasillia Federal District, Brazil.

Next we hear from **Nicholas Try** from Gerrards Cross who mentions hearing Radio Nacional de Espania on 9515 at 1900, not in itself great DX but how many QSL collectors I wonder bother with the Europeans? For those of us that are pop fans, for instance, AFRTS puts out the American top-of-the-pops every Saturday night over their German transmitters and there is a "night owl" show that I am told is of a very free and easy nature from RAI in Italy. While these are local it must be remembered that in certain propagational circumstances even Radio Nederland cannot be heard here in the UK.

Speaking of B. Nederland I recently heard a jingle put out by the BBC stating that Radio One was "The Happy Station" I wonder what RN will reply to that!

Its time to draw stumps for this month alas so all I can say is good DX and 73s to you and yours.

BROADCAST BANDS
Short Wave reports by the 15th of the month to Derek Bell c/o Practical Wireless, Fleetway House, Farringdon Street, London, EC4A 4AD.
Medium Wave Logs to Charles Molloy, 132 Segars Lane, Southport, PR8 3JG.

AMATEUR BANDS
Logs covering any amateur band/s in band/alphabetical order by the 25th of the month to Eric Dowdeswell G4AR, Silver Firs, Leatherhead Road, Ashtead, Surrey, KT21 2TW.

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O	■	S	■	11 A	■	12 H	E	A	R	■	■	13 O
14 R	O	T	O	R	■	E	■	■	15 S	16 L	U	R
G	■	O	■	17 P	I	A	N	18 O	■	U	■	C
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N	■	■	22 E	A	23 C	H	■	T	■	A	■	E
■	24 B	■	C	■	A	■	25 E	■	26 I	N	N	S
27 R	E	C	O	R	D	E	R	S	■	I	■	T
■	T	■	N	■	E	■	I	■	28 U	S	E	R
29 B	A	N	D	S	T	A	N	D	■	T	■	A

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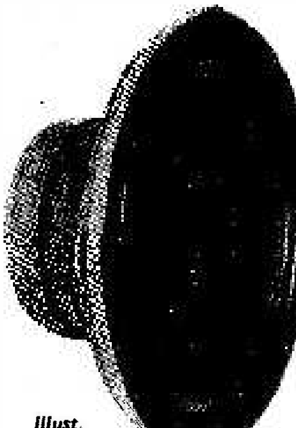

Illust. 12" DISCO 60'

12" 'DISCO 60' 60 watts R.M.S.

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AND for those who can afford the very best there is our range of

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MODELS
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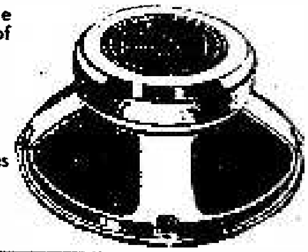

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Consisting of 12" 13,000 Gauss BASS UNIT, HPX1 HIGH POWER Cross-over and PH50 TWEETER. All purpose. Full range. Imp. 8-15 ohms. Bass Guitar requires pair in one cabinet

£21·50

Prices shown correct at Oct. 8, 1975

Please send S.A.E. for leaflets on any of above ranges

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BC149	15p	CD4014AE	94p
BC158	16p	CD4015AE	94p
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Superb performance and beautifully finished in selected teak veneers. A professional standard four-way speaker system giving 25 watts RMS power handling. Bass unit is 14"×9" with 8"×5" unit for mid-range and twin 3" high frequency units to give monitor type quality and performance.
Specification – Size 33"×14"×16" approx. Impedance 8 ohms. Power handling 25W RMS. (Peak 50 watts.) Frequency range 35 Hz–20 KHz.

Our Price £34.00 each
(normally £66.00)+£5.80 p & p.
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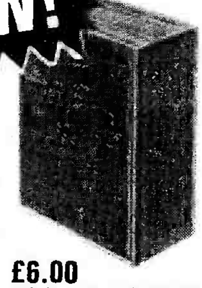
THE 'COMPACT'

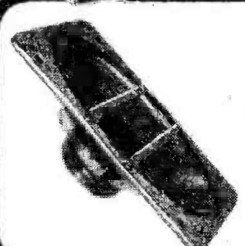
NEW!

EASY BUILD SPEAKER KIT

A compact bookshelf speaker system giving a high electro accoustic efficiency for the low powered amplifier.
The professional finish can be obtained with the minimum of tools, the infinite baffle type enclosures come ready mitred and professionally finished, simply apply glue, fold up around baffle board, and fix together with masking tape till glue dries.
The cabinet measures 12"x9"x5" deep approx finished in simulated teak, incorporating a quality 7"x4" elliptical speaker, power handling 4 watts, flux density 30,000 maxwells, impedance 8-15 ohms nominal, voice coil dia $\frac{3}{4}$" magnet size $2\frac{7}{8}$" approx.



£6.00
pair inclusive.P & P £1.70



EMI 350 KIT

System consists of a 13" × 8" approx. woofer with a 3" tweeter, crossover components and circuit diagram. Frequency response: 20 Hz to 20 KHz. Power handling 15 watts RMS into 8 ohms. (Peak 30 watts.)

£7.25 +£1.20 p & p.

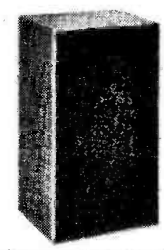
Complete with crossover Components and circuit diagram

EASY TO BUILD SPEAKER KITS

These superb simulated teak-finished speaker kits have been specially designed by RT-VC for the cost-conscious hi-fi enthusiast who wants top quality speakers but doesn't want to spend the earth. Built to EMI's exacting specification, these new RT-VC speaker kits (350 type kit) incorporate 13" × 8" woofer, $3\frac{1}{4}$" tweeter and matching crossover.
Easily put together with just a few basic tools.
Specification (each speaker): Impedance 8 ohms. Power handling 15 watts RMS (30 watts peak). Response 20–20,000 Hz. Size 20" × 11" × $9\frac{1}{2}$" approx. Comparable built units (EMI LE3) sold elsewhere for over £45 pair.

£22.00 pair complete +£5.20 p & p.

Complete with crossover Components and circuit diagram



RTVC*

NEW!

VISCOUNT IV STEREO SYSTEM

System 1a. £69.00

The new 20+20 watt Stereo Amplifier incorporating the latest silicon transistor solid state circuitry, the RT-VC VISCOUNT IV gives you a powerful 20 watts RMS per channel into 8 ohms. Superb teak-finished cabinet, with anodised fascia to harmonise with any decor. Polished trim and knobs.
The VISCOUNT IV has a comprehensive range of controls – volume, bass, treble, balance, mono/stereo, mode selector, and scratch filter.
Front panel socket for stereo headphones. And a host of sockets at the rear – for left and right speakers, tape recorder, auxiliary, tuner, disc and microphone.
SPECIFICATION: 20 watts RMS per channel 40 watts peak. Suitable 8-15 ohms speakers. Total distortion @ 10 watts better than 0.2%. Six switched inputs: 1. Magnetic P.U. – 3 millivolts @ 47 K ohms (R.I.A.A.); 2. Crystal/ceramic P.U. – 50 millivolts @ 50 K ohms (R.I.A.A.); 3, 4, 6. Tape Tuner/Aux. – 140 millivolts @ 50 K ohms (flat frequency response); 5. Microphone – 3 millivolts @ 50 K ohms (flat frequency response).
CONTROLS: Push button ON/OFF, stereo/mono, scratch filter. 6 position rotary selector. Individual rotary controls for treble, bass, balance and volume. Headphone socket, tape out socket. Aux. mains output. **Frequency response:** 25 Hz to 25 KHz @ full rated output. **Signal to noise ratio:** better than –50 dB on all inputs. **Tone control range:** Bass ±15 dB @ 50 Hz; Treble ±12 dB @ 10 KHz.
Power requirements: 200-250V A.C. mains @ 60 watts. **Approx. size:** $15\frac{1}{4}$" × 3" × 10".
MP60 type deck with magnetic cartridge, de luxe plinth and cover.
Two Duo Type IIa matched speakers – Enclosure size approx. $19\frac{1}{2}$" × $10\frac{3}{4}$" × $7\frac{3}{4}$" in simulated teak. Drive unit 13" × 8" with 3" tweeter. 15 watts handling. 30 watts peak.
Complete System with these speakers £69.00 +£6.50 p & p.

System 2. £85.00

Viscount IV amplifier (As System 1a)
MP60 type deck (As System 1a)
Two Duo Type III matched speakers – Enclosure size approx. 27" × 13" × $11\frac{1}{2}$". Finished in teak simulate. Drive units 13" × 8" bass driver, and two 3" (approx.) tweeters. 20 watts RMS, 8 ohms frequency range – 20 Hz to 18,000 Hz.
Complete System with these speakers £85.00 +£7.60 p & p.

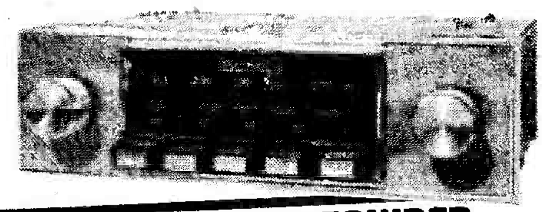
PRICES: SYSTEM 1a
Viscount IV R103
amplifier £27.50+£1.90 p & p.
2 Duo Type IIa
speakers £30.00+£6.50 p & p.
MP60 type deck with Mag. cartridge de luxe plinth and cover £22.00+£3.30 p & p.
Total if purchased separately: £79.50
Available complete for only: £69.00 +£6.50 p & p.

PRICES: SYSTEM 2
Viscount IV R103
amplifier £27.50+£1.90 p & p.
2 Duo Type III
speakers £46.00+£7.50 p & p.
MP60 type deck with Mag. cartridge de luxe plinth and cover £22.00+£3.30 p & p.
Total if purchased separately: £95.50
Available complete for only £85.00 +£7.60 p & p.

20x20 SYSTEM

Scotland and the Orkneys P & P Surcharge
System 1a £1.75 System 2 £3.50

PUSH BUTTON CAR RADIO KIT– THE TOURIST TT*



NO SOLDERING REQUIRED

NOW BUILD YOUR OWN PUSH BUTTON CAR RADIO
Easy to assemble construction kit comprising fully completed and tested printed circuit board on which no soldering is required. All connections are simple push fit type making for easy assembly. Fine tuning push button mechanism is fully built and tested to mate with printed circuit board. **TECHNICAL SPECIFICATION: (1) Output** 4 watts RMS output. For 12 volt operation on negative or positive earth. (2) **Integrated circuit** output stage, pre-built three stage IF Module. **Controls volume** manual tuning and five push buttons for station selection, illuminated tuning scale covering full, medium and long wave bands. Size chassis 7" wide 2" high and 4¾" deep approx. **£9.50** + £1.05 p & p. Speaker including baffle and fixing strip £2.00 +45p p & p. Car Aerial Recommended – fully retractable £1.60 + 40p p & p.

The Tourist I Kit For the experienced constructor. If you can solder on a printed circuit board you can build this model. Same technical specification as Tourist TT. **Price £8.20** + £1.05 p & p.

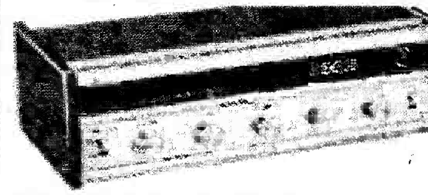
*STEREO 21 QUALITY SOUND FOR LESS THAN £24.00

Stereo 21. easy to assemble audio system kit. No soldering required.
The unit is finished in white P.V.C. and the acrylic top presents an unusually interesting variation on the modern deck plinth.
Includes – **BSR 3 speed deck**, automatic, manual facilities together with stereo cartridge.
Two speakers with cabinets.
Amplifier module. Ready built with control panel, speaker leads and full, easy to follow assembly instructions.
Specifications – For the technically minded,
Input sensitivity 600mV. Aux. input sensitivity 120mV. Power output 2.7 watts per channel. Output impedance 8–15 ohms. Stereo headphone socket with automatic speaker cutout. Provision for auxiliary inputs – radio, tape, etc., and outputs for taping discs.
Overall Dimensions. Speakers approx 15½"×8"×4". Complete deck and cover in closed position approx. 15½"×12"×6".

Complete only £23.20 +£3.00 p & p.

Extras if required. Optional Diamond Styli £1.60.
Specially selected pair of stereo headphones with individual level controls and padded earpieces to give optimum performance £5.80.

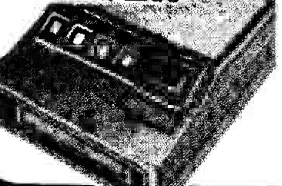
*DISCO AMPLIFIER



Reliant Mk IV Mono Amplifier, ideal for the small disco or house parties. Output 20 watts RMS into 8 ohms (suitable for 15 ohms).
Inputs *4 electrically mixed inputs. *3 individual mixing controls. *Separate bass and treble controls common to all 4 inputs. *Mixer employing F.E.T. (Field Effect Transistors). *Solid State circuitry. *Attractive styling.
INPUT SENSITIVITIES – Input – 1). Crystal mic. guitar or moving coil mic, 2 and 10mV. (Selector switch for desired sensitivity.) – Inputs – 2), 3), 4). Medium output equipment – ceramic cartridge, tuner, tape recorder, organs, etc. – all 250mV sensitivity. AC Mains, 240V operation. Size approx: 12½"×6"×3½".

£20.00 +£1.35 p & p.

8 TRACK HOME CARTRIDGE PLAYER



Elegant self selector push button player for use with your stereo system. Compatible with Viscount IV system, Unisound module and the Stereo 21. Technical specification Mains input, 240V, Output sensitivity 125mV.

Yours for only
£16.20 +£1.70 p & p.

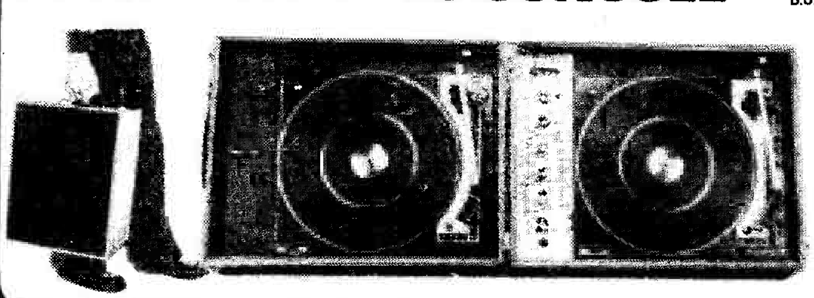
BUILD YOUR OWN STEREO AMPLIFIER*

For the man who wants to design his own stereo – here's your chance to start, with Unisound – pre-amp, power amplifier and control panel. No soldering – just simply screw together. 4 watts per channel into 8 ohms. Inputs: 120mV (for ceramic cartridge). The heart of Unisound is high efficiency I.C. monolithic power chips which ensure very low distortion over the audio spectrum. 240V. AC only.

Also available with 2 speakers (7"×4") £10 + £1.75 p & p. **£8.95** + £1.05 p & p.
Also available with the 'Compact' (see opposite page) easy build speaker kit £13.50 + £2 p & p

PORTABLE DISCO CONSOLE*

INCORPORATES: Pre-Amp with full mixing facilities, including switched input for mic with volume control, switched input for auxiliary with volume control, bass and treble controls, volume control and blend control for turntables. Two B.S.R. MP60 type single play professional series decks, fitted with crystal cartridges.



TECHNICAL SPECIFICATION:
Pre-amp – Output – 200mV. Auxiliary inputs – 200mV and 750mV into 1 meg. Mic input – 6mV into 100K. 240 volt operation. **Turntables capacity** – 7", 10" or 12" records. **Rumble, wow and flutter** Rumble Better than –35dB. Wow Better than 0.2%. Flutter Better than 0.06% (Gaumont kalee meter).
Finish – Satin black mainplate with black turntable mat inlaid with brushed aluminium trim. Tonearm and controls in black and brushed aluminium.

Console size –
Unit Closed – 17¾"×13¾"×8¾" (app.)
Unit Open – 35¾"×13¾"×4¾" (app.)
This disco console is ideally matched for the Reliant IV and Disco 50 or any other quality amplifier.
The unit is finished in black PVC with contrasting simulated teak edging, diamond spun control knobs with matching control panel.

Yours for only
£49.00 +£6.50 p & p.

All prices include VAT at current rates

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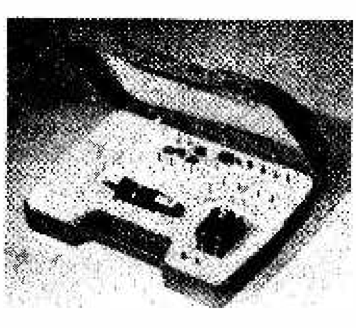

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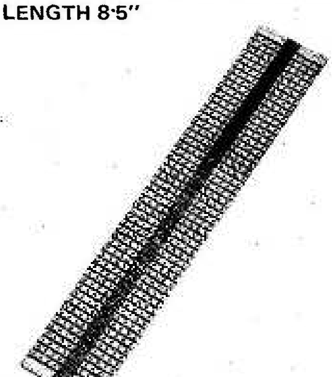

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9-0-9	0·5	1·96
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12-0-12	2·0	3·13
12-0-12	3·0	4·32
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15-0-15	2·0	3·78
18-0-18	2·0	4·32
20-0-20	1·0	3·03
20-0-20	2·0	4·32
30-0-30	1·0	4·32
0-10-12-14-16-18	4·0	4·58
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Mfd.	Volts	Pence	
47	4	7	
330	4	7	
68	6·3	7	
470	6·3	9	
1000	6	11	single end p/c fitting
25	10	7	
47	10	7	
220	10	7	
330	10	9	
15	16	7	
33	16	7	
68	16	7	
220	16	9	
220	16	9	single end p/c fitting
330	16	12	
1000	16	20	
10	25	7	
22	25	7	
47	25	7	
100	25	7	
150	25	9	
200	25	11	
1250	25	24	single end can
5000	25	55	single end can
1000+1000	30	32	single end can
2500	30	40	single end can
6·8	40	7	
16	40	7	
100	40	9	
1000	50	35	single end can
1	63	7	
4·7	63	7	
10	63	7	
32	63	7	
800	63	32	single end can
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BC107/8/9	0·09	IN4148	0·04	1A 200v W02	0·22
BC109C	0·11	BY127	0·14	1A 600v W06	0·30
BC147/8/9	0·10	IN4001/2	0·05	25A 200v	£2·00
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BFX88	0·20	IN4006/7	0·08	BZY88c 3·3-33v 5%	0·09
BFY50	0·18	IN5401	0·11	1 watt 6·8-200v 5%	0·15
BFY51/52	0·12				
2N1132	0·25	3015F	1·00	L.E.D.	
2N1711	0·25	DL747	2·45	209-RED	0·17
2N2646	0·30	TBA800	0·90	LED CLIP	0·02
2N2905A	0·21	555 Timer	0·50	OP. AMP. IC's	
2N3053	0·14	D.I.L. SOCKETS		709C TO99	0·30
2N3055	0·38	8 Pin	0·12	709C D.I.L.	0·30
OC28	0·45	14 Pin	0·12	741C TO99	0·36
OC35	0·35	16 Pin	0·14	741C D.I.L.	0·36
OC26	0·45			723C D.I.L.	0·80
OC36	0·35	ADD 17% V.A.T.		747C D.I.L.	0·85
TIP41A	0·74			748C D.I.L.	0·36
TIP42A	0·90				
7400N	0·16	74 SERIES TTL		74121N	0·50
7404N	0·18	7447N	1·00	74123N	1·26
7410N	0·18	7474N	0·37	74141N	1·13

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0·68µF	50·8	19	93p	1·5µF	89p	71p	58p
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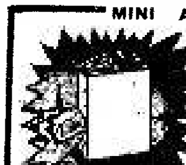

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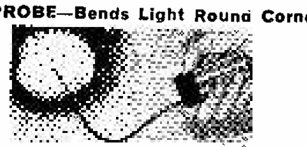

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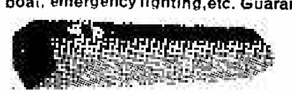

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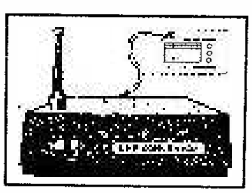

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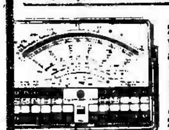

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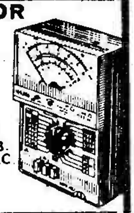

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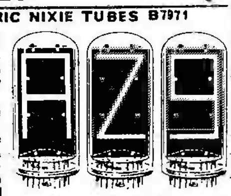

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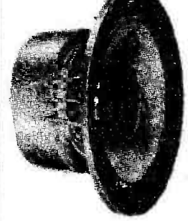

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Baker Deluxe 12" d/cone	£13·75
Baker Major „ „	£11·87
Baker Regent	£10·00
Baker Superb	£18·12
Baker Auditorium 12	£16·25
Celestion MH1000 horn, 8 or 15 ohm	£13·50
Celestion PS8 for Unilex	£3·75
Celestion G12M 8 or 15 ohm	£12·95
Celestion G12H 8 or 15 ohm	£15·95
Celestion G15C 8 or 15 ohm	£26·95
Celestion G18C 8 or 15 ohm	£34·50
EMI 13 x 8" 150 d/c 8 ohm	£2·94
EMI 13 x 8" type 350 8 or 15 ohm	£9·56
EMI 13 x 8" 25 watt base	£9·00
EMI 6½" 93850 4 or 8 ohm	£4·37
EMI 8 x 5 d/cone, roll surr 10 watt	£3·44
EMI 2¼" tweeter 97492AT	·77
Eagle DT33 30 watt tweeter	£6·31
Eagle HT15 horn tweeter	£4·40
Eagle CT5 cone tweeter	£2·06
Eagle CT10 tweeter 8 or 16 ohm	£3·00
Eagle MHT10 horn tweeter	£4·44
Eagle crossover CN23, CN28, CN216	£1·75
Eagle FR4	£6·12
Eagle FR65	£9·62
Eagle FR8	£12·31
Elac 9 x 5, 59RM109 15 ohm, 59RM114 8 ohm	£3·44
Elac 6½" 6RM171 d/c roll surr.	£4·06
Elac 6½" 6RM220 d/cone	£3·12
Elac 4" tweeter TW4	£1·75
Elac 8" 8CS175 3 ohm	£2·87
Fane Pop 15 watt 12"	£5·25
Fane Pop 25/2 25 watt 12"	£7·50
Fane Pop 50 watt 12"	£12·00
Fane Pop 55 60 watt 12"	£13·95
Fane Pop 60 watt 15"	£14·75
Fane Pop 100 watt 18"	£25·95
Fane Crescendo 12A 100 watt 12"	£34·50
Fane Crescendo 12B bass	£36·50
Fane Crescendo 100 watt 15"	£47·50
Fane Crescendo 150 watt 18"	£62·95
Fane 801T 8" d/c roll surr.	£8·50
Fane 807T 8" d/c roll surr.	£5·75
Fane 808T 8" d/c	£3·95
Fane 910 horn	£14·95
Fane 920 horn	£33·95
Goodmans 8P 8" or 15 ohm	£5·50
Goodmans 10P 8 or 15 ohm	£5·80
Goodmans 12P 8 or 15 ohm	£13·95
Goodmans 12P-D 8 or 15 ohm	£16·95
Goodmans 12P-G 8 or 15 ohm	£15·95
Goodmans Audiomax 12AX 100 watt	£36·50
Goodmans Audiomax 15AX	£40·25
Goodmans 15P 8 or 15 ohm	£21·00
Goodmans 18P 8 or 15 ohm	£36·00
Goodmans Hifax 750	£16·00
Goodmans Axent 100 tweeter	£8·44
Goodmans Audiom 100 12"	£13·90
Goodmans Axiom 402 12"	£20·00
Goodmans Twinaxiom 8	£10·14
Goodmans Twinaxiom 10	£10·75
Kef T27	£6·06
Kef T15	£6·94
Kef B110	£8·37
Kef B200	£9·50
Kef B139	£16·95
Kef DN8	£2·31
Kef DN12	£5·99
Kef DN13	£4·50
STC4001G super tweeter	£6·56
Richard Allan CG8T 8"d/c r/surr.	£7·50
2½" 64 ohm, 70mm 80 ohm, 70mm 8 ohm	·77
2½" 75 ohm	·55
7" x 4" 3 or 8 ohm	£1·65
8" x 5" 3 or 8 ohm	£1·75
10" x 6" 3, 8 or 15 ohm	£2·69

Prices correct at 25.9.75.

SPEAKER KITS

Baker Major Module	each £13·44
Goodmans Mezzo Twinkit	pair £47·19
Goodmans DIN 20	each £14·75
Helme XLK 25	pair £25·44
Helme XLK 30	pair £17·19
Helme XLK 50	pair £46·25
Keffit 1	pair £48·44
Keffit 3	each £42·50
Richard Allan Twinkit	each £10·95
Richard Allan Triple 8	each £16·50
Richard Allan Triple 12	each £23·95
Richard Allan Super Triple	each £28·75
Wharfedale Linton 2 kit	pair £23·12
Wharfedale Glendale 3 kit	pair £40·62
Wharfedale Dovedale 3 kit	pair £63·12

PA/DISCO AMPLIFIERS

(carr. and ins. £1)

Baker Major 100 watt	£57·25
Linear 30/40	£30·00
Linear 40/60	£35·00
Linear 80/100	£58·95
Linear 100 watt slave	£44·00

Eagle PA range in stock—ask for catalogue.

Free with speaker orders over £7—

"Hi-Fi Loudspeaker Enclosures" book. All units guaranteed new and perfect. Prompt despatch. Carriage and packing: speakers 50p each, 12" and up 75p each. Speaker kits 80p each (£1·60 pair) tweeters and crossovers 30p.

Including V.A.T. 25% on Hi Fi, 8% on PRO and PA

WILMSLOW AUDIO (Dept. PW)

Loudspeakers: Swan Works, Bank Square, Wilmslow, Cheshire. SK9 1HF
Discount Radio, PA, Hi-Fi: 10 Swan Street, Wilmslow

Send stamp for free booklet "Choosing a Speaker"

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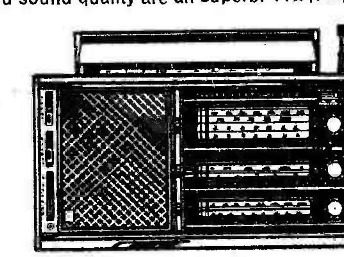
You've got your yacht, private aircraft, Rolls Corniche?—then all you need for a full set of status symbols is this latest model Grundig Satellit, Germany's top radio! Radio performance, appearance and sound quality are all superb. VHF/FM, MW, LW, 10 SW bands plus bandspread, 27 transistors and 22 diodes, Battery/Mains (110/240v) 2 speakers, 57" telescopic aerial.



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Big discounts on Grundig, ITT, Koyo, etc. Send stamp for list.

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DEPT. (PW),
10 Swan Street,
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WATFORD ELECTRONICS

33/35 CARDIFF ROAD, WATFORD, HERTS, ENGLAND
MAIL ORDER, CALLERS WELCOME.

ALL DEVICES BRAND NEW AND FULLY GUARANTEED. ORDERS DESPATCHED BY RETURN OF POST. TERMS OF BUSINESS: CASH/CHEQUE/P.O.s OR BANKERS DRAFT WITH ORDER. GOVERNMENT AND EDUCATIONAL INSTITUTIONS OFFICIAL ORDERS ACCEPTED. TRADE AND EXPORT INQUIRY WELCOME. P & P ADD 25p* TO ALL ORDERS UNDER £10.00. OVERSEAS ORDERS POSTAGE AT COST, AIR/SURFACE.

VAT Applicable to U.K. Customers only. All prices are exclusive of VAT. Please add 8% to devices marked* To the rest add 25%.

Callers welcome to our New Shop at 33, Cardiff Road, behind Watford Football Ground. Monday to Saturday. Ample Free Car Parking space available.

TRANSISTORS (less 10% for 25+ of one type)

AC125	16p	BC148	7p	BF115	22p	OC72	11p	ZTX304	22p	2N2926O	8p
AC126	13p	BC149	9p	BF177	26p	OC74	28p	ZTX311	10p	2N2926R	8p
AC127	13p	BC154	18p	BF178	28p	OC81	12p	ZTX341	19p	2N2926Y	8p
AC128	13p	BC157	13p	BF179	33p	OC82	12p	ZTX500	16p	2N3053	18p
AC141	20p	BC158	12p	BF180	33p	OC83	28p	ZTX501	13p	2N3054	42p
AC142	15p	BC159	13p	BF181	33p	OC140	100p	ZTX502	18p	2N3055	45p
AC176	12p	BC167	12p	BF184	22p	OC201	70p	ZTX504	42p	2N3614	85p
AC187	12p	BC168	12p	BF185	22p	OC202	80p	ZTX531	23p	2N3615	85p
AC188	12p	BC169	12p	BF194	10p	TIC44	30p	ZTX550	18p	2N3702	10p
ACY17	35p	BC170	11p	BF195	10p	TIP29	43p	2N696	15p	2N3703	12p
ACY19	25p	BC171	11p	BF196	12p	TIP29A	45p	2N697	13p	2N3704	10p
ACY20	24p	BC172	11p	BF197	12p	TIP29C	70p	2N698	30p	2N3705	12p
ACY21	20p	BC177	16p	BF257	32p	TIP30	48p	2N706	11p	2N3706	10p
ACY22	16p	BC178	16p	BF595	18p	TIP30A	54p	2N708	16p	2N3707	10p
AD140	48p	BC179	18p	BFX86	21p	TIP30B	64p	2N918	40p	2N3708	8p
AD149	45p	BC182	10p	BFX88	22p	TIP30C	76p	2N930	18p	2N3709	8p
AD161	37p	BC182L	12p	BFY50	15p	TIP31	54p	2N1131	20p	2N3710	9p
AD162	37p	BC183	10p	BFY51	15p	TIP32	64p	2N1132	20p	2N3771	140p
AF114	18p	BC184	12p	BFY52	15p	TIP32B	80p	2N1301	20p	2N3772	160p
AF115	18p	BC184L	11p	BSX20	16p	TIP32C	99p	2N1302	17p	2N3773	240p
AF116	18p	BC212	12p	BSY95A	12p	TIP33	95p	2N1303	20p	2N3819	22p
AF117	18p	BC212L	13p	BU105	£2·20	TIP33B	112p	2N1304	24p	2N3820	47p
AF118	40p	BC213	10p	MJE370	63p	TIP33C	130p	2N1305	24p	2N3823	60p
AF121	33p	BC214	14p	MJE371	78p	TIP34	130p	2N1306	24p	2N3824	50p
AF125	30p	BC214L	14p	MFP102	30p	TIP35	259p	2N1307	24p	2N3904	15p
AF126	30p	BC461	40p	MPF103	30p	TIP36A	330p	2N1893	30p	2N3905	17p
AF127	30p	BCY42	28p	MPF104	30p	TIP41A	64p	2N1990	45p	2N3906	17p
AF139	33p	BCY43	25p	MPF105	30p	TIP41B	68p	2N2160	62p	2N4037	35p
AF181	45p	BCY58	18p	OC23	144p	TIP42A	68p	2N2217	23p	2N4058	15p
AF186	48p	BCY59	18p	OC26	40p	TIP42B	74p	2N2219	20p	2N4061	13p
AF239	38p	BCY70	15p	OC28	54p	TIS43*	26p	2N2221	20p	2N4062	14p
BC107	9p	BCY71	18p	OC35	54p	TIS44	17p	2N2222	20p	2N4871	31p
BC108	9p	BCY72	12p	OC36	52p	ZTX107	10p	2N2303	25p	2N5457	30p
BC108B	12p	BD124	75p	OC41	15p	ZTX108	10p	2N2369	14p	2N5458	30p
BC108C	12p	BD131	40p	OC42	15p	ZTX109	12p	2N2483	30p	2N5459	30p
BC109	9p	BD132	40p	OC44	12p	ZTX300	12p	2N2646	38p	3N140	85p
BC109B	12p	BD137	45p	OC45	12p	ZTX301	14p	2N2904	20p	3N141	85p
BC109C	12p	BD145	55p	OC70	11p	ZTX302	18p	2N2906	15p	40361	40p
BC117	20p	BDY60	75p	OC71	11p			2N2907	18p	40362	40p
BC147	7p	BDY61	65p					2N2926G	10p	40673	58p

TTL 74*

Less 5% for 15+ mixed
Less 10% for 25+ mixed

DIGITAL ICs

7400	13p	7430	15p	7475	32p
7401	13p	7432	25p	7476	32p
7402	14p	7433	36p	7480	44p
7403	15p	7437	27p	7481	99p
7404	18p	7438	27p	7482	75p
7405	18p	7440	15p	7483	83p
7406	38p	7441	65p	7484	90p
7407	38p	7442	65p	7485	125p
7408	15p	7443	120p	7489	275p
7409	15p	7444	105p	7490	40p
7410	13p	7445	66p	7491	80p
7411	20p	7446	105p	7492	48p
7412	20p	7447	80p	7493	39p
7413	35p	7448	70p	7495	63p
7414	60p	7450	15p	7496	72p
7416	35p	7451	15p	74121	30p
7417	35p	7453	15p	74122	45p
7420	15p	7454	15p	74123	63p
7422	24p	7460	15p	74141	63p
7423	27p	7470	30p	74151	69p
7425	27p	4772	26p	74190	145p
7426	27p	7473	33p	74191	145p
7428	38p	7474	32p		

DIODES

BY100	18p
BY127	11p
OA5	38p
OA9	9p
OA10	36p
OA47	8p
OA70	8p
OA79	8p
OA81	8p
OA85	10p
OA90	6p
OA91	6p
OA95	8p
OA200	6p
OA202	6p
1N914	4p
1N4001/2	5p
1N4003	5p
1N4004/5	6p
1N4006/7	6p
1N4148	5p
1S920	6p
1S921	6p

PANEL METERS*

60mm x 46mm x 35mm requires 1¼" hole

FULL SCALE

ME 6	0–50µA
ME 7	0–100µA
ME 8	0–500µA
ME 9	0–1mA
ME 10	0–5mA
ME 11	0–10mA
ME 12	0–50mA
ME 13	0–100mA
ME 14	0–500mA
ME 15	0–1 amp
ME 16	0–50V DC
ME 17	0–300V AC
ME 18	"S" Meter
ME 19	"VU" Meter

Price £2·75, p & p 10p

DALO PEN 78p each

LINEAR IC'S

709C 14 pin	29p	LM301	38p	SN76033	150p
710	46p	LM304H	170p	SN76115	200p
741C	22p	LM305	170p	TAD100	130p
747C	70p	LM380	95p	TBA800	95p
748C	28p	LM381	160p	TBA810	150p
AY-1-0212	5·50p	LM3900	65p	ZN414	99p
AY-1-5051	1·20p	M252	875p		
AY-5-1224*	365p	MC724P	55p		
AY-5-3500*	610p	MC1303L	148p		
AY-5-3507*	610p	MC1304P	360p		
AY-5-4007*	735p	MC1310P	220p		
CA3018	72p	MC1312	150p		
CA3020	145p	MC1710CG	55p		
CA3035	135p	MFC4000B	65p		
CA3036	80p	MFC6040	99p		
CA3046	55p	MLM309K	185p		
CA3048	220p	NE555*	45p		
CA3075	150p	NE556DB*	99p		
CA3081	150p	NE565	304p		
CA3089E	195p	NE562	270p		
CA3090AQ	255p	NE567	249p		
CA3123E	140p	SL403D	176p		
LM300H	170p	SL414A	176p		

REGULATOR*

723C	45p
7805 (TO3)	150p
7815 (TO3)	160p
LM309K	185p
MVR12	158p

ZENER DIODES
Range 2·7V–33V 400mW 9p
3·3V–33V 1·3W 17p

BRIDGE RECTIFIERS (plastic case)

1A50V	20p
1A100V	24p
1A200V	26p
1A400V	27p
1A600V	29p
2A50V	30p
2A100V	38p
2A200V	44p
2A400V	48p
2A600V	54p
4A100V	53p
4A400V	60p
4A800V	90p
6A100V	64p
6A400V	80p
BY122	54p
BY164	54p

DIAC ST2 20p

SCR* (Thyristors)

1A 50V	38p
1A 100V	42p
1A 200V	47p
1A 400V	52p
1A 600V	70p
3A 50V	38p
3A 100V	43p
3A 200V	55p
3A 400V	74p
3A 600V	99p
5A 400V	90p
7A 400V	125p
106D	55p
MCR101	29p
TIC44	29p
2N4444	191p

CRYSTAL MICROPHONES with cable & plug 56p

DENCO COILS

Miniature Dual purpose 'DP' Type
Rng. 1-5 B,Y,R,W 60p
6-7 B,Y,R 58p
1-5 Green 65p
Transistor Tuning coils 'T' Type
Rng. 1-5 B,Y,R,W 70p
IFT 13/14/15 65p each
IFT 18/465 75p
IFT 18/1·6 MHZ 75p
TOC 1 70p
MW F.R. Aerial 70p

PW EASY BUILD ELECTRONIC ORGAN
Send SAE for complete list

OPTO ELECTRONICS*

LED TIL 209 (red) with socket 14p
LED Larger 0·2" diam. Red 15p
LED Larger Green, Yellow, Amber 19p
Seven Seg Displays

Minitron 3015F	110p	OCP 70	40p
MAN 3610	170p	OCP 71	85p
MAN 3640	170p	ORP 12	60p
LIT 704 (Cmn. Cath.)	125p	ORP 61	50p
LIT 707 (Cmn. Anode)	125p	2N 5777	36p
LIT 747 (Cmn. Anode)	215p		

ALUM. BOXES with lid*

2¾x5¼x1½"	50p
4x4x1½"	50p
4x2¼x1¼"	50p
4x5¼x1½"	58p
4x2¼x2"	50p
3x2x1"	44p
6x4x2"	78p
7x5x2½"	84p
8x6x3"	106p
10x7x3"	122p
10x4½x3"	110p
12x5x3"	120p
12x8x3"	180p

FUSES AND HOLDERS*

20mm 150mA-5A 3p
1¼" 500mA-15A 3p
Anti-surge 20mm 100, 250, 500, 800mA, 1A, 1·6, 2, 2·5, 3·15, 5A 7p each
1" Mains, 2A, 3A, 5A, 7A, 10A, 13A. 5p

HOLDERS
Panel Single 6p
Panel Double 8p
20mm Chassis 16p
1¼" Chassis 22p

SPEAKERS
8Ω 0·5W 2¼" & 3" 62p

POLYESTER CAPACITORS: Axial lead type. (Values are in µf).

400V: 0·001, 0·0012, 0·0015, 0·0018, 0·0022, 0·0033 3p; 0·0047, 0·0068, 0·01, 0·015, 0·022 4p; 0·033, 0·047, 0·068 5p; 0·1, 0·15, 0·22, 7p; 0·33, 13p; 0·47, 17p; 160V: 0·1, 0·15 4p; 0·22 5p; 0·33 6p; 0·47 9p; 0·68 13p; 1·0 18p; 2·2 24p; 0·1µF/1000V 20p.

POLYESTER RADIAL LEAD P.C. TYPE (Values are in µf).

250V: 0·01, 0·015, 0·022, 0·033 3p; 0·047, 0·068, 0·1 4p; 0·15 6p; 0·22, 0·33 7p; 0·47 9p; 0·68 10p; 1·0 14p; 1·5 22p; 2·2 24p.

FEED THROUGH CAPACITORS 1000pF/350V 8p

ELECTROLYTIC CAPACITORS. Axial lead type (Values are in µf)

63V: 0·47, 1·0, 1·5, 2·2, 3·3, 4·7, 6·8, 10, 15, 20, 22, 47, 6p; 68, 10p; 100 12p; 50V: 220 15p; 1000, 42p; 40V: 100 6p; 470, 22p; 30V: 3500, 41p; 25V: 10, 68, 150, 6p; 220 11p; 470 13p; 640, 18p; 1000, 24p; 2200, 34p. 3000, 39p; 4700, 47p; 16V: 40, 125, 250, 6p; 1000, 1500, 18p; 10V: 4, 100, 5p; 640, 10p; 1000, 14p; 2200, 18p.

POTENTIOMETERS (AB) Carbon

Track, 0·25W Log & 0·5W Linear values
1KΩ–2MΩ single gang 16p
5KΩ–2MΩ single gang D/P switch 32p
2KΩ–2MΩ dual gang stereo 45p

SLIDER POTENTIOMETERS

0·25W log and linear values 60mm
5KΩ–500KΩ single gang 35p
10KΩ–500KΩ Dual gang 50p
50KΩ Lin 150mm WS 150 250p

PRESET POTENTIOMETERS

0·1W 50Ω–2·5MΩ Vertical only 5p
0·25W 100Ω–2·2MΩ Horizontal 6p
0·25W 200Ω–1MΩ Vertical 6p

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. 16V: 10µF, 22. 10V: 15µF, 33. 6V: 47µF. 3V: 100µF.
Price: 11p each.

MYLAR FILM CAPACITORS

100V: 0·001, 0·002, 0·005, 0·01µF 4p
0·015, 0·02, 0·04, 0·05µF, 0·1µF 5p
0·15, 0·2 50V: 0·47µF 6p

CERAMIC CAPACITORS

50V d.c. Plaquette body 25mm leads.
Range: 0·5pF to 10,000pF 2p
0·015µf, 0·022µf, 0·033µf, 0·047µf 3p

RESISTORS—Erie make

Carbon, Miniature, High Stability, Low Noise

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

100 off price per value not mixed.

JACKSONS VARIABLE CAPACITORS

Dielectric		6:1 Ball Drive	
100pF	80p	4511/DAF	97p
300pF	88p	00-365	240p
500pF	95p	00-208/176	240p
Dilemin		C804-15pF	118p
300pF	125p	C804-25pF	118p
500pF	195p		

JACK PLUGS / SOCKETS

	JACK PLUGS Screened chrome	JACK PLUGS Plastic body	SOCKETS Open metal	SOCKETS Moulded with break contacts
2·5mm	10p	8p	8p	
3·5mm	14p	10p	8p	
Standard Mono	19p	13p	13p	17p
Standard Stereo	32p	18p	15p	22p

TRIACS
3A 400V 100p
6A 400V 120p
6A 500V 150p
10A 500V 165p

	Plugs	Sockets
DIN 2pin Loudspeaker 3, 4, 5 (180° & 240°) 6pin Audio type	12p	8p
CO-AXIAL (TV)	10p	8p
PHONO assorted colours	7p	5p (sgl.) 7p (dbl.)
Metal screened	12p	10p (trpl.)
BANANA	6p	7p

TERMINAL POST 4mm 20p each

CERAMIC TRIMMER CAPACITORS

2-7pF; 4-15pF; 6-25pF; 8-30pF 17p each

MINIATURE
3-10pF; 3-30pF; 10-40pF 15p

COMPRESSION TRIMMERS
3-40pF 18p
20-250pF 27p
100-500pF 32p

DAU TRIMMERS
miniature 5-25pF 20p

EARPHONES
With Cord and Jack Plug Magnetic
2·5 mm plug 15p
3·5 mm plug 15p
Crystal
3·5mm plug 30p

SWITCHES*

TOGGLE: SPST 20p
DPDT 24p

SUB-MIN TOGGLE
SP changeover 45p
SPST on/off 40p
DPDT 6 Tag 64p
DPDT Centre off 80p

SLIDE:
1A DP 250V 10p
1A DP 250V C/O 12p
½A DP 250V 9p

PUSH BUTTON:
Push on/Push off, spring loaded 44p
Miniature Non Locking
Push to Make 15p
Push to Break 25p

ROCKER (white): 10A 250V
SP changeover centre off 25p

ROCKER: (black) on/off 10A 250V 20p

ROCKER: illuminated (white) lights when on. 3A 240V 46p

ROTARY: 1p/2w, 2p/6w, 2p/2w, 2p/4w, 3p/3w 3p/4w, 4p/2w, 4p/3w 24p

DIL SOCKETS*

Low profile
8 pin 12p
14 pin 13p
16 pin 14p

HEAT SINKS

TO5/5F 8p
TO18/18F 8p
TO66/TV2 15p
TO3/TV3 15p
Insulation Kit (Mica & 2 washers) 8p

TRANSFORMERS MAINS

Primary 220–240V
6–0–6 (miniature) 100mA 90p
9–0–9 (miniature) 100mA 90p
12–0–12 (miniature) 100mA 90p
24–0–24V 500mA 220p
30-24-20-15-12-0 (MT 79AT) 1A* 285p
30-24-20-15-12-0 2A* 340p
ITT Pulse Transformer £1·10
6·3v 1A Heater/Cathode Short £3·30
LT44 Mini. Driv. Pri 20K Sec 1K 54p
LT700 Mini. Output, Pri 1·2K Sec 5Ω 54p

VEROBOARD*

	0·1 (copper clad)	0·15 (copper clad)	0·15 (plain)
2½x3¾"	32p	24p	15p
2½x5"	35p	35p	18p
3¾x3¾"	35p	35p	—
3¾x5"	40p	41p	29p
2½x17"	105p	78p	60p
3¾x17"	145p	115p	75p
4¾x17"	185p	—	110p
Pkt of 36 pins			22p
Spot face cutter			52p
Pin insertion tool			72p

LAMP HOLDERS AND LAMPS*

LES HOLDER Dome shaped, Red, Blue, Green, Yellow, White 14p
LES BULBS 6v and 12v 7p
MES HOLDERS Chrome cover, Red or Amber, Jewelled top 28p
MES BULBS 3·5V 6V 12V 7p
NEON: ½" square top, red, green, Req. ⅜" hole 21p

KNOBS*(fits ¼" shaft, with grub screw, except K2 (push fit) & K8 (for sliders).

KI Black or White pointer type	9p
K2 Slim silvered aluminium	10p
K3 Black 1¼" with chrome rim	15p
K4 Black serrated. Metal top with line indicator 33m diam.	20p
K5 Black fluted metal top and skirt calibrated 0–10, 37mm dia.	22p
K6 PK2 as K5 with pointer on skirt	22p
K7 Black, knurled, tapered. Metal top & skirt. Calib. 0–10, 30mm	22p
K8 Black or silvered for slider pot	7p

INDEX TO ADVERTISERS

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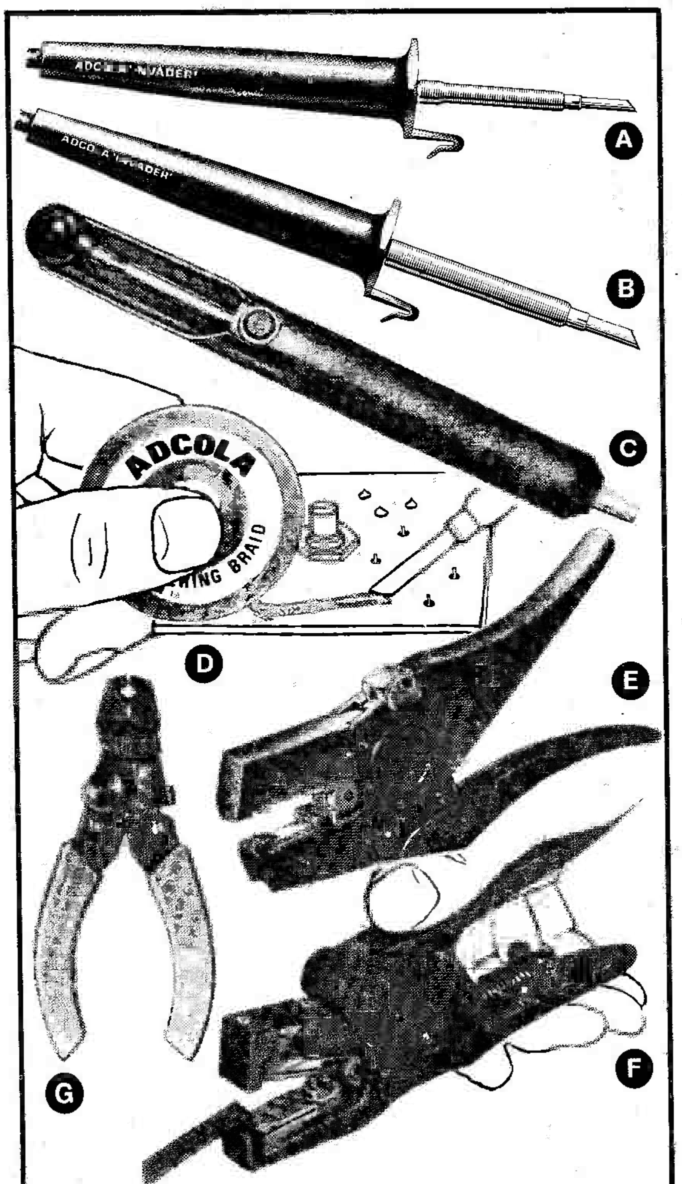

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F **FM27.** A slightly heavier version of the FM28 stripper but without wire cutter. Capacity 0.2mm – 3.75mm. Weight 243gms. Price **£13.66.**

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