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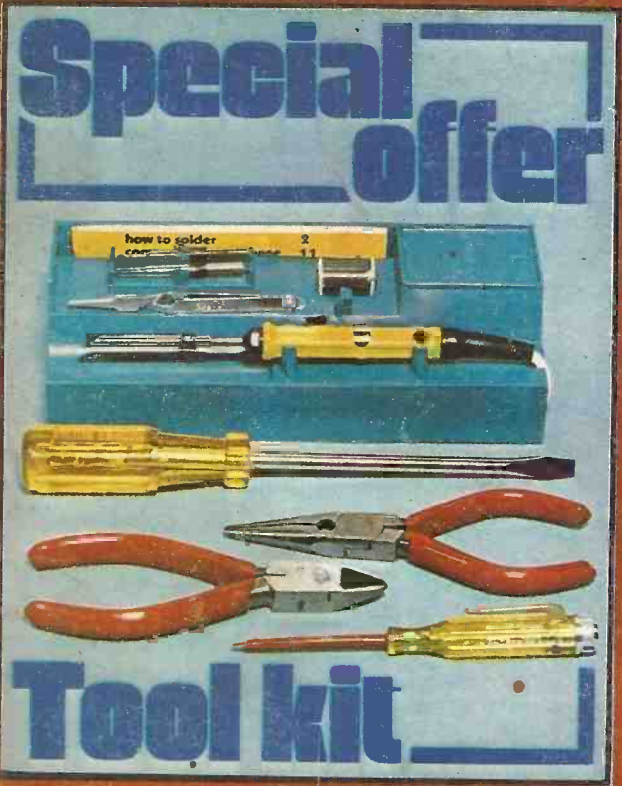

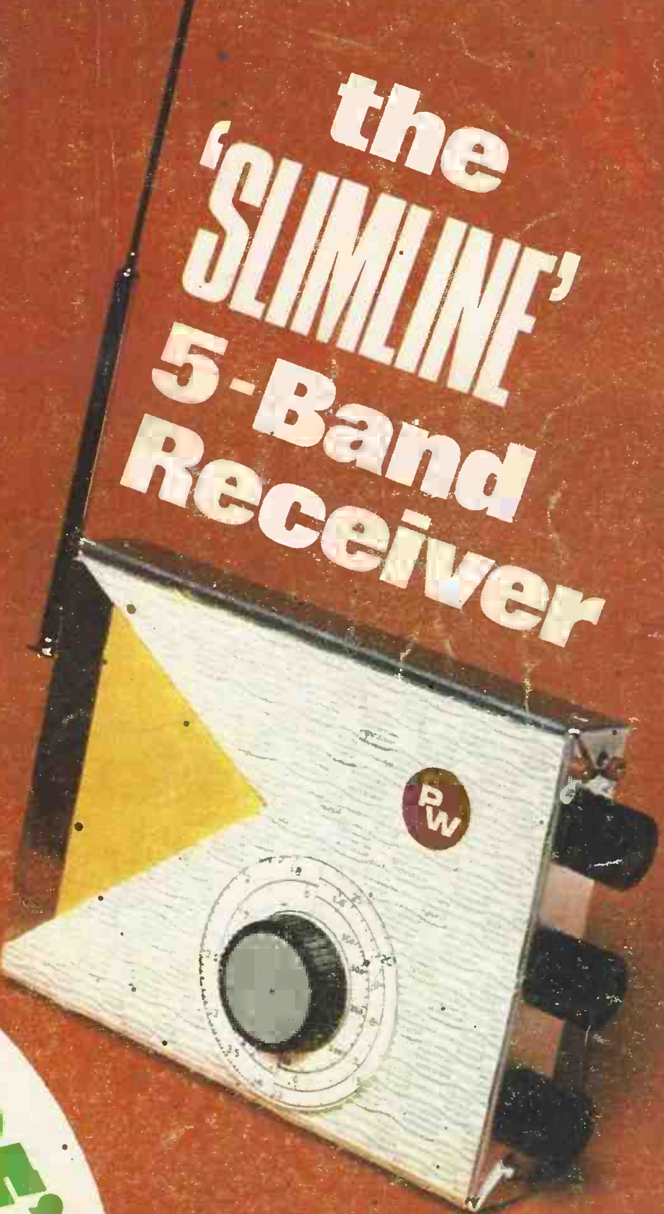

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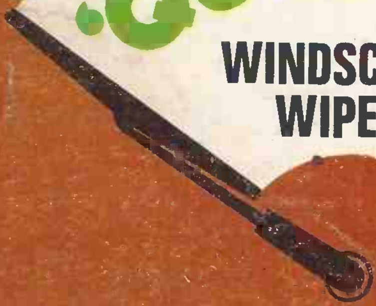

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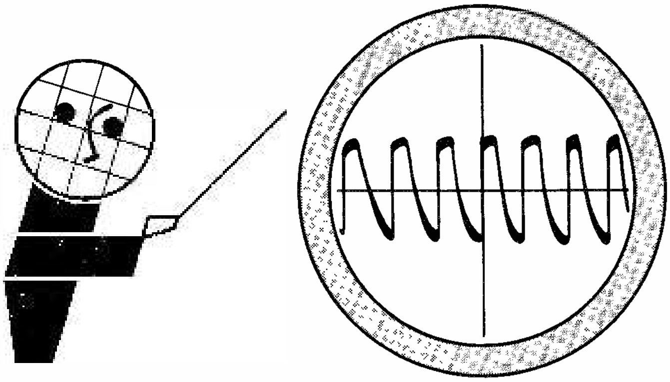

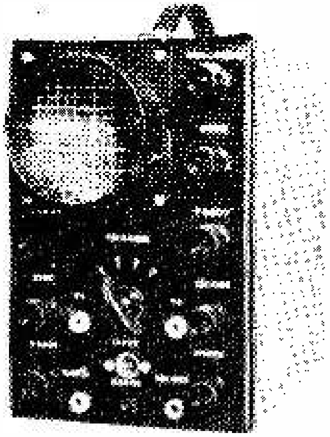

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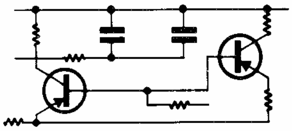

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PRACTICAL WIRELESS

VOL. 49 NO. 12
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APRIL 1974

BRITAIN'S PREMIER MAGAZINE FOR THE DO-IT-YOURSELF RADIO AND ELECTRONICS CONSTRUCTOR

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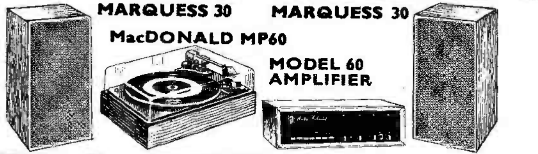

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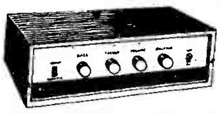

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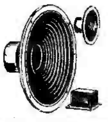

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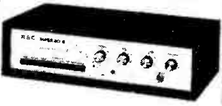

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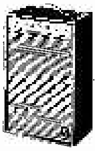

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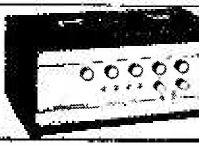

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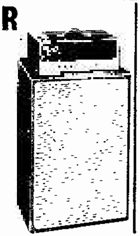

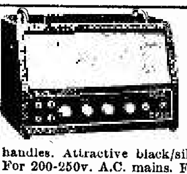

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EL91	.88	PC97	.45	PY800	.31	U801	.76	AD140	·40	BF194	·17	OC75	·12
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EY81	.40	PCF801	.48	UAF42	.55	2N1756	·55	AF126	·20	BYZ13	·28	OC139	·25
EY83	.54	PCF802	.50	UBC41	.53	2N2147	·94	AF139	·72	CG12E	·22	OC169	·25
EY84	.70	PCF806	.70	UBC81	.45	2N2297	·25	AF178	·75	GD9	·22	OC172	·39
EY87/6	.33	PCH200	.70	UBF80	.38	2N2369	·24	AF180	·53	GET113	·22	OC200	·24
EY88	.40	PCL82	.32	UBF89	.35	2N2613	·43	AF186	·61	OA5	·31	OC201	·42
EY91	·58	PCL83	.54	UBL21	.77	2N3053	·36	BA115	·15	OA9	·14	OC202	·47
EZ40	.55	PCL84	.38	UC92	.45	2N3121	2·75	BA116	·28	OA10	·47	OC203	·33
EZ41	.50	PCL805/85		UCC84	.75	2N3703	·21	BA129	·14	OA47	·11	OC204	·33
EZ80	.24		.55	UCC85	.38	2N3709	·22	BA130	·11	OA70	·17	OC205	·47
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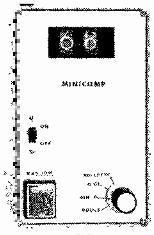

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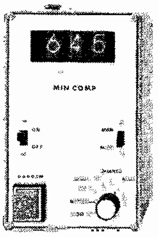

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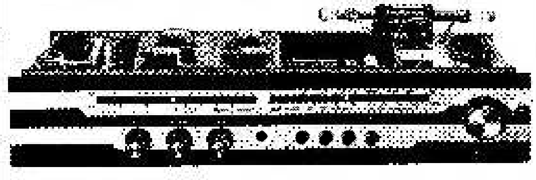
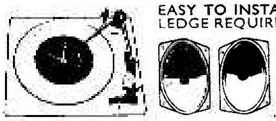


The uncabineted system is ideal as an economical replacement for an outdated chassis. Stereo Amplifier for Stereo/Mono record reproduction. Tuner with medium, long and short wavebands provides Worldwide coverage, even the weakest continental stations can be received with superb clarity. Push button band selection, 10 watts total output. Frequency response 25-18000 Hz.

LATEST BSR STEREO/MONO RECORD CHANGER plays all types of 7in., 10in., and 12in. Mono or Stereo records. Manual or automatic play.

TWIN ELLIPTICAL SPEAKERS These low impedance, permanent magnet units have been specially selected to provide the fullest range of audio reproduction.



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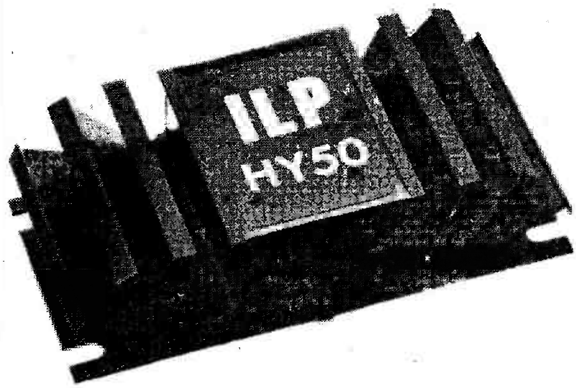
SECOND GENERATION 25 WATT HYBRID



A brand new hybrid fabrication technique, recently perfected in our laboratories, has enabled us to achieve our latest range of completely integrated devices.
We have now finally reduced the modular amplifier to a simple input/output device requiring only the addition of a basic unstabilized (split line) power supply.
The HY50 takes medium power modules to their logical conclusion by incorporating with it a heatsink, which is designed in special high conductivity alloy, sufficient for normal audio use without additional chassis sinking. All this without significantly increasing the size of the module comparable in size to a packet of 'King-size' cigarettes.

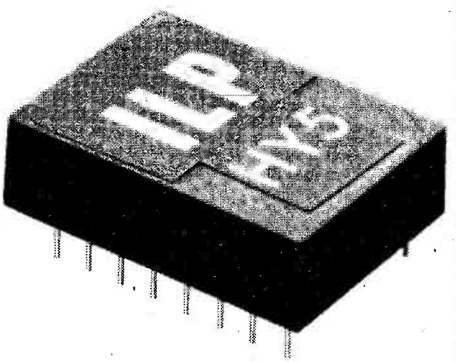
Consistent with modern thinking a triple rated output circuit with a load fuse allows for peak transient response without distortion but ensures the necessary protection.

	SPEC.
OUTPUT POWER:	25 watts RMS. 50 watts peak music power
LOAD IMPEDANCE:	4·16Ω into 8Ω
INPUT SENSITIVITY:	Odb (0·775 volts RMS)
INPUT IMPEDANCE:	47KΩ
TOTAL HARMONIC DISTORTION:	Less than 0·1% at 25 watts typically 0·05
SIGNAL/NOISE RATIO:	better than 75db
FREQUENCY RESPONSE:	10Hz-50KHz ± 1db
SUPPLY VOLTAGE:	± 25 volts
SIZE:	105 x 50 x 25 mm

Price £5·80 mono, £11·60 stereo

Price inclusive of VAT & P & P

NEW HY5 PRE-AMPLIFIER



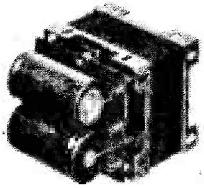
Unchallenged for two tears, the HY5, our unique multifunction preamplifier/tone hybrid, has been brought into line with the advancements in our power hybrids.
Like the HY50, the new HY5 has no external components & has been redesigned to run off a split power-line with improvements in signal/noise, overload, capability & reduced distortion. The output has been increased to match the power module (Odb), and to share the same power supply.
Overall size is reduced by the use of a new thin film circuitry while the device still retains all the functions of the earlier device.
When combined with the HY50 & power supply only potentiometers are required to complete a simple mono amplifier with input & output facilities expected to be found on Hi-Fi amplifiers.
The combination of two HY5's two HY50's sharing a common power supply (PSU50) are linked by a balance control to form a complete stereo system.

INPUTS **SPEC.**
Magnetic Pick-up 3mV (within 1db RIAA curve)
Ceramic Pick-up up to 3mV
Microphone 10mV
Tuner 250mV
Auxiliary 3–100mV
Input impedance 47kΩ 1kHz

OUTPUTS
Tape 100mV.
Main output, Odb (0·775volts)

ACTIVE TONE CONTROLS
Treble ± 12db at 10kHz
Bass ± 12db at 100Hz
OVERLOAD CAPABILITY (equalization stage) 40db on most sensitive input
OUTPUT NOISE LEVEL (below 10mV magnetic input) 68db
DISTORTION 0·05% at 1kHz
SUPPLY VOLTAGE ± 16-25 volts
SUPPLY CURRENT 15mA
Price £4·85 mono, £9·70 stereo
Price inclusive of VAT & P & P

POWER SUPPLY PSU50



The new PSU50 has a low profile look being only 2¼ inches high and can be used for either mono or stereo systems.

SPEC.
OUTPUT VOLTAGE ± 25 volts
INPUT VOLTAGE 210-240 volts
SIZE L. 70, D. 90, H. 60 mm

Price £5·23
Price inclusive of VAT & P & P

CROSSLAND HOUSE · NACKINGTON · CANTERBURY · KENT

CANTERBURY 63218

Please note we reserve the right to substitute at our discretion updated versions of advertised designs where applicable.

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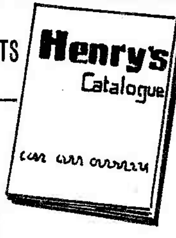
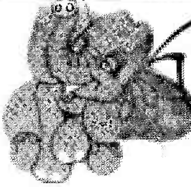
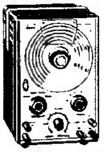
PANEL METERS · TRANSFORMERS · CONTROLS · RELAYS
IRONS · TOOLS · VALVES · POT CORES MOST TYPES OF COMPONENTS
You need a catalogue! 55p post paid complete with Discount Vouchers





UK's
LARGEST RANGE
OF KITS &
GADGETS



TEST EQUIPMENT

MULTIMETERS

(carr. etc. 30p)

M210 (Case £1·25)	20K/Volt Slimline	6·75
TLH33D	2K/Volt Robust	7·50
U437	10K/Volt Steel case. AC up to 40 KHz	4·95
U4324	20K/Volt with AC current ranges	8·00
AF105 (Case £1·90)	50K/Volt	11·95
U4313	20K/Volt AC current. Steel case	10·50
U4341	Plus Built in transistor tester	10·50
Model 500 (Case £1·95),	30K/Volt	9·95

OTHER EQUIPMENT

SE250B	Pocket Signal Injector	2·10 carr. 15p
SE500	Pocket Signal Tracer	1·70 carr. 15p
TE15	Grid Dip meter 440kHz–280mHz	15·00 carr. 30p
TE40	AC Millivoltmeter 1·2mHz	19·75 carr. 35p
TE65	28 Range valve voltmeter	22·50 carr. 40p
TE20D	120kHz–500mHz RF Generator	18·95 carr. 40p
TE22D	20Hz–200kHz Audio Generator	19·95 carr. 40p
SE350A	Deluxe Signal Tracer	12·50 carr. 20p
SE400	Volts/ohms/R-C sub./ RF field/RF gen.	14·75 carr. 20p

New Revolutionary Supertester 680R

680R Multi-tester
£18·50

Accessories

Transistor tester	11·00
Electronic voltmeter	18·00
Ampclamp	11·95
Temperature probe	11·95
Guass meter	11·95
Signal Injector	5·95
Phase Sequence	5·95
EHT Probe	5·95
Shunts 25/50/100A	4·50

A SELECTION OF INTERESTING ITEMS

C3025 Compact transistor tester	6·50 p & p 15p
Q4002 Photoelectric System	£13·70
E1310 Stereo mag. cart. preamp.	4·80 p & p 25p
Easiphone D1201 telephone amplifier	7·50 p & p 25p
D1203 Teleamp. with PU coil	4·95 p & p 20p
LL1 Door Intercomm. and chime	8·40 p & p 25p
1 Kw Dimmer/controller	3·00 p & p 10p
9" Twin spring unit For	3·30 p & p 15p
16" Twin spring unit Reverbs	6·85 p & p 25p
US50 Ultrasonic Switch Transmitter/Receiver	£12·75
C3041 1-250 MHz	£4·25
C3043 5CH 1-300 MHz	£5·75
VHF 105 Aircraft Band Convertor	4·50 p & p 15p
B2005 4 Ch. mic. mixer	4·20 p & p 15p
B2004 2 ch. Stereo mixer	6·75 p & p 15p
PK3 Kit. Etch your own printed circuits	£1·95 p & p 20p

EXCLUSIVE: SPECIAL OFFERS

MW/LW CAR RADIO
+ or − Earth with speaker and fixings. £6·50 carr./packg. 30p.

8 TRACK CAR STEREO
(-- Earth) with speakers in Pods & fixings. £12·50 carr/packg. 40p.

Portable Battery Cassette Tape Player £7·25.
Car Lighter Plug and adaptor for all cassette and radio 6/7½/9 volt output (state width) £1·95 each

Rotel Stereophones

RH630	£4·50
RH700	£6·75
RH430	£3·30

Rotel RA310 15+15 watt Stereo Amplifier (List £52·00) £34·52.

Wein W500 Battery/Mains Cassette Recorder £12·75

AKAI GXC40
Stereo cassette recorder. £59·95 carr/packg. 50p.
Pair Akai ADM microphones. £6·95 carr/packg. 20p.

PORTABLE CASSETTE TAPE PLAYER—
for car or carry around. £7·25 carr/packg. 20p.

HANIMAX BC808 POCKET CALCULATOR WITH % KEY. £28·95.

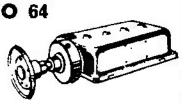
HANIMAX BC811M MEMORY VERSION £37·50

MAINS UNIT for BC808, BC811M £2·85 (state model)

HANIMAX H101 STEREO COMPACT RECORD PLAYER 2 x 7 watts
Complete with Speakers (List £54·50) Price £39·95 Plus free pair of stereo phones.

SPECIAL PURCHASES

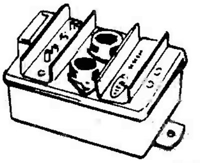
UHF TV TUNERS CHANNELS 21 TO 64



Brand new transistorised geared tuners for 625 Line Receiver IF output.
£2·50. Post 20p.

EASY TO BUILD KITS BY AMTRON— EVERYTHING SUPPLIED

Model No.		
310	Radio control receiver	2·98
300	4-channel R/C transmitter	5·95
345	Superhet R/C receiver	5·95
455	AM signal generator	12·33
65	Simple transistor tester	1·40
115	8 watt Amplifier	3·90
120	12 watt amplifier	4·70
125	Stereo control unit	5·70
130	Mono control unit	3·60
605	Power supply for 115	4·55
610	Power supply for 120	4·55
615	Power supply for 2 x 120	5·73
230	AM/FM aerial amplifier	2·93
240	Auto packing light	5·90
275	Mic. preamplifier	6·08
570	LF generator 10Hz–1mHz	15·80
575	Sq. wave generator 20Hz–20Khz	14·60
590	SWR meter	12·85
620	Ni-CAD Charger 1·2–12v	8·00
630	STAB Power supply 6-12v 0·25-0-1A	8·15
690	DC motor speed Gov.	2·87
700	Electronic Chaffinch	7·00
705	Windscreen wiper timer	6·80
760	Acoustic switch	10·75
780	Metal Detector (electronics only)	9·65
790	Capacitive Burglar alarm	6·85
835	Guitar preamp.	4·25
840	Delay car alarm	6·15
875	CAP. Discharge ignition for car engine (–Ve Earth)	13·15
80	Scope Calibrator	2·25
255	Level Indicator	6·15
525	120–160mHz VHF timer	11·30
715	Photo cell switch	7·70
795	Electronic continuity tester	4·30
860	Photo timer	13·25
871	Slide projector auto feed control	7·15
235	Acoustic Alarm for driver	7·60
465	Quartz XTAL checker	8·75
220	Signal Injector	2·30
390	VOX	15·50
432	Testakit	19·30
670	Buffer Battery Charger	6·55
885	Capacitive Contact Alarm	6·25
850	Electronic Keyer	18·75
820	Electronic Digital Clock	58·50



ALL KITS OFFERED SUBJECT TO STOCK AVAILABILITY

Prices correct at time of preparation. Subject to change without notice.

BUILD THIS TUNER

MW/LW Radio Turner to use with any amplifier. Features Mullard RF/IF module Ferrite aerial, built in battery. Excellent results. Size 7" x 2¾" x 3⅞". All parts £4·85, carr. 15p.

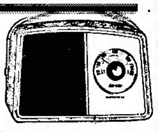
MULTI-USE & RADIONIC KITS

10–1	10 Projects	3·60
50–1	10 Projects	8·00
150–1	150 Projects	13·20
Telephone Communicator		7·20
X20	20 (Elec.) Projects	4·95
X40	40 (radio) Projects	9·45

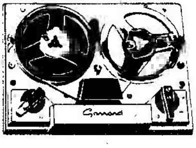
(carr./packing 40p)

All transistor circuits with hand books

BUILD THIS RADIO



Portable MW / LW radio kit using Mullard RF/IF module. Features MW — bandspread for extra selectivity. Slow motion tuning. Fibre glass PVC cabinet. 600MW output. All parts £7·98 (battery 22p), carr etc. 32p.



GARRARD BATTERY TAPE DECK

GARRARD 2 speed 9 volt tape decks. Fitted record/play and oscillator/Erase heads. Wind and rewind controls. Takes up to 4" spools. Brand new complete with head circuits.
£9·50 carr. 30p

TOP QUALITY SLIDER CONTROLS

60mm stroke high quality controls complete with knobs (post, etc. 15p any quantity).

Singles Log and Lin 5K, 10K, 22K, 50K, 100K, 250K, 500K, 1 Meg. **45p** each.

Ganged Log and Lin 10K, 22K, 50K, 100K, 250K, **65p** each. (Quantity discounts available)

Complete with knobs.

MARRIOT TAPE HEADS

4 TRACK MONO or 2 TRACK STEREO

'17' High Impedance	£2·00
'18' Med. Impedance	£2·00
R730/E73 2 track mono Record/Erase low imp.	75p pair.
Erase Heads for '17' and '18'	75p
'63' 2 track mono, Hi Imp.	£1·75
'43' Erase Head for '63'	75p

(Post, etc. 15p any quantity).

SINCLAIR, MINIATURE AMPLIFIERS & TUNER/DECODER

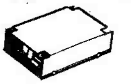
AMPLIFIERS (carr., etc. 20p)

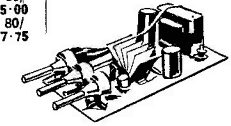
4-300, 0·3 watt 9 volt	1·75
104, 1 watt 9 volt	3·10
304, 3watt 9 volt	3·95
555, 3 watt 12 volt	4·10
E1208, 5 watt 12 volt	5·10
608, 10 watt 24 volt	4·95
410, 10 watt 28 volt	4·95
E1206, 30 watt 45 volt	9·95
E1210, 2½ + 2½ watts 12 volt	7·75
RE500, 5 watt IC mains operated Amplifier with controls	6·30
SAC14, 7 + 7 watt Stereo with controls	11·75
SAC13, 15 + 15 watt Stereo with controls	14·95
SP40-5 2Z40/Stereo 80/PZ5	25·00
SP40-6 2Z40/Stereo 80/PZ6	27·75
SP60 2Z60/Stereo 80/PZ8	30·45

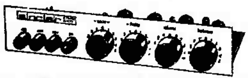
Transformer PZ8 3·95)

New SINCLAIR PROJECT 80

Stereo Preamp.	11·95
Audio Filter Unit	6·95
Z40 15 Watt Amp.	5·45
Z60 25 Watt Amp.	6·95
PZ5 Mod. for 1 on 2 Z40	4·98
PZ6 Mod. (S Tab) 1 on 2 Z40	7·98
PZ8 Mod. (S Tab) 1 on 2 Z60	7·98
TRANSFORMER FOR PZ8	3·95
Project 605 Kit	19·95
Project 805	26·95







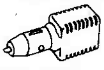
POWER SUPPLIES FOR EVERY PURPOSE

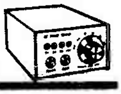
(All cased unless stated chassis)

470C 6/7½/9 volt 300 MA (Includes Multi-Adaptor for Tape Recorders, etc.)	2·15 post 20p
Car Lighter Voltage Adaptors 300mA (State voltage 6v, 7½v, 9v)	1·95 ea. post 25p
SC202 3/6/7½/9 volt 400mA	3·35 carr. 30p
HC244R Stabilised version	4·35 carr. 30p
P500 9 volt 500mA	2·90 post 20p
P11 24 volt 500mA (chassis)	2·90 post 20p
P15 26/28 volt 1 amp (chassis)	2·90 post 20p
P1080 12v 1 amp (chassis)	4·50 post 20p
P1081 45v 0·9 amp (chassis)	7·50 post 20p
P12 4½–12 volt 0·4–1 amp	7·15 post 30p
SE101A 3/6/9/12 volt 1 amp (Stab.)	10·30 post 25p
RP164 6/7½/9/12 1 amp (Stab.)	12·95 post 30p

FIBRE OPTICS

0·01 Diam. Mono Filament £3·00 per 50 metre reel
0·13 Diam. 64 Fibres Sheathed. £1·00 per metre
SPRAYS 15mm Diam. (Mares Tail Spray £10·50 7mm. Diam. £5·00)





All types offered subject to availability. Prices correct at time of press E & OE. 10% VAT TO BE ADDED TO ALL ORDERS. UK post etc. 15p per order unless stated.

Henry's RADIO LIMITED
EDGWARE ROAD, W2

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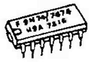

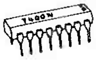

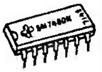

Type	1/11	12/29	30/99
	£ p	£ p	£ p
SN7400N	0·20	0·18	0·16
SN7401N	0·20	0·18	0·16
SN7401AN	0·38	0·38	0·33
SN7402N	0·20	0·18	0·16
SN7403N	0·20	0·18	0·16
SN7403AN	0·38	0·38	0·33
SN7404N	0·24	0·21	0·18
SN7405N	0·20	0·18	0·16
SN7405AN	0·44	0·44	0·38
SN7406N	0·40	0·38	0·35
SN7407N	0·40	0·38	0·35
SN7408N	0·25	0·22	0·19
SN7409N	0·33	0·33	0·28
SN7409AN	0·44	0·44	0·38
SN7410N	0·20	0·18	0·16
SN7411N	0·25	0·23	0·21
SN7412N	0·28	0·28	0·25
SN7412AN	0·38	0·38	0·33
SN7413N	0·30	0·27	0·25
SN7414N	0·72	0·72	0·63
SN7416N	0·30	0·27	0·25
SN7417N	0·30	0·27	0·25
SN7420N	0·20	0·18	0·16
SN7422N	0·28	0·28	0·25
SN7422AN	0·38	0·38	0·33
SN7423N	0·37	0·34	0·32
SN7425N	0·37	0·37	0·32
SN7427N	0·37	0·37	0·32
SN7428N	0·43	0·43	0·37
SN7430N	0·20	0·18	0·16
SN7432N	0·37	0·37	0·32
SN7433N	0·43	0·43	0·38
SN7433AN	0·57	0·57	0·50
SN7437N	0·43	0·43	0·37
SN7438N	0·43	0·43	0·37
SN7438AN	0·57	0·57	0·50
SN7440N	0·20	0·18	0·16
SN7441AN	0·85	0·79	0·73
SN7442N	0·85	0·79	0·73
SN7443N	1·50	1·27	1·13
SN7444N	1·50	1·27	1·13
SN7445N	2·16	2·16	1·89
SN7446N	2·16	2·16	1·89
SN7447AN	1·80	1·80	1·57

Type	1/11	12/29	30/99
	£ p	£ p	£ p
SN7448N	1·50	1·27	1·13
SN7450N	0·20	0·18	0·16
SN7451N	0·20	0·18	0·16
SN7453N	0·20	0·18	0·16
SN7454N	0·20	0·18	0·16
SN7460N	0·20	0·18	0·16
SN7470N	0·33	0·30	0·27
SN7472N	0·38	0·38	0·34
SN7473N	0·44	0·41	0·37
SN7474N	0·48	0·48	0·42
SN7475N	0·59	0·55	0·51
SN7476N	0·45	0·36	0·32
SN7480N	0·80	0·70	0·50
SN7481N	1·25	1·10	0·95
SN7482N	0·87	0·80	0·72
SN7483N	1·20	1·10	1·00
SN7485N	1·87	1·87	1·63
SN7486N	0·50	0·50	0·44
SN7489N	4·32	4·32	3·78
SN7490N	0·75	0·70	0·63
SN7491AN	1·10	1·00	0·90
SN7492N	0·75	0·70	0·63
SN7493N	0·75	0·70	0·63
SN7494N	0·85	0·80	0·75
SN7495N	0·85	0·80	0·75
SN7496N	1·00	0·90	0·83
SN74100N	2·16	1·89	1·89
SN74104N	0·60	0·53	0·45
SN74105N	0·60	0·53	0·45
SN74107N	0·51	0·51	0·45
SN74110N	0·57	0·57	0·50
SN74111N	0·86	0·86	0·75
SN74116N	2·16	2·16	1·89
SN74118N	1·00	0·90	0·83
SN74119N	1·92	1·92	1·68
SN74120N	1·05	1·05	0·92
SN74121N	0 57	0·57	0·50
SN74122N	0·80	0·80	0·70
SN74123N	1·44	1·44	1·26
SN74125N	0·69	0·69	0·60
SN74126N	0·69	0·69	0·60
SN74132N	0·72	0·72	0·63
SN74136N	0·63	0·63	0·55
SN74141N	1·00	0·90	0·80

Type	1/11	12/29	30/99
	£ p	£ p	£ p
SN74142N	2·88	2·88	2·52
SN74145N	1·44	1·44	1·26
SN74147N	2·30	2·30	1·83
SN74148N	2·01	2·01	1·63
SN74150N	2·30	2·30	2·01
SN74151N	1·15	1·15	1·00
SN74153N	1·09	1·09	0·95
SN74154N	2·30	2·30	2·01
SN74155N	1·15	1·15	1·00
SN74156N	1·09	1·09	1·00
SN74157N	1·09	1·09	0·95
SN74159N	2·44	2·44	2·14
SN74160N	1·58	1·58	1·38
SN74161N	1·58	1·58	1·38
SN74162N	1·58	1·58	1·38
SN74163N	1·58	1·58	1·38
SN74164N	2·01	2·01	1·76
SN74165N	2·01	2·01	1·76
SN74166N	2·16	2·16	1·89
SN74167N	4·10	4·10	3·59
SN74170N	2·88	2·88	2·52
SN74172N	5·76	5·76	5·04
SN74173N	1·66	1·66	1·45
SN74174N	1·80	1·80	1·57
SN74175N	1·29	1·29	1·13
SN74176N	1·44	1·44	1·26
SN74177N	1·44	1·44	1·26
SN74180N	1·44	1·44	1·26
SN74181N	5·18	5·18	4·53
SN74182N	1·44	1·44	1·26
SN74184N	2·16	2·16	1·89
SN74185AN	2·16	2·16	1·89
SN74188N	6·48	6·48	5·67
SN74190N	2·30	2·30	2·01
SN74191N	2·30	2·30	2·01
SN74192N	2·30	2·30	2·01
SN74193N	2·30	2·30	2·01
SN74194N	1·72	1·72	1·51
SN74195N	1·44	1·44	1·26
SN74196N	1·58	1·58	1·38
SN74197N	1·58	1·58	1·38
SN74198N	3·16	3·16	2·77
SN74199N	2·88	2·88	2·52

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AC128	20p	BCY39	1·00	GET111		OC45	18p	ZTX302	18p	2N3773	2·25
AC187	20p	BCY55	2·50		55p	OC71	15p	ZTX500	15p	2N3790	2·25
ACY17	35p	BCY70	15p	GET115	75p	OC72	25p	2G301	40p	2N3819	35p
ACY39	65p	BCY71	20p	GET880	55p	OC77	55p	2N697	15p	2N3866	75p
AD149	50p	BCY72	13p	LM309K		OC81	28p	2N706	10p	2N3903	15p
AD161	39p	BD124	80p		1·87	OC83	25p	2N930	20p	2N4002	14p
AD162	39p	BD131	45p	MAT121	25p	OC140	65p	2N987	45p	2N4126	15p
AF117	20p	BF115	22p	MJE340	50p	OC170	25p	2N1132	25p	2N4871	35p
AF118	50p	BF180	33p	MJE520	65p	OC200	55p	2N1304	22p	2N5457	36p
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ASY27	30p	BFX88	22p	NKT217	45p	ORP60	45p	2N2160	69p	40250	45p
BA115	10p	BFY50	20p	NKT404	60p	P346A	20p	2N2926	10p	40361	45p
BAX13	5p	BFY51	20p	OA5	60p	TIL209	25p	2N3053	20p	40362	40p
BC107	15p	BFY64	45p	OA81	10p	TIP29A	49p	2N3054	45p	40408	50p
BC108	15p	BFY90	75p	OA200	8p	TIP30A	58p	2N3055	45p	40486	75p
BC109	15p	BLY36	6·25	OA202	10p	TIP31A	61p	2N3440	50p	40636	1·00
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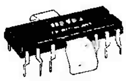

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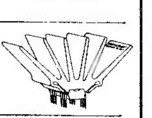

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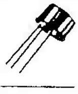

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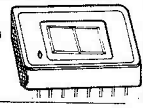

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3 Amp
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B1/20	200v	28p
B1/60	600v	30p

½H x ½L x 3/16" dia.

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B2/10	100v	40p
B2/20	200v	45p
B2/60	600v	50p
B2/100	1000v	55p

½H x ½L x 3/16" dia.

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CRS 1/40AF	400v	45p
CRS 1/60AF	600v	55p
THREE AMP (T048)		
CRS 3/05AF	50v	40p
CRS 3/10AF	100v	40p
CRS 3/20AF	200v	45p
CRS 3/40AF	400v	55p
CRS 3/60AF	600v	65p
FIVE AMP		
CRS 5/400	400v	60p
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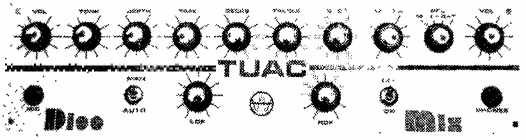

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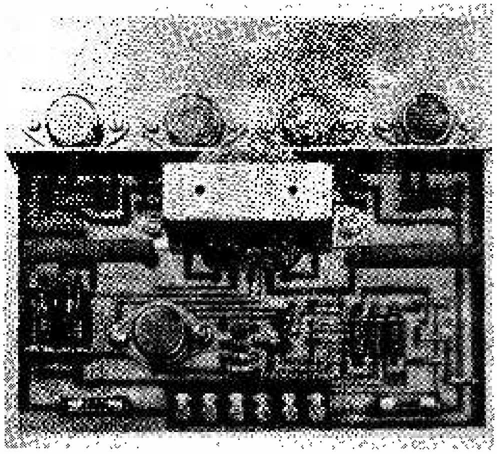

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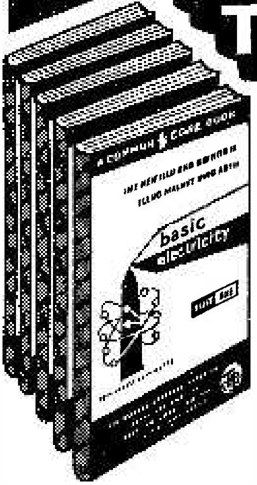

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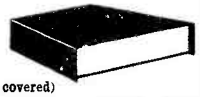


(Black Vinyl covered)

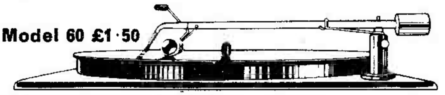
No.	Length		Width		Height	Price
BV1	8″	×	5½″	×	2″	**90p**
BV2	11″	×	6″	×	3″	**£1·20**

ALUMINIUM BOXES

BA1	5¼″	×	2¾″	×	1½″	**42p**
BA2	4″	×	4″	×	1½″	**41p**
BA3	4″	×	2¾″	×	1½″	**41p**
BA4	5¼″	×	4″	×	1½″	**47p**
BA5	4″	×	2½″	×	2″	**41p**
BA6	3″	×	2″	×	1″	**34p**
BA7	7″	×	5″	×	2½″	**66p**
BA8	8″	×	6″	×	3″	**84p**
BA9	6″	×	4″	×	2″	**54p**

BIB HI-FI ACCESSORIES

De Luxe Groov-Kleen
Model 42 £1·84
Chrome Finish Model 60 £1·50



Ref. 36A. Record/Stylus Cleaning Kit **28p**
Ref. 43. Record Care Kit **£2·35**
Ref. 31. Cassette Head Cleaner **54p**
Ref. 32. Tape editing Kit **£1·54**
Model 9. Wire Stripper/Cutter **83p**
Ref. P. Hi-Fi Cleaner **31p**
Ref. 32A. Stylus Balance **£1·36**
Ref. J. Tape Head Cleaning Kit **51p**
Ref. 34. Cassette Case **£1·27**
Ref. 56. Hi-Fi Stereo Hints & Tips **32p**

ANTEX SOLDERING IRONS

X25. 25 watt **£1·93**
CCN 240. 15 watt **£2·15**
Model G. 18 watt **£2·15**
SK2. Soldering Kit **£2·86**
STANDS: ST1 **£1·21**. ST2 **77p**
SOLDER: 18SWG Multicore 7oz **82p**
22SWG 7oz **82p**. 18SWG 22ft **28p**
22SWG Tube **22p**

ANTEX BITS and ELEMENTS

Bits No.		
102	For model CN240 3/32″	**38p**
104	For model CN240 3/16″	**38p**
1100	For model CCN240 3/32″	**38p**
1101	For model CCN240 3/8″	**38p**
1102	For model CCN240 ¼″	**38p**
1020	For model G240 3/32″	**38p**
1021	For model G240 1/8″	**38p**
1022	For model G240 3/16″	**38p**
50	For model X25 3/32″	**38p**
51	For model X25 1/8″	**38p**
52	For model X25 3/16″	**38p**

ELEMENTS

ECN 240 **£1·16** ECCN 240 **£1·32**
EG 240 **£1·16** EX 25 **£1·16**

ANTEX HEAT SINKS 10p

V.A.T. included in all prices. Please add 10p P. & P. (U.K. only). Overseas orders—please add extra for postage.

NEW COMPONENT PAK BARGAINS

Pack No.	Qty.	Description	Price
C1	250	Resistors mixed values approx. count by weight	0·55
C2	200	Capacitors mixed values approx. count by weight	0·55
C3	50	Precision Resistors 1%, 2% mixed values	0·55
C4	75	⅛th W Resistors mixed preferred values	0·55
C5	5	Pieces assorted Ferrite Rods	0·55
C6	2	Tuning Gangs, MW/LW VHF	0·55
C7	1	Pack Wire 50 metres assorted colours	0·55
C 8	10	Reed Switches	0·55
C 9	3	Micro Switches	0·55
C10	15	Assorted Pots & Pre-Sets	0·55
C11	5	Jack Sockets 3 × 3·5m 2 × Standard Switch Type	0·55
C12	40	Paper Condensers preferred types mixed values	0·55
C13	20	Electrolytics Trans. types	0·55
C14	1	Pack assorted Hardware—Nuts/Bolts, Grommets etc.	0·55
C15	4	Mains Slide Switches	0·55
C16	20	Assorted Tag strips & Panels	0·55
C17	10	Assorted Control Knobs	0·55
C18	4	Rotary Wave Change Switches	0·55
C19	3	Relays 6—24V Operating	0·55
C20	4	Sheets Copper Laminate approx. 10″ × 7″	0·55

PLUGS AND SOCKETS

SOCKETS

PS 35 DIN	2 Pin (Speaker)	0·06
PS 36 DIN	3 Pin	0·10
PS 37 DIN	5 Pin 180°	0·10
PS 38 DIN	5 Pin 240°	0·10
PS 39	Jack 2·5mm Switched	0·09
PS 40	Jack 3·5mm Switched	0·10
PS 41	Jack ¼″ Switched	0·17
PS 42	Jack Stereo Switched	0·26
PS 43	Phono Single	0·06
PS 44	Phono Double	0·10
PS 45	Car Aerial	0·09
PS 46	Co-Axial Surface	0·09
PS 47	Co-Axial Flush	0·14

INLINE SOCKETS

PS 21	D.I.N. 2 Pin (Speaker)	0·13
PS 22	D.I.N. 3 Pin	0·17
PS 23	D.I.N. 5 Pin 180°	0·17
PS 24	D.I.N. 5 Pin 240°	0·17
PS 25	Jack 2·5mm Plastic	0·10
PS 26	Jack 3·5mm Plastic	0·12
PS 27	Jack ¼″ Plastic	0·24
PS 28	Jack ¼″ Screened	0·28
PS 29	Jack Stereo Plastic	0·22
PS 30	Jack Stereo Screened	0·32
PS 31	Phono Screened	0·14
PS 32	Car Aerial	0·15
PS 33	Co-Axial	0·17

PLUGS

PS 1	D.I.N. 2 Pin (Speaker)	0·11
PS 2	D.I.N. 3 Pin	0·12
PS 3	D.I.N. 4 Pin	0·15
PS 4	D.I.N. 5 Pin 180°	0·14
PS 5	D.I.N. 5 Pin 240°	0·15
PS 6	D.I.N. 6 Pin	0·15
PS 7	S.I.N. 7 Pin	0·15
PS 8	Jack 2·5mm Screened	0·10
PS 9	Jack 3·5mm Plastic	0·09
PS 10	Jack 3·5mm Screened	0·12
PS 11	Jack ¼″ Plastic	0·13
PS 12	Jack ¼″ Screened	0·18
PS 13	Jack Stereo Screened	0·29
PS 14	Phono	0·06
PS 15	Car Aerial	0·15
PS 16	Co-Axial	0·10

CABLES

CP 1	Single Lapped Screen	0·06
CP 2	Twin Common Screen	0·08
CP 3	Stereo Screened	0·08
CP 4	Four Core Common Screen	0·23
CP 5	Four Core Individually Screened	0·30
CP 6	Microphone Fully Braided Cable	0·10
CP 7	Three Core Mains Cable	0·07
CP 8	Twin Oval Mains Cable	0·06
CP 9	Speaker Cable	0·04
CP 10	Low Loss Co-Axial	0·10

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	0·44
VC 4	1K Lin Less Switch	0·14
VC 5	100K Log anti-Log	0·44

HORIZONTAL CARBON PRESETS

0·1 watt 0·06 each
100, 220, 470, 1K, 2·2K, 4·7K, 10K, 22K, 4K7, 100K, 220K, 470K, 1M, 2M, 4·7M

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JUMBO SEMICONDUCTOR PACK

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20 Boards packed with Semiconductors and other Electronic Components. Each board approx. size 8″ x 7″. All known type no's and easily recognisable.

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2N3055. Silicon Power Transistors NPN. Famous manufacturers out-of-spec devices free from open and short defects—every one able! 115w. T03. Metal Case.

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LOW COST CAPACITORS

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500UF 50v. Elect. **10p each**

RECORD STORAGE/ CARRY CASES

7″ EP. 18⅜″ x 7″ x 8″. (50 records) **£2·10**
12″ LP. 13¾″ x 7⅜″ x 12¾″. (50 records) **£2·95**

CASSETTE CASES

Holds 12. 10″ x 3¾″ x 5″. Lock & Handle. **£1·30**

8-TRACK CARTRIDGE CASES

Holds 14. 13″ x 5″ x 6″. Lock & Handle **£1·95**

Holds 24. 13⅝″ x 8″ x 5⅜″. Lock & Handle **£2·70**

COLOURS: Red, Black and Tan—Please state preference.

REPANCO TRANSFORMERS

240v. Primary. Secondary voltages available from selected tappings 4v, 7v, 8v, 10v, 14v, 15v, 17v, 19v, 21v, 25v, 31v, 33v, 40, 50 and 25v-0-25v.

Type	Amps.	Price	P & P
MT50/½	½	£1·93	30p
MT50/1	1	£2·42	35p
MT50/2	2	£3·30	40p

CARTRIDGES

ACOS GP91-18C. 200mV at 1·2cms/sec	**£1·16**
ACOS GP93-1. 280mV at 1cm/sec	**£1·65**
ACOS GP96-1. 100mV at 1cm/sec	**£2·65**
TTC J-2005. Crystal/Hi Output	**95p**
TTC J-20 10C Crystal/Hi Output Compatible	**£1·10**
TTC J-200 CS Stereo/Hi Output	**£1·60**
TTC J-2105 Ceramis/Med. Output	**£1·64**

CARBON FILM RESISTORS

The E12 Range of Carbon Film Resistors, 1/8th watt available in PAKS of 50 pieces, assorted into the following groups:—

R1	50 Mixed 100 ohms–820 ohms	**40p**
R2	50 Mixed 1K ohms–8·2K ohms	**40p**
R3	50 Mixed 10K ohms–82K ohms	**40p**
R4	50 Mixed 100K ohms–1 Meg. ohms	**40p**

THESE ARE UNBEATABLE PRICES—LESS THAN 1p EACH INCL. V.A.T.

BI-PAK SUPERIOR QUALITY LOW - NOISE CASSETTES

C60, **32p** C90, **41p** C120. **52p**

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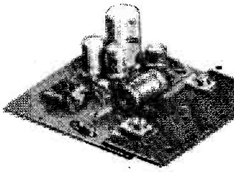
-the lowest prices!

BI-PAK *QUALITY* COMES TO AUDIO!

AL10/AL20/AL30
AUDIO AMPLIFIER MODULES



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.

Parameter	Conditions	Performance
HARMONIC DISTORTION	Po = 3 WATTS f=1KHz	0·25%
LOAD IMPEDANCE	—	8 - 16 Ω
INPUT IMPEDANCE	f=1KHz	100 k Ω
FREQUENCY RESPONSE Œ 3dB	Po=2 WATTS	50 Hz - 25KHz
SENSITIVITY for RATED O/P	Vs=25V. Rl=8 Ω f=1KHz	75mV. RMS
DIMENSIONS	—	3″ × 2½″ × 1″

The above table relates to the AL10, AL20 and AL30 modules. The following table outlines the differences in their working conditions.

Parameter	AL10	AL20	AL30
Maximum Supply Voltage	25	30	30
Power output for 2% T.H.D. (RL = 8 Ω f = 1 KHz)	3 watts RMS Min.	5 watts RMS Min.	10 watts RMS Min.

AUDIO AMPLIFIER MODULES

AL 10.	3 watts	RMS	£2·19
AL 20.	5 watts	RMS	£2·59
AL 30.	10 watts	RMS	£3·01

POWER SUPPLIES

PS 12. (Use with AL10 & AL20)	88p
SPM 80. (Use with also AL30 & AL50)	£3·25
FRONT PANELS SP 12 with Knobs	£1·10

PRE-AMPLIFIERS

PA 12. (Use with AL10 & AL20)	£4·35
PA 100. (Use with AL30 & AL50)	£13·15

TRANSFORMERS

T461 (Use with AL10)	£1·38	P & P 15p
T538 (Use with AL20)	£1·93	P & P 15p
BMT80 (Use with AL30 & AL50)	£2·15	P & P 25p

PA 12. PRE-AMPLIFIER SPECIFICATION

The PA 12 pre-amplifier has been designed to match into most budget stereo systems. It is compatible with the AL 10, AL 20 and AL 30 audio power amplifiers and it can be supplied from their associated power supplies. There are two stereo inputs, one has been designed for use with *Ceramic cartridges while the auxiliary input will suit most †Magnetic cartridges. Full details are given in the specification table. The four controls are, from left to right: Volume and on/off switch, balance, bass and treble. Size 152mm × 84mm × 35mm.

Frequency response—
20Hz – 50KHz (– 3dB)
Bass control—
± 12dB at 60Hz
Treble control—
± 14dB at 14KHz
*Input 1. Impedance
1 Meg. ohm
Sensitivity 300mV
†Input 2. Impedance
30 K ohms
Sensitivity 4mV

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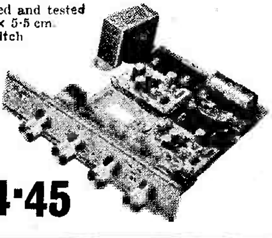
ALL PRICES INCLUDE V.A.T.

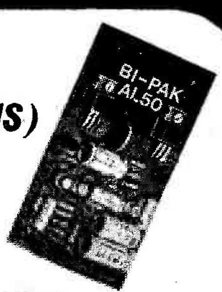
The STEREO 20



The 'Stereo 20' amplifier is mounted, ready wired and tested on a one-piece chassis measuring 20 cm × 14 cm × 5·5 cm. This compact unit comes complete with on/off switch volume control, balance, bass and treble controls, Transformer, Power supply and Power amps. Attractively printed front panel and matching control knobs. The 'Stereo 20' has been designed to fit into most turntable plinths without interfering with the mechanism or, alternatively, into a separate cabinet. Output power 20w peak. Input 1 (Cer.) 300mV into 1M. Freq. res. 25Hz-25kHz. Input 2 (Aux.) 4mV into 30K. Harmonic distortion. Bass control ±12dB at 60Hz typically 0·25% at 1 watt. Treble con. ±14dB at 14kHz.

£14·45

50W pk 25w (RMS)



0·1% DISTORTION!
HI-FI AUDIO AMPLIFIER

THE AL50

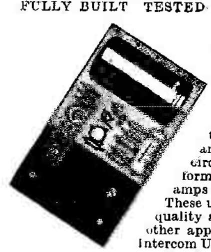
- ★ Frequency Response 15Hz to 100,000—1dB.
- ★ Load—3, 4, 8 or 16 ohms.
- ★ Distortion—better than ·1% at 1 KHz.
- ★ Signal to noise ratio 80dB.

ONLY £3·58 each

- ★ Supply voltage 10–35 Volts.
- ★ Overall size 63mm 105mm × 13mm.

Tailor made to the most stringent specifications using top quality components and incorporating the latest solid state circuitry and ALSO was conceived to fill the need for all your A.F. amplification needs.
FULLY BUILT TESTED -GUARANTEED.

STABILISED POWER
MODULE SPM80



AP80 is especially designed to power 2 of the AL50 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 MT80, the unit will provide outputs of up to 1·5 amps at 35 volts. Size: 63mm × 105mm × 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 £3·25**

TRANSFORMER BMT80 £2·15 p. & p. 28p

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 AL50 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 features of the PA100 which also has a STEREO/MONO switch, volume, balance and continuously variable bass and treble controls.

SPECIFICATION

Frequency Response	20Hz – 20KHz ± 1dB
Harmonic Distortion	better than 0·1%
Inputs: 1. Tape Head	1·25 mV into 50K Ω
2. Radio, Tuner	35 mV into 50K Ω
3. Magnetic P.U.	1·5 mV into 50K Ω

All input voltages are for an output of 250mV. Tape and P.U. inputs equalised to RIAA curve within ± 1dB. from 20Hz to 20KHz.

Bass Control	± 15bB at 20Hz
Treble Control	± 15dB at 20 KHz
Filters: Rumble (High Pass)	100Hz
Scratch (Low Pass)	8KHz
Signal/Noise Ratio	better than –65dB
Input overload	+ 26dB
Supply	+ 35 volts at 20mA
Dimensions	292mm × 82mm × 35mm

ONLY £13·15

SPECIAL COMPLETE KIT COMPRISING 2 AL50's, 1 SPM80, 1 BMT80 & 1 PA100 ONLY £25·30 FREE p. & p.

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Guaranteed Satisfaction or Money Back

TRANSFORMERS

SAFETY MAINS ISOLATING TRANSFORMERS

Pri. 120/240 V Sec. 120/240 V Centre Tapped and Screened

Ref. No.	VA (Watts)	Weight lb	oz	Size cm.	£	P & P p
07	20	1	8	7·0 x 6·0 x 6·0	2·32	30
149	60	3	12	9·9 x 7·7 x 8·6	3·45	36
150	100	5	8	9·9 x 8·9 x 8·6	3·79	52
151	200	8	0	12·1 x 9·3 x 10·2	6·45	52
152	250	13	12	12·1 x 11·8 x 10·2	8·41	67
153	350	15	0	14·0 x 10·8 x 11·8	11·22	82
154	500	19	8	14·0 x 13·4 x 11·8	16·25	–
155	750	29	0	17·2 x 14·0 x 14·0	22·10	
156	1000	38	0	17·2 x 16·6 x 14·0	29·87	–
158	2000	60	0	21·6 x 15·3 x 18·1	49·25	–

PLEASE NOTE NEW ADDRESS AS BELOW

AUTO TRANSFORMERS

Ref. No.	VA (Watts)	Weight lb	oz	Size cm.	Auto Taps	£	P & P p
113	20	1	0	5·8 x 5·1 x 4·5	0-115-210-240	1·22	22
64	75	2	4	7·4 x 6·7 x 6·1	0-115-210-240	2·40	30
4	150	3	4	8·9 x 7·7 x 7·7	0-115-200-220-240	2·89	36
66	300	6	4	9·9 x 9·6 x 8·6	,,	5·63	52
67	500	12	8	12·1 x 11·2 x 10·2	,, ,,	8·36	67
84	1000	19	8	14·0 x 13·4 x 14·3	,, ,,	15·19	82
93	1500	30	4	14·0 x 15·9 x 14·3	,, ,,	21·99	–
95	2000	32	0	17·2 x 16·6 x 14·0	,, ,,	28·70	*
73	3000	40	0	21·6 x 13·4 x 18·1	,, ,,	39.17	*

CASED AUTO TRANSFORMERS

115V 500W enclosed transformer, with mains lead and two 115V outlet sockets. **£9·49.** P & P 67p. 20 Watt version **£2·02** P & P27p

TRANSFORMERS

PRIMARY 240·250 VOLTS 12 AND OR 24 VOLT RANGE

Ref. No.	Amps. 12V	Amps. 24V	Weight lb	oz	Size cm.	Secondary Windings	£	P & P p
111	0·5	0·25		8	4·8 x 2·9 x 3·5	0·12V at 0·25A x 2	1·22	22
213	1·0	0·5	1	4	6·1 x 5·8 x 4·8	0·12V at 0·5A x 2	1·44	22
71	2	1	1	12	7·0 x 6·4 x 6·1	0·12V at 1A x 2	1·90	22
18	4	2	2	12	8·3 x 7·7 x 7·0	0·12V at 2A x 2	2·68	30
70	6	3	3	8	8·9 x 8·0 x 7·7	0·12V at 3A x 2	3·20	42
108	8	4	5	8	9·9 x 8·9 x 8·6	0·12V at 4A x 2	3·60	52
72	10	5	6	4	9·9 x 9·6 x 8·6	0·12V at 5A x 2	4·25	52
116	12	6	6	12	9·9 x 10·2 x 8·6	0·12V at 5A x 2	5·10	52
17	16	0	8	12	12·1 x 9·9 x 10·2	0·12V at 8A x 2	6·56	52
115	20	10	11	8	14·0 x 9·6 x 11·8	0·12V at 10A x 2	8·36	67
187	30	15	15	8	14·0 x 12·1 x 11·8	0·12V at 15A x 2	15·40	82
226	60	30	32	0	17·2 x 15·3 x 14·0	0·12V at 30A x 2	28·44	*

30 VOLT RANGE

Ref. No.	Amps.	Weight lb	oz	Size cm.	Secondary Taps	£	P & P p
112	0·5	1	4	6·1 x 5·8 x 4·8	0-12-15-20-24-30V	1·42	22
79	1·0	2	4	7·0 x 6·7 x 6·1	,, ,,	1·92	36
3	2·0	3	4	8·9 x 7·7 x 7·7	,, ,,	2·90	36
20	3·0	4	8	9·9 x 8·3 x 8·6	,, ,,	3·58	42
21	4·0	6	4	9·9 x 9·6 x 8·6	,, ,,	4·25	52
51	5·0	6	12	12·1 x 8·6 x 10·2	,, ,,	5·30	52
117	6·0	8	0	12·1 x 9·3 x 10·2	,, ,,	6·31	52
88	8·0	12	0	12·1 x 11·8 x 10·2	,, ,,	8·18	67
89	19·0	13	12	14·0 x 10·2 x 11·8	,, ,,	10·33	67

50 VOLT RANGE

Ref. No.	Amps.	Weight lb	oz	Size cm.	Secondary Taps	£	P & P p
102	0·5	1	12	7·0 x 6·4 x 6·1	0-19-25-33-40-50V	1·90	30
103	1·0	2	12	8·3 x 7·4 x 7·0	,, ,,	2·80	36
104	2·0	5	8	9·9 x 8·9 x 8·6	,, ,,	3·87	42
105	3·0	6	12	9·9 x 10·2 x 8·6	,, ,,	5·26	52
106	4·0	10	0	12·1 x 10·5 x 10·2	,, ,,	6·99	52
107	6·0	12	0	14·0 x 10·2 x 11·8	,, ,,	10·35	67
118	8·0	18	0	14·0 x 12·7 x 11·8	,, ,,	13·51	97
119	10·0	25	0	17·2 x 12·7 x 14·0	,, ,,	16·93	*

60 VOLT RANGE

Ref. No.	Amps.	Weight lb	oz	Size cm.	Secondary Taps	£	P & P p
124	0·5	2	4	7·0 x 6·7 x 6·1	0-24-30-40-428-69C	1·93	36
126	1·0	3	4	8·9 x 7·7 x 7·7	,, ,,	2·70	36
127	2·0	6	4	9·9 x 9·6 x 8·6	,, ,,	4·25	42
125	3·0	8	12	12·1 x 9·9 x 10·2	,, ,,	6·46	52
123	4·0	13	12	12·1 x 11·8 x 10·2	,, ,,	8·36	67
40	5·0	12	00	14·0 x 10·2 x 11·8	,, ,,	9 85	87
120	6·0	15	8	14·0 x 12·1 x 11·8	,, ,,	12·14	82
121	8·0	25	00	14·0 x 14·7 x 11·8	,, ,,	13·65	*
122	10·0	25	0	17·2 x 12·7 x 14·0	,, ,,	20·09	*
189	12·0	29	00	17·2 x 14·0 x 14·0	,, ,,	22·49	*

MINIATURE TRANSFORMERS WITH SCREENS

Ref.	MA.	Weight		Size cm	VOLTS	£	P & P p
238	200		2	2·8x2·6x2·0	3-0-3	1·31	10
212	1A 1A	1	4	6·1x5·8x4·8	0-6 0-6	1·52	22
13	100		4	3·9x2·6x2·9	9-0-9	1·12	10
235	330,330		4	4·8x2·9x3·5	0-9, 0-9	1·52	10
207	500, 500	1	00	6·1x5·4x4·8	0-8-9, 0-8-9	2·03	22
208	1A, 1A	1	12	7·0x6·4x6·1	0-8-9,0-8-9	2·73	30
236	200, 200		4	4·8x2·9x3·5	0-15, 0-15	1·52	10
214	300, 300	1	4	6·1x5·8x4·8	0-20, 0-20	1·60	22
221	700 (D.C.)	1	8	7·0x6·1x6·1	20-12-0-12-20	1·41	30
206	1A, 1A	2	12	8·3x7·7x7·0	0-15-20, 0-15-20	3·08	36
203	500, 500	2	4	8·3x7·0x7·0	0-15-27, 0-15-27	2·82	38
204	1A, 1A	3	4	8·9x7·7x7·7	0-15-27, 0-15-27	2·86	38

PLEASE ADD 10% FOR V.A.T.
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Savbit alloy
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60/40 alloy
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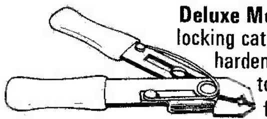

Deluxe Model 9 Automatic opening spring, locking catch, plastic-covered handles. Case hardened and precision ground. Adjusts to most wire sizes. Cuts and strips flex, splits plastic twin flex. **75p**

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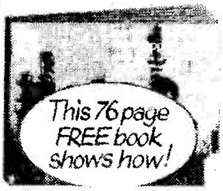

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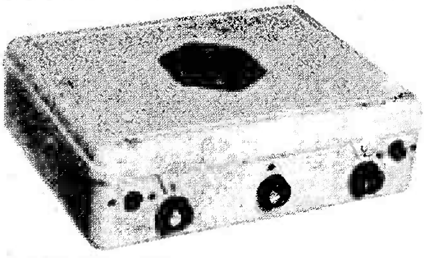

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Build these projects without soldering iron or solder

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Total Building Costs
£7·23 P P & Ins. 44p (Overseas P & P £1·85)
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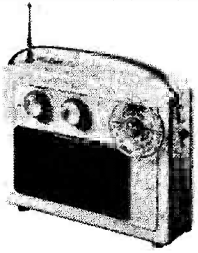
Components Include: 24 Resistors ● 21 Capacitors ● 10 Transistors ● 3¼" Loudspeaker ● Earpiece ● Mica Baseboard ● 3 12-way connectors ● 2 Volume controls ● 2 Slider Switches ● 1 Tuning Condenser ● 3 Knobs ● Ready Wound MW/LW/SW Coils ● Ferrite Rod ● 6½ yards of wire ● 1 Yard of sleeving etc. ● Parts Price List and Plans 50p. (Free with parts).

NEW ROAMER NINE



WITH V.H.F. INCLUDING AIRCRAFT

Nine Transistors, 9 Tuneable wavebands as Roamer Ten Built in ferrite rod aerial for MW/LW. Retractable chrome-plated telescopic aerial for VHF and SW. Push Pull output using 600 mW transistors. 9 Transistors and 3 diodes, tuning condenser with V.H.F. section, separate coil for aircraft, moving coil loudspeaker, volume ON/OFF and wavechange controls. Attractive all white case with red grille and carrying strap. Size 9½" × 7" × 2¾" approx. Parts Price List and Plans 30p (Free with parts).

Total Building Costs **£6·95** P P & Ins. 44p (Overseas P & P £1·85)
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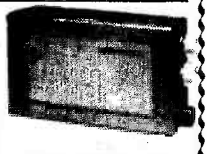
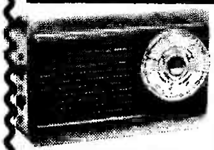
POCKET FIVE



3 Tunable wavebands, M.W. L.W. and Trawler Band, 7 stages, 5 transistors and 2 diodes, supersensitive ferrite rod aerial, moving coil loudspeaker, attractive black and gold case. Size 5½" × 1½" × 3½" approx. Plans and Parts Price List 15p (Free with parts).

Total Building Costs **£2·28** P P & Ins. 26p
(+10% VAT 22p)
(Overseas P & P £1·25)

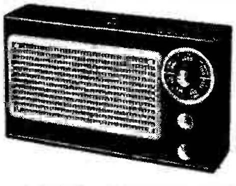
TRANSONA FIVE



Wavebands, transistors and speaker as Pocket Five. Larger Case with Red Speaker Grille and Tuning Dial. Plans and Parts Price List 15p (Free with parts).

Total Building Costs **£2·50** P P & Ins. 26p
(+10% VAT 25p)
(Overseas P & P £1·25)

NEW Everyday Series



Build this exciting New series of designs

E.V.5. 5 Transistors and 2 diodes. MW/LW. Powered by 4½ volt Battery. Ferrite rod aerial, tuning condenser, volume control, and loudspeaker. Attractive case with red speaker grille. Size 9" × 5¼" × 2¼" approx. Parts Price List and Plans 15p. Free with parts.

Total Building costs **£2·73** P P & Ins. 30p (+ 10% VAT 27p). (Overseas P & P £1·25)

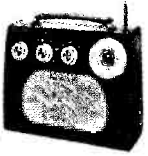
E.V.6. Case and looks as above. 6 Transistors and 3 diodes. Powered by 9 volt battery. Ferrite rod aerial, 3" loudspeaker, etc., MW/LW coverage. Push Pull output. Parts Price List and Plans 15p. Free with parts.

Total Building Costs **£3·60** P P & Ins. 30p (+ 10% VAT 36p) (Overseas P & P £1·25)

E.V.7. Case and looks as above. 7 Transistors and 3 diodes. Six wavebands. MW/LW, Trawler Band, SW1. SW2, SW3. powered by 9 volt battery. Push Pull output. Telescopic aerial for short waves. 3" Loudspeaker. Parts Price List and Easy Build Plans 20p. Free with parts. Overseas P & P £1·05.

Total Building Costs **£4·08** P P & Ins. 31p Overseas P & P £1·85 (+ 10% VAT 40p)

ROAMER EIGHT Mk I

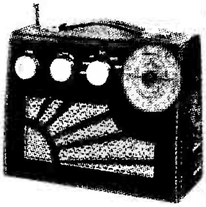


NOW WITH VARIABLE TONE CONTROL

7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Built in Ferrite Rod Aerial for MW and LW. Retractable chrome plated Telescopic aerial for Short Waves. Push pull output using 600mW transistors. Car aerial and Tape record sockets. Selectivity switch. 8 transistors plus 3 diodes. Latest 4" 2 watt ferrite magnet loudspeaker. Air spaced ganged tuning condenser. Volume/on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shade with gold blocking. Size 9 × 7 × 4in. approx. Easy to follow instructions and diagrams. Parts price list and plans 25p (FREE with parts).

Total building costs Overseas P & P £1·85) **£6·98** P P & Ins. 47p (+ 10% VAT 69p)

ROAMER TEN



WITH VHF INCLUDING AIRCRAFT

10 Transistors. Latest 4" 2 watt Ferrite Magnet Loudspeakers. 9 Tunable Wavebands, MW1, MW2, LW, SW1, SW2, SW3, Trawler Band, VHF and Local Stations also Aircraft Band.

Built in Ferrite Rod Aerial for MW/LW. Retractable, chrome plated 7 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 30p (FREE with parts).

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Five units including master unit to construct.

Components include:
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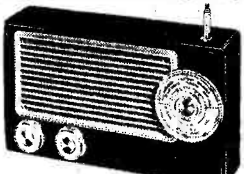
TRANS EIGHT

8 TRANSISTORS and 3 DIODES



6 Tunable Wavebands: MW, LW, SW1, SW2, SW3 and Trawler Band. Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. 3in. Speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2½in. approx. Push pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and plans 25p. (FREE with parts).

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ROAMER SIX

CASE AND LOOKS AS TRANS-EIGHT

6 Tunable Wavebands: MW, LW, SW1, SW2, Trawler band plus an extra Medium waveband for easier tuning of Luxembourg, etc. Sensitive ferrite rod aerial and telescopic aerial for Short Waves. 3in. Speaker. 8 stages—6 transistors and 2 diodes. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2½in. approx. Plans and parts price list 25p (FREE with parts).

Total building costs **£3·98** P P & Ins. 31p (Overseas P & P £1·85)
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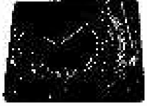
STEREO AND MONO



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Suitable 7″ × 4″ speaker, £1. **£5·95** Post 25p

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Most will play with cover in position.
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32/500V	50p	8+8/450V	22p	32+32/450V	60p
25/25V	10p	8+16/450V	25p	350+50/325V	55p
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ALL POST 25p each

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SET OF 3 MOTORS FOR COLLARO STUDIO 115 volt TAPE DECK £2·50 Post 50p.

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Long spindles. Midget Size 5 K. ohms to 2 Meg. LOG or LIN. L/S 15p. D.P. 25p. STEREO L/S 55p. D.P. 75p. Edge 5K. S.P. Transistor 25p

80 Ohm Coax 4p yd.

BRITISH AERIALITE AERAXIAL-AIR SPACED 40 yd. £1·40; 60 yd. £2.
FRINGE LOW LOSS Ideal 625 and colour. **10p** per yd

Wirewound controls 1¼in. diam. 3 watts. 10 ohms to 100K British made with long spindles ¼in. dia 45p ea.

HELICAL POT 10k LIN List £3, Bargain 75p.
DUAL CONCENTRIC POT 500k LOG + 500k LIN D.P. switch. Inner spindle 3¼in; outer spindle 2¼in. 75p.

E.M.I. 13½ × 8 in. SPEAKER SALE!

With twin tweeters. And crossover. 10 watt. State 3 or 8 or 15 ohm. As illustrated. **£4·50** Post 25p

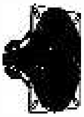
With flared tweeter cone and ceramic magnet. 10 watt.
Bass res. 45-60 cps.
Flux 10,000 gauss.
State 3 or 8 or 15 ohm. Post 25p **£2·75**

Bookshelf Cabinet 16 × 10 × 9in. Teak Veneer **£6·60** Post 35p

E.M.I. 6½in. HI-FI WOOFER

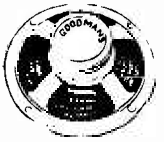
8 ohm, 10 watt. Large ceramic magnet Special Rubber cone surround. Freqnency response 30-12,000 cps. Ideal P.A. Columns, Hi-Fi Enclosure Systems, etc. **£4**
Suitable cabinet 12 × 8 × 6 £4·00.
Suitable Tweeter £2·00.

ELAC CONE TWEETER



The moving coil diaphragm gives a good radiation pattern to the higher frequencies and a smooth extension of total response from 1,000 cps to 18,000 cps. Size 8½ × 3½ × 2in. deep. Ratiug 10 watt, 3 ohm.
Crossover £1.25
Post 20p **£1·90**

GOODMANS 8 in. WOOFER



8 ohm 12 watt. Deep cone. Heavy ceramic magnet. Bass resonance 35 cps. Frequency response 30-8,000 cps.
Ideal bass unit for Hi-Fi systems **£3·75**

LOUDSPEAKERS P.M. 3 OHMS. 7 × 4in. £1·25; 6½in. £1·50; 8 × 5in. £1·60; 8in. £1·75; 10 × 6in. £1·90; 10in. £2·00.
SPECIAL OFFER! 80 ohm, 2¼ in. 2¾in. 35 ohm, 2in.; 3in; 25 ohm, 2½in. dia.; 3in. dia.; 5 × 3 in. 15 ohm. 3½in. dia.; 5in. /6 × 4in.; 7 × 4in.; 8 × 5in **£1** EACH TYPE
3 ohm, 2½in, 2⅝in., 3½in., 5in. dia. (6 × 4in., 8 ohm, £1·50).
RICHARD ALLAN TWIN CONE LOUDSPEAKERS. 8in. diameter 4W £2·50, 10in. diameter 5W £2·50; Post 25p. 12in. diameter, 6W, £2·95; 3 or 8 or 15 ohm models.
SPEAKER COVERING MATERIALS. Samples Large S.A.E.
Horn Tweeters 2-16Kc/s. 8W 8 ohm or 15 ohm £1·95.
De Luxe Horn Tweeters 2-18 Kc/s, 15W, 15 ohm £3·50.
TWO-WAY 3,000 c.p.s. CROSSOVERS 3, 8 or 15 ohm 95p.

TWO-WAY CROSSOVER NETWORK 3,000 c/s

With variable tweeter attenuator giving accurate high/low frequency balance. Mounted on panel 5½in. × 4in. with control knob, tweeter and woofer leads and input terminals. Suitable for 3 to 8 ohm impedance. **£2·20** Post 20p

VALVE OUTPUT TRANSFORMER 25p
MIKE TRANSFORMER MU. metal 100-1 £1·25.
5 WATT MULTI RATIO. 3, 8 and 15 ohms, 80p.
PUSH-PULL VALVE OUTPUT TRANSFORMERS.
50 watt .... £12·50 100 watt £15

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1·5v d.c. operation over 250 hrs. continuous on SP2 battery. fully adjustable swing and speed. Ideal displays teaching electro magnetism or for metronome; strobe etc. 95p, Post 20p

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2 Stage Triode Pentode valve. 3 watts 3 ohm output. Volume on/off and tone controls AC mains. Complete and tested. £4·50. Post 25p.

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Printed Circuit 60p. Twin Gang 75p.

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OUTLET BOXES, SURFACE MOUNTING 25p.
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JACK PLUGS Std. Chrome 20p; 3·5mm Chrome 12p. DIN SOCKETS Chassis 3-pin 10p; 5-pin 10p. DIN SOCKETS Lead 3-pin 18p; 5-pin 15p. DIN PLUGS 3-pin 18p; 5-pin 25p.
VALVE HOLDERS 5p; CERAMIC 10p; CANS 5p.

BRITISH FM/VHF TUNING HEART

88 to 108 Mc/s British made. 2 Transistors ready aligned—requires 10.7 Mc/s IF. Complete with tuning gang. Connections supplied but some technical experience essential. Our Price **£3·95** Post 20p.

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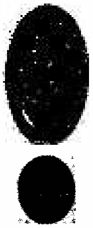
E.M.I. WOOFER AND TWEETER KIT



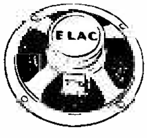
£6·75 THE PAIR. Post 25p. (Available separately. Woofer £4·25; Tweeter £1·90).

Comprising a fine example of a Woofer 10¾ × 6½in. with a massive Ceramic Magnet. 44oz. Gauss 13,000 lines. Aluminium Cone centre to improve middle and top response. Also the E.M.I. Tweeter 3¾in. square has a special lightweight paper cone and magnet flux 10,000 lines. Crossover condenser and full instructions supplied.

Impedance Standard	8 ohms
Maximum power	12 watts
Useful Response	25 to 18,000 cps
Bass Resonance	45 cps

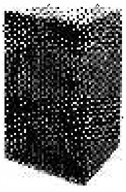
SUITABLE ENCLOSURE 20 × 13 × 9in. MODERN DESIGN. TEAK WOOD FINISH. **£9·90** Post 25p

8in. or 10in. ELAC HI-FI SPEAKER



Dual cone plasticised roll surround. Large ceramic magnet. 50–16,000 cps. Bass resonance 55 cps. 8 ohm impedance. 8in. 10 watts **£3·75**

TEAK VENEER HI-FI SPEAKER CABINETS
Fluted Wood Fronts



MODEL "A". 20 × 13 × 9in. For 12in. dia. or 10in. speaker. **£9·90** Post 25p

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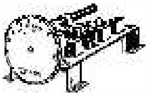
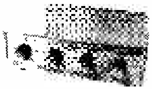
MODEL "C". 16 × 8 × 6in. For 8 × 5in. speaker. **£4·40** Post 25p

LOUDSPEAKER CABINET WADDING 18in. wide. 15p ft.



BARGAIN AM TUNER. Medium Wave. Transistor Superhet Ferrite aerial. 9 volt. **£4·95**



BARGAIN 4 CHANNEL TRANSISTOR MONO MIXER. Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. 9 volt battery operated. **£3·95**

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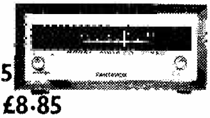
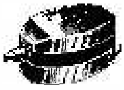


BARGAIN FM TUNER. 88-108 Mc/s Six Transistor. 9 volt. Printed circuit. Calibrated slide dial tuning. Walnut Cabinet. Size 7 × 5 × 4in. **£12·85**

BARGAIN FM TUNER. As above less cabinet. **£8·85**

BARGAIN 3 WATT AMPLIFIER. 4 Transistor Push-Pull Ready built with volume, treble and bass controls. 18 volt battery operated. **£4·50**



THE "INSTANT" BULK TAPE ERASER & HEAD DEMAGNETISER. Suitable for cassettes, and all sizes of tape reels. A.C. mains 200/250V. Leaflet S.A.E. **£3·50** Post 20p

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OFFERING 1001 USES for every type of heating and drying applications in the home, garage, greenhouse, factory (available in manufacturing quantities). Approx. size 10¾ × 8¼ × 1/16in. Operating voltage 200/250V. a.c. 250 watts approx. Printed circuit element enclosed in asbestos fitted with connecting wires. Completely flexible providing safe Black heat. British-made for use in photocopiers and print drying equipment.

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Post Free

30-14,500 c/s. 12in. double cone, woofer and tweeter cone together with a BAKER ceramic magnet assembly having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 40 c/s Rated 20 watts. NOTE: 3 or 8 or 15 ohms must be stated.

Module kit, 30-17,000 c/s with tweeter, crossover, baffle and instructions. **£12·50**

Please state 3 or 8 or 15 ohms. Post Free

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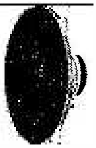
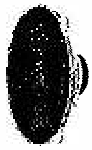
Robustly constructed to stand up to long periods of electronic power. As used by leading groups. Useful response 30-13,000 cps. Bass Resonance 55 cps.



GROUP "25" 12in. 25 watt 3, 8 or 15 ohms. **£8·80** Post Free



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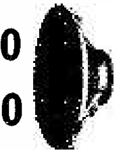
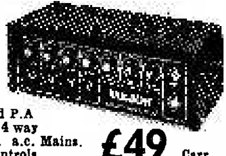


GROUP "50" 15in. 50 watt 8 or 15 ohms. **£22·00**

NEW 12″ VERSION 50 watt 8 or 15 ohms **£17·60**

MAJOR 100 WATT ALL PURPOSE TRANSISTOR AMPLIFIER



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7 valve version, 4 input 10 wide range controls. For mikes, Discos, Organs, Guitars, etc. 4, 8 & 15 ohm loudspeakers matching £69·00.

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Key 'T' for above 6p
1/2″, 9/16″, 5/8″ 90p
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1 5/8″ ....£1·70
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120v. or 240v. A.C. 2,400 rpm. 2-pole 70mA. Size 2⅞ × 2½ × 2¼in. **£1·00** Post 25p.

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HIGH QUALITY — BRITISH MADE

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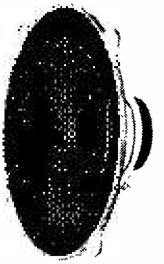

An inexpensive unit for the beginner in high fidelity and for general purposes. May be used to improve any Radio. Amplifier. Hi-Fi or Television receiver.

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Flux Density	12,000gauss
Useful response	45-13,000cps

3 or 8 or 15 ohm models.

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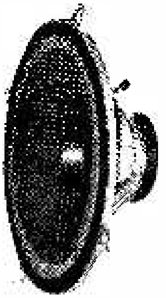

Especially designed to provide full range reproduction at an economical cost. Suitable for use with any high fidelity system. Built-in concentric tweeter cone.

Bass Resonance	30cps
Flux Density	14,000gauss
Useful response	25-16,000cps

8 or 15 ohms models.

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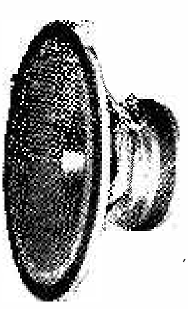
SUPERB
12in. 20 watts



A high quality loudspeaker, its remarkable low cone resonance ensures clear reproduction of the deepest bass. Fitted with a special copper drive and concentric tweeter cone resulting in full range reproduction with remarkable efficiency in the upper register.

Bass Resonance	25cps
Flux Density	16,500gauss
Useful response	20-17,000cps

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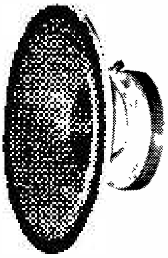
12in. 25 watts



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Flux Density	15,000gauss
Useful response	25-16,000cps

8 or 15 ohms models.

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A high wattage loudspeaker of exceptional quality with a level response to above 8,000 cps. Ideal for Public Address, Discotheques, Electronic instruments and the home.

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Useful response	20-14,000cps

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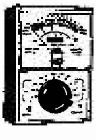
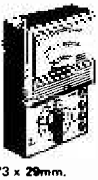
INCORPORATING LASKYS RADIO AND G. W. SMITH & CO. (RADIO).

AUDIOTRONIC Model ATM1


Top value 1,000 opv pocket multimeter. Ranges:— 0/10/50/250/1,000 volt AC and DC. DC current 0-1mA/100mA. Resistence: 0/150k ohms. Decibels: −10 to +22dB. Size 90 x 60 x 28mm. Complete with test leads.

OUR PRICE £2.95 P&P 15p

AUDIOTRONIC Model ATM5


Jewel movement, attractively moulded case with edgwise ohms adjustment. Ranges: 0-3/15/150/300/1200V AC, (2500 opv). 0-6/30/300/600V DC, (5000 opv). 0-300 uA/0-300mA DC. Resistance: x 10 & x 100. −10 to +16dB. Supplied with battery test leads and data booklet. Size: 121 x 73 x 29mm.

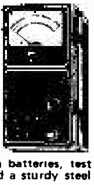
OUR PRICE £3.50 P&P 15p

MODEL C1092 MULTIMETER


Features 5,000 opv jewel movement and a good selection of range functions. Edgwise ohms adjustment. Ranges:— 0–3/15/150/300/1,200V AC (2,500 opv). 0–6/30/300/600 V DC (5,000 opv). DC current. 0–300uA/300mA. Resistence: R x 10, R x 1,000. −10 to +16dB. Complete with battery, test leads and data booklet. Size: 120 x 73 x 28mm.

OUR PRICE £3.75 P&P 35p

MODEL U437 MULTIMETER


10,000opv. A first class, instrument manufactured in USSR to the highest standards. Ranges: 2.5/10/50/ 250/500/1000V DC. 2.5/10/50/250/500/1000V AC. DC current 100uA/1/10/100mA/1A. Resistence 300 ohms/3/30/300k/3 Meg. ohms. Complete with batteries, test leads, instructions and a sturdy steel carrying case.

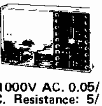
OUR PRICE £4.95 P&P25p

MODEL TH12


20,000 opv. Overload protection. Slide switch selector. 0/0.25/2.5/10/50/150/1000V DC. 0/10/50/250/1000V AC. 0/50uA/25/250mA DC. 0/3k/30k/300k/3 Megohms. −20 to +50dB.

OUR PRICE £5.95 P&P 15p

U4323 MULTIMETER


20,000opv. Simple unit with audio/1F 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: 5/50/500 ohms/5/10/100k ohms/1Meg. Battery operated. Size: 160 x 97 x 40mm. Supplied in carrying case complete with test leads.

OUR PRICE £7.00 P&P 20p

MODEL TE300

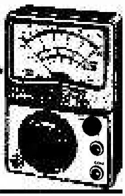

30,000opv. Mirror scale. Overload protection. 0/0.6/3/15 60/300/1200V DC. 0/6/30/120/600/1200V AC. 0/30uA/6mA/60mA/300mA 600mA. 0/8k/80k/800k/8 Meg ohms. −20 to +63dB.

OUR PRICE £7.50 P&P 15p

ALL PRICES EXCLUDE VAT

Also see following pages

HIOKI Model 720X VOM


A versatile accurate measuring instrument. 20,000 opv. 0/5/25/100/500/1000V DC. 0/10 50/250/1000V AC. 0–50uA/250mA. 0–20k/2 Megohms.

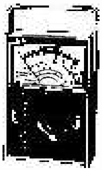
OUR PRICE £5.97 P&P 20p

U4324 MULTIMETER


High sensitivity, overload protected. 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.

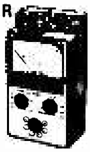
OUR PRICE £8.00 P&P 20p

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

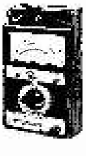
OUR PRICE £8.50 P&P 17p

U435 MULTIMETER


20,000opv. Overload protected. Ranges: 75mV/2.5/10/25/100/250/500/1000V DC. 2.5/10/25/100/250/500/1000V AC. Current: 50uA/1/5/25/100mA/0.5/2.5A DC. 5/25/100mA/0.5/2.5A AC. Resistance: 0.3/3/30/300k ohms. Size: 205 x 110 x 84mm. Supplied complete with leads, crocodile clips and steel carrying case.

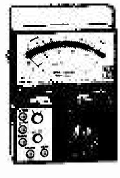
OUR PRICE £8.75 P&P 20p

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 £9.75 P&P 25p

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 £13.95 P&P 25p

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 £10.50 P&P 20p

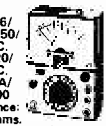
MODEL 500


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 £10.95 Carr. paid

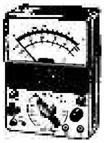
Leather case for above £1.75

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.

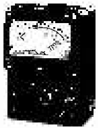
OUR PRICE £11.95 P&P 40p

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

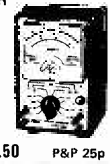
OUR PRICE £14.95 P&P 30p

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 £17.50 P&P 25p

TE40 HIGH SENSITIVITY AC VOLTMETER


10 Meg input. 10 ranges: 0.001/0.03/0.1/0.3/1/3/11/30/100/300V RMS. 5cps–1.2MHz. −40 to +50dB supplied complete with leads and instructions.

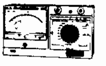
OUR PRICE £17.50 P&P 25p

MODEL U4311 Sub-standard Multi-range Volt-Ammeter


Sensitivity 330 Ohms/Volt AC and DC. Accuracy 0.5% DC. 1% AC. Scale length: 165mm. 0/300/750uA/1.5/3/7.5/15/30/75/150/300/750mA/1.5/3/7.5A DC. 0/3/7.5/15/30/75/150/300/750mA/1.5/3/7.5A AC. 0/75/150/300/750mV/1.5/3/7.5/15/30/75/150/300/750V DC. 0/750mV/1.5/3 /7.5/45/30/75/150/300/750V AC. Automatic cut out device. Supplied complete with test leads, manual and test certificates.

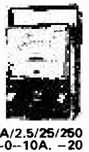
OUR PRICE £49.00 P&P 50p

U4317 MULTIMETER


High sensitivity instrument for field and laboratory work. Knife edge pointer, 86mm. mirror scale. 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.

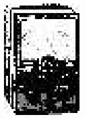
OUR PRICE £15.00 P&P 20p

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 £15.00 P&P 40p

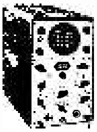
TE65 VALVE VOLTMETER


28 ranges. DC volts 1.5–1500V. AC volts 1.5–1500V. Resistance up to 1000 Megohms, 200/240V AC operation. Complete with probe and instructions.

OUR PRICE £17.50 P&P 30p

Additional probes available. RF £2.12, HV £2.50

CI5 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.

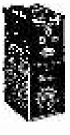
OUR PRICE £39.00 Carr. paid

RUSSIAN CI16 Double Beam OSCILLOSCOPE


5 MHz pass band. Separate Y1 and Y2 amplifiers. Rectangular 5" x 4" CRT. Calibrated triggered sweep from 0.2usec to 100 milli-sec/cm. Free running time base, 50Hz–1MHz. Built-in time base Calibrator and amplitude Calibrator. Supplied complete with all accessories and instruction manual.

OUR PRICE £87.00 Carr. paid

LB4 TRANSISTOR TESTER


Tests PNP or NPN transistors. Audio indication. Operates on two 1.5V batteries. Complete with instructions etc.

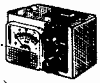
OUR PRICE £4.50 P&P 20p

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.

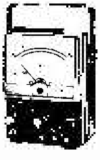
OUR PRICE £10.50 P&P 20p

LB3 TRANSISTOR TESTER


Tests ICO and B. PNP/NPN. Operates from 9V battery. Instructions supplied.

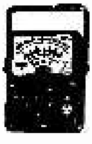
OUR PRICE £3.95 P&P 20p

KAMODEN HM350 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.

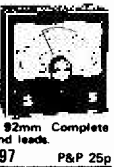
OUR PRICE £12.50 P&P 30p

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.

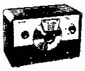
OUR PRICE £15.95 P&P 25p

TE16A TRANSISTORISED SIGNAL GENERATOR


5 ranges, 400kHz to 30 MHz. An inexpensive instrument for the handy-man. Operates on 9V battery. Wide easy to read scale. 800kHz modulation. Size: 149 x 149 x 92mm Complete with instructions and leads.

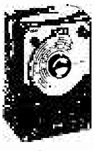
OUR PRICE £8.97 P&P 25p

MODEL TE20 RF SIGNAL GENERATOR


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 £17.50 P&P 40p

ARF 300 AF/RF SIGNAL GENERATOR


All transistorised compact fully portable. AF sinewave 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

OUR PRICE £29.95 P&P 50p

AT201 Decade ATTENUATOR


Frequency range 0–200kHz. Attenuator 0–111dB, 0.1dB steps. Impedence 600 ohms. Input power maximum 30dBm. Size: 180 x 90 x 55mm.

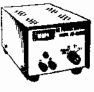
OUR PRICE £12.50 P&P 37p

MCA220 Automatic Voltage Stabiliser


Input 88–125V AC or 176–250V AC. Output 120V AC or 240V AC 200V/A rating. P&P 50p

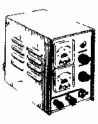
OUR PRICE £11.97

PS100B Regulated POWER SUPPLY UNIT


Solid state. Output 6, 9 or 12V DC up to 3 Amp. Meter to monitor current. Input 220/240V AC Size: 100 x 82 x 159mm.

OUR PRICE £11.97 P&P 25p

PS200 Regulated POWER SUPPLY UNIT


Solid state. Variable output 5–20V DC up to 2 Amp. Independent meters to monitor voltage and current. Output 220/240V AC. Size: 190 x 136 x 98mm.

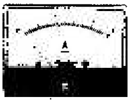
OUR PRICE £19.95 P&P25p

SEW CLEAR PLASTIC PANEL METERS

USED EXTENSIVELY BY INDUSTRY, GOVERNMENT DEPARTMENTS, EDUCATIONAL AUTHORITIES ETC.

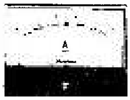
Over 200 ranges in stock—other ranges to order. Quantity discounts available. Send for fully illustrated brochure.

CLEAR PLASTIC MODEL SD640
Size: 85 x 64mm



50uA	£3.35
100uA	£3.30
200uA	£3.30
500uA	£3.25
50-0-50uA	£3.35
100-0-100uA	£3.30
1mA	£3.20
5mA	£3.20
10mA	£3.20
50mA	£3.20
100mA	£3.20
500mA	£3.20
1A DC	£3.20
5A DC	£3.20
10A DC	£3.20
5V DC	£3.20
20V DC	£3.20
50V DC	£3.20
300V DC	£3.20
15V AC	£3.30
300V AC	£3.30
VU Meter	£3.45

CLEAR PLASTIC MODEL SW100
Size: 100 x 80mm



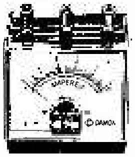
50uA	£4.55
100uA	£4.35
500uA	£4.10
50-0-50uA	£4.35
100-0-100uA	£4.30
1mA	£3.95
1A DC	£3.95
5A DC	£3.95
20V DC	£3.95
50V DC	£3.95
300V DC	£3.95
300V AC	£4.00
VU Meter	£4.75

EDGWISE MODEL PE70
Size: 90 x 34mm

50uA	£4.15
100uA	£3.95
200uA	£3.75
500uA	£3.50
50-0-50uA	£3.95
100-0-100uA	£3.85
1mA	£3.50
300V AC	£3.50
VU Meter	£4.25

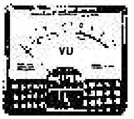
MODEL ED107 EDUCATIONAL METER
Size: 100 x 90 x 150mm including terminals

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	£7.60
100uA	£7.05
50-0-50uA	£7.05
1A DC	£6.55
5A DC	£6.55
5V DC	£6.55
10V DC	£6.55
15V DC	£6.55
20V DC	£6.55
50V DC	£6.55
300V DC	£6.55
500mA/5A DC	£7.70
5V/50V DC	£7.70
5V/15V DC	£7.70
1A/15A DC	£7.70

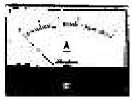
CLEAR PLASTIC MODEL 85P
Size: 120 x 110mm



50uA	£4.85
100uA	£4.70
200uA	£4.45
500uA	£4.30
50-0-50uA	£4.70
100-0-100uA	£4.45
500-0-500uA	£4.30
1mA	£4.30
1-0-1mA	£4.30
5mA	£4.30
10mA	£4.30
50mA	£4.30
100mA	£4.30
500mA	£4.30
1A DC	£4.30
5A DC	£4.30
15A DC	£4.30
30A DC	£4.35
10V DC	£4.30
20V DC	£4.30
50V DC	£4.30
150V DC	£4.30
300V DC	£4.30
15V AC	£4.35
300V AC	£4.35
S Meter 1mA	£4.30
VU Meter	£5.00
1A AC	* £4.30
5A AC	* £4.30
10A AC	* £4.30
20A AC	* £4.30
30A AC	* £4.30

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

CLEAR PLASTIC MODEL SD830
Size: 110 x 83mm



50uA	£3.75
100uA	£3.70
200uA	£3.65
500uA	£3.45
50-0-50uA	£3.75
100-0-100uA	£3.70
1mA	£3.40
5mA	£3.40
10mA	£3.40
50mA	£3.40
100mA	£3.40
500mA	£3.40
1A DC	£3.40
5A DC	£3.40
10A DC	£3.40
5V DC	£3.40
10V DC	£3.40
20V DC	£3.40
50V DC	£3.40
300V DC	£3.40
15V AC	£3.65
300V AC	£3.65
VU Meter	£3,85

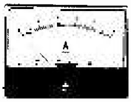
CLEAR PLASTIC MODEL 45P
Size: 50 x 50mm

50uA	£3.00
100uA	£2.85
200uA	£2.75
500uA	£2.70
50-0-50uA	£2.90
100-0-100uA	£2.75
500-0-500uA	£2.65
1mA	£2.65
5mA	£2.65
10mA	£2.65
50mA	£2.65
100mA	£2.65
500mA	£2.65
1A DC	£2.65
5A DC	£2.65
10V DC	£2.65
20V DC	£2.65
50V DC	£2.65
300V DC	£2.65
15V AC	£2.70
300V AC	£2.70
S Meter 1mA	£2.75
VU Meter	£3.00
1A AC	* £2.65
5A AC	* £2.65
10A AC	* £2.65
20A AC	* £2.65
30A AC	* £2.65

CLEAR PLASTIC MODEL 38P
Size: 42 x 42mm

50uA	£2.80
100uA	£2.70
200uA	£2.65
500uA	£2.50
50-0-50uA	£2.75
100-0-100uA	£2.65
500-0-500uA	£2.50
1mA	£2.50
1-0-1mA	£2.50
2mA	£2.50
5mA	£2.50
10mA	£2.50
20mA	£2.50
50mA	£2.50
100mA	£2.50
150mA	£2.50
200mA	£2.50
300mA	£2.50
500mA	£2.50
750mA	£2.50
1A DC	£2.50
2A DC	£2.50
5A DC	£2.50
10A DC	£2.50
15A DC	£2.50
20A DC	£2.50
3V DC	£2.50
10V DC	£2.50
15V DC	£2.50
20V DC	£2.50
50V DC	£2.50
100V DC	£2.50
150V DC	£2.50
300V DC	£2.50
500V DC	£2.50
750V DC	£2.50
15V AC	£2.55
50V AC	£2.55
150V AC	£2.55
300V AC	£2.55
500V AC	£2.55
S Meter 1mA	£2.55
VU Meter	£2.90

CLEAR PLASTIC MODEL SD460
Size: 59 x 46mm



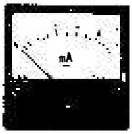
50uA	£3.10
100uA	£3.05
200uA	£3.00
500uA	£2.80
50-0-50uA	£3.10
100-0-100uA	£3.05
1mA	£2.85
5mA	£2.85
10mA	£2.85
50mA	£2.85
100mA	£2.85
500mA	£2.85
1A DC	£2.85
5A DC	£2.85
10A DC	£2.85
5V DC	£2.85
10V DC	£2.85
50V DC	£2.85
300V DC	£2.85
15V AC	£3.00
300V AC	£3.00
VU Meter	£3.20

POSTAGE & PACKING 15p

CLEAR PLASTIC MODEL 65P
Size: 86 x 78mm

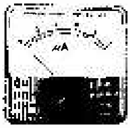
50uA	£4.10
100uA	£3.45
200uA	£3.35
500uA	£3.05
50-0-50uA	£3.45
100-0-100uA	£3.40
500-0-500uA	£2.85
1mA	£2.85
5mA	£2.85
10mA	£2.85
50mA	£2.85
100mA	£2.85
500mA	£2.85
1A DC	£2.85
5A DC	£2.85
10A DC	£2.85
15A DC	£2.85
20A DC	£2.85
30A DC	£3.10
50A DC	£3.20
5V DC	£2.85
10V DC	£2.85
20V DC	£2.85
50V DC	£2.85
150V DC	£2.85
300V DC	£2.85
15V AC	£3.10
50V AC	£3.10
150V AC	£3.10
300V AC	£3.10
500V AC	£3.10
S Meter 1mA	£3.15
VU Meter	£4.10
1A AC	* £2.85
5A AC	* £2.85
10A AC	* £2.85
20A AC	* £2.85
30A AC	* £2.85
50mA AC	* £2.85
100mA AC	* £2.85
200mA AC	* £2.85
500mA AC	* £2.85

BAKELITE MODEL S80 Enlarged Window
Size: 80 x 80mm



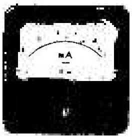
50uA	£3.85
100uA	£3.75
500uA	£3.35
50-0-50uA	£3.75
100-0-100uA	£3.65
1mA	£3.00
1A DC	£3.30
5A DC	£3.30
20V DC	£3.30
50V DC	£3.30
300V DC	£3.30
300V AC	£3.30
VU Meter	£4.05

CLEAR PLASTIC MODEL 52P
Size: 60 x 60mm



50uA	£3.85
100uA	£3.30
500uA	£2.90
50-0-50uA	£3.35
100-0-100uA	£3.25
1mA	£2.75
5mA	£2.75
10mA	£2.75
50mA	£2.75
100mA	£2.75
500mA	£2.75
1A DC	£2.75
5A DC	£2.75
10V DC	£2.75
20V DC	£2.75
50V DC	£2.75
300V DC	£2.75
15V AC	£2.85
300V AC	£2.85
S Meter 1mA	£2.85
VU Meter	£3.95
1A AC	* £2.75
5A AC	* £2.75
10A AC	* £2.75
20A AC	* £2.75
30A AC	* £2.75

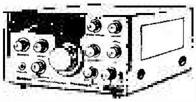
BAKELITE MODEL 65
Size: 80 x 80mm



25uA	£5.05
50uA	£3.90
100uA	£3.30
500uA	£3.00
50-0-50uA	£3.35
100-0-100uA	£3.30
500-0-500uA	£2.85
1mA	£2.85
1-0-1mA	£2.85
5mA	£2.85
10mA	£2.85
50mA	£2.85
100mA	£2.85
500mA	£2.85
1A DC	£2.85
2A DC	£2.85
5A DC	£2.85
15A DC	£2.85
30A DC	£2.85
50A DC	£2.85
5V DC	£2.85
10V DC	£2.85
20V DC	£2.85
50V DC	£2.85
150V DC	£2.85
300V DC	£2.85
30V AC	* £2.85
50V AC	* £2.85
150V AC	* £2.85
300V AC	* £2.85
500V AC	£2.85
VU Meter	£4.00
1A AC	* £2.85
5A AC	* £2.85
10A AC	* £2.85
20A AC	* £2.85
30A AC	* £2.85
50A AC	* £2.85
500mA AC	£2.85
50mV DC	£3.20
100mV DC	£3.20

SUPER VALUE TOP QUALITY TRIO equipment

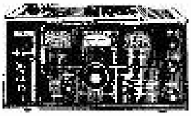
TRIO JR599 RECEIVER



Nine wave-bands covering 1.8—29.7 MHz, 144—146MHz and 10MHz WWV SSB, CW, AM and FM. AF output is more than 1 watt. S Meter. Squelch control. BFO. Variable AF and RF controls. 4—16 ohm output and jack for phones. Power requirement 100/240V AC, 12/14V DC. Size: 270 x 140 x 310mm.

Our Price £132.50 CARR. PAID

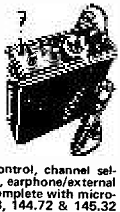
TRIO 9R590S RECEIVER



Four bands covering 550kHz to 30 MHz continuous and electrical bandspread on 10, 15, 20, 40,and 80 mtrs. 8 valve plus 7 diode circuit. 4 to 8 ohm output and phone jack. SSB—CW, ANL, variable BFO. S Meter and separate band spread dial. IF frequency 445kHz, audio output 1½ watt. Variable RF and AF gain controls. 115/250V AC, with instructions.

Our Price £42.50 CARR. PAID

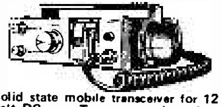
TRIO TR2200 TRANSCEIVER



Fully transistorised portable VHF transceiver Will transmit and receive on six channels between 144—146MHz. 1 watt transmitter. 12V DC internal or external supply. Built-in charger for Ni-Cad cells. Power/volume switch, squelch control, channel selector, mic. socket, earphone/external speaker socket. Complete with microphone and 144.48, 144.72 & 145.32 crystals. Size: 134 x 58 x 180mm.

OUR PRICE £79.50 Carr.paid

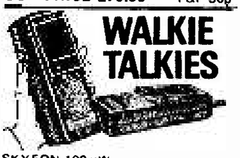
BELTEK W5400 CAR TRANSCEIVER



Solid state mobile transceiver for 12 volt DC neg. Transmits and receives on any 12 of 28 channels between 144 and 146MHz. Power output 10W and 1W switchable. Controls: On/off/volume, squelch and channel selector. Internal 3" speaker. Complete with dynamic mic. PTT switch, three sets of crystals for 144.48, 144.6 and 145MHz, mounting bracket and instructions. Size: 150 x 70 x 220mm.

OUR PRICE £75.00 P&P 50p

WALKIE TALKIES



SKYFON 100mW

OUR PRICE £24.95 per pair

P302 Two Channel 300mW

OUR PRICE £52.50 per pair

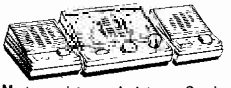
P1003 Three Channel 1 Watt

OUR PRICE £71.25 per pair

P&P 50p per pair

NB. Licence required for use in UK

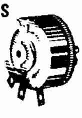
KE630 3 Station INTERCOM



Master and two sub-stations. Can be used on desk or wall mounted. Complete with cable and batteries

OUR PRICE £5.25 P&P 50p

POWER RHEOSTATS



High quality ceramic construction. Windings embedded in vitreous enamel. Heavy duty brush wiper. Continuous rating. Wide range available ex-stock. Single hole fixing. ¼" diameter shafts. Bulk quantities available.

25 WATT 10/25/50/100/250/500/1000 Ohms **£1.15** P&P 10p

50 WATT 10/25/50/100/250/500/1000/2500/5000 Ohms. **£1.62** P&P 10p

100 WATT 1/5/10/25/50/100/250/500/1000/2500 Ohms **£2.34** P&P 15p

ALL PRICES EXCLUDE VAT

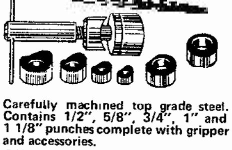
Also see previous page

AUTO TRANSFORMERS

0/115/250V. Step up or step down. Fully shrouded.

80 WATTS	£2.75	P&P 18p
150 WATTS	£3.50	P&P 18p
300 WATTS	£4.50	P&P 23p
500 WATTS	£6.95	P&P 33p
1000 WATTS	£9.50	P&P 38p
1500 WATTS	£12.50	P&P 43p
2250 WATTS	£20.95	P&P 50p
5000 WATTS	£44.95	P&P £1

CP110 CHASSIS PUNCH SET

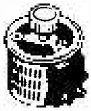


Carefully machined top grade steel. Contains 1/2", 5/8", 3/4", 1" and 1 1/8" punches complete with gripper and accessories.

OUR PRICE £3.00 P&P 40p

YAMABISHI VARIABLE VOLTAGE TRANSFORMERS

Excellent quality at low cost. Input: 230V 50/60Hz. Output 0—260V.



MODEL S260 BENCH MOUNTING

		P&P
1A	£10.50	30p
2.5A	£12.00	35p
5A	£17.50	37p
8A	£30.35	50p
10A	£33.75	75p
12A	£29.50	75p
20A	£85.00	125p
25A	£95.00	130p
40A	£120.00	150p

MODEL S260B PANEL MOUNTING

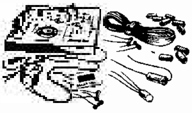
1A	£10.00	30p
2.5A	£12.00	35p

BVD5 Vernier TUNING DIAL

App. 7:1 ratio planetary drive vernier dial. Log scale 0—180 degrees. Blank scales 1—5. Dial size 128 x 76mm. Overall size 190 x 117 x 41mm. deep including knob and coupling. ¼" diam. shaft

OUR PRICE £1.62 P&P 15p

2 TRANSISTOR RADIO KIT



No Soldering required. All connect-made with spring clips. Kit includes all parts and wire including ear-piece. Will receive all normal broadcasts on Medium Wave 535—1605kHz. Operates from standard 9V battery or Solar Cell included.

OUR PRICE £1.30 P&P 30p

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 £4.25 P&P 25p

LASKYS

INCORPORATING LASKYS RADIO AND G. W. SMITH & CO. (RADIO).

LH02S STEREO HEADPHONES

Light weight headphones with padded ear pieces. 4/16 ohms 20–20,000Hz. Complete with 6' lead and plug.

OUR PRICE £1.97 P&P 30p

TE1018 Deluxe Mono High Impedence Headset.

Sensitive magnetic headset with soft ear pads. Impedence 2,600 ohms (600 ohms DC). Frequency response: 200–4,000Hz.

OUR PRICE £2.25 P&P 30p

DH02S STEREO HEADPHONES

Wonderful value and excellent performance combined. Adjustable head band. Impedence 8 ohms 20–12,000Hz. Complete with lead and plug.

OUR PRICE £2.25 P&P 30p

TE1035 Stereo HEAOPHONES

Low cost with excellent response. Foam rubber earcups. Adjustable headband. 8 ohms impedence. Frequency response 25Hz–18kHz Complete with cable and stereo jack plug.

OUR PRICE £2.60 P&P 30p

SH8DV MONO/STEREO HEADPHONES

Volume control for each channel. 4/16 ohms impedence. Frequency response 20Hz–18kHz. Complete with 10ft. coiled lead and jack plug

OUR PRICE £4.97 P&P 30p

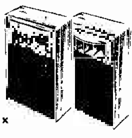
BH001 HEADSET and Boom Microphone

Moving coil. Ideal for language teaching, communications etc. Headphone impedence 16 ohms. Microphone impedence 200 ohms.

OUR PRICE £5.95 P&P 30p

SPECIAL BARGAIN!!

PHONIC 10 Two Way Speakers

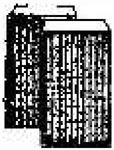


Matched pair of compact book-shelf speakers of unique design. Incorporating a 2" high frequency unit & 6" woofer. 8 ohms impedence. Size: 348 x 228 x 110mm.

OUR PRICE £8.85 Pair P&P 50p

SPECIAL BARGAIN !!

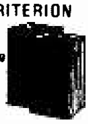
STEREOSOUND SPEAKERS



Matched pair of stereo bookshelf speakers. Deluxe teak veneered finish. Size: 368 x 229 x 190mm. 8 ohms. 8 watts RMS, 16 watts peak. Complete with Din lead.

OUR PRICE £12.95 P&P 50p

AUDIOTRONIC CRITERION SPEAKERS



High quality three way speaker system offering a performance better than more expensive units. Teak finished with dark fronts. Frequency response: 40Hz–20kHz. 8 ohms impedence. Maximum power 20 watts. Size: 476 x 232 x 232mm.

OUR PRICE £27.50 Pr. P&P £1

HIGH QUALITY CONSTRUCTION KITS

JOSTY KIT

WE ARE APPOINTED STOCKISTS AT ALL BRANCHES

All kits are complete with comprehensive easy to follow instructions and covered by full guarantee..

Post and Packing 15p per kit.

AE1 100mW output stage	£1.65
AE2 Pre-amplifier	£1.26
AE3 Diode receiver	£2.00
AE4 Flasher	£1.09
AE5 Astable multi-vibrator	£1.05
AE6 Monostable multi-vibrator	£1.02
AE7 RC generator	£1.06
AE8 Bass filter	99p
AE9 Treble filter	99p
AE10 CCIR filter	99p
AF20 Mono amplifier	£4.80
AF25 Mixer	£3.60
AF30 Mono pre-amplifier	£2.61
AF35 Emitter amplifier	£2.27
AF80 0.5W mic. amplifier	£4.22
AF305 Intercom	£9.52
AF310 Mono amplifier	£5.91
AT5 Automatic light control	£2.58
AT25 Window wiper robot	£5.82
AT30 Photo cell switch unit	£5.70
AT50 400W triac light dimmer/speed control	£4.80
AT56 2,200W triac light dimmer/speed control	£6.90
AT60 1 channel light control	£7.80
AT65 3 channel light control	£14.55
GP304 Circuit board	£4.94
GP310 Stereo pre-amplifier for use with 2 x AF310	£21.27
GP312 Circuit board	£11.45
GU330 Tremolo unit	£7.50
HF61 Diode detector	£3.32
HF65 FM transmitter	£2.70
HF75 FM receiver	£2.87
HF310 FM tuner	£15.81
HF325 Deluxe FM tuner	£24.12
HF330 Decoder (HF310/325)	£9.96
HF380 lw/vhf aerial amplifier	£4.94
HF395 broadband aerial amp.	£1.77
LF380 Quadraphonic device	£11.36
M160 Multi-vibrator	£1.71
M191 VU Meter	£4.55
M192 Stereo balance meter	£4.97
M1302 Transistor tester	£8.45
NT10 Stabilised power supply 100mA, 9V	£6.15
NT300 Stabilised p. supply	£12.51
NT305 Voltage converter	£4.50
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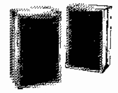

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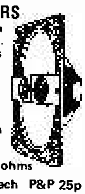

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Truly pocket-sized

With all its calculating capability, the Cambridge still measures just $4\frac{1}{2}$″ x 2″ x $\frac{11}{16}$″. That means you can carry the Cambridge wherever you go without inconvenience – it fits in your pocket with barely a bulge. It runs on ordinary U16-type batteries which give weeks of life before replacement.

Easy to assemble

All parts are supplied – all you need provide is a soldering iron and a pair of cutters. Complete step-by-step instructions are provided, and our service department will back you throughout if you've any queries or problems.

Total cost? Just £27·45!

The Sinclair Cambridge kit is supplied to you direct from the manufacturer. Ready assembled, it costs £32·95 – so you're saving £5·50 ! Of course we'll be happy to supply you with one ready-assembled if you prefer – it's still far and away the best calculator value on the market.

Features of the Sinclair Cambridge

- Uniquely handy package. $4\frac{1}{2}$″ x 2″ x $\frac{11}{16}$″, weight $3\frac{1}{2}$ oz.
- Standard keyboard. All you need for complex calculations.
- Clear-last-entry feature.
- Fully-floating decimal point.
- Algebraic logic.
- Four operators (+, –, x, ÷), with constant on all four.
- Constant acts as last entry in a calculation.
- Constant and algebraic logic combine to act as a limited memory, allowing complex calculations on a calculator costing less than £30.
- Calculates to 8 significant digits, with exponent range from 10^{-20} to 10^{79}.
- Clear, bright 8-digit display.
- Operates for weeks on four U16-type batteries. (MN 2400 recommended.)

A complete kit!

The kit comes to you packaged in a heavy-duty polystyrene container. It contains all you need to assemble your Sinclair Cambridge. Assembly time is about 3 hours.

Contents:
1. Coil.
2. Large-scale integrated circuit.
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5. Case mouldings, with buttons, window and light-up display in position.
6. Printed circuit board.
7. Keyboard panel.
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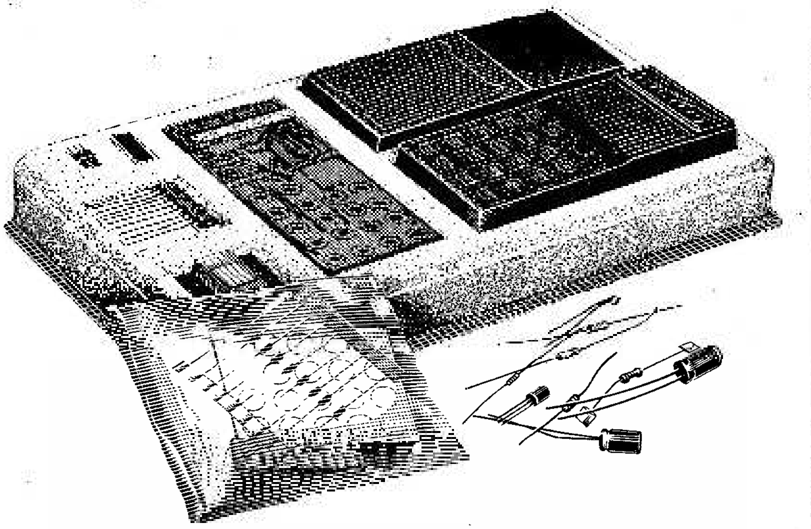
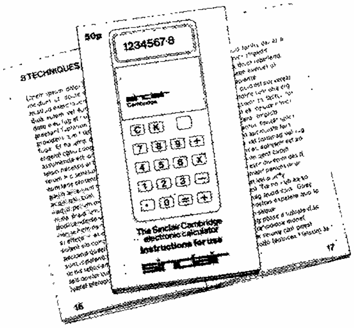


This valuable book – free!
If you just use your Sinclair Cambridge for routine arithmetic – for shopping, conversions, percentages, accounting, tallying, and so on – then you'll get more than your money's worth.

But if you want to get even more out of it, you can go one step further and learn how to unlock the full potential of this piece of electronic technology.



How? It's all explained in this unique booklet, written by a leading calculator design consultant. In its fact-packed 32 pages it explains, step by step, how you can use the Sinclair Cambridge to carry out complex calculations.

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But that in itself wouldn't be enough. Sinclair also have a very long experience of producing and marketing electronic kits. You may have used one, and you've almost certainly heard of them – the Sinclair Project 60 stereo modules.

It seemed only logical to combine the knowledge of do-it-yourself kits with the knowledge of small calculator technology.
And *you* benefit!

Take advantage of this money-back, no-risks offer today
The Sinclair Cambridge is fully guaranteed. Return your kit within 10 days, and we'll refund your money without question. All parts are tested and checked before despatch – and we guarantee a correctly-assembled calculator for one year.

Simply fill in the preferential order form below and slip it in the post today.

Price in kit form: £24·95 + £2·50 VAT. (Total: £27·45)
Price fully built: £29·95 + £3·00 VAT. (Total: £32·95)

PW 4/74

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PLEASE PRINT

SAFETY FIRST

TO encourage safety in the mere *presence* of electrical, electronic, radio or television apparatus, let alone during their operation, is not only laudable but vital. Hence the British Electrotechnical Approvals Board for Household Equipment (now affectionately BEAB) is extending the BEAB Approval Scheme to include audio and radio products including record players, radios, radiograms, mains/battery portable receivers with (curiously) "continuously rated audio outputs up to 6 + 6 watts stereo or 10 watts mono". Manufactured equipment that is licensed to bear the BEAB approval marking has to be first subjected to some detailed and stringent tests at the BSI laboratory.

The specification for the tests, detailed in BS 415: 1972 (with amendments), highlights for the more casual of the manufacturers, and probably some of the amateur constructor fraternity, areas of potential risk in mains driven equipment that all too often are taken for granted. There are, of course, extreme cases like the ladies' dangling necklace test and the test which inserts artificial fingers into apertures almost in determination to find live contact.

Generally the scheme is an excellent one. In most British equipment, that is designed and manufactured by responsible people, it is unlikely that no thought will be given to hazards such as shock, fire risk, ionised radiation, implosion and the like.

What has been needed is some form of yardstick by which a known hazard can be measured. Let us not be carried away by any thought that this standard is for manufacturers only. There are frequent cases where more strict attention to detail is needed by everyone who has mains driven appliances or electronic equipment.

We have only one serious complaint: that is the use of graphical symbols to indicate the nature of the supply (a.c. or d.c.) and to indicate live terminals. To the uninitiated layman, technical symbols mean nothing and he will not be inclined to buy BS3939 to find out before operating his new purchase.

Elsewhere in this issue we have highlighted only a few of the points in BS415 that we feel the general public need to know about. It is stressed that the detailed specification is designed to cover most contingencies of normal operation; we recommend manufacturers, suppliers and users to refer to this for more information.

M. A. COLWELL—*Editor.*

The May issue of Practical Wireless will include a special pull-out feature to make a handy booklet "Guide to Long Distance Reception of Radio and TV", (useful for locals, too!). Also appearing will be constructional projects: the medium wave "Mini-Pop" (goes in a jacket pocket); an audio booster and power supply to enable you to hear cassette recordings in the car; a trace doubler to enable you to convert a single-beam oscilloscope for four displays. We shall also be giving first details of a super new project that we know will appeal to sports fans all over the world. Don't miss out—order your copy regularly NOW.

(All advanced details are subject to the current national industrial situation).

Further details on page 1167

NEWS...

Export sales of British made Dolby

IN a recent statement Phoenix Videosonic Ltd., of Braintree, Essex, Europe's only manufacturer of Dolby Noise Reduction Units announced significant export sales to Europe, North America and Japan.

A Videosonic spokesman stated: "Videosonic leads the world in the technical specification of its equipment: in the PD4 we have introduced a new high level Dolby 'B' circuit providing a unique range of over 95dB between noise and 0·1% distortion. At this time the PD4 represents the ultimate way to take the PSSST! out of tape.

To further extend our lead in the World Hi-Fi market, the PD2b has been introduced as the world's first battery operated Dolby Unit, allowing 'field' use in the most rigorous conditions. The integral microphone pre-amplifier makes this an ideal unit for reporter or similar usage.

World recognition of Videosonic technical manufacturing competence has been most encouraging, and we can only take pride in our immediate penetration of the Japanese market in the face of very strong local competition. We are advised that our range of Dolby products will be displayed and demonstrated in the top 850 Hi-Fi Retail Shops in Japan, and that local response to date has been very positive. Our first shipment to Japan leaves this week.

Portable Fluorescent Lamp (March P.W.)

WILL readers please note, that the transformer specified is now no longer available. An improved transformer is available from Messrs G. F. Milward at 77p plus 20p p & p. This includes full modification details and uses fewer components. A 21 in. 13W tube is available at 50p + 20p p & p, and it is claimed that this tube gives a greater light output than the 15W tube. S.A.E. to G. F. Milward for further details.

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

Bargains galore

IF you are in the "Ally Pally" area on March 24th, pay a visit to the Collector's Bazaar which is being held in the Palm Court.

This is a five-bazaar event which includes militaria, vintage post cards, vintage toys, transport relics and, of most interest to our readers, vintage records, horn gramophones, phonographs and probably some items of vintage radio equipment.

Practical Wireless visited one of these bazaars held at St. Johns Wood a few months ago, and it was there that Colin Riches purchased an Edison "Gem" phonograph to be featured in a future "Going Back."

If any readers want to find out the details of hiring a stall at the bazaar (£3·50 for the day) contact the organiser John Carter, Smewins, Shottesbrooke, nr. Maidenhead, Berks, SL6 3SR (Tel. Shurlock Row 539).

Otherwise, put on your cycle clips and pedal along to Alexandra Palace, Wood Green, London N.22, on March 24th. They'll let you in at 1 p.m. but be sure to have your entrance fee of 30p at the ready.

Hi-Fidelity 74

HI-FIDELITY 74 is a rival exhibition to the Sonex show. It will be run at the same time and held at the Heathrow Hotel, Bath Road. It's the idea of Malcolm Blockley who is the Hi-Fi Division Sales Manager of Pyser-Britex Ltd.—the sole UK distributor of Marantz, Teledyne and Kensonic equipment.

The organiser states that this show has been arranged because many manufacturers are fed-up with trying to demonstrate their products in small, cramped hotel bedrooms.

Hi-Fidelity 74 will run from March 27th to 31st inclusive but the first two days will be for the trade and press only.

Blast them out!

IN order to reduce the effects of interference from an East German station at night, the BBC has increased the transmitting power of the Radio 4 Moorside Edge transmitter to 300kW.

R and TV Components Ltd.

IN their March advertisement, the price of postage and packing for the "Stereo 21" should have read £1·60. Apologies to R and TV Ltd.

Public Address Exhibition

Readers who have an interest in outdoor activities, such as rallies, will be planning events for the coming season. To get up to date on public address installations, it would be worthwhile to visit Sound '74, the international exhibition of the Association of Public Address Engineers. A lecture programme will be held concurrently on p.a. design, building acoustics, microphones, and the financial side of public address work from the practical point of view.

The A.P.A.E. has received more stand space bookings than previously, but there are still a few left for those who wish to come in at a late stage, including suppliers of disco equipment.

Admission is free to all interested persons: tradesmen, manufacturers, buyers, and users of public address and allied equipment in the entertainments business. Tickets can be obtained from exhibitors or from the A.P.A.E. Secretariat, 6 Conduit Street, London W1R 9TG.

The scope of activities covered is extended to include audio-visual effects.

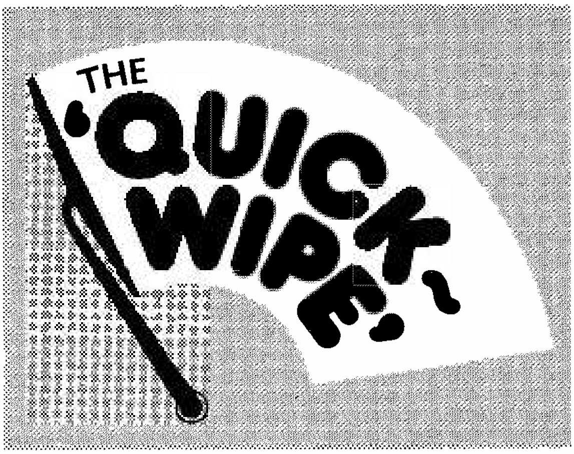
Overseas readers will be interested to learn that the A.P.A.E. are exhibiting in Hall 9A at the Hanover Fair from 25th April to 3rd May 1974 and at the I.C.E.T.I.A. exhibition at Melbourne, Australia from 7th to 11th October.

Practical Wireless will be on show at the Hanover Fair.

UK wavebands and frequencies

THE BBC Engineering Department have issued a useful data sheet which shows the frequencies and wavebands allocated to broadcasting in the United Kingdom. Below we give the details from that sheet:

Band	Frequencies	Service
Low frequency (l.f.) (long waves)	160–255kHz (1875–1176m)	a.m. radio
Medium frequency (m.f.) (medium waves)	525–1605kHz (571-187m)	
High frequency (h.f.) (short waves)	3950–4000kHz (75-m band)	
	5950–6200kHz (49-m band)	
	7100–7300kHz (41-m band)	
	9500–9775kHz (31-m band)	
	11700–11975kHz (25-m band)	
	15100–15450kHz (19-m band)	
	17700–17900kHz (16-m band)	
	21450–21750kHz (13-m band)	
	25600–26100kHz (11-m band)	
Band I (v.h.f.)	41–68MHz (channels 1 to 5)	405-line television
Band II (v.h.f.)	88–97·6MHz	f.m. radio
Band III (v.h.f.)	174–216MHz (channels 6 to 13)	405-line television
Band IV (u.h.f.)	470–582MHz (channels 21 to 34)	625-line television
Band V (u.h.f.)	614–854MHz (channels 39 to 68)	625-line television
Band VI (s.h.f.)	11700–12500MHz (11·7–12·5GHz)	Not yet in use for broadcasting

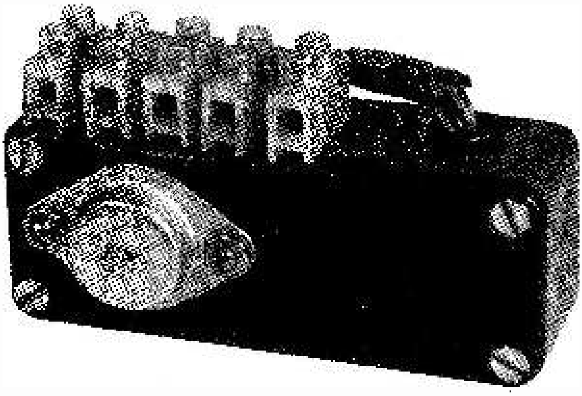


A VARIABLE TIME SWEEP WINDSCREEN WIPER

P. S. COLLINS

IMAGINE the situation: you are driving your car in drizzly rain, you put on the windscreen wiper. One sweep is sufficient, so you switch it off. Five, ten or fifteen seconds later the windscreen needs another wipe, so you switch on the wiper again for another single stroke. This could go on for some time and tends to be wearisome.

The circuit here described saves this tiresome routine and allows you to relax in the automation of a variable time-sweep wiper. Although the circuit is designed for wiper motors with automatic parking facility, there is some information at the end of the article which will be helpful to those who have wiper motors without this facility.



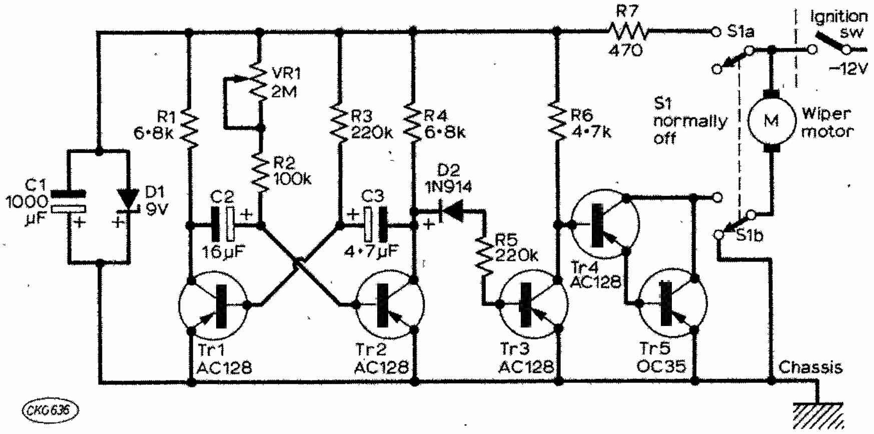


Fig. 1. Circuit of the Quickwipe for a vehicle with a ***POSITIVE*** *earth system. It is essential to be quite sure which side of the battery is connected to chassis.*

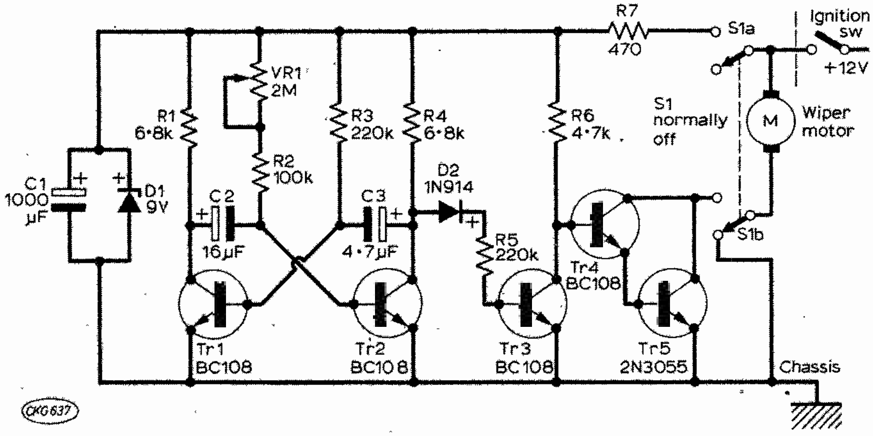


Fig. 2. In this circuit for a ***NEGATIVE*** *earth system, different transistors are used and capacitors and diodes are reversed compared to those in Fig. 1.*

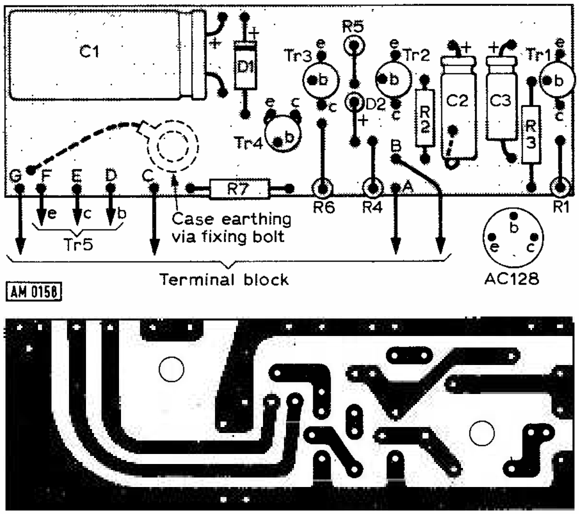
Figures 1 and 2 are the circuits for positive and negative earthed vehicles; the difference lies only with the active components and reverse connection of the polarised ones. The circuit action remains the same. Tr1 and Tr2 form a multivibrator generating a pulse of fixed length with a variable repetition rate. VR1 allows this rate to be varied between approximately 3 and 30 seconds. Tr3, 4 and 5 form a pulse amplifier to drive the wiper motor.

The fixed pulse length is $\frac{3}{4}$ second which is sufficient time to drive the motor long enough for its internal switches to take over the drive and thus return it to the park position. Switch S1 is centre off. One switch, S1b, switches for continuous operation, earth being directly applied to the motor.

In the other position, S1a, applies 12 volts to the circuit and S1b connects the motor as the load for the pulse amplifier. The vehicle wiper switch may now be regarded as redundant, or left in the circuit, as desired.

CONSTRUCTION

The whole unit can be comfortably housed in a die-cast box measuring 3$\frac{1}{2}$ x 1$\frac{3}{8}$ x 1$\frac{1}{8}$ in. Figure 3 shows the printed circuit board. Tr5 is mounted on the lid with insulating washer and bushes. All leads from the circuit board and Tr5 are connected to a five-way terminal strip fixed to the side of the box. This enables easy connection to the vehicle's wiring, as shown in Fig. 4.



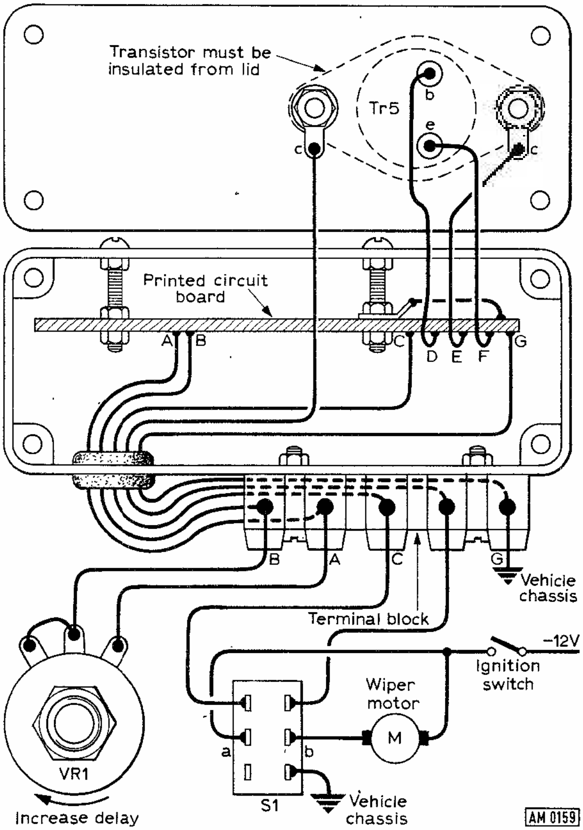
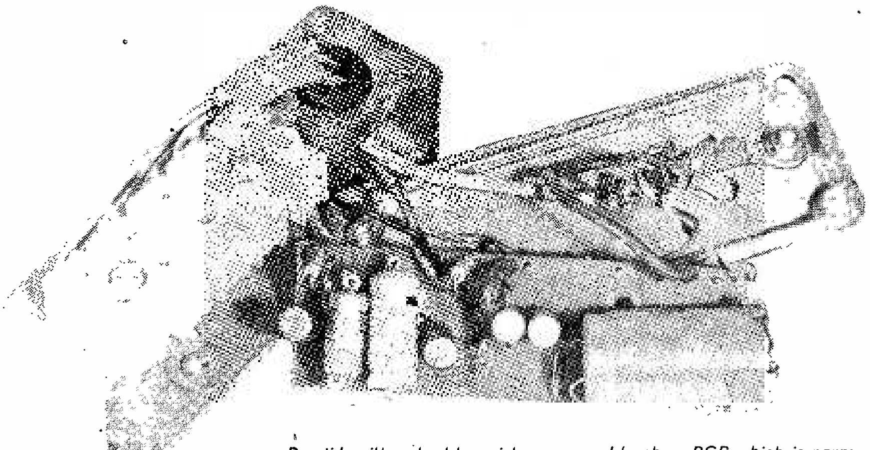


Fig. 3, left, shows PCB actual size and component layout for POSITIVE earth unit. Fig. 4, above, illustrates external wiring of Quickwipe.

Confirm the chassis polarity of the vehicle before constructing the unit, then use Fig. 1 OR Fig. 2 as appropriate.



Box lid, with output transistor, removed to show PCB which is normally bolted into box, as in Fig. 4.

★ components list

Resistors

R1	6·8kΩ	R5	220kΩ
R2	100kΩ	R6	4·7kΩ
R3	220kΩ	R7	470Ω
R4	6·8kΩ	VR1	2MΩ linear

Resistors 10% ¼W except R7 ½W

Capacitors

C1 1000μF 25V C2 16μF 16V C3 4·7μF 16V

Semiconductors

D1 9V zener 400mW D2 1N914

Positive Earth	Tr1—4 AC128	Tr5 OC35
Negative Earth	Tr1—4 BC108	Tr5 2N3055

Miscellaneous

S1, Double pole—double throw switch, centre off. Diecast box (RS Comps.—"Box 992"). Printed circuit board. Insulation kit for Tr5. Five way terminal block.

NOTE: It may be possible to arrange the fixed pulse length to correspond with the time taken for the wipers to travel one complete sweep, in the case of wipers without the self-park facility. This could be achieved by altering the values of R3 and C3.

These points are offered only as helpful guides. The author has conducted no tests in this regard and cannot therefore give any facts regarding accuracy or success. ■

PW TECHNICROSS PUZZLE No. 3 Solution

1 U	2 S	E	3 S	■	4 V	5 I	B	6 R	A	7 T	O	8 R
■	E	■	I	■	■	M	■	E	■	U	■	E
9 C	R	A	G	■	10 S	P	E	C	I	F	I	C
■	V	■	11 N	I	P	■	■	O	■	T	■	I
12 R	I	T	A	■	A	■	13 P	R	E	S	E	T
■	C	■	14 L	O	C	K	■	D	■	■	■	A
15 B	E	S	S	■	E	■	16 M	■	17 T	O	18 L	L
L	■	■	■	19 D	■	20 S	O	L	O	■	O	■
21 U	P	22 R	O	O	T	■	U	■	23 R	O	U	T
F	■	E	■	R	■	■	24 L	E	O	■	D	■
25 F	I	L	A	M	E	26 N	T	■	27 I	C	E	D
E	■	I	■	I	■	I	■	■	D	■	S	■
28 R	O	C	H	E	L	L	E	■	29 S	E	T	S

TELEVISION

IN THE APRIL ISSUE

CLOSED-CIRCUIT TV
Next month we start a new series aimed at giving an essentially practical account of closed-circuit TV equipment, its use and the servicing techniques required. To start with, the basic element in CCTV work, the vidicon camera tube, is explained along with its basic circuitry.

TRANSISTOR FIELD TIMEBASES
Fully transistorised field timebases have been around for some time now, particularly in colour receivers, and have proved to be generally very reliable. Nevertheless it is time we took a look at common faults and their causes, also at the operation of the class A output stage generally used.

THE DIODE DROPPER
The use of a diode dropper in the heater circuit reduces heat dissipation and is also cheaper than using a completely resistive dropper. The action of the diode dropper circuit is often misunderstood however, which can lead to the use of an incorrect accompanying resistor value and damage to the valves in the chain. The circuit action will be explained and the procedure for determining the value of the accompanying resistor given, either for designing a new circuit or for working out a diode dropper substitution for an existing set.

SERVICING TELEVISION RECEIVERS
The next chassis to be dealt with by Les Lawry-John is the Pye 169 single-standard monochrome chassis and its derivatives, the 569, 769 and 173.

PLUS ALL THE REGULAR FEATURES

Details of the April issue are subject to the current national situation at the time of going to press.

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GUIDE TO multi-range test meters

H. LEEMING G3LLL

IT does not seem many years since test meters were so expensive that, in the radio and TV trade, at least, one was shared between several engineers, the losers having to make do with wet fingers and neon screwdrivers! Test meters are now relatively cheap so that no enthusiast or handyman can really afford to be without one; whether it be for attending to the Hi-Fi system, fixing the car, or even sorting out a fault on the front door bell. Despite their simplicity in operation these meters can deceive the unwary and so it is hoped that a little basic theory will be of practical assistance.

The multi-range test meter commonly contains ranges such as AC and DC voltage, DC current and at least one resistance range. Other functions may be included on the more elaborate instruments but all use the basic meter movement plus the switching of various internal components in or out of circuit.

The DC Voltmeter

The meter movement fitted to most modern test instruments needs a current of something in the range of 1 to 1/100 of a milliamp to move a pointer across the full extent of the scale. The theoretical circuit of the basic meter movement is shown in Fig. 1. The "internal resistance" is not an actual resistor, but is the resistance of the coil of wire in the meter movement. From Ohm's Law, (voltage = current × resistance) this 1mA meter movement shown will require a voltage of 0·1 volt for full scale deflection, (1/1,000×100/1=0·1 volt). This basic meter could therefore be used to measure voltages of up to 0·1 volt or currents of up to 1 milliamp—not very useful!

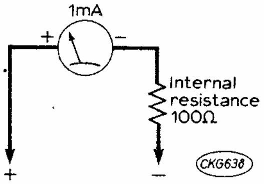


Fig. 1: Representation of meter movement must include resistance of moving coil.

The meter movement is basically a current operated device, but it can be made to read various quantities. A little thought will show that a 1mA meter movement will read full scale if 1 volt is applied to it through a series resistance which, including internal resistance, totals 1,000 ohms. From Ohm's Law, 1 volt across 1,000 ohms causes a current of 1mA to pass. A voltmeter using a 1mA meter movement is said to have a sensitivity of 1000 ohms per volt.

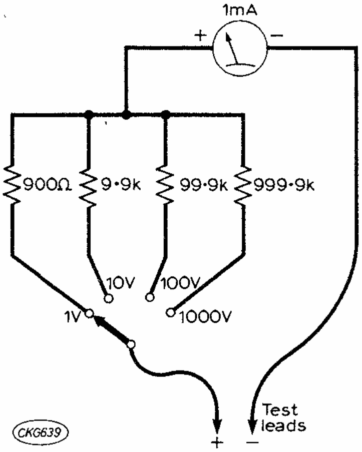


Fig. 2: Series resistors for voltmeter allow for coil resistance. Only of importance on lower ranges.

Fig. 2 shows the meter wired to read four ranges of voltage and it will be seen that the total resistance of the meter is 1,000 ohms for every volt of the range in question. For this reason it is referred to as 1,000 OPV and this would usually be marked on the meter scale.

Such a meter does have its disadvantages and its relatively low resistance can greatly affect circuit voltages as will be shown. In Fig. 3a two 1 ohm resistors are connected across the supply and the voltage between X and Y is measured. If the meter is switched to the 1 volt range it has a total resistance of 1,000 ohms (remember 1,000 OPV) this resistance being shunted across R2. As the meter resistance is very high, compared to R1 and R2, its effect is negligible and the reading is given accurately as 0·5 volts. If, however, the meter is transferred to the circuit in Fig. 3b and another reading is taken the resulting accuracy is quite different. Once again, the reading should be 0·5 volts, but note what happens when the meter is connected across R2. R2 is shunted by the meter's resistance of 1,000 ohms and the resistance of the bottom half of the circuit drops to around 900 ohms. The voltage divides itself according to the ratio of the resistors and the meter reads just below 0·1 volts.

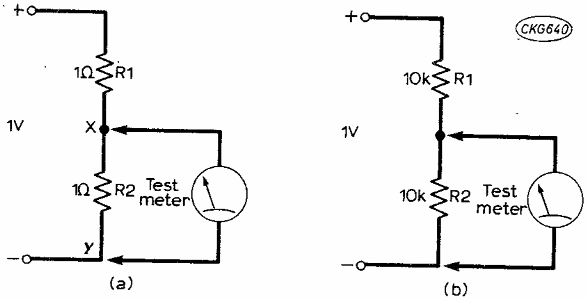


Fig. 3 (a) and (b): to demonstrate effect of meter resistance on high and low resistance circuits.

The meter is not really wrong, it simply reads the voltage that is present when it is connected. Using the same meter a more accurate reading could be taken by switching to the 10 volt range when the test meter's resistance would rise to 10,000 ohms; the meter's resistance in parallel with R2 would then total 5,000 ohms and whilst the voltage reading would still be low at 0·33 instead of 0·5, it would be a little more realistic. Could we take the same argument further and switch to the 100 volt range with a meter resistance totalling 100,000 ohms, and obtain an accurate result? Unfortunately, no, since when the meter was switched to this range the pointer would move so little that we would not be able to take an accurate reading from it.

If we want a more accurate reading in a high resistance circuit the answer is a more sensitive meter movement that will allow us to insert larger values of voltage multiplier resistors. If for instance, we substitute a meter with a 50 micro-amp movement, (0·05mA), we will obtain a sensitivity of 20,000 OPV. Using circuit Fig. 3b we would then obtain, on the 1 volt range, a reading that was almost correct, (20,000 ohms being shunted across R2), or by switching to the 10 volt range using this higher sensitivity meter we would obtain a reading that was accurate to within all normal requirements.

As has been illustrated, the DC voltmeter can only read the voltage which is present when it is connected. It cannot guess at the voltage which appears when it is disconnected. When using a voltmeter one should get into the habit of comparing the resistance of the range being used with the resistance of the circuit being measured.

In many cases when operating in a high resistance circuit a more accurate reading will be obtained if a higher voltage range is used. If in doubt a reading should be taken on two adjacent ranges of the test meter. With any good quality instrument these readings should be about the same, but if they are not it implies that the meter is loading the circuit on the lower voltage range.

Valved or Transistorised Voltmeters

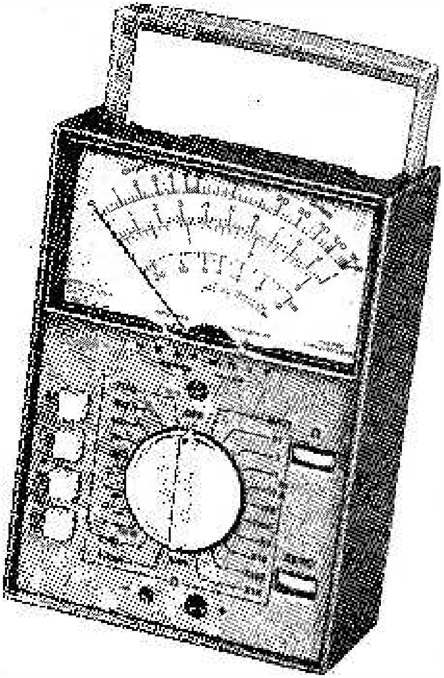
To obtain higher sensitivities using normal techniques requires very expensive and delicate meter movements. It is not common practice, therefore, to make multi-range test meters with a sensitivity of much over 50,000 OPV. In some circumstances an even higher sensitivity is required, so that test meters of as high a sensitivity as this would be of little use at measuring, say, 0·1 volts in a circuit with resistance of several megohms. To enable higher sensitivities to be obtained, the valve and then the transistorised voltmeter were introduced. In these devices amplification is used so that an input resistance of 10 megohms or more is presented, even on the lowest voltage ranges. Such instruments are essential if tests are to be made in some high impedance transistorised circuits where very small voltages are present.

Frequency Response

Most test meters are basically intended for making tests at the mains frequency and their accuracy often falls off at frequencies in the audio range. One should check the frequency response of a test meter before relying upon it to check audio or bias frequency voltages. In the latter case it should be remembered that high frequency bias voltages can damage the rectifier in some test meters, and also that even if the meter's frequency response is adequate that its loading (possibly only a few hundred OPV) can, in many circuits, much reduce any voltage present. If it is desired to accurately measure voltages at high audio or radio frequencies the valve or transistorised voltmeter is again essential.

The AC Voltmeter

The AC ranges of multi-range test meter function in very much the same way as the DC ranges except that a rectifier is incorporated to enable the basic DC meter movement to function, see Fig. 4. As with the DC voltage section of the meter, the amount of loading on the circuit being tested is indicated by the sensitivity in ohms-per-volt. Rectifiers have a tendency to be non-linear at low current



The Heathkit IM-104 mu timeter, a modern design providing 53 ranges on four scales. Frequency response up to 50kHz on AC voltage ranges. Input resistance of 10 MΩ on DC voltage ranges.

(Courtesy Heath (Glos.) Ltd.)

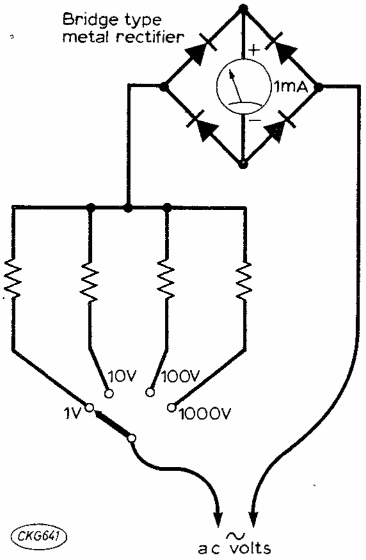


Fig. 4: Incorporation of meter bridge rectifier on AC voltage ranges.

levels and so, in the interest of accuracy, it is common to reduce the sensitivity of the test meter when switched to the AC ranges. The popular Avo Model 8, for instance, has a sensitivity of 20,000 OPV on the DC ranges but only 1,000 OPV on the AC ranges.

The Direct Current Ranges

The basic DC meter movement, as we have seen, will reach full scale when a small current is passed through it. The example shown in Fig. 1 needed 1mA for full scale deflection. If it is desired to measure a larger current, some of the current must be by-passed. The circuit with various resistors which are known as "shunts" is shown in Fig. 5. The value of shunt resistor R3, for instance, is calculated so that when the test meter is measuring 1A, 999 milliamps go via R3 and 1mA passes through the meter.

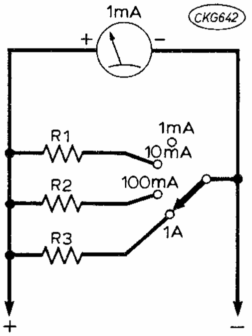


Fig. 5: Switchable shunts to increase current range of basic meter.

It is important to note that when measuring current, some voltage is required to operate the meter, as was shown earlier, when dealing with the DC voltmeter. In this case 0·1 volts will be dropped across the meter terminals. In most cases when making measurements, as in Fig. 6a, this small voltage drop will make negligible difference, being small in relation to the voltages in the circuit. If we try to make a test as shown in Fig. 6b however, this is not the case. Here the effect of adding the meter in series with the circuit is to considerably increase the value of the emitter resistor. Increasing this effective value would mean that the current which flowed with the test meter connected would be much less than the current which normally flowed in the circuit.

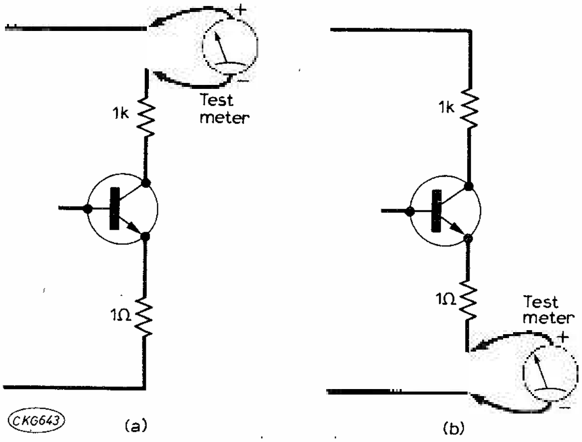
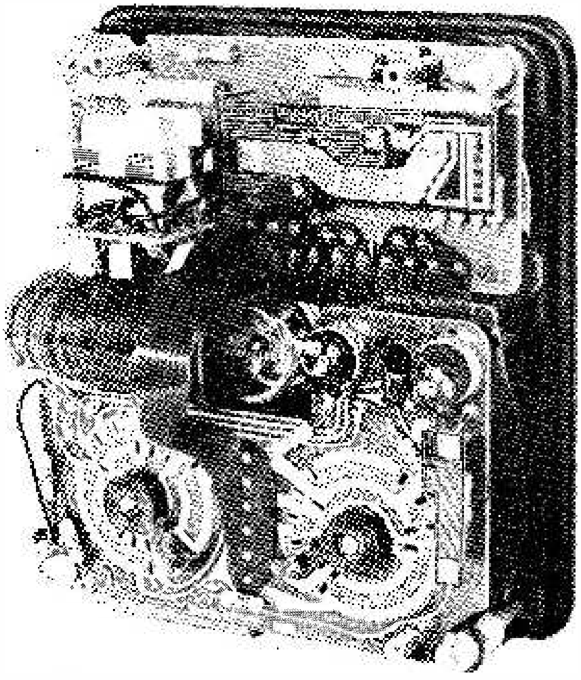


Fig. 6 (a) Correct and (b) incorrect method of inserting meter in transistor circuit.

When checking current flow in low impedance circuits, it is better to measure the voltage across a known resistor and then to calculate the current.

The Resistance Ranges

Figure 7 shows a basic method of resistance measurement. If the test prods are touched together R2 can be adjusted until the meter reads full scale, the current being provided by the battery. As we have seen a 1mA meter when used as a voltmeter



An excellent view of the latest AVO Model 8. It uses printed circuit techniques for shunts and switchboards. (Courtesy AVO Ltd. Dover) has a sensitivity of 1,000 OPV and here, if the battery is exactly 1·5V, R1 plus R2, plus internal resistance must equal 1,500 ohms, when R2 is set to provide full scale deflection with the test prods touching. If now, instead of touching the test prods together, we connect them to a resistor being tested, of 1,500 ohms, the meter will then read half-scale as an external resistor of the same value as the built-in resistance has been added to the circuit. The centre of the scale would be marked 1,500 ohms and with suitable calibration resistors of between, say, 50 and 50,000 ohms, resistors could be checked using this set-up, with reasonable accuracy.

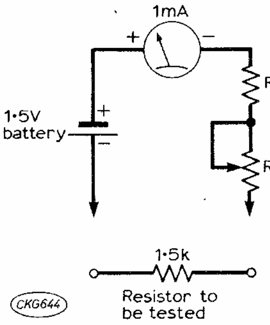


Fig. 7: Basic circuit for measuring resistance.

To divide the range by 10 we can shunt the meter as was done on the current ranges so that the sensitivity of the circuit becomes 100 OPV, enabling R1 and R2 to be reduced to 1/10 of their previous value. Alternatively, we can multiply the range by 10 by fitting a 15V battery and increasing R1 and R2 tenfold. In this way we obtain a meter with a centre scale range of 150, 1,500 and 15,000 ohms on three ranges enabling resistors from below 10 to above 500,000 ohms to be checked with good accuracy.

A large, clear scale with an anti-parallax mirror is the highlight of the latest AVO.

Use of Ohms Range

From the above discussion it will be seen that a current is passed through the component to be tested and that a voltage is also applied across it. In most cases this will do no harm, but it is wise to be aware that voltages of up to 25 or so are possible on the high resistance ranges and that currents in the order of 100mA or more may be found on the low ohms ranges of some test meters. When checking circuits where there is the slightest risk of damage being caused, it is wise to avoid using the highest or lowest ohms range on the test meter and to concentrate tests on the range which applies low voltage **and** low current. If magnetic devices, such as tape heads, are tested, note that they will be magnetised by the meter current. These tests should not be made, therefore, unless a defluxer is available to remove the residual magnetism.

It should be noted that no checks of resistance can be made unless the circuit which is being tested, is completely dead. All voltage sources should therefore be disconnected before tests take place, as, quite apart from giving the wrong results, severe damage can be caused to the test meter and equipment if resistance tests are attempted on live circuits. Devices such as transistors, diodes and electrolytic capacitors are inherently polarity sensitive so the polarity of the voltage output of the test meter should be noted whilst making tests on these devices. As will be seen from Fig. 8 using normal circuit arrangements the polarity of the test prods is normally **opposite** on the ohms range to that marked on the meter for the voltage and current ranges.

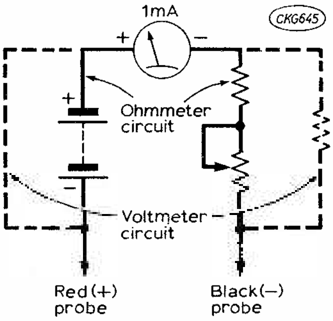


Fig. 8: Illustration of reverse polarity of probes in an ohmmeter circuit.

Decibels

Many test meters have a scale marked in decibels marked in + and − values over a total of 15dB's or so. It must be clearly understood that the decibel is **not** an absolute value, such as the ohm or volt, but, as will be seen from the shape of the dB scale, is a logarithmically based system of comparison. Whilst many test meters are calibrated so that 0dB=0·775V this is just an abitrary figure. In practical use, such as measuring the frequency response of an amplifier, the signal level is adjusted so that the output when measured with the test meter set to a suitable range, reads 0dB. If the input frequency is then varied the output variation, and hence the frequency response of the equipment being tested, can be read off directly in decibels.

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ECC83	0·45
ECC84	0·55
ECC85	0·53
ECC88	0·75
ECC189	0·71
ECF80	0·56
ECF82	0·73
ECF86	0·71
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ECH83	1·00
ECH84	0·78
ECL80	0·53
ECL82	0·61
ECL83	0·68
ECL86	0·63
EF80	0·46
EF83	1·03
EF85	0·43
EF86	0·90
EF89	0·81
EF91	1·30
EF92	1·40
EF95	1·35
EF183	0·60
EF184	0·60
EH90	0·56
EL34	0·95
EL36	1·05
EL81	0·90
EL84	0·47
EL85	0·55
EL86	0·95
EL95	0·70
EL91	1·31
ELL80	1·30
EM84	1·18
EM87	1·18
EY51	0·88
EY86/87	0·42
EY88	0·64
EZ80	0·51
EZ81	0·40
GY501	0·90
GZ34	0·78
PC86	0·75
PC88	0·75
PC97	0·45
PC900	0·56
PCC84	0·52
PCC88	0·80
PCC89	0·65
PCC189	0·65
PCF80	0·51
PCF82	1·30
PCF86	0·65
PCF200	0·85
PCF201	0·87
PCF801	0·65
PCF802	0·71
PCF806	0·66
PCH200	0·88
PCL82	0·54
PCL83	0·66
PCL84	0·59
PCL85	0·63
PCL86	0·63
PCL805/85	0·63
PD500	1·55
PFL200	0·80
PL36	0·88
PL81	0·75
PL81A	0·88
PL82	0·50
PL83	0·96
PL84	0·66
PL504	0·88
PL508	1·05
PL509	1·55
PL802	0·96
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PY88	0·60
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PY800	0·50
PY801	0·50
U26	1·00
U191	1·00
U193	0·50
UABC80	0·90
UBC81	0·70
UBF89	0·60
UCC85	0·60
UCH81	1·00
UCL82	0·70
UCL83	0·70
UF89	0·80
UL84	0·95
UY85	0·50
6/30L2/ECC804	1·00
6F23/EF812	1·05
30C1/PCF80	0·51
30C15/PCF800	1·05
30C17	1·00
30C18/PCF805	0·90
30F5/PF818	1·10
30FL1/PCE800	0·75
30FL2	0·75
30FL12	1·05
30FL14	0·85
30L1/PCC84	0·52
30L15/PCC805	1·05
30L17	0·90
30P4MR	1·30
30P12/PC801	1·05
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DL92	0·40
DL94	0·48
DL96	0·55
DY86/7	0·36
DY802	0·37
EABC80	0·38
EAF42	0·75
EB91	0·22
EBC33	1·00
EBC41	0·75
EBC81	0·33
EBF80	0·40
EBF83	0·40
EBF89	0·32
EBL31	1·50
ECC81	0·40
ECC82	0·33
ECC83	0·33
ECC84	0·30
ECC85	0·40
ECC88	0·40
ECH35	1·25
ECH42	1·00
ECH81	0'30
ECH83	0·45
ECL80	0·55
ECL82	0·35
ECL83	0·70
ECL86	0·40
ECLL800	3·20
EF37A	1·20
EF39	1·20
EF80	0·25
EF85	0·35
EF86	0·30
EF89	0·28
EF91	0·37
EF92	0·50
EF95	0·40
EF98	0·75
EF183	0·30
EF184	0·35
EL32	0·60
EL33	1·75
EL34	0·50
EL36	0·50
EL37	2·50
EL41	0·90
EL42	0·90
EL84	0·28
EL95	0·40
ELL80	1·00
EM80	0·45
EM81	0·60
EM84	0·35
EM85	1·00
EY51	0·40
EY86	0·40
EZ40	0·75
EZ41	0·75
EZ80	0·28
EZ81	0·29
GY501	0·80
GZ30	0·45
GZ32	0·50
GZ34	0·65
GZ37	1·25
HN309	1·50
KT61	1·75
KT66	2·50
KT81 (7C5)	1·30
KT81	1·75
KT88	2·90
KTW61	1·00
MU14	1·00
N78	2·75
PC86	0·60
PC88	0·60
PC97	0·50
PC900	0·48
PCC84	0·40
PCC88	0·55
PCC89	0·50
PCC189	0·60
PCF80	0·30
PCF82	0·35
PCF86	0·60
PCF801	0·50
PCF802	0·50
PCF805	0·90
PCF806	0·75
PCF808	0·90
PCL82	0·35
PCL83	0·66
PCL84	0·45
PCL85	0·50
PCL86	0·45
PCL805/85	0·50
PD500	1·30
PEN45	0·75
PL36	0·55
PL81	0·50
PL82	0·45
PL83	0·45
PL84	0·40
PL500	0·75
PL504	0·75
PL508	0·90
PL509	1·55
PL802	0·95
PX4	3·50
PX25	3·50
PY33	0·63
PY81	0·30
PY82	0·35
PY83	0·38
PY88	0·40
PY500	1·00
PY81/800	0·50
PY801	0·50
SP41	3·00
SP61	0·75
T41	1·00
U14	1·00
U25	0·85
U26	0·85
U191	0·75
UABC80	0·40
UAF42	0·75
UBC41	0·75
UBC81	0·45
UBF80	0·40
UBF89	0·40
UCC85	0·45
UCH42	0·75
UCH81	0·40
UCL82	0·35
UCL83	0·70
UF41	0·75
UF89	0·40
UL41	0·85
UL84	0·43
UY41	0·48
UY85	0·40
VR105-30	0·40
VR150-30	0·40
OA2	0·40
OB2	0·40
1R5	0·45
1S5	0·30
1T4	0·30
3S4	0·40
3V4	0·70
5R4GY	0·80
5U4G	0·40
5V4G	0·50
5Y3GT	0·45
5Z4G	0·45
6/30L2	0·90
6AK5	0·40
6AM5	0·90
6AQ5	0·45
6AS7G	0·85
6AT6	0·45
6AU6	0·30
6BA6	0·28
6BE6	0·35
6BH6	0·75
6BJ6	0·55
6BQ7A	0·55
6BR7	1·00
6BS7	1·35
6BW6	0·90
6BW7	0·90
6C4	0·35
6CD6G	1·30
6CH6	1·40
6CW4	1·00
6F23	1·05
6F25	1·00
6F28	0·70
6J5M	0·65
6J5G	0·45
6J6	0·30
6J7M	0·45
6J7G	0·40
6K6GT	0·75
6K7M	0·45
6K7G	0·30
6K8M	0·70
6K8G	0·45
6K25	0·75
6L6G	0·55
6Q7M	0·50
6Q7G	0·50
6SL7GT	0·48
6SN7GT	0·48
6SQ7GT	0·50
6U5G	0·75
6V6G	0·40
6V6GT	0·45
6X4	0·40
6X5G	0·40
6X5GT	0·45
7B6	0·75
7B7	0·70
7C5	1·30
7C6	0·75
7H7	0·70
7R7	0·75
7S7	2·25
7Y4	0·75
12AT6	0·40
12AT7	0·40
12AU6	0·45
12AU7	0·33
12AX7	0·33
12BA6	0·45
12BE6	0·50
30C1	0·30
30C15	1·05
30C17	1·10
30C18	0·90
30F5	1·10
30FL1	0·80
30FL2	0·75
30FL14	0·90
30L15	1·05
30L17	0·95
30P4MR	1·30
30P12	1·05
30P19	1·00
30PL1	0·95
30PL13	1·20
30PL14	1·25
35W4	0·50
35Z4GT	0·70
50CD6G	1·20
807	0·50
813 ITT	£13
813 USSR	£5·75
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AAZ13	0.10
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AC107	0·35
AC126	0·25
AC127	0·25
AC128	0·20
AC176	0·25
AC187	0·20
AC188	0·20
ACY21	0·22
ACY39	0·65
AD140	0·50
AD149	0·50
AD161	0·39
AD162	0·39
AF115	0·25
AF116	0·25
AF117	0·20
AF186	0·40
AF239	0·44
ASY27	0·30
ASY28	0·25
BA102	0·25
BA115	0·10
BC107	0·12
BC108	0·12
BC109	0·12
BC113	0·16
BC117	0·21
BC143	0·30
BC147	0·12
BC148	0·10
BC169C	0·14
BC182	0·12
BC182L	0·12
BC184L	0·13
BCY32	1·20
BCY33	0·38
BCY34	0·45
BCY70	0·15
BCY71	0·20
BCY72	0·15
BCZ11	0·65
BD121	1·00
BD124	0·80
BD131	0·45
BD132	0·50
BF115	0·22
BF167	0·25
BF173	0·28
BF179	0·33
BF180	0·35
BF181	0·35
BF194	0·13
BF195	0·13
BF197	0·15
BF200	0·32
BFS61	0·25
BFS98	0·25
BFX29	0·28
BFX88	0·22
BFY50	0·20
BFY51	0·20
BFY52	0·20
BFW10	0·61
BY100	0·15
BY126	0·14
BY127	0·15
BZX61 series	0·20
BZY88 series	0·10
CR81-05	0·30
CRS1-40	0·45
CR83-05	0·40
CR83-40	0·55
MJE340	0·50
MJE370	0·68
MJE520	0·65
MJE2955	1·10
MJE3055	0·75
MPF102	0·40
MPF103	0·36
MPF104	0·35
MPF105	0·46
NKT404	0·60
OA5	0·60
OA10	0·40
OA79	0·10
OA81	0·10
OA91	0 7
OA200	0·08
OA202	0·10
OC16	1·00
OC20	2·00
OC23	1·25
OC25	0·40
OC28	0·70
OC35	0·55
OC36	0·65
OC42	0·40
OC44	0·18
OC45	0·18
OC71	0·15
OC72	0·25
OC76	0·30
OC77	0·55
OC81	0·28
OC81D	0·28
OC81Z	0·45
OC83	0·25
OC140	0·65
OC170	0·25
OC171	0·30
OC200	0·55
OC201	0·80
OC202	0·90
OC203	0·55
OCP71	1·00
ORP12	0·55
ORP60	0·45
T1005	0·20
TIC44	0·29
TIC226D	1·50
TIL209	0·25
TI843	0·26
ZTX107	0·12
ZTX108	0·10
ZTX300	0·14
ZTX301	0·14
ZTX302	0·20
ZTX304	0·24
ZTX500	0·15
ZTX501	0·15
ZTX503	0·16
ZTX531	0·25
ZTX550	0·18
1N914	0·06
IN4001	0·6
IN4002	0·7
IN4003	0·8
IN4004	0·8
IN4005	0·10
IN4006	0·12
IN4007	0·12
1N4009	0·06
1N4148	0·06
1S921	0·07
1S2033	0·20
1S2051A	0·10
1S2100A	0·20
1S3010	0·25
2N698	0·15
2N697	0·15
2N706	0·10
2N706A	0·12
2N1131	0·25
2N1132	0·25
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2N1303	0·18
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2N1305	0·22
2N1306	0·28
2N1307	0·28
2N1308	0·28
2N1309	0·30
2N1613	0·20
2N1614	0·45
2N2147	0·75
2N2160	1·00
2N2369A	0·16
2N2646	0·50
2N2904	0·20
2N2904A	0·25
2N2905	0·32
2N2905A	0·25
2N2906	0·20
2N2926	0·10
2N3053	0·20
2N3055	0·60
2N3525	0·80
2N3614	0·59
2N3615	0·65
2N3702	0·11
2N3703	0·12
2N3704	0·14
2N3705	0·12
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2N3707	0·13
2N3708	0·07
2N3709	0·10
2N3710	0·11
2N3711	0·11
2N3819	0·35
2N3820	0·50
2N3823	0·50
2N3903	0·15
2N3904	0·20
2N3905	0·25
2N3906	0·16
2N4058	0·15
2N4059	0·10
2N4060	0·13
2N4061	0·13
2N4062	0·14
3N141	0·81
40360	0·40
40361	0·45
40362	0·40
40430	0·85

SN7400	0·20
SN7401	0·20
SN7402	0·20
SN7403	0·20
SN7404	0·20
SN7405	0·20
SN7406	0·40
SN7407	0·40
SN7408	0·25
SN7409	0·33
SN7410	0·20
SN7411	0·23
SN7412	0·28
SN7413	0·30
SN7416	0·30
SN7417	0·30
SN7420	0·20
SN7422	0·28
SN7423	0·40
SN7425	0·37
SN7427	0·37
SN7428	0·43
SN7430	0·20
SN7432	0·37
SN7433	0·43
SN7437	0·43
SN7438	0·43
SN7440	0·20
SN7441AN	0·85
SN7442	0·85
SN7450	0·20
SN7451	0·20
SN7453	0·20
SN7454	0·20
SN7460	0·20
SN7470	0·33
SN7472	0·38
SN7473	0·44
SN7474	0·48
SN7475	0·59
SN7476	0·45
SN7480	0·80
SN7482	0·87
SN7483	1·20
SN7484	1·00
SN7486	0·50
SN7490	0·75
SN7491AN	1·10
SN7492	0·75
SN7493	0·75
SN7494	0·85
SN7495	0·85
SN7496	1·00
SN7497	4·32
SN74100	2·16
SN74107	0·51
SN74110	0·57
SN74111	0·86
SN74118	1·00
SN74119	1·92
SN74121	0·57
SN74122	0·80
SN74123	1·44
SN74141	1·00
SN74145	1·44
SN74150	2·30
SN74151	1·15
SN74154	2·30
SN74155	1·15
SN74156	1·15
SN74157	1·09
SN74170	2·88
SN74174	1·80
SN74175	1·29
SN74176	1·44
SN74190	2·30
SN74191	2·30
SN74192	2·30
SN74193	2·30
SN74194	1·72
SN74195	1·44
SN74196	1·58
SN74197	1·58
SN74198	3·16
SN74199	2·88

DIL	14 pin	**15p**
SOCKETS	16 pin	**17p**

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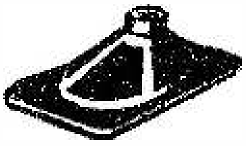

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THE Firm for speakers!

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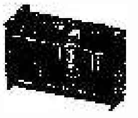

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Tuner **£9·95** (£1·20)
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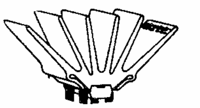

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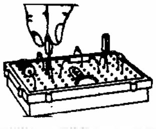

S-DEC	**£1·98** (31p)
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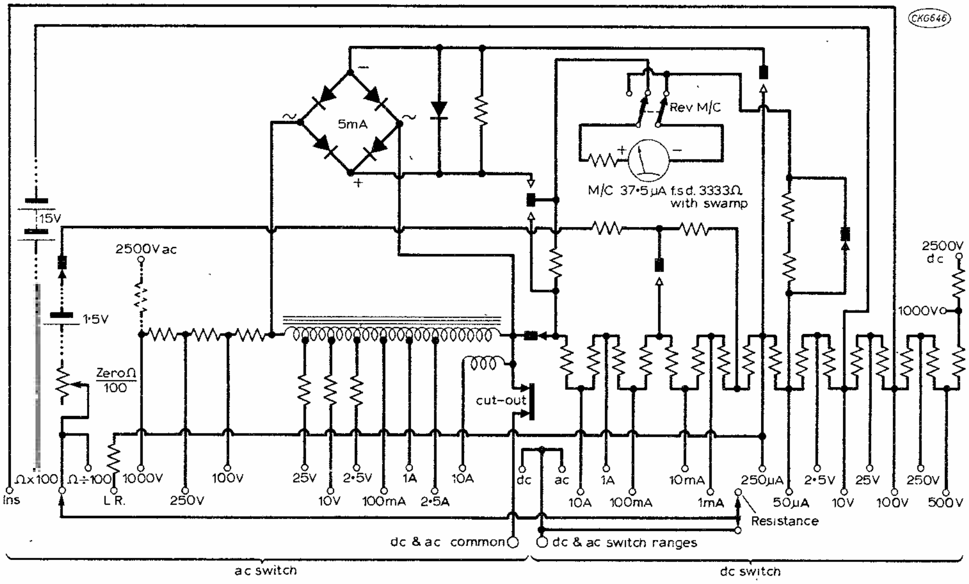


Fig. 9: Basic circuit of the Model 8 Avometer Mk II to show the complexity of a modern multi-meter. (Courtesy AVO Ltd Dover)

To be really useful in making this kind of test the response of the test meter and the output of the audio generator must be flat with frequency, otherwise one is liable to end up in the position of the wheel-tapper who condemned 100 wheels only to find he had a cracked hammer! Remember, it costs next to nothing to print a decibel scale on a meter but it costs pounds to incorporate the response and accuracy needed to make it really meaningful for even simple audio frequency response measurements.

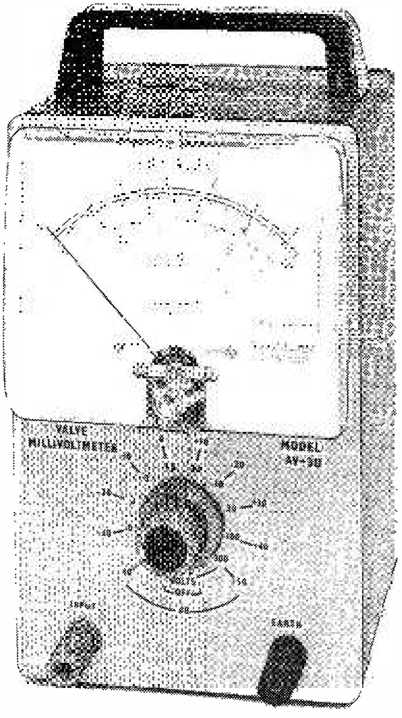
Precautions in use

Multirange test meters are precision instruments which can easily be damaged by over-loading. Whilst many meters have built-in automatic protection, these circuits only give a **limited** protection; they do not cater for gross overloads. A moments carelessness can leave an instrument which is beyond economical repair. To avoid disasters follow the makers' instructions, together with the following suggestions:—

1. Always leave the instrument switched to a high voltage range when not in use. **Never** on a current or ohms range.
2. Never connect meter to any live circuit when switched to ohms.
3. Be extra careful to avoid short circuits when using the current ranges.
4. When measuring unknown voltages or currents switch to the highest range **first,** and only change over to a lower range if less than, say, one third of full scale deflection is registered.

Buying a meter

There is a host of small test meters available, many of which should be more than adequate for the average hobbyist. Aim to get a meter which has a sensitivity of 10,000 OPV or more on the DC ranges and which has a scale which is clear to read. A resistance range coverage of from, say, 1 ohm to 2 megohms, will fill most needs. AC current ranges are not really of any great importance, as current can always be calculated from resistance and voltage measurements, but a few DC current ranges will be found useful.



This valve millivoltmeter, type AV-3U, is mains operated and has a sensitivity of 10mV f.s.d. on the lowest range and 300V RMS on top range. (Courtesy Heath (Glos.) Ltd.)

When comparing meters it can be advantageous to take along a battery and a few known values of resistors. There is nothing like a practical test to prove whether readings are plain and straightforward or confused and ambiguous. The cost?—£15 will buy a meter which is likely to be more than good enough but look around and testers costing well under £10, which are by no means cheap and nasty, can be found. ■

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PART 6—GROUNDED EMITTER AMPLIFIERS

LAST month's emitter followers were all types of current amplifiers. In every case the output voltage was the same, or slightly less than the input voltage. Many applications require voltage amplification—e.g. raising the output level of a microphone to an extent that when current amplification is applied the resultant signal could drive a loudspeaker. The grounded emitter amplifier will provide a reasonable degree of voltage *and* current amplification and is, perhaps, the most used type of amplifier stage in the whole of electronics. Because both voltage *and* current is amplified we call the grounded emitter stage a *power amplifier* but not necessarily in the sense that you can expect several watts of useful output; specialised power stages are better equipped for the latter purpose and these will be covered later in the series.

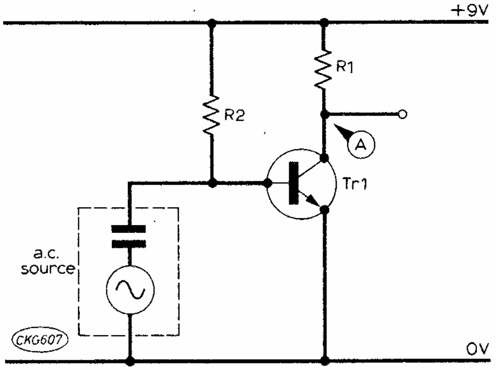

Fig. 42: It is difficult to predict a value for R2 to set the potential at A to mid-rail unless the h_{FE} for Tr1 is accurately known.

Referring to Fig. 42, we know that we can make the voltage at point A go to +9V by ensuring that the transistor is cut off (i.e. by passing zero base current) and conversely we can make it fall to zero volts by passing a certain amount of base current through R2. By knowing an accurate value of h_{FE} for the transistor we could calculate a value for R2 that will cause just sufficient collector current to flow that the voltage drop across R1 will be 4·5V. Theoretically we could hold the voltage at A exactly mid-way between the two supply rails. At the same time we could connect a source of voltage through a capacitor to the base of the same transistor and (assuming the source voltage was zero at the time) this would not affect our *bias* condition. However, as soon as we begin to generate a voltage from the source this would cause current to be added or subtracted from the bias current (depending on the polarity of the a.c. signal) and would cause the voltage at A to rise and fall in exact relation—except for the 180° change of phase. Having point A biased "mid rail" allows maximum peak swings of voltage without the transistor clipping (going totally out of conduction) or bottoming (going into saturated conduction) unsymmetrically. In the ideal amplifier the voltage seen at A should faithfully represent that from the source.

In practice the method of obtaining this mid-rail bias shown in Fig. 42 is not very satisfactory because the h_{FE} for the transistor must be accurately known and this can vary widely from one device to another (even though they may be of the same type number).

Base current

A simple way of compensating for this device variation is to use the potential at A as the voltage source for providing the base current—shown in Fig. 43. If the potential at A is too high the base current will be increased, hence the collector potential falls; conversely if A tends to be too low the base current decreases and the potential at A is forced to rise. By careful selection of component values this feedback bias circuit caters well for quite wide variations in the gains of transistors. It is not perfect by any means but is an improved way of getting a mid rail voltage reliably. You can make up the circuit of Fig. 43 on T Dec and try different BC108 devices. The voltage you measure should not fall outside the range of +3·5 to +5·5V. For those interested it is quite easy to arrive at the component values. First of all assume that the collector load is to be 1kΩ. For the potential at A to be +4·5V (assuming a 9V supply) the drop of 4·5V across R1 will be caused by a collector current of

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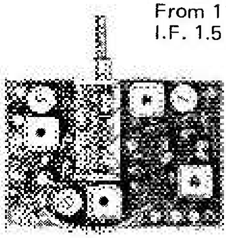

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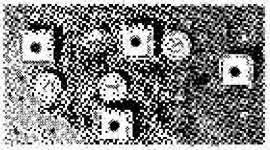

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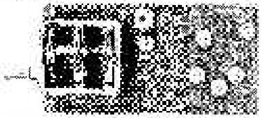

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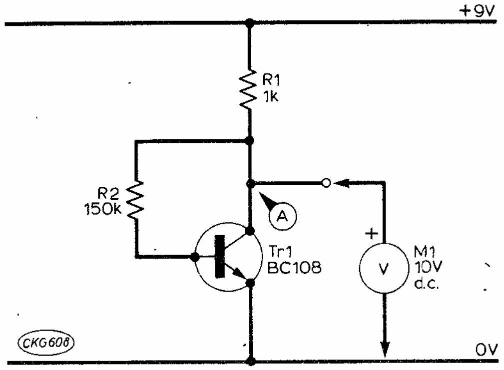


Fig. 43: Using the potential at A as the driving source for base current helps compensate for variations in h_{FE}.

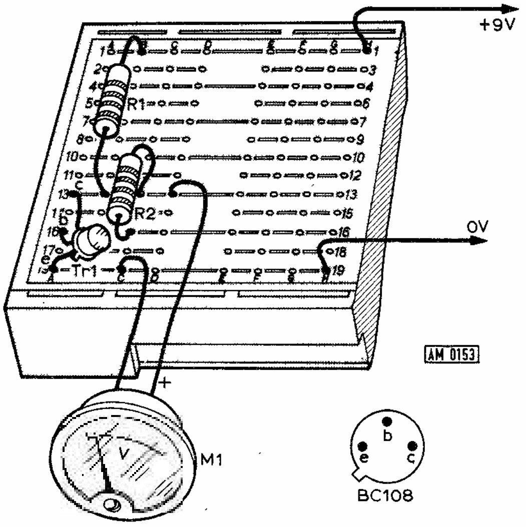


Fig. 44: Component layout for Fig. 43.

4·5mA. If we expect an h_{FE} of around 200 for the BC108 this means that the base current needed to cause 4·5mA collector current is 4·5/200 = 0·0225mA. The value of R2, to give this current is calculated from the potential difference across it (potential at A minus the 0·6V base emitter drop) divided by the base current 3·9/0·0225kΩ = 170kΩ. The small base current drawn will theoretically modify our original assumption of the potential at A but is so small that it can be ignored. Strictly speaking we should have shown R2 as having a value of 170kΩ but because of other experiments to follow we have made it 150kΩ. The effect of this is to cause the quiescent voltage to be slightly less than mid-rail—but near enough for the experiment.

A crystal microphone is a very easily obtainable source of a.c. voltage that is of a capacitive nature and this can be connected straight across the base of Tr1 and ground of our circuit without affecting the bias conditions (see Fig. 45). Note that we have split the value of our original R2 between two resistors (R2 and R3) in series. Initially leave out the capacitor C1 and connect a meter set to a low a.c. range through a capacitor to point A. Most modern test meters have this capacitor built into them if you use the input socket marked "Output". The capacitor is there so that the meter only responds to a.c. components on top of the d.c. quiescent voltage at A. Whistle loudly into the microphone and you should see a slight movement of the meter (probably IV maximum).

Remember, though, that the output from the microphone is unlikely to be greater than a few tens of millivolts. Clearly there is some form of voltage amplification. If you think about it, though, the a.c. fluctuations at A are being fed back, out of phase, to the base through resistors R2 and R3. This will negate the input signal and the overall gain of the amplifier is going to be considerably impaired. We can, however prevent the a.c. component of the feedback signal reaching the base by connecting a capacitor from the junction of R2 and R3 to ground. Do this while whistling into the microphone and you should see at least a two to one improvement in amplification. We call C1 a decoupling capacitor and it should be of a high enough capacitance to shunt even the lowest frequencies to ground.

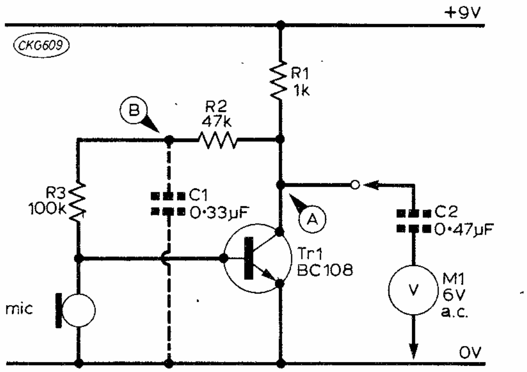


Fig. 45: A signal from a crystal microphone can be superimposed on the bias current but the components have to be slightly modified. Use a meter with an "Output" connection switched to a.c. or alternatively insert C2 when using an a.c. voltmeter.

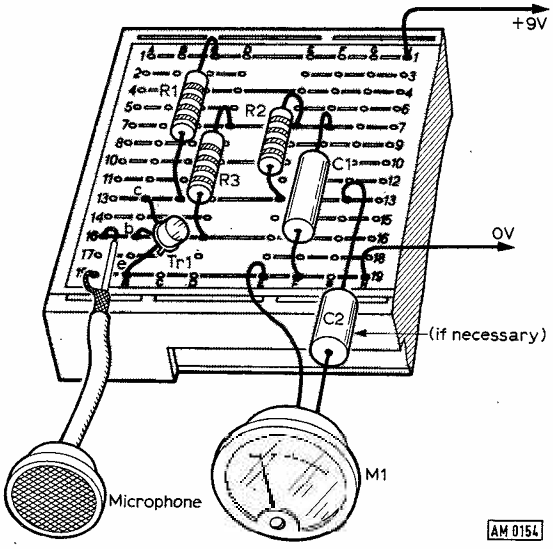


Fig. 46: Component layout for Fig. 45.

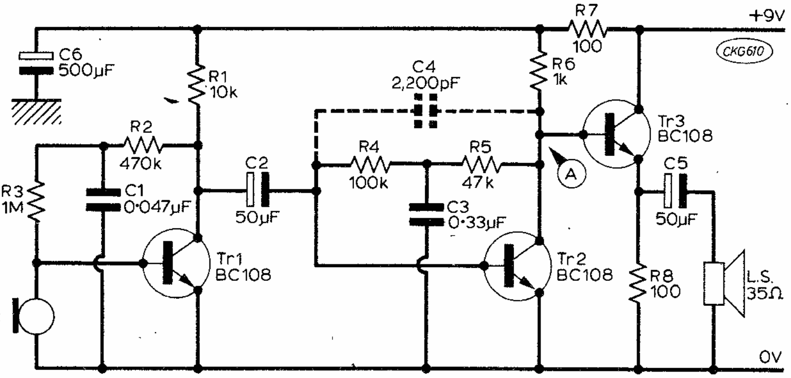
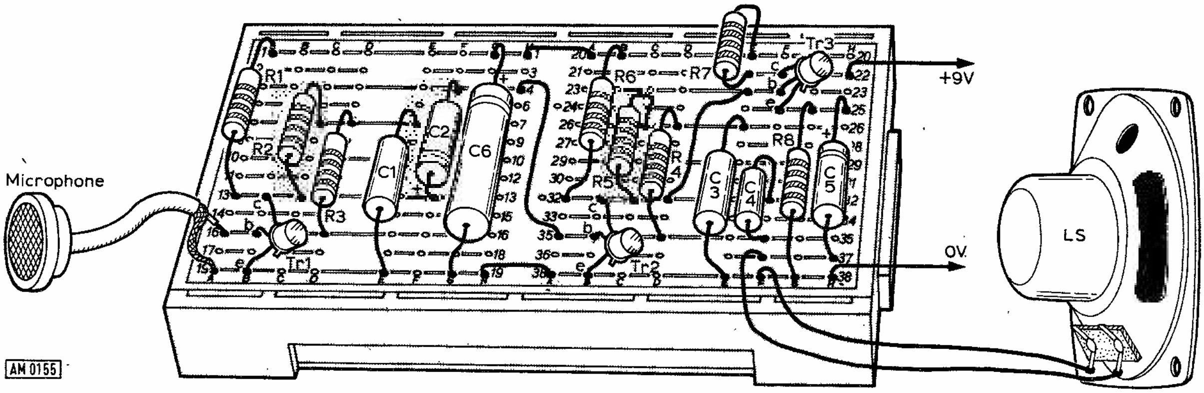


Fig. 47: A basic amplifier capable of driving a small loudspeaker from a crystal microphone and suitable for an intercom or baby alarm.

Fig. 48: Component layout for Fig. 47.



The output current from a crystal microphone is very small—because of its high impedance—particularly at low frequencies but there must be quite a reasonable current generated between collector and emitter of the transistor to give rise to the voltage swings we can see at point A. Thus the transistor can be seen to give both current and voltage amplification. The component values in Fig. 45 are not really ideal for coupling from a crystal microphone because we require a fair amount of a.c. base current from the source, and as mentioned earlier, there is not much of this available at low frequencies. The low frequency response of this amplifier would therefore be pretty poor. We can, however, use exactly the same approach to make a stage that needs only one tenth of the input current by increasing all our resistance values by factors of ten (the first stage of Fig. 47. The output from the collector of Tr1 is now coupled as an a.c. signal source to the base of Tr2 which, excluding C4, is identical to the stage we have just described. Before connecting C4 or Tr3 measure the a.c. signal at point A exactly as before; you should see a really high voltage swing (getting on for three or four volts) and more than that, you can get a useful reading for ordinary speech a few inches away from the microphone.

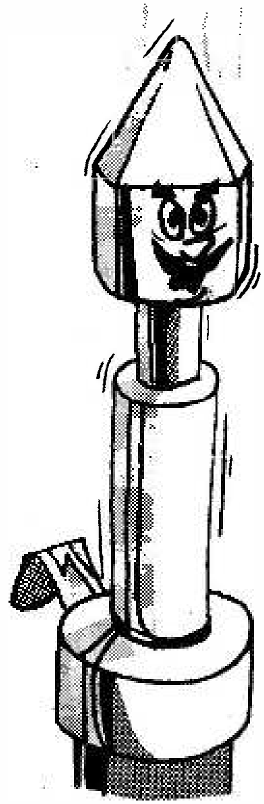
The circuit is clearly providing more voltage gain and has a more useful response at the lower frequency of the human voice. Obviously by increasing the gain at low frequencies we must be overdoing it at high frequencies therefore we insert capacitor C4 which is used, deliberately, to feedback signal from the collector of Tr2 to its base. Because it has a low value it will provide more negative feedback at high frequencies than at low frequencies and hence helps to linearise the frequency response of the two stage amplifier. Use the "whistle and speech" test to see that the amplitude for the whistle is reduced but the level for normal speech has not been appreciably affected. Because we now have a useful voltage swing at A for speech we can use a current amplifier (an emitter follower) to give sufficient current at that voltage to drive a loudspeaker. This is provided by Tr3.

Note that it is necessary to decouple the power rail between the output stage and the amplifiers by means of R7 and C6. Without these components the current drawn by the output transistor could cause voltage variations on the line which are then seen as a form of signal by the preceding stages and amplified. This leads to instability and the whole circuit would oscillate wildly.

The amplifier of Fig. 47 does not have a particularly good frequency response but is quite adequate for intercom or baby alarm applications. No volume control is provided and in some circumstances you might encounter accoustic feedback (howl-round). This can be prevented by keeping the microphone and the loudspeaker well apart.

A problem with the circuits we have covered, so far, is that the voltage gain is very much dependent on the h_{FE} of the transistor in question. There are other circuits which—at the expense of a little gain—enable us to get what there is under reasonably accurate control.

To be continued



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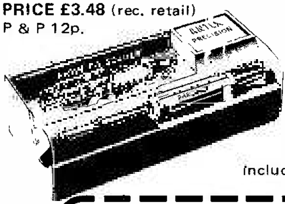

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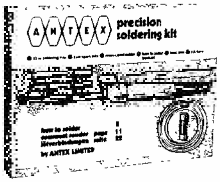

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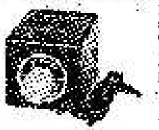

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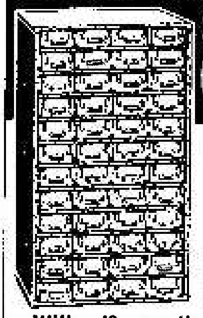

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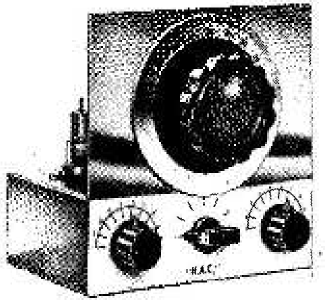

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THE WHYS AND WHEREFORES

C. BUDD

THE concepts of input impedance and output impedance are not really difficult to understand although there is no single rule to cover every situation. What is correct practice depends almost entirely on the individual design requirements.

The most important rule of impedance matching is derived from the maximum power transfer theorem.

The maximum power transfer theorem

If a signal source with a purely resistive output source is required to drive a purely resistive load, maximum power will be transferred from source to load when the load resistance is equal to the output impedance of the source. It should be noted that the theorem assumes that the input and output impedances to be purely resistive, which will rarely be the case in practice, and that to deliver maximum power to the load is the sole requirement.

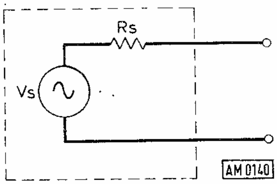


Fig. 1: Equivalent circuit of signal source with resistive output impedance.

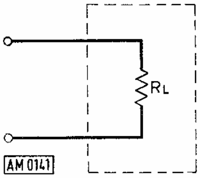


Fig. 2: Equivalent circuit of resistive load.

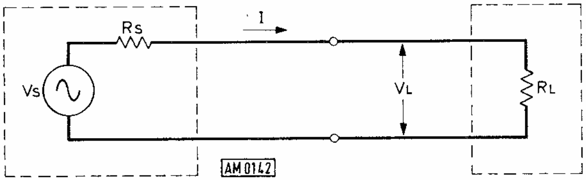


Fig. 3: Equivalent circuit of the source of Fig. 1 driving the load of Fig. 2.

Assuming that our signal source may be represented by an a.c. voltage source in series with a resistance (Fig. 1) and that our load may be represented by a pure resistance (Fig. 2), we can combine the two (Fig. 3) and write some pertinent equations as follows.

Calling the power delivered to the load P

$$V_L = \frac{V_S R_L}{R_L + R_S} \text{ by potential divider action}$$

$$\text{and } I = \frac{V_S}{R_L + R_S} \text{ where I is the a.c. current flowing}$$

$$P = IV_L$$

$$\therefore P = \frac{V_S^2 R_I}{(R_L + R_S)^2}$$

where V_L = load voltage, V_S = source voltage, R_L = load resistance, and R_S = source resistance.

Given the source voltage and the source and load resistances we can, with this formula, calculate the power delivered to the load. But we can do more than that. If we assume arbitrary values for V_S and R_S we can plot a graph of R_L against P. The curve obtained will be similar to that in Fig. 4. From the graph it may be seen that the power transferred is at maximum at approximately the point where R_L equals R_S. It may be shown that P reaches a maximum when R_L is exactly equal to R_S.

Maximum power transfer between source and load occurs when the source resistance is equal to the load resistance.

Other considerations

In practice, however, it is not as straightforward as this because maximum power transfer may not be our only concern. Consider the simple audio output stage shown in Fig. 5. The purpose if T1 is to match the speaker impedance to the output impedance presented by the transistor.

From the maximum power transfer theorem, one could reasonably assume the the "correct" load resistance would be the output resistance of the transistor, but this is not so. In this case maximum efficiency (i.e. power transfer from amplifier to load) is not our main concern.

Of greater importance is the maximum power that the stage will deliver without distortion due to bottoming (the transistor being turned off by the input signal) or saturation. In fact the load resistance into which the stage will deliver the maximum power without distortion, known as the optimum load, is equal to the supply voltage divided by the quiescent collector current and has nothing to do with the actual output resistance of the stage.

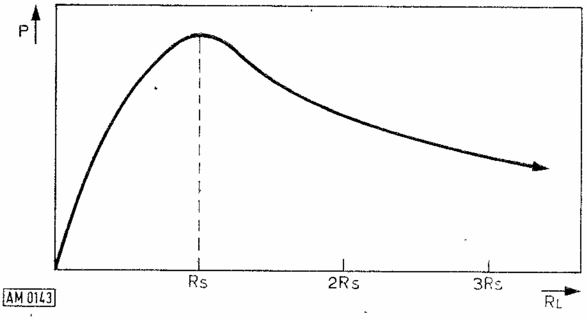


Fig. 4: Sketch graph showing that the power delivered to the load is at a maximum when $R_L = R_S$.

In a practical case the optimum load will generally be higher than the output resistance for an audio power amplifier, and this is the reason that commercial audio power amplifiers, intended to drive load impedances of 3, 8 or 16 ohms, often have output impedances of a fraction of an ohm.

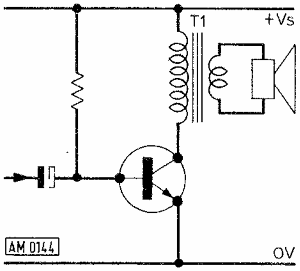


Fig. 5: Simple audio output stage.

Reactive components

An input or output impedance will have reactive components as well as a resistive one. If possible, the reactive element of the source impedance should be cancelled by those of the load impedance. In other words, a source with an equivalent series capacitance should "see" a load with an equivalent series inductance, the reactance being equal, but opposite, to that of the source capacitance.

In this way, the source capacitance and the load inductance form a series-tuned circuit which, ideally, has zero dynamic impedance (zero resistance). Any net reactance in the source-load circuit is undesirable since it reduces the maximum power that can be delivered to the load by the source. Such "reactance balancing" is only possible at a single frequency and in a system of large relative bandwidth (e.g. an audio preamplifier) it is of no use.

At r.f. however, the relative bandwidth will generally be much less and it is usually easy to make the reactive elements of source and load cancel out in the frequency band in use. As an example, one of the functions of the aerial tuning unit in a transmitting system is to cancel out the reactive elements of the aerial impedance.

Equal load and source resistance

Now let us consider another situation in which it would be better to deviate from the rule of making the load resistance equal to the source resistance because maximum power transfer is not our only concern. Fig. 6 shows the equivalent circuit diagram of a typical crystal microphone or ceramic pick-up. The output impedance of such a device consists of a fairly large resistance (typically a few megohms) in series with a small capacitance of perhaps two or three hundred picofarads. If the capacitive element was absent, the transducer drives a pre-amp with an input resistance equal to R_S and all would be well.

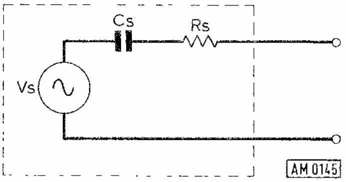


Fig. 6: Equivalent circuit of typical crystal microphone or ceramic pick-up.

However, at the lower audio frequencies, the reactance of C_s in a practical transducer becomes large enough to be significant in comparison to R_s and attenuation of the bass frequencies would result if the input impedance of the pre-amp were equal to R_s.

Since an inductance in series with the transducer would only cancel the capacitance at a single frequency and would, in any case be ridiculously large, the simplest solution to the problem is to make the input impedance of the pre-amp very large compared to R_S. The reactance of C_s at bass frequencies would then be insignificant compared to the total resistance in circuit and no significant attenuation of the bass frequencies would occur.

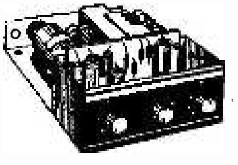
High impedance input

The circuit diagram of a crystal microphone driving a pre-amp with an ample input resistance of 10MΩ is shown in Fig. 7. One could reasonably think, from the maximum power transfer theorem, that the large ratio between the resistive component of the source impedance and the load resistance would result in a large loss of available power.

This is the case, but it may be shown that the power gain of a common source f.e.t. stage (and that of a common cathode valve stage) is proportional to the value of the resistor (R1 in Fig. 7) shunting the input, which is roughly equal to the

—continued on page 1166

SUPERSOUND 13 HI-FI MONO AMPLIFIER



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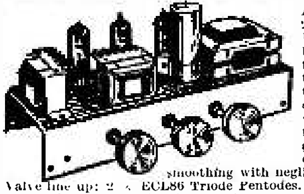

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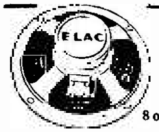

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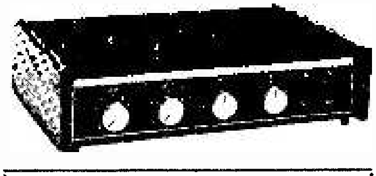

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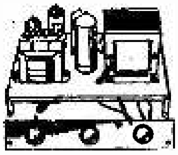

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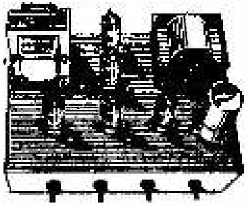

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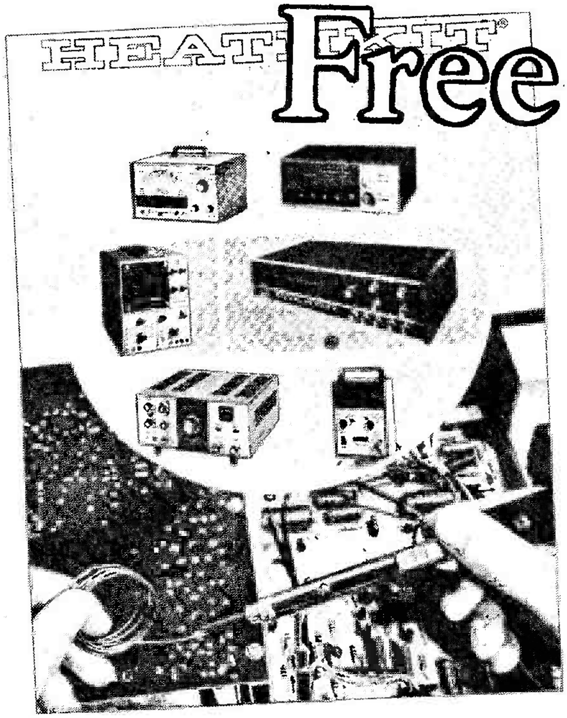

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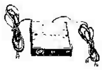

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AUTOMATIC 12V CAR BATTERY CHARGER

Richard Collin

THIS simple automatic battery charger was originally designed for use with the very popular battery operated fluorescent lamp described in the December issue of *Practical Wireless*. Its purpose was to keep the battery in a fully charged state, restoring energy used when mains power is available.

The circuit is of course suitable for charging any 12 volt car battery at a maximum rate of 2·25A. When the battery reaches full charge (13·5 volts) a "crowbar" circuit operates and shuts off the charge current. Interruption of the mains supply restores the crowbar to its off state.

Circuit description

The circuit diagram is shown in Fig. 1. A mains isolation transformer with a 30V centre-tapped secondary winding feeds a full-wave thyristor circuit to provide the charging current. The thyristors are triggered by the d.c. potential applied to the gate electrodes via diodes D1 and D2 and the associated smoothing capacitor C1.

Resistors R1, R2 and R3 limit the gate current together with the indicator lamp LP2. Resistor R1 and lamp LP2 also limit the current through the crowbar thyristor CSR3 when it is 'on'. Resistors R4 and R5 are connected in parallel. They limit the charge current to 2·25A to protect the transformer, CSR1 and CSR2. Diode D3 is included to stop current flowing back from the fully charged battery into the crowbar circuit once it has triggered.

The crowbar trigger potential is set by the 6·8V zener diode D4 in the gate circuit of CSR3. By using the potentiometer across the circuit output it is possible to adjust the voltage of the output to a predetermined level at which the crowbar circuit 'fires'. The crowbar thyristor 'shorts' the main gates to earth and stops them from receiving gate pulses, so stopping conduction.

★ components list

R1	68Ω 5W wirewound resistor
R2, R3	270Ω ½W
R4, R5	1Ω 10W wirewound
R6	1·2kΩ ½W
R7	330Ω ½W
VR1	2·2k potentiometer (miniature preset)
C1	640µF 25V
LP1	Mains neon indicator
LP2	6·3V 0·2A lamp
S1	Single pole, single throw toggle
FS1	3A fuse
T1	Mains transformer, secondary 30V centre tapped, 3A
CSR1	2N3228 TO-66 or any 50V 5A thyristor, and mounting hardware
CSR2	2N3228 TO-66 or any 50V 5A thyristor, and mounting hardware
CSR3	TIC44
D1	1N4001
D2	1N4001
D3	1N1612R or any 50V 5A stud type (stud is anode) and mounting hardware
D4	6·8V 1 watt zener diode

Lamp holder (m.e.s.), connecting wire, mains lead, fuseholder, nuts, bolts, etc. Heatsinks (see Fig. 3.)

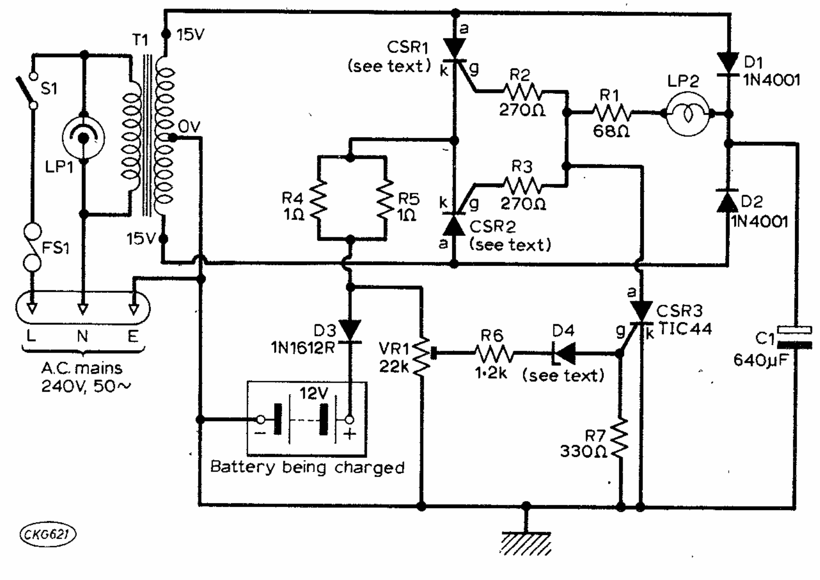

Fig. 1: Schematic circuit of the automatic battery charger.

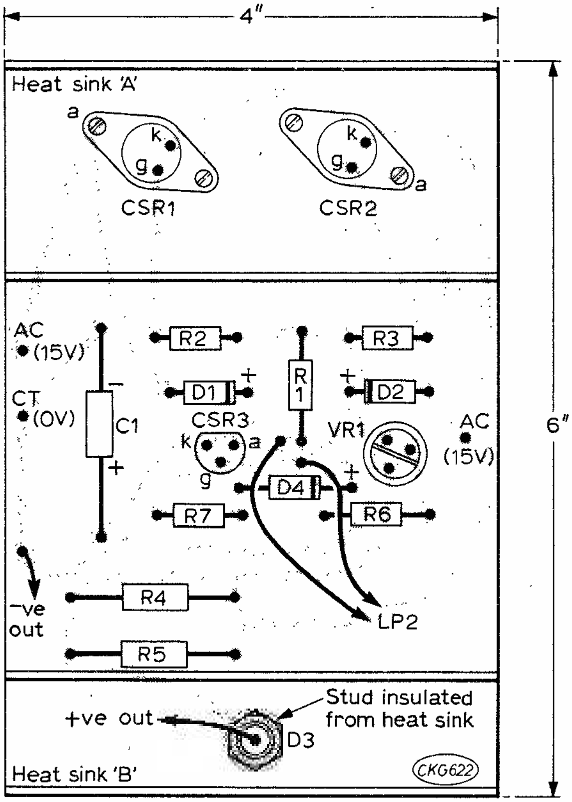

Fig. 2: Printed circuit board and component layout.

The circuit board layout is shown in Fig. 2. All components should be mounted onto the board and soldered up. Ensure that electrolytic C1 is connected correctly and check also the polarity of the thyristor and diode connections. The main thyristors, CSR1 and CSR2 and diode D3 must be mounted with insulators on their respective heatsinks. A smear of silicon grease should be applied to each side of the mica washers to ensure good thermal contact. Resistors R4 and R5 should be spaced clear of the board as they will run quite warm.

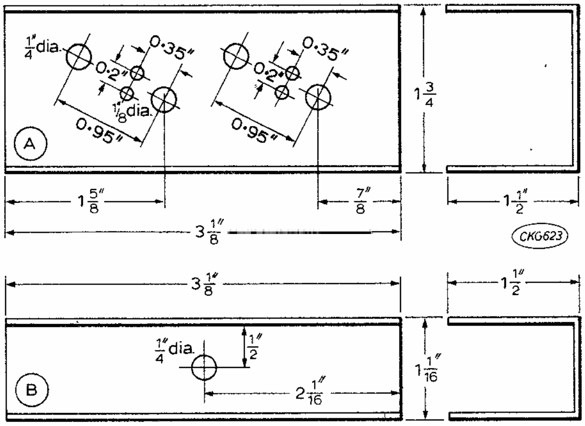

Fig. 3: Heat sink details, in 16 s.w.g. aluminium.

When the board is complete and all wires to the transformer are connected make a final wiring check. Then set VR1 fully anticlockwise, and switch on the mains. Measure the voltage across C1; it should be approximately 20V.

Then connect a fully charged 12V battery (about 13·4V off load) across the output terminals. Advance VR1 slowly until the crowbar circuit just operates (lamp LP2 comes 'on'). The voltage measured between earth and R4, R5 and D3 junction should then be about 14V. Do not move the setting of VR1 again —sealing with a dab of glue is a good safeguard. Switch off the unit and disconnect the battery.

Connect a discharged battery to the unit and switch on. If an ammeter is available check the charge rate—about 2·25A. Alternatively measure the voltage across R4, R5; this should be about 1·1V. The crowbar circuit should not operate until the battery is fully charged and reaches 13·4V. Once operated the crowbar cannot be reset unless the mains supply is interrupted.

During power cuts this will be "automatically' accomplished. ■

IMPEDANCE MATCHING—*continued from page 1162*

input impedance of the stage. Thus, a high input impedance makes for higher power gain and, hence, greater output power from the stage as well as improving the bass response, as it does in this particular application.

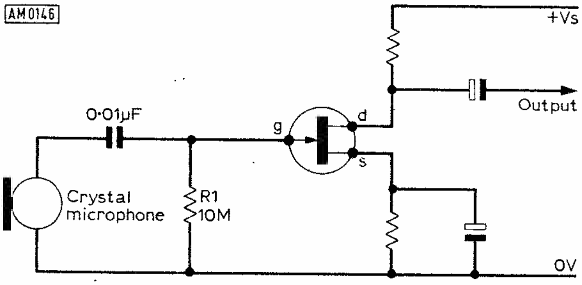

Fig. 7: A crystal microphone driving an audio preamp with a high input impedance.

Power fall-off

There are many such situations in which maximum transfer of power from source to load is not our only concern and load resistance should not be made equal to source output resistance. But the basic principles should be borne in mind. The maximum possible power will be delivered to the load when the input resistance of the load is equal to the output resistance of the source and any reactive components in the source impedance should be cancelled out by equal but opposite reactive elements in the load impedance.

In many practical cases exact equality of source and load resistances is not easy to achieve. It may be seen from Fig. 1 that the power transfer falls off more rapidly with decreasing load resistance than it does with increasing load resistance. Therefore, if it is necessary for a mismatch to occur, it is clearly much better to make the load resistance greater than the source resistance. ■

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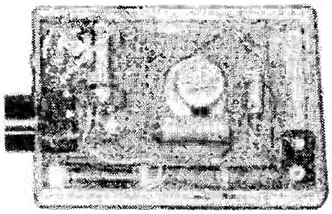

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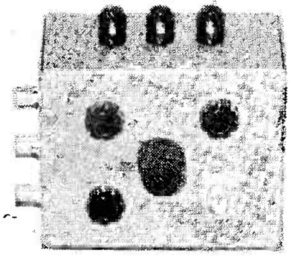

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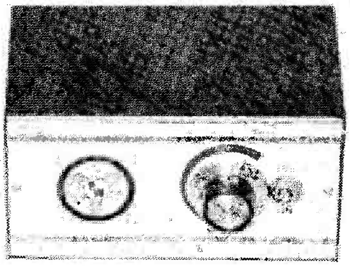

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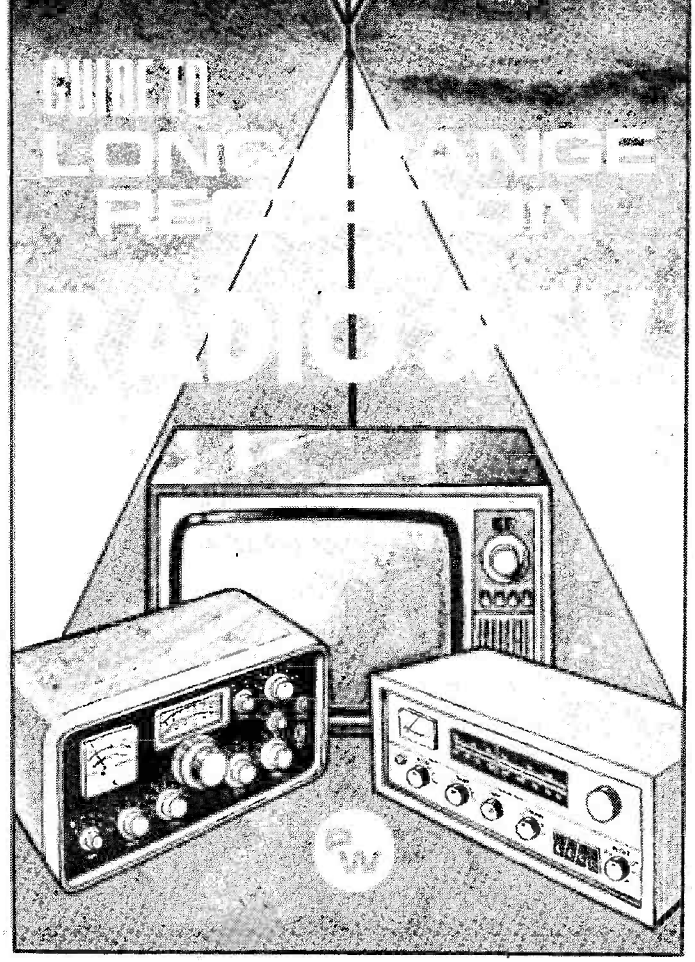

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THE 'SLIMLINE' 5-Band

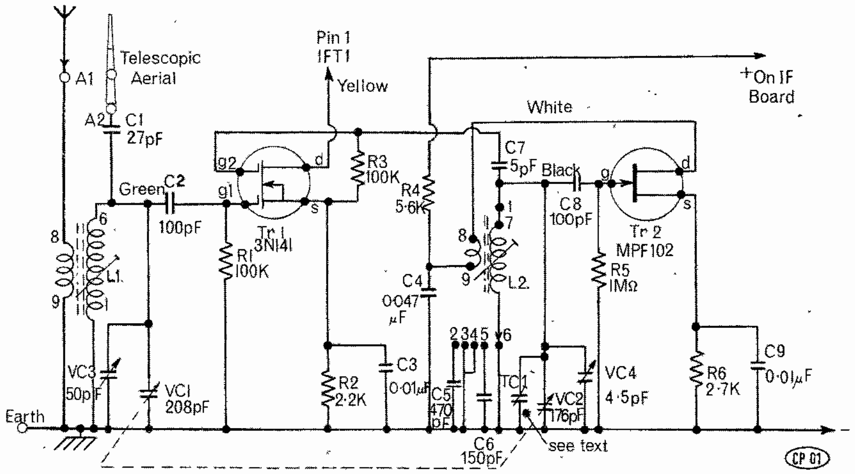


Fig. 1. First part of the circuit of the Slimline receiver. This contains the mixer stage Tr1 and the oscillator Tr2. Padders C5 and C6 are automatically connected into circuit when the appropriate coil L2 is inserted.

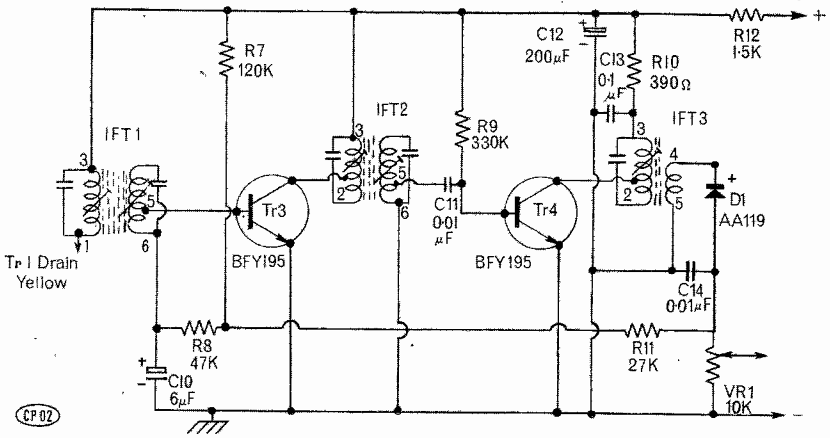


Fig. 2. The output from the mixer stage feeds into the first IF transformer IFT1 and amplified by Tr3 and Tr4. The capacitors across the windings are part of the IFT assemblies.

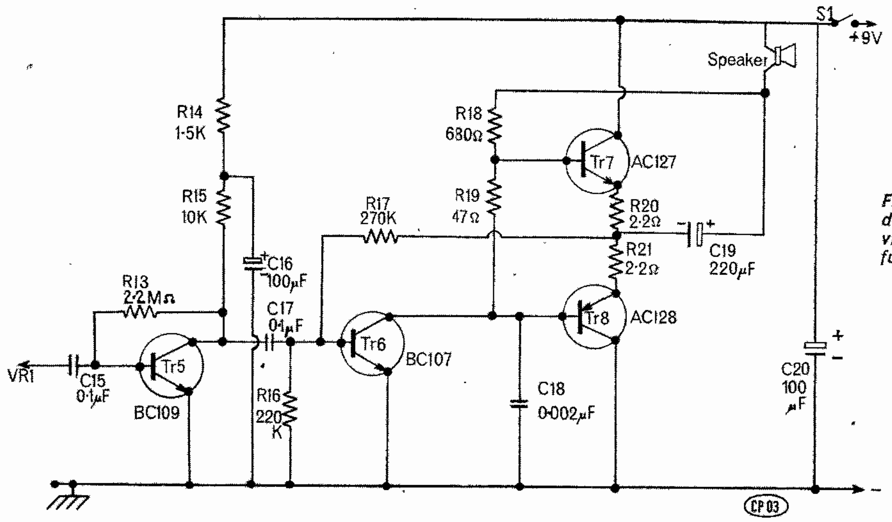


Fig. 3. The audio signal from the detector diode D1 in Fig. 2 is fed via the volume control to Tr5 and further amplified by Tr6, 7 and 8 and thence to the speaker.

Portable Receiver

F. G. RAYER

THIS portable receiver is in a 7×5in. case only 1in. deep, though to these dimensions must be added those of the Trimmer, Fine Tuning and Volume/On-Off controls at one end, and the Band-setting dial on the front. These do not however increase the size very much. The receiver may be operated with its own telescopic rod aerial, with an improved aerial such as a few yards of thin insulated flexible wire or with a conventional aerial.

The coverage of the five bands is approximately as follows:—

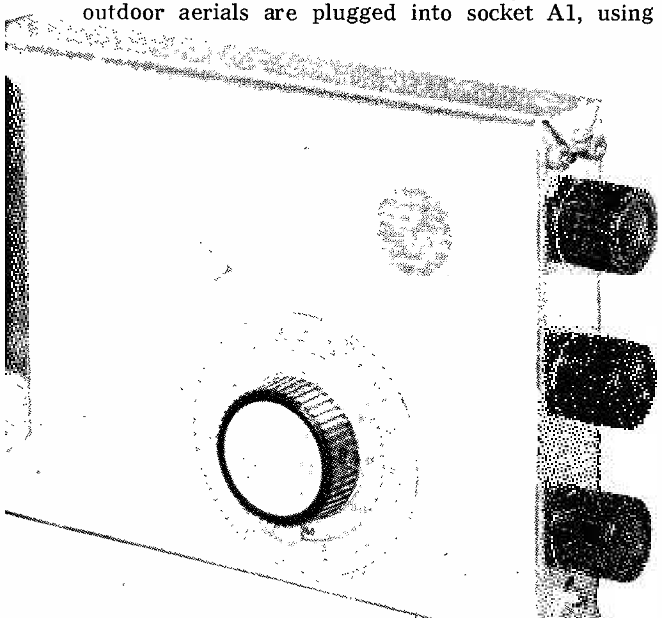
Band 1	160—350kHz
„ 2	580—1500kHz
„ 3	1·75—4·0MHz
„ 4	5·9—11·5MHz
„ 5	13—27MHz

The receiver thus has a wide general utility, tuning medium and long waves, if required, in addition to the most popular short wave bands.

Eight transistors and one diode are employed and the receiver is wired and assembled in separate units. A dual-gate 3N141 mixer is used with an MPF102 FET oscillator, followed by two BFY195's and AA119 diode for IF amplification, demodulation and AGC. The audio section has a BC109 pre-amplifier and BC107 driving an AC127 and AC128 complementary output stage, which provides adequate power for the internal speaker.

CIRCUIT DETAILS

The telescopic aerial, or a **short** wire aerial, is connected to socket A2 Fig. 1, but longer indoor or outdoor aerials are plugged into socket A1, using the primary coupling winding of the aerial coil L1. This circuit is tuned by VC1 and the panel trimmer VC3 is provided so that this can be peaked for maximum efficiency with any aerial. Signals are taken to gate 1 of Tr1 and gate 2 is coupled by C7 to the oscillator Tr2. The oscillator coil L2 is tuned by the second section of the ganged capacitor VC1/VC2. VC4 is a bandspread tuning control to allow easy tuning on the short wave bands.



L1 and L2 are plug-in coils so there is no need to obtain coils for those bands which are not required. Band 1 is for long wave coverage and may not be wanted in some areas. The extreme high frequency end of this band is not used (above about 350kHz) as instability arises when this stage is tuned near the intermediate frequency, as would be expected.

Band 2 is for medium wave coverage while Band 3 includes shipping and other transmissions, as well as the 160m and 80m amateur bands. Most general short wave broadcasts come in Band 4 and also Band 5.

Capacitors C5 and C6 in Fig. 1 are padders and the correct value is brought into circuit for each coil when it is inserted, by wiring to the appropriate socket pins. TC1 is an integral trimmer on VC2. If VC1/2 is a type without trimmers a separate 30pF or similar small pre-set must be connected here.

Fig. 2 is the circuit of the IF amplifier. IFT1 and IFT2 are double tuned and IFT3 single tuned and these, with the two BFY195's, result in good selectivity and gain. The demodulator diode D1 provides audio signals for the volume control VR1, and automatic gain control bias for the first IF stage. Current for the IF stages is taken from the 9V supply, through R12, the mixer drain circuit being supplied through the primary of IFT1. The on-off switch S1 is incorporated with the volume control VR1.

The circuit of the audio stages is shown in Fig. 3. Tr5 is a low level high gain amplifier with output to the driver Tr6 which drives the NPN/PNP pair Tr7 and Tr8, R17 providing stabilisation of the DC operating conditions. The circuit is intended for an 18 ohm speaker but it will be found that good results are obtained with a 25 ohm or 35 ohm unit.

CONSTRUCTION

Both sides of the mixer/oscillator board are shown in Fig. 4. Plain perforated Veroboard is most suitable, with 0·15in matrix. The resistors and capacitors are inserted as shown and the board turned over and leads soldered underneath. In most places the wire ends of the components are long enough to reach other points. Soldered joints should be small and leads kept near the board, with sleeving on leads which may touch each other. The tag MC is later secured with a 6BA or 8BA bolt, to hold the board clear of the panel and to form a negative or earth return.

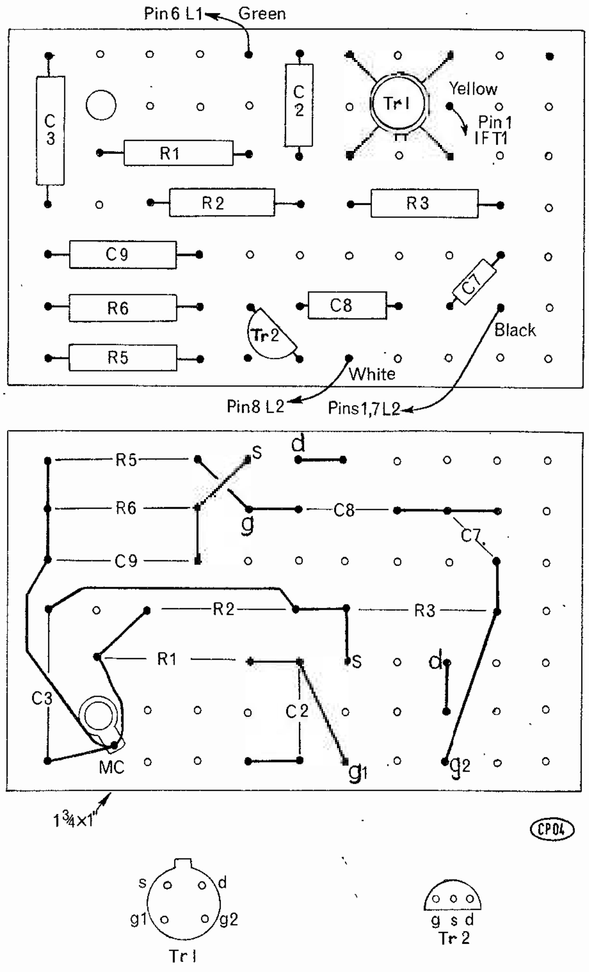


Fig. 4. Layout of the mixer/oscillator board. Veroboard pins can be used where necessary, if component leads are too short.

Important. An insulated gate transistor of the 3N141 type has an extremely high gate internal resistance and it can be destroyed by the static charge of metal or plastic tools, or by touching its leads with the fingers. Despite this, there is virtually no danger to the transistor if it is installed correctly and once R1, R2 and R3 are connected to it, these protect the gate circuits from static charges.

Leave Tr1 until other wiring on this board is finished. Tr1, as supplied, should have a thin spring or loop which short circuits its four leads, to protect it. This is not removed until the transistor is soldered in place. If it has to be unsoldered for any reason, a length of thin, clean wire should be wound round the four leads, under the transistor, before this is done. Spread the leads with a matchstick so that they come through the holes shown in Fig. 4, bend over the wires from R1, R2 and R3, and solder them to the transistor leads.

It is convenient to use colour coded leads for the external connections. These may be green from C2 for VC1 and pin 6 of L1, yellow for the drain circuit, white from Tr2 drain to pin 8 of L2 and black for VC2 and pins 1 and 7 of the holder for L2.

The IF board is shown in Fig. 5. Holes for the IFT pins and screening can tags should be drilled first. The pins are identified by their spacing, and should be arranged as in Fig. 5. A very small round file may be useful in adjusting the positions of holes, if drilling is not quite correct, so that the IFTs fit without strain on their pins. Holes should also be drilled so that the cores can be reached. Two small tags are secured with the bolts MC, which also fix two angle brackets in place. These brackets allow the board to be fixed to the receiver panel.

Note the polarity of C10, C12 and D1. Proceed with the wiring as for the mixer-oscillator board, with insulated sleeving where required. The wire ends of R12 and C14 can be left projecting, so that other connections can be soldered on later.

The AF amplifier board is built in a similar manner, components being positioned as in Fig. 6. As it is rather difficult to see the transistor lead positions when these are in place, short pieces of coloured sleeving may be put on these wires first. to identify them—green for emitter, blue for base and orange for collector.

Capacitors C16 and C20 are arranged vertically. Bolts secure the tags MC and small brackets, as with the IF board. If necessary, these brackets can be cut from a small spare section of flanged universal

★ components list

Resistors

R1	100kΩ	R8	47kΩ	R15	10kΩ
R2	2·2kΩ	R9	330kΩ	R16	220kΩ
R3	100kΩ	R10	390Ω	R17	270kΩ
R4	5·6kΩ	R11	27kΩ	R18	680Ω
R5	1MΩ	R12	1·5kΩ	R19	47Ω
R6	2·7kΩ	R13	2·2MΩ	R20	2·2Ω
R7	120kΩ	R14	1·5kΩ	R21	2·2Ω

All resistors 5% ¼ watt

VR1 10kΩ log. pot. with switch S1

Capacitors

C1	27pF	C8	100pF	C15	0·1μF
C2	100pF	C9	0·01μF	C16	100μF 10V
C3	0·01μF	C10	6μF 4V	C17	0·1μF
C4	0·047μF	C11	0·01μF	C18	0·002μF
C5	470pF	C12	200μF 10V	C19	220μF 6·4V
C6	150pF	C13	0·1μF	C20	100μF 10V
C7	5pF	C14	0·01μF		

VC1/2	208—176pF gang (Jackson 00)
VC3	50pF (Jackson C804)
VC4	4·5pF (Jackson C804)
TC1	30pF trimmer, see text

Semiconductors

Tr1	3N141	Tr4	BFY195	Tr7	AC127
Tr2	MPF102	Tr5	BC109	Tr8	AC128
Tr3	BFY195	Tr6	BC107	D1	AA119

Inductors

IFT1/2	IF Transformer (Denco IFT18/465)
IFT3	IF Transformer (Denco IFT14)
L1/2	Plug-in coils, 9 pin miniature **valve** type for ranges required (Denco—'Blue' for aerial coils and 'Red' for oscillator coils)

Miscellaneous

Speaker, about 2¼in dia., 18 to 35 ohms. Telescopic aerial. Small sockets (2). B9A valveholders, plain (2). Perforated veroboard 0·15in matrix, 1¾ x 1in, 3¼ x ⅝in and 2¼ x ⅝in. Knobs (4). Perspex for dial.

Casework Plates 7 x 5in (2) (CU168)
Flanged members 7 x 1in (2) (CU54A)
Flanged members 5 x 1in (2) (CU52A)
All from Home Radio.

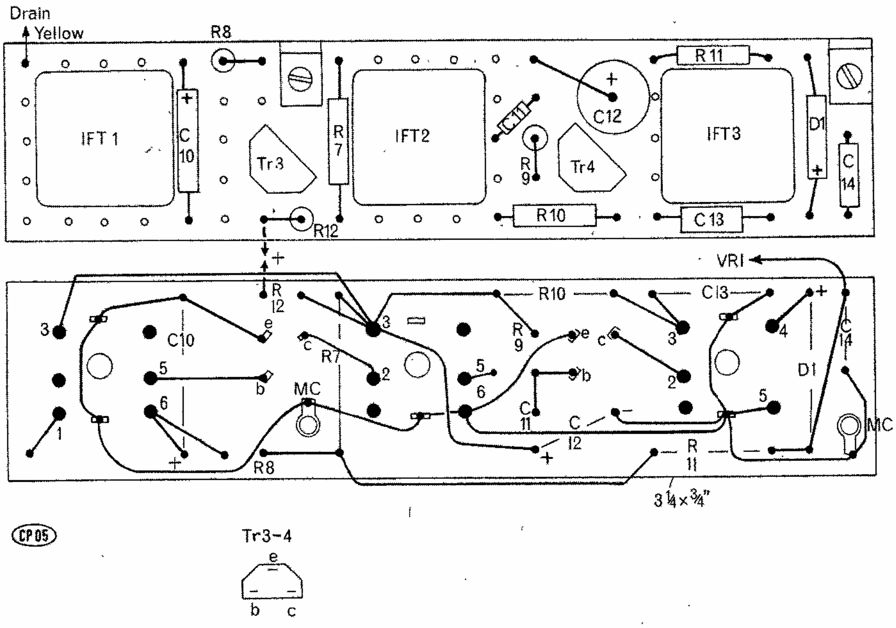


Fig. 5. Constructional details and layout of the two-stage IF amplifier strip and detector. Note holes in board below IFT's to permit lower core adjustments.

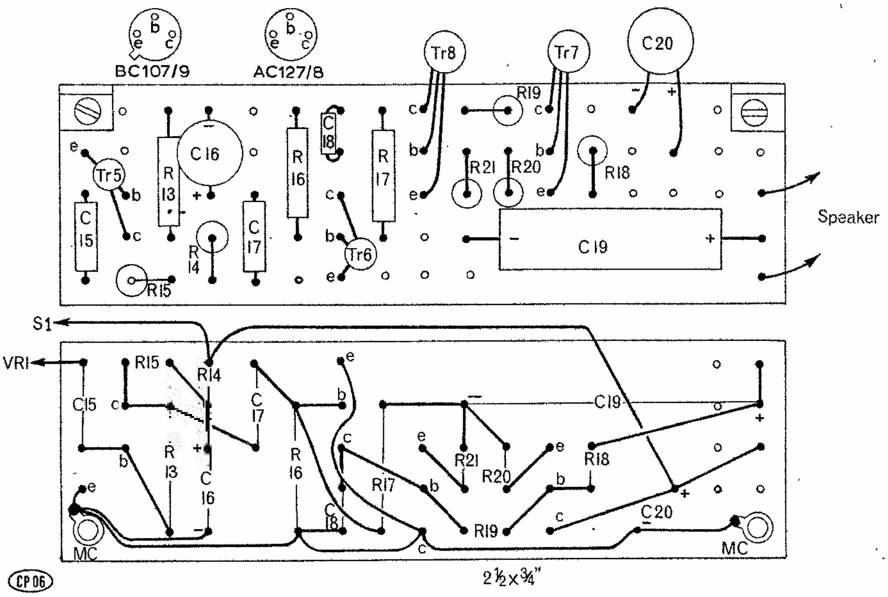


Fig. 6. This board comprises the audio stages. Observe correct polarity of electrolytic capacitors C16 and C19. Leads to Tr7 and Tr8 may be kept shorter than indicated above.

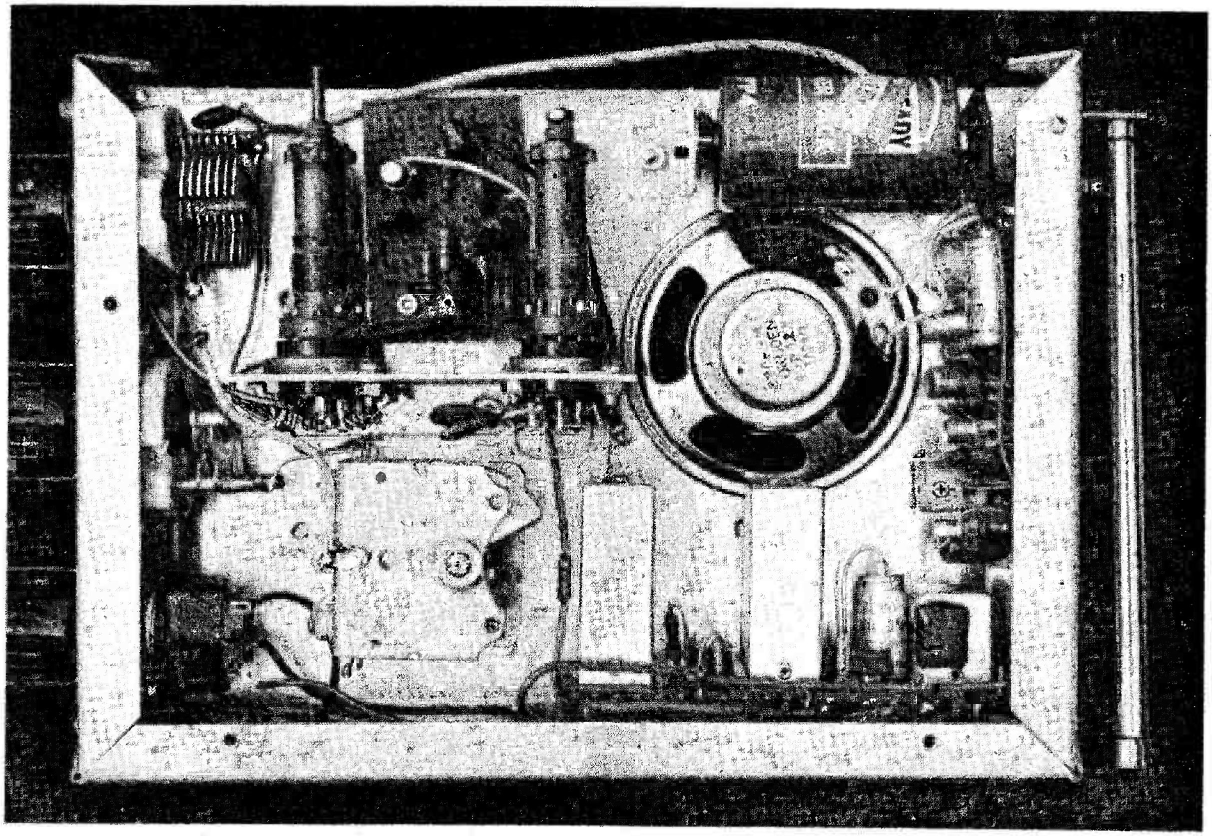
chassis, as used later for the coil holders. Both brackets and insulated board are drilled for 8BA bolts.

A piece of metal with a flange, for mounting the coil holders, is cut 2¾×1in so that the holders can be fitted as in Fig. 7. A small section is cut away near L2 as shown, to allow the speaker to fit.

The flange is bolted 1in. from the edge of the panel, as in Fig. 8. There is little free space so items should be positioned carefully. The flange is held with 6BA countersunk bolts and nuts. The ganged capacitor is held with three 4BA bolts, which must be cut or filed short so that they do not project beyond the thickness of the capacitor's front plate.

Wiring can then be completed as in the diagrams. The IF, AF and mixer-oscillator boards are held with 8BA countersunk bolts. The one 5×1in flanged runner is fixed with bolts or self-tapping screws so that VC3, VC4 and VR1 can be mounted, but the other flanged members are left off until later. Leads between units are run against the metal. The speaker is cemented over a 1¾in diameter hole and the leads soldered to it. Other connections will be seen in Figs. 7 and 8.

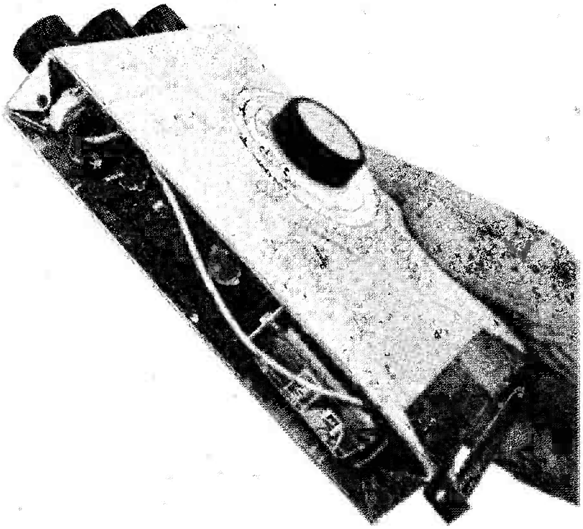
The battery is mounted by a bracket, to which a negative snap connector is bolted. This both holds the battery and provides the negative connection. Two small sockets provide A1 and Earth connections. When all wiring is finished, except for the telescopic aerial, the receiver can be aligned. Do not forget to remove the shorting collar or wire from the mixer transistor.



Inside the Slimline receiver. Main components may be identified from Fig. 8.

IF ALIGNMENT

As the IFT's are supplied pre-aligned, the cores should not be touched until reasonable results are being obtained. A properly fitting tool must be used, such as that available from the IFT maker, as a wedge-shaped blade may easily break the cores so that they cannot be rotated. Where a signal generator is available, place the output lead of this near the yellow lead (mixer drain) and adjust the cores for best output.



Removal of edge panel permits easy coil changing or replacement of battery.

If no generator is available turn the audio gain control to near maximum and tune in a weak but stable signal, such as that obtained from a local BBC transmitter, with no aerial at all in use. With this tuned in correctly, adjust the five cores slightly, as may prove to be necessary, for best volume. An alternative is to connect a high resistance test meter across VR1 (positive to chassis) and use a somewhat stronger signal, so that cores can be peaked for the best reading. When these cores have been adjusted, they should be left alone since their settings are not changed when dealing with the mixer and oscillator circuits.

MIXER/OSCILLATOR ALIGNMENT

If VC1/2 has trimmers, open fully the trimmer on VC1 and screw down the trimmer on VC2 and set VC3 and VC4 about half open. Each range is dealt with separately. Suppose that Range 3 is aligned first. Adjust the core of L2 (Red coil) so that band coverage is approximately correct. Then tune in a signal around 3·5 to 4·0MHz and adjust VC3 for best volume. Leave VC3 at this setting and tune to a signal around 1·9MHz. The core of L1 is then adjusted for best results, after which there is little need for much adjustment of VC3, throughout the band. When VC3 is peaked for best results, it should be neither fully closed nor fully open.

The other ranges are dealt with in the same manner. The cores of L2 are adjusted in that

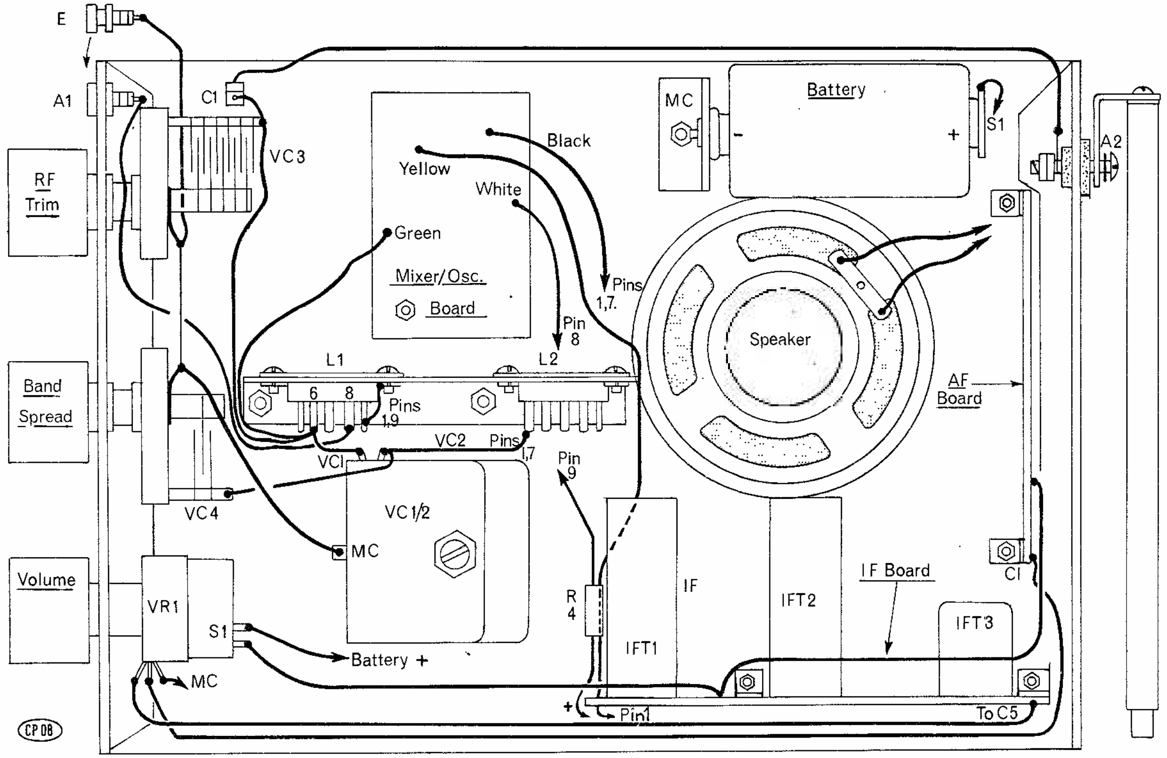


Fig. 8 Location of the three boards and major components. The battery is held in position by the bracket holding the negative clip.

direction which takes them away from the smaller winding for Ranges 1 and 3, otherwise continuous oscillation may prove troublesome at the high frequency end of these bands. This arises from the degree of coupling between L2 and its feedback winding. Should excess oscillation or "squegging" of the oscillator be troublesome, R4 could be increased in value. On the other hand, if Tr2 has somewhat reduced gain the value of R4 could be reduced. However, with the value shown, several MPF102 transistors proved satisfactory, so this should not be necessary.

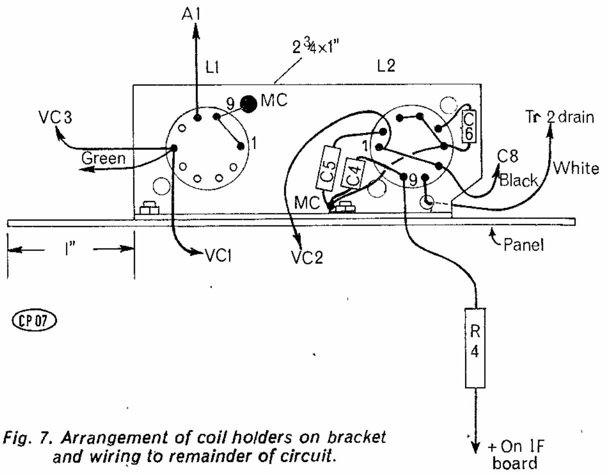


Fig. 7. Arrangement of coil holders on bracket and wiring to remainder of circuit.

FINISHING OFF

The aerial is fixed to a small right angle bracket which is pivoted on a 6BA bolt passing through the side of the case. The hole is drilled to take an insulated bush and an insulated washer rests between the bracket and case. A spring washer is placed under the screw head and the nuts locked together so that the aerial can be extended vertically with the case flat or standing upright. A flexible lead runs from the aerial to C1.

The dial is marked on card and is about 2¾in. in diameter. The control knob is a shallow type to which is attached a 2¾in. diameter disc of 1/16in. thick Perspex. This can be fixed with adhesive or self-tapping screws. A line is marked across the Perspex. A disc can be easily cut with an adjustable tank or washer cutter, but if this is not available a pointer knob could be substituted for the disc.

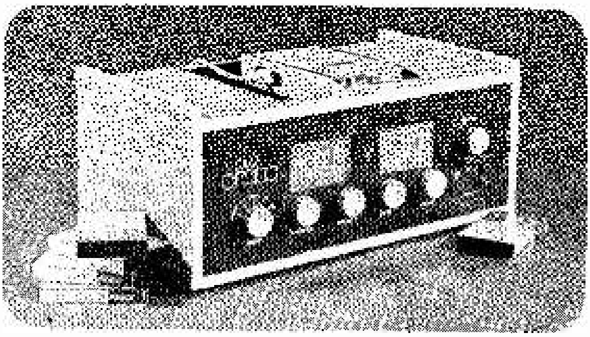
The case is completed by screwing on one 7×1in member and the remaining 5×1in member. The 5×1in members fit inside the 7×1in members so that the top 7×1in flanged member can be taken off to change the battery or coils. The back, a 7 × 5in flat plate, is permanently attached with self-tapping screws, but only one screw is run into the top member flanges.

There is some opportunity for individual choice in the way in which the case is finished. If left bare or painted, gauze or perforated metal should be fitted over the speaker aperture inside. The case shown was covered at the front with fabric and self-adhesive material as used for shelves, boxes, etc. ■

CASSETTE RECORDER AND TUNER AMPLIFIER

PART 2

RICHARD COLLIN



POWER AMPLIFIER ASSEMBLY

The first stage in assembly is to mount all components except the plastic power transistors onto the board, ensuring correct polarity of electrolytic capacitors. Solder each joint carefully—do not over heat the components, but make sure joints are properly made. Check that all parts are in the correct position and then cut off all excess lead wires. Note that R13 and C9 are mounted on the speaker sockets, not on the printed board.

Next fit the output and driver transistors onto their respective heat sinks ensuring that the mica washers and nylon bushes are correctly located. Check that each device is isolated from the heatsink after assembly. Then form the leads for insertion into the printed board. **Do not** bend the leads less than $\frac{1}{8}$in from the transistor body. **Do** support the leads near the body with long-nose pliers whilst forming. **Do not** radius the bends tighter than $\frac{1}{16}$in.

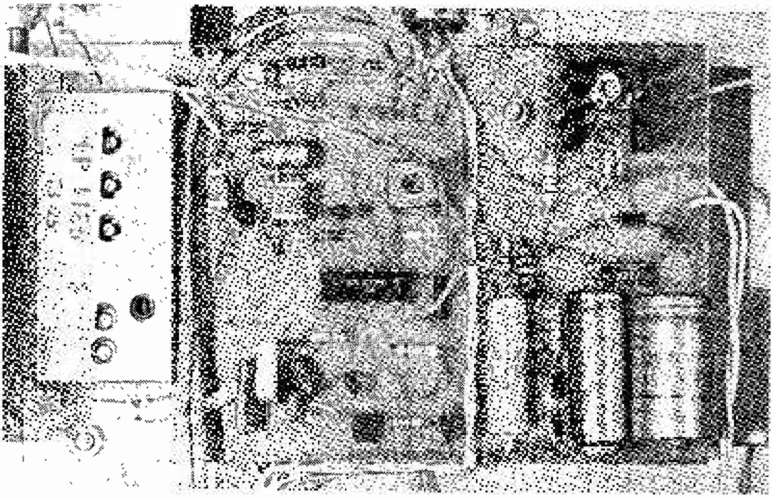
Mount the strip of four output devices onto the circuit board and solder up the connections. Then mount the two driver transistors in a similar fashion. Once soldered ensure that the power transistors are not bent back and forth on their leads—plastic packaged devices can be easily damaged by stressing the lead outs. Once complete the power board should be put away safely until needed later on.

TUNER AND IF CIRCUIT (UNIT 3)

The AM section utilises the Ferranti ZN414 integrated circuit IC1 and a single transistor amplifier Tr1. A small ferrite rod aerial forms part of a double-tuned aerial circuit which is used to eliminate swamping effects of strong local transmissions by improving the selectivity. The circuit and printed board illustrated are for the single-station version. Further channels may be added by inserting a suitable two-pole rotary switch at the points marked "X" and "Y" in Fig. 10 to select additional pairs of trimmer capacitors for each station required.

The ferrite aerial may be insufficient in some areas of poor signal strength. The AM aerial socket, which is loosely coupled to the ferrite rod by two turns of insulated wire, allows adequate reception under such conditions by connection of an external aerial.

In the FM section, a Mullard varicap tuned module type LP1186 feeds an RCA IF amplifier integrated circuit IC2 through a ceramic filter tuned to 10·7 MHz. This integrated circuit requires only one IF coil to provide the audio output for the decoder and also an AFC control voltage.



The prototype Tuner and IF board shown here has some variations in layout from the final version given in Fig. 12

continued on page 1176

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7409	29p	24p
7410	20p	18p
7411	23p	21p
7412	40p	33p
7413	31p	29p
7416	49p	47p
7417	57p	53p
7420	20p	18p
7422	60p	58p
7423	60p	58p
7425	60p	53p
7426	35p	31p
7427	55p	51p
7428	85p	79p
7430	20p	18p
7432	42p	33p
7433	97p	91p
7437	77p	74p
7438	77p	74p
7440	20p	18p
7441	81p	78p
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7444	£1·57	£1·52
7445	£2·31	£2·18
7446	£2·31	£2·18
7447	£1·48	£1·37
7448	£1·98	£1·81
7450	20p	16p
7451	20p	19p
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7454	20p	18p
7460	20p	18p
7470	33p	27p
7472	33p	30p
7473	46p	42p
7474	44p	40p
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7480	£1·10	99p
7481	£1·37	£1·26
7482	£1·10	99p
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7484	£1·32	£1·21
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7486	49p	41p
7489	£4·95	£4·29
7490	82p	71p
7492	84p	65p
7493	82p	66p
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74105	£1·18	£1·14
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74111	£1·52	£1·40
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74121	47p	42p
74122	£1·70	£1·59
74123	£3·35	£3·28
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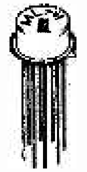
74156	£1·65	£1·21
74157	£1·54	£1·43
74160	£2·18	£2·05
74161	£2·18	£2·05
74162	£4·84	£4·54
74163	£4·84	£4·54
74164	£2·73	£2·63
74165	£2·73	£2·63
74166	£4·28	£3·94
74174	£2·78	£2·66
74175	£1·94	£1·81
74176	£1·99	£1·87
74177	£2·75	£2·64
74180	£2·75	£2·64
74181	£6·49	£6·05
74182	£2·16	£2·02
74184	£2·69	£2·42
74190	£3·08	£2·69
74191	£2·30	£2·24
74192	£2·53	£2·30
74193	£2·53	£2·30
74194	£3·27	£3·15
74195	£2·42	£2·30
74196	£2·18	£2·06
74197	£2·18	£2·06
74198	£6·65	£6·05
74199	£6·65	£6·05
74200	£26·40	£21·12

Linear Integrated Circuits

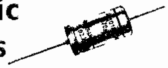
301	DIL	50p
301	TO99	55p
301	8 PIN DIL	46p
301A	DIL	69p
301A	TO99	69p
301A	8 PIN DIL	66p
307	DIL	69p
307	TO99	69p
307	8 PIN DIL	66p
308	TO99	6·45p
308A	TO99	6·40p
709c	DIL	35p
709c	TO99	31p
723c	DIL	99p
723c	TO99	95p
741c	8 PIN DIL	38p
741c	14 PIN DIL	39p
741c	TO99	41p
747c	DIL	46p
748c	DIL	39p
748c	TO99	41p

THE FERRANTI RADIO IC

ZN414 £1·32



Electrolytic Capacitors



4 VOLT

47µF	6½p
100µF	6½p
220µF	6½p
330µF	6½p
1000µF	13p
4700µF	29p

6·3 VOLT

33µF	6½p
68µF	6½p
150µF	6½p
470µF	11p
680µF	13p
1500µF	18p
2200µF	18p
3300µF	26p

10 VOLT

22µF	6½p
47µF	6½p
100µF	6½p
220µF	8p
330µF	10p
470µF	10p
1000µF	11p
1500µF	20p
2200µF	24p

16 VOLT

15µF	6½p
33µF	6½p
150µF	6½p
150µF	8p
220µF	9p
680µF	17p
1000µF	17p
1500µF	25p
2000µF	43p

25 VOLT

10µF	6½p
22µF	6½p
47µF	6½p
100µF	8p
150µF	8p
220µF	10p
470µF	13p
680µF	20p
1000µF	22p
2200µF	39p
5000µF	68p

40 VOLT

6·8µF	6½p
15µF	6½p
33µF	6½p

40 VOLT

47µF	6½p
100µF	9p
68µF	10p
220µF	11p
470µF	19p
680µF	25p
1000µF	25p
2200µF	44p

63 VOLT

1µF	6½p
2·2µF	6½p
4·7µF	6½p
6·8µF	6½p
10µF	6½p
22µF	6½p
68µF	10p
100µF	11p
150µF	13p
220µF	19p
330µF	22p
470µF	26p
1000µF	44p

VOLUME CONTROLS
Potentiometers

Carbon track 500 Ω to 2·2M Ω. Log or Linear. Single **13p**. Dual gang (stereo) **44p**. Single type with D.P. switch **13p** extra.

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—2·5 watt **6½p** each

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P.I.V.	50	100	200
1 Amp	28p	35p	41p
3 Amps	44p	50p	60p
P.I.V.		300	400
1 Amp		44p	53p
3 Amps		—	60p

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Mullard Polyester Capacitors

C280 SERIES

250V P.C. mounting: 0·01µF, 0·015, 0·022 **3½p**. 0·033, 0·047, 0·068 **4p**. 0·1 **4½p**. 0·15, 0·22 **5½p**. 0·33 **7p**. 0·47 **9½p**. 0·68 **12p**. 1µF **14p**. 1·5µF **22p**. 2·2µF **27p**.

C296 SERIES

400V: 0·001µF, 0·0015, 0·0022, 0·0033, 0·0047 **3p**. 0·0068, 0·01, 0·015, 0·022, 0·033 **3½p**. 0·047, 0·068, 0·1 **4½p**. 0·15 **6½p**. 0·22 **8½p**. 0·33 **12p**. 0·47 **14½p**.

160V: 0·01µF, 0·015, 0·022, 0·033, 0·047, 0·068 **3½p**. 0·1 **4p**. 0·15 **4p**. 0·1 **4½p**. 0·15, 0·22 **5½p**. 0·33 **7p**. 0·47 **9½p**. 0·68 **12p**. 1µF **14½p**. 1·5µF **22p**. 2·2µF **24p**

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UK300 Four Channel Radio Control transmitter	£6·55
UK310 Radio Control Receiver	£3·28
UK325 'GXC2' Channel Splitting Unit. 1000 & 2000 Hz	£7·85
UK330 'GXC2' Channel Splitting Unit. 1500 & 2500 Hz	£7·86
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UK515 MW Radio Receiver	£7·86
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Spot face cutter	46p	46p
Pk 36 Pins	20p	20p

Resistors

¼ watt 5% carbon	1p
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1 watt 10% carbon	2½p

range 10 ohms to 4·7 megohms.

½ watt m/o 2 %	4p

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				P/P
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MT71	12 volt	2 amp	£1·76	22p
MT71/B	24 volt	1 amp	£1·76	22p
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MT18/B	24 volt	2 amp	£2·47	36p

30 volt transformers

Prim 200–220–240v. Secondary voltage. 12 15, 20, 24, 30v or 12–0–12v or 15–0–15v.

MT112	·5 amps	£1·32	22p
MT79	1	£1·80	36p
MT 3	2	£2·96	36p
MT20	3	£3·30	42p
MT51	5	£4 84	49p

50 volt transformers

Prim 200–220–240v, Secondary volt. 19, 25,33, 40, 50v or 25–0–25 volt.

MT102	·5 amps	£1·76	30p
MT103	1	£2·58	38p
MT105	3	£4·84	52p
MT106	4	£6·02	52p

60 volt transformer

Prim 200–220–240 Secondary 24, 30, 40, 48, 60v or 24-0–24v or 30–0–30v

MT124AT	·5 amp	£1·76	38p
MT126AT	1	£2·47	34p
MT127	2	£3·90	44p

Miniature transformers

Prim 220 volt

BT606	100mA	6–0–6v	98p	15p
BT909	100mA	9–0–9v	98p	15p
BT12012	100mA	12–0–12v	£1·08	15p
BT24024	100mA	24–0–24v	£1·95	15p

Transistors/ Diodes

AC107	16p
AC126	14p
AC127	13p
AC128	13p
AC142K	22p
AC141K	20p
AC176	15p
AC187	18p
AC187K	20p
AC188	18p
AC188K	20p
ACY17	24p
ACY18	21p
ACY19	25p
ACY20	22p
ACY21	23p
ACY22	18p
ACY39	68p
AD140	40p
AD142	44p
AD143	39p
AD149	38p
AD150	60p
AD161	38p
AD162	38p
AF114	18p
AF115	18p
AF116	18p
AF117	18p
AF118	92p
AF124	27p
AF139	39p
AF239	41p
AL100	77p
AL102	66p
AL103	55p
BC107	11p
BC108	11p
BC109	11p
BC113	15½p
BC116	16p
BC125	18p
BC126	25p
BC132	16p
BC134	16p
BC135	16p
BC137	16p
BC138	36p
BC142	33p
BC143	33p
BC144	30p
BC145	26p
BC147	9p
BC148	9p
BC149	9p
BC153	16p
BC154	17p
BC157	13p
BC158	12p
BC159	14p
BC167	13p
BC168	11p
BC169	11p
BC177	15p
BC179	15p
BC182L	10p
BC183L	11p
BC184L	11p
BC186	33p
BC212L	11p
BC213L	11p
BC214L	11p
BC258	9p
BC259	9p
BC267	14p
BC268	15p
BC300	40p
BC301	32p
BC302	30p
BC303	50p
BC304	40p
BCY70	17p
BCY71	37p
BCY72	17p
BD131	68p
BD132	90p
BD135	42p
BD136	50p
BD141	£1·87
BD142	50p
BF159	33p
BF173	29p
BF177	28p
BF178	29p
BF179	35p
BF194	15p
BF195	17p
BF244	27p
BF260	29p
BF329	18p
BF330	18p
BF390	37p
BFX84	28p
BFX85	35p
BFX86	22p
BFX87	28p
BFX88	26p
BFY50	21p
BFY51	17p
BFY52	17p
BFY64	39p
BFY90	72p
BSX20	19p
C407	22p
C426	33p
C428	31p
C450	17p
MP8111	35p
MP8112	42p
MP8113	35p
MP8121	33p
MP8122	44p
MP8123	50p
NKT211	28p
NKT212	28p
NKT214	25p
NKT217	55p
NKT261	23p
NKT271	20p
NKT274	20p
NKT275	25p
NKT403	71p
NKT405	83p
NKY603F	66p
NKT613G	33p
NKT674	26p
NKT677G	24p
NKT713	32p
NKT773	27p
OC19	55p
OC20	55p
OC23	49p
OC25	45p
OC28	50p
OC29	50p
OC35	50p
OC36	50p
OC44	14p
OC45	14p
OC70	23p
OC71	14p
OC72	14p
OC81	14p
OC83	22p
OC84	28p
TIP29A	53p
TIP30A	64p
TIP31A	64p
TIP32A	73p
TIP33	£1·05
TIP34A	£1·54
TIP35A	£2·53
TIP36A	£3·19
TIP41A	79p
TIP42A	91p
2N706	13p
2N930	23p
2N1131	22p
2N1132	28p
2N1613	22p
2N1711	26p
2N2904	40p
2N2904A	44p
2N2905	46p
2N2924	18p
2N2926	10p
2N3053	26p
2N3054	55p
2N3055	52p
2N3702	11p
2N3703	11p
2N3704	11p
2N3705	11p
2N3706	11p
2N3707	11p
2N3708	11p
2N3709	11p
2N3710	11p
2N3711	9p
2N3794	17p
2N3819	28p
40361	50p
40362	50p
40636	50p

Diodes & Rectifiers

1N914	8p
1N916	8p
1N4148	8p
1S44	10p
1N4007	22p
1S113	17p
BA100	16p
BA102	25p
BA115	8p
BA144	14p
BA145	22p
BA154	14p
BAX13	14p
BAX16	14p
BAY18	19p
BAY31	9p
BY100	19p
BY126	16p
BY127	19p
BYX10	24p
OA5	19p
OA10	24p
OA47	9p
OA70	8p
OA73	11p
OA79	8p
OA81	9p
OA85	11p
OA90	8p
OA91	8p
OA95	8p
OA200	11p

CRATA—continued from page 1174

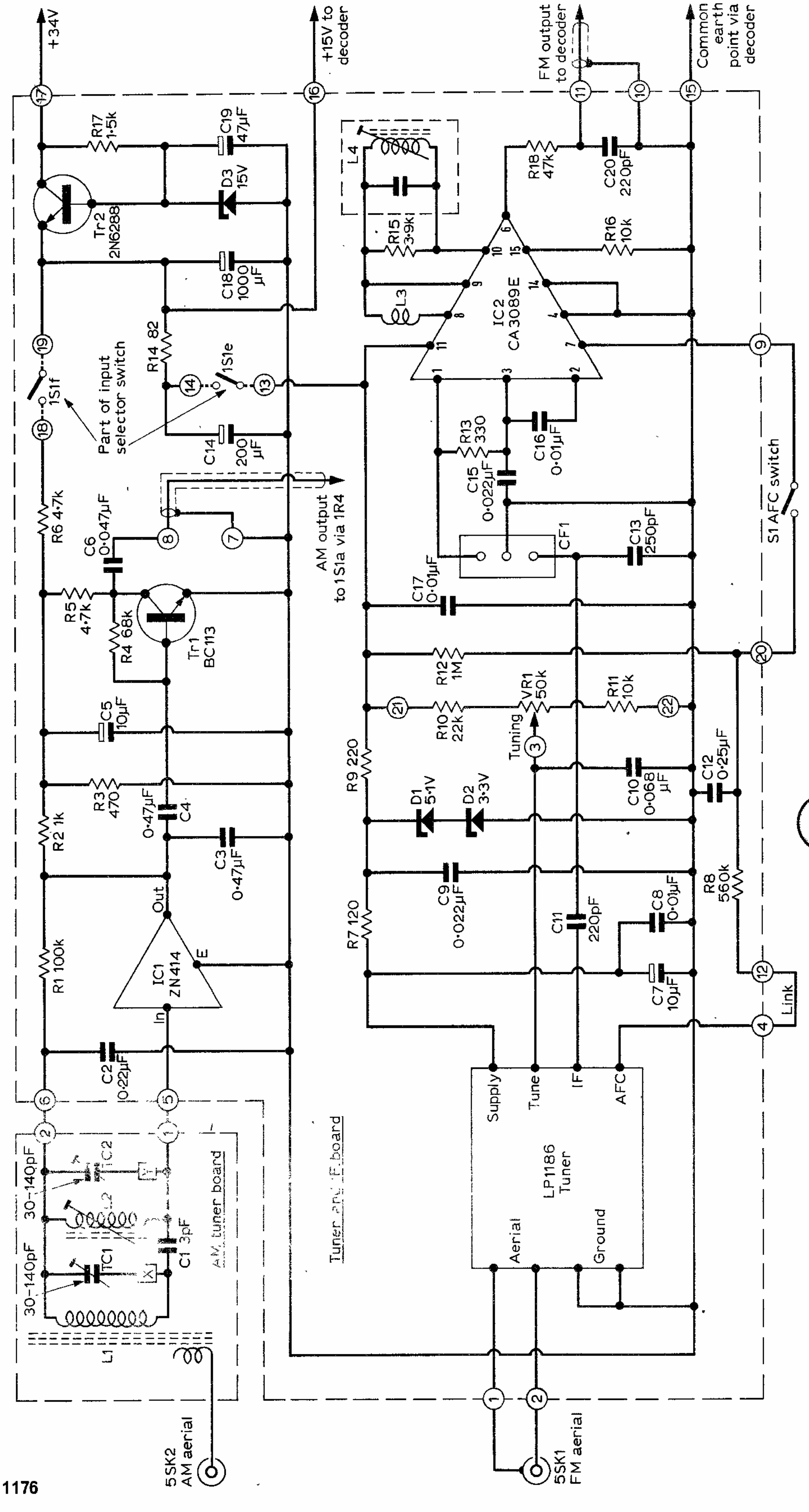


Fig. 10: Circuit of the Tuner and IF section, including the separate AM Tuner Board.

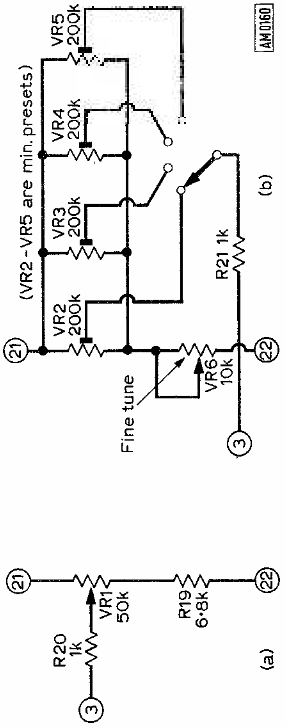


Fig. 11: Circuits of the alternative VHF tuning control arrangements described in the text:—
(a) Full Band II coverage
(b) Four-station preselected tuning.

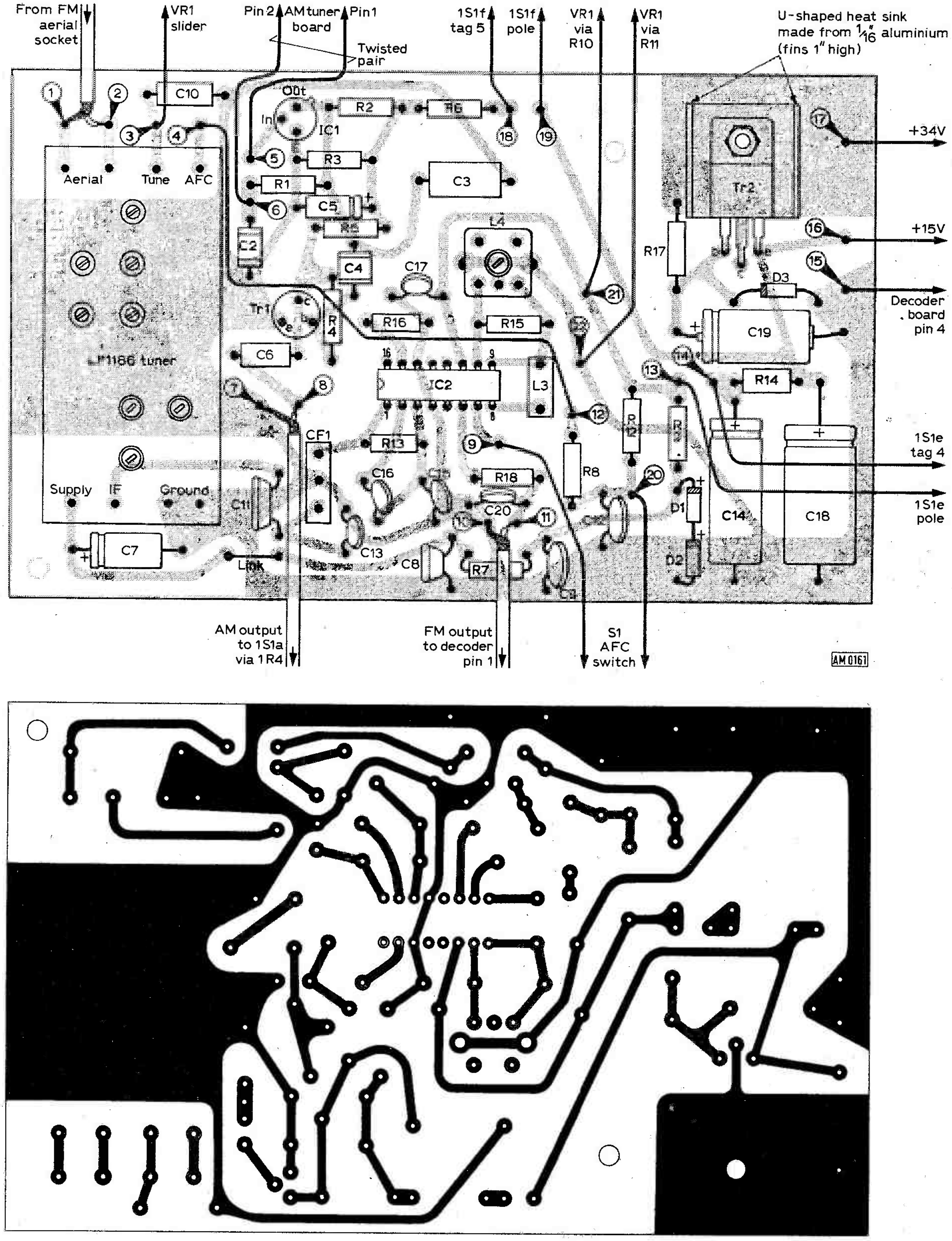


Fig. 12: Component location and printed circuit layout for the main Tuner and IF board. Both drawings are actual size.

★ components list

TUNER & IF BOARDS

Resistors

R1	100kΩ	R11	10kΩ
R2	1kΩ	R12	1MΩ
R3	470Ω	R13	330Ω
R4	68kΩ	R14	82Ω
R5	4·7kΩ	R15	3·9kΩ
R6	4·7kΩ	R16	10kΩ
R7	120Ω	R17	1·5kΩ
R8	560kΩ	R18	47kΩ
R9	220Ω		
R10	22kΩ	VR1	50kΩ lin

Note—The alternative VHF tuning arrangements require the following changes in components.

(1) Full range continuous tuning (Fig. 11a)
Delete R10 and R11 above and add
R19 6·8kΩ R20 1kΩ

(2) Preselected tuning (Fig. 11b)
Delete R10, R11 and VR1 above and add
R21 1kΩ VR2–VR5 each 200kΩ min. preset
VR6 10kΩ lin

All fixed resistors ¼W 5% carbon film

Capacitors

C1	3pF ceramic	C11	220pF ceramic
C2	0·22μF ceramic	C12	0·25μF ceramic
C3	0·47μF polyester	C13	250pF ceramic
C4	0·47μF polyester	C14	200μF 25V
C5	10μF 16V	C15	0·022μF polyester
C6	0·047μF polyester	C16	0·01μF polyester
C7	10μF 16V	C17	0·01μF polyester
C8	0·01μF polyester	C18	1000μF 16V
C9	0·022μF polyester	C19	47μF 16V
C10	0·068μF polyester	C20	220pF ceramic
TC1	30–140pF compression trimmer		
TC2	30–140pF compression trimmer		

Semiconductors

Tr1	BC113	IC1	ZN414 (Ferranti)
Tr2	2N6288 (RCA)	IC2	CA3089 E (RCA)
D1	BZY88 C5V1	D2	BZY88 C3V3
D3	BZY88 C15		

Miscellaneous

L1	55 turns of 30swg enamelled copper wire on 2¼″ x $\frac{5}{16}$″ dia. ferrite rod
L2	Single-tuned Medium Wave coil
L3	RF Choke 15μH Toko 7BA 150J
L4	Toko KACS-K586-HM
CF1	Crystal filter Vernitron FM4 or Toko CFS10·7
S1	SPST min. toggle switch

FM tuning head Mullard LP1186
Tuning drive drum 1¼″ dia.
Slow-motion cord drive spindle
Cord tension spring ½″
3 small nylon pulleys
Printed circuit boards

Notes

1. RCA semiconductors are available from E.C.S. (Windsor) Ltd. (see Part 1 of this project).
2. Toko components are available from Ambit International.

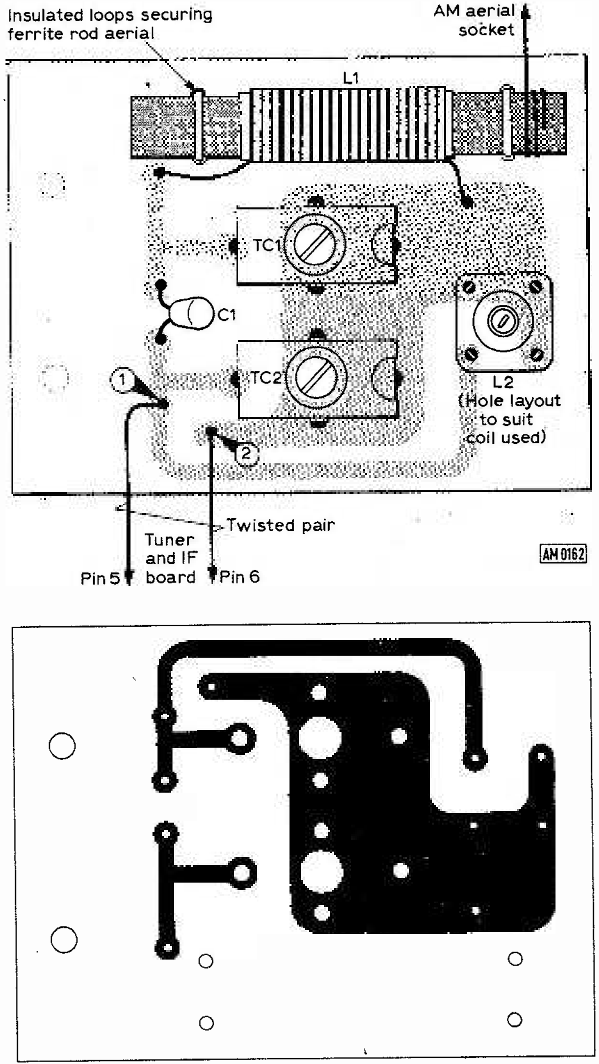


Fig. 13: Location of components and actual size layout for the AM Tuner Board.

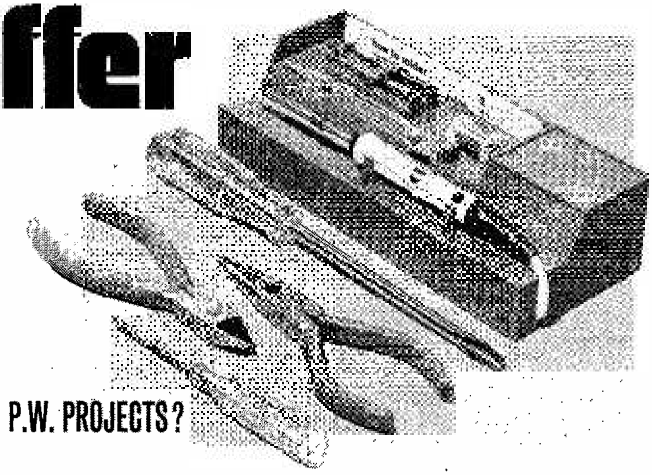
The values given for the tuning control circuit allow coverage of 88-100 MHz. A restricted coverage has the advantage of making the tuning finer and spaces the stations farther apart. The alternative circuit of Fig. 11a provides coverage of the full band 88-104 MHz whilst a four-station preselected tuning arrangement is given in Fig. 11b.

Four power supplies are derived from the main 34V rail through a series stabiliser transistor Tr2 and various filter networks.

1. The decoder 15V supply is taken direct from the stabiliser and decoupled via C18.
2. The AM tuner 1·5V supply is provided by a resistive potential divider across the 15V supply R3/R6. Decoupling is provided by capacitor C5.
3. The FM IF and tuner varicap supply is taken from the 15V supply via R14 and decoupled by C14/C17. This supply is 12V.
4. The FM tuner 8V supply is provided from the 12V supply by R9, D1/D2 and R7. Decoupling is provided by C7, C8 and C9.

When assembling the printed board care must be taken not to overheat the integrated circuit pins and also not to short-circuit the adjacent connections as they are fairly close together. Ensure that all electrolytics and diodes are polarised correctly and that the ZN414 leads are correctly positioned. The ceramic filter CF1 may be mounted any way round—the centre pin is earthed and either of the other two pins may be input or output. The series stabiliser transistor Tr2 does not require isolation from either its heatsink or the copper print on the board.

Special Offer tool kit



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This kit comprises the tools for doing most of the constructional projects that we publish and others too! In it you will find:

Wire cutters with insulated handles;

Long-nose wiring pliers with stripping and cutting blades and insulated handles;

Small insulated handle screwdriver with neon mains tester;

Large insulated handle screwdriver;

Soldering iron kit containing 15 watt soldering iron with $\frac{3}{16}$" bit, two spare bits $\frac{5}{32}$" and $\frac{3}{32}$", heat shunt clip, stand, solder and instruction booklet "How To Solder".

The normal total recommended retail value of these tools is **£6**. This kit is supplied to readers of Practical Wireless at the special price of **£3·70** (inc. V.A.T.).

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CRATA—continued

The AFC switch is mounted on the tuner back panel near the aerial sockets—it may be sited on the front panel if required, but do not locate it near to the mains neon and switch.

The AM aerial board, Fig. 13, on which the ferrite rod is mounted should ideally be mounted such that it can be rotated through 90° for maximum signal pickup. Alternatively it may be rigidly mounted in the correct position if the tuner will always be sited in one particular place. The leads between the printed board and the rotary switch in the multi-station version should be kept very short. A suitable position for the switch is immediately above the Input Selector.

Due to pressure on editorial space, details of the Stereo Decoder have been held over until our May issue which will also describe the Power Unit and Chassis.

Oscilloscope techniques

PART 2

ALAN AINSLIE

OSCILLOSCOPE DISPLAYS

The very heart of any oscilloscope is the cathode ray display tube. After all the electronic functions have been executed the ultimate result is displayed, visibly, on the face of the tube. We shall take a look at a few types of CRT and their associated circuitry as applied to oscilloscopes.

The electron beam, produced by an electron gun, passes through a deflecting mechanism and arrives at the screen where it causes the screen material to fluoresce. The whole mechanism is housed in an evacuated glass container and, in an oscilloscope, only the front face is visible. Fig. 1 shows the general arrangement. For oscillographic use we require a bright spot of light, intense but very small.

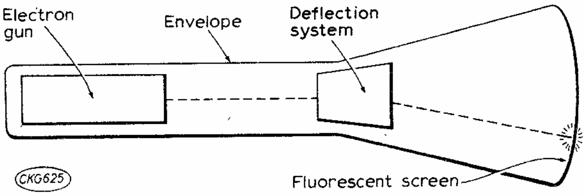

Fig. 1: Main elements in a CRT intended for use in an oscilloscope.

It is the purpose of the electron gun to produce the narrow stream of electrons of high energy to cause local luminescense of the screen. When the beam hits the phosphor screen it causes fluorescence. However, if the beam is cut off suddenly the screen continues to glow with phosphorescent light. It is this phosphorescent light that determines the afterglow of the tube.

ELECTRON GUN

A hot cathode on the axis of the tube produces electrons by thermionic emission, as in a conventional electronic valve. By a suitable arrangement of anodes an electric field distribution inside the tube is created focusing the electrons into a high velocity pencil, arranged to converge on to the screen. A simple gun arrangement is shown in Fig. 2 This type of arrangement is often used and is known as a pentode or five electrode gun.

The cathode is heated to emissive temperature and is surrounded by the grid, in this case shaped like a top hat with a hole in it, known as a Wehnelt cylinder. The grid is maintained slightly negative with respect to the cathode and focuses the space charge around the cathode along the axis of the gun.

The first anode (A1) is positive with respect to the cathode by perhaps a couple of hundred volts. Fig. 3 shows how the electrons are accelerated out of the grid area towards the first anode, and in so doing are focused at Z by the equipotential lines, shown dotted. The diameter at Z is used as an "image" and consequently should be as small as possible for a small spot on the screen. The electron beam enters the first anode diverging and a number of stops are added to keep the beam width small and keep out fringe electrons which impair definition. The diverging electron beam emerging from the first anode now needs to be focused on to the screen, or put another way, an image of Z is projected on to the screen.

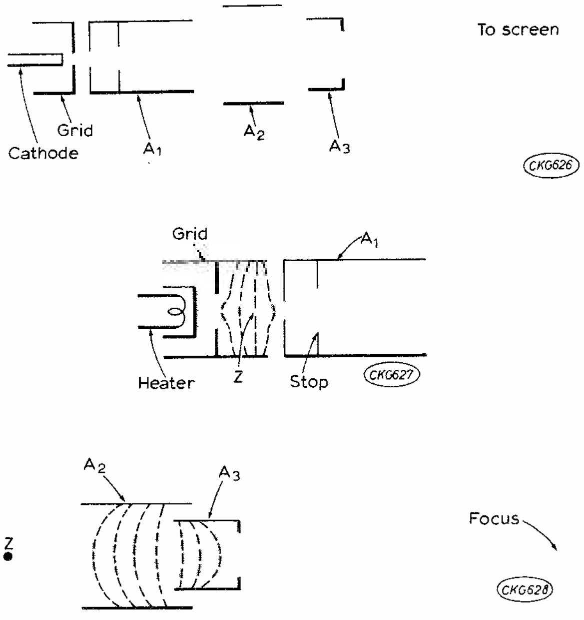

Fig. 2: top, arrangement of electrodes used in a pentode gun. Fig. 3, centre, shows the beam focusing action of the grid and A1. Fig. 4, bottom, the effect of the remaining anodes A2 and A3 in focusing the beam on to the screen.

Fig. 4 shows how the second (A2) and third (A3) anodes accomplish this focusing. The second anode is at a higher potential than A1, and A3, the final anode, is at a still higher potential. Thus the equipotential lines are as shown dotted. The beam of electrons now converges as it crosses the A2-A3 fields and by adjustment of the voltage between A2 and A3 the beam can be focused on the screen of the CRT.

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½	2%	10 Ω–1M Ω	E24	3·5p	3p
⅛	10%	1 Ω–3·9 Ω	E12	1p	0·8p
⅛	5%	4·7 Ω–1M Ω	E12	1p	0·8p
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POTENTIOMETERS

Carbon track 5k Ω to 2M Ω, log or linear (log ¼W, lin ½W).
Single, **12p.** Dual gang (stereo), **40p.** Single D.P. switch, **24p.**

SKELETON PRESET POTENTIOMETERS

Linear: 100, 250, 500 Ω and decades to 5M Ω. Horizontal or vertical P.C. mounting (0·1 matrix).
Sub-miniature 0·1W, **5p** each. Miniature 0·25W, **7p** each.

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AC126	12p	AF139	32p	BF173	20p	OC44	12p	2N3708	10p
AC127	15p	AF178	32p	BF177	28p	OC45	12p	2N3709	11p
AC128	15p	AF180	40p	BF178	32p	OC70	12p	2N3710	11p
AC131	12p	AF181	40p	BF179	32p	OC71	12p	2N3711	11p
AC132	12p	BC107	12p	BF180	32p	OC72	12p	2N3819	32p
AC176	15p	BC108	12p	BF181	32p	OC81	12p	2N4062	12p
AC187	22p	BC109	12p	BF194	14p	OC82D	12p	2N4286	20p
AC188	22p	BC147	12p	BF195	14p	2N2646	60p	2N4289	20p
AD140	50p	BC148	12p	BF197	15p	2N2904	20p	40360	35p
AD149	45p	BC149	12p	BF200	32p	2N2926	10p	40361	35p
AD161	33p	BC157	14p	BFY50	20p	2N3054	58p	40362	40p
AD162	36p	BC158	14p	BFY51	20p	2N3055	60p	40408	40p
AF114	20p	BC159	14p	BFY52	20p	2N3702	13p	ZTX108	15p
AF115	20p	BC187	22p	BUY105	225p	2N3703	12p	ZTX300	15p
AF116	20p	BD131	75p	OC26	45p	2N3704	13p	ZTX302	20p
AF117	20p	BD132	75p	OC28	50p	2N3705	12p	ZTX500	15p
AF118	38p	BD133	75p	OC35	50p	2N3706	11p	ZXT503	20p

ZENER DIODES

400mW 5% 3·3V to 30V, **12p.**

WIRE WOUND POTS. 3W, 10, 25, 50 Ω and decades to 100k Ω, **35p.**

DIODES

RECTIFIER

BY127	1250V	1A	12p
1N4001	50V	1A	7p
1N4002	100V	1A	8p
1N4004	400V	1A	8p
1N4006	800V	1A	10p
1N4007	1000V	1A	10p

SIGNAL

OA85	7p
OA90	5p
OA91	5p
OA202	7p
1N4148	5p
BA114	8p

SLIDER POTENTIOMETERS

86mm x 9mm x 16mm, length of track 59mm.

SINGLE 10K, 25K, 100K log. or lin. **40p.**

DUAL GANG, 10K + 10K etc. log. or lin. **60p.**

KNOB FOR ABOVE, **12p.**

FRONT PANEL, **65p.**

18 Gauge panel 12in x 4in with slots cut for use with slider pots. Grey or matt black finish complete with fixings for 4 pots.

BRUSHED ALUMINIUM PANELS

12in x 6in, **25p**
12 in x 2½in, **10p**
9in x 2in, **7p**

THYRISTORS

2N5060	50V	0·8A	30p
2N5064	200V	0·8A	47p
106F	50V	4A	40p
106D	400V	4A	55p

ALUMINIUM BOXES

AB7	2¾" x 5½" x 1½"	50p	AB14	7" x 5" x 2½"	84p
AB8	4" x 4" x 1½"	50p	AB15	8" x 6" x 3"	108p
AB9	4" x 2¾" x 1½"	50p	AB16	10" x 7" x 3"	122p
AB10	4" x 5¼" x 1½"	50p	AB17	10" x 4½" x 3"	108p
AB11	4" x 2½" x 2"	60p	AB18	12" x 5" x 3"	120p
AB12	3" x 2" x 1"	44p	AB19	12" x 8" x 3"	160p

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2W	24p	4W	45p	TO5	Clip	5p	TO1	Single	5p
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160V: 0·01µF, 0·015µF, 0·022µF, 0·033µF, 0·047µF, 0·068µF, **3p.** 0·1µF, **3½p.** 0·15µF, **4½p.** 0·22µF, **5p.** 0·33µF, **6p.** 0·47µF, **7½p.** 0·68µF, **11p.** 1·0µF, **13p.**

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1·0µF	35V	10µF	25V	100µF	3V

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17 x 5 (plain)	—	82p
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12V × 2 3A × 2	MT70AT	£3·95
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12V × 2 5A × 2	MT 72AT	£5·28

30 Volts. All tapped at 0-12-15-20-30V.

Output Amps.	Ref. No.	Price	Output Amps.	Ref. No.	Price
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1A	MT79CT‡	£2·51	5A	MT51AT	£6·10
2A	MT 3AT	£3·77	8A	MT88AT	£9·88
3A	MT20AT	£4·31	10A	MT89AT	£11·97

50 Volts. All tapped at 0-19-25-33-40-50V

500mA	MT102AT‡	£2·36	3A	MT105AT	£6·34
1A	MT103AT‡	£3·50	4A	MT106AT	£8·02
2A	MT104AT	£4·74	5A	MT107AT	£11·51

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400V. Output at 50HZ.

C-D Ignition System by R. M. Marston, Esq., Wireless World.
Reference IT3AT £4·26

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AT indicates open universal fixing with tags; CT is open U-clamp fixing with tags; CS is open U-clamp fixing with P.C. spills; * with interwinding screen; † untapped 240 primary; ‡ tapped at 210-240V.; other primaries tapped at 200-220-240V.

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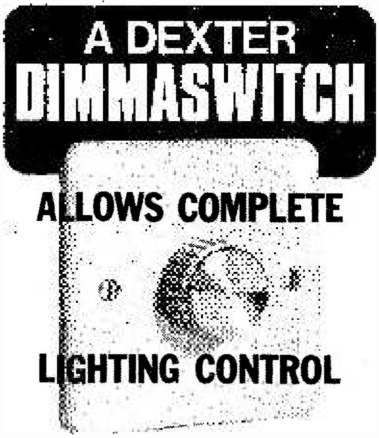

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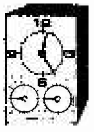

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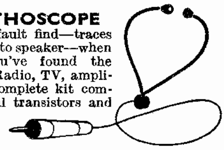

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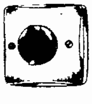

For any lamp up to 1kw. Mounted on switch plate to fit in place of standard switch. Virtually no radio interference. Price **£2·95** plus 20p post and insurance. Industrial model 5A **£3·30.** (Not on plate).

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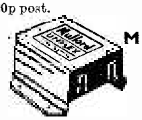

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In simpler types of CRT A2 is omitted giving a tetrode electron gun. The final focusing takes place between A1 and the final anode and geometrically is suitable for a fine spot. However, if focusing is achieved by varying A1 (the final anode potential is fixed as we shall see later) this affects the velocity of the beam because A1 is the primary accelerating anode. The change in velocity changes the position of the point Z and the range of focus is restricted for a good spot size. This situation in practice means that when the grid potential (brightness) or the A1 potential (focus) is altered the other potential must be changed as well, giving restricted focus and brightness range. It is for this reason that the pentode type of tube is almost universally used.

BEAM DEFLECTION

An electron has a negative charge of 1·6 x 10^{-19} coulombs. This is a very small charge, and conversely any electric field acting on the electron will produce only a very small force. However the mass of the electron is very small and so large accelerations can be produced with only moderate potentials.

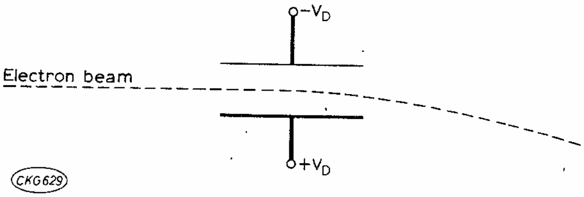


Fig. 5: Effect of the deflecting plates on the electron beam.

If a beam of electrons, focused into a fine pencil, is allowed to pass between two parallel plates as in Fig. 5, the electrons will experience a force towards the positive plate and it can be shown that the deflection is proportional to the deflecting voltage (Vd) and inversely proportional to the accelerating voltage (Va). A purely mathematical outlook shows that electrostatic deflection produces a (theoretically) linear deflection mechanism.

DEFLECTION PLATES

In order to keep the sensitivity as high as possible the tube is physically large and the deflector plates are placed as close together as possible, usually of the form shown in Fig. 6 to permit high deflection sensitivity to be achieved without the beam catching the actual deflector plates. If this occurs (for example if the timebase is overdriven to give X expansion) secondary emission occurs at the surface of the plates, and the low energy secondary electrons can be accelerated towards the screen causing flare and high background illumination. This undesirable effect can be avoided by coating the plates with a material of low secondary emission, or providing "beam catchers," small cups that accept the beam when driven off the screen. The X plates are usually mounted nearer to the tube face so that the Y plates have the maximum sensitivity.

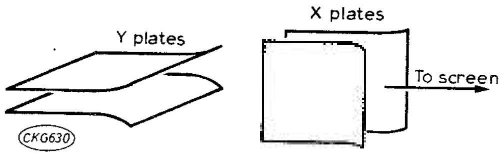
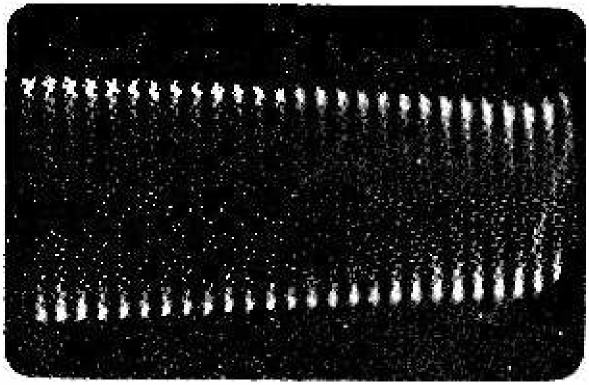


Fig. 6: Arrangement of the X and Y plates, the Y plates being nearer to the gun system.

To ensure that the electron beam does not become distorted in any way by extra acceleration due to the deflector plates they are arranged to be at the same potential as the final anode. Of course this is only true when the beam is travelling along the axis, but to prevent any gross errors on deflection it is common to provide symmetrical or push-pull deflection. This ensures that the mean electric field is not altered by deflection.



Trapezium distortion on a simple CRT operating with asymmetrical deflection on both axes. The focus and definition make this scope useful only for the simplest applications.

If the plates and final anode were at differing potentials then there would be a deformation of the circular cross-section of the beam (remember it is NOT in focus at this point, only at the screen where the cross-section area should be almost zero) by the plates attracting, or repelling, the outer electrons at opposite sides of the beam. This gives a sausage-shaped spot and the remedy is to make the final anode potential variable so that it may be matched to the Y plates. The X plates are then adjusted to be equal to the Y plate potential (as we shall see in a later section, it would be difficult to alter the Y plate potential). The control for setting the final anode volts is known as the "Astigmatism" potentiometer and is usually a front panel control.

The same CRT displaying a 1kHz square wave. Astigmatism is most noticeable as is the lack of HF response due to the simple deflection amplifier.

Another cause of incorrect spot size and shape is due to the pencil of electrons tending to spread, all being negatively charged. However, in high voltage tubes the velocity of the beam is high enough to keep the electrons in line by the magnetic field that they produce. The mechanism of electrostatic deflection relies on the electron beam being in the field of the deflector plates for a finite time. This means that when a very high frequency, say above 100MHz, signal is applied to the plates the signal may have changed before the electrons have emerged.

If, for example, a beam of electrons takes 10ns to travel through the plates a 100MHz signal will have completed one cycle and the deflection will be zero. In modern high velocity tubes the effect only occurs over 150 or 200MHz and the remedy is to arrange a series of deflectors, linked so that the velocity of the signal down the plates is the same as the velocity of the electron beam. However there are few uses for deflection amplifiers that can produce 200MHz output so this is of academic interest only.

THE FINAL ANODE

In order to produce the high velocity beams that are required to display fast transients, a high accelerating voltage is required. As we have seen, if this is applied to the final anode deflection sensitivity will be reduced so we apply the accelerating potential after deflection, called post deflection acceleration or PDA. Several methods of applying the PDA potential are used but they all aim at not reducing the deflection sensitivity, most important when the deflection amplifiers use transistors having only a limited output voltage swing.

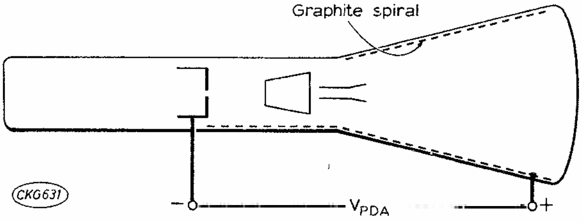


Fig. 7: Location of post deflection acceleration electrode in CRT.

The most popular form of PDA until a few years ago was the form shown in Fig. 7 and used in a lot of Cossor CRT's. The electron gun and tube are as they have been described so far and the beam is accelerated and deflected and focused normally. Around the inner wall of the tube is wound a resistive graphite spiral, connected to the final anode, and at the other end to a few kV positive. The beam is thus accelerated through this field to arrive at the screen with high velocity.

The screen tends to charge negatively at these high energies because more electrons are being gained than lost by secondary emission from the screen. The back of the phosphor is therefore given a very thin coating of aluminium and this conducts the charge to positive PDA, eliminating "screen sticking". This occurs where a local area of screen acquires a negative charge and tends to repel the beam, giving low light output. The aluminium also produces a more axial accelerating field giving better geometry and increased light output by reflecting the light forwards.

The field of the PDA is such as to produce a slightly convergent lens giving a smaller image and also, if it penetrates into the deflector plate region, causes acceleration before and during deflection, decreasing the scan even further. But in spite of this the PDA system offers a distinct advantage of increased trace brightness.

A fine wire mesh can be placed in the path of the beam just after deflection and if connected to the final anode acts as a screen to keep any PDA fields out of the deflection system. This arrangement gives rise to a PDA field that acts as a diverging lens, magnifying the deflection considerably, but also the spot size. Alternatively this mesh can be placed near the screen and PDA applied between the mesh and the screen. This gives very good results without affecting geometry but such tubes are prone to internal flashover.

SCREEN PHOSPHORS

The screen material or phosphor is arranged to give the highest possible light output of the correct colour and persistence. The table shows the range of phosphors used in cathode ray tubes, the most usual being P1 or P5, whilst P7 is sometimes used for medical applications.

Phosphor	Persistence	Fluorescence	Phosphorescence (Afterglow)	Uses
P1	Medium	Green	Green	Scopes (Visual)
P2	Long or Short	Blue/Green	Yellow/Green	Scopes (Visual)
P3	Medium	Yellow	Yellow	
P4	Medium	White	White	Television
P5	Short	Blue	Blue	Scopes (Photography)
P6	Medium	White	White	Television
P7	Long	Blue/White	Yellow	Radar
P8	Short	Blue/White	Yellow	
P9	Long	White	White	
P10	Permanent	Magenta	Magenta	Storage Tube
P11	Short	Blue	Blue/Green	Scopes (Photography)
P12	Long	Orange	Orange	Radar
P14	Long	White	Orange	Radar
P15	Short	Blue/Green	Blue/Green	Flying Spot Scanners
P19	Long	Orange	Orange	Radar

Table of phosphor types and principal applications.

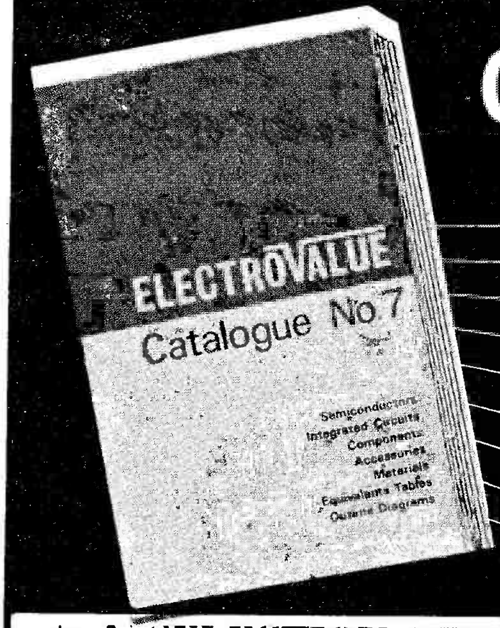
Although the trace produced on a tube can be intensely bright, even with only a couple of kV, the contrast between the trace and the background (grey/white) is usually quite small. A filter of about 65% transmission, of the colour of the trace, placed in front of the tube can increase the contrast by a large amount despite a decrease in light output.

GRATICULES

The graticule or measuring scale can be engraved on the filter or a better idea is to cut the graticule into a piece of $^1{}_8$in. perspex. If the markings are on the front, the observer can move so that the reflection of the line from the back surface of the graticule are in line with the actual lines. This ensures zero parallax when making measurements. The perspex can be lit from the side by a red bulb causing the cuts in the perspex to light up red, although white light is better for photography due to the uneven spectral response of films. Constructors making their own graticules out of perspex must bear in mind that the clearest line, especially with side illumination, is produced by cutting the perspex with a sharp knife and not by scratching.

ELECTROVALUE

CATALOGUE 7



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Code	*Watts*	*Ohms*	*1 to 9*	*10 to 99*	*100 up*	
				(see note below)		
C	1/20	82–220K	9	8	7·5	
C	1/3	4·7–470K	1·3	1·1	0·9	nett
C	1/2	4·7–10M	1·3	1·1	0·9	nett
C	3/4	4·7–10M	1·5	1·2	0·9	nett
C	1	4·7–10M	3·2	2·5	1·9	nett
MO	1/2	10–1M	4	3·3	2·3	nett
WW	1	0·22–3·9	9	9	8	
WW	3	1–10K	7	7	6	
WW	7	1–10K	9	9	8	nett

Codes:
C = carbon film, high stability, low noise.
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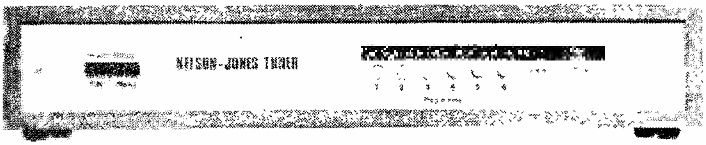

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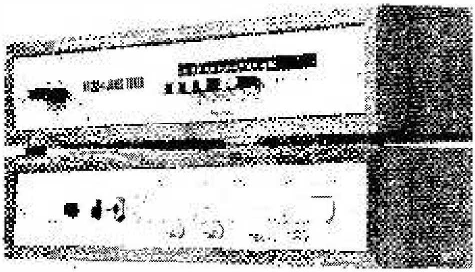

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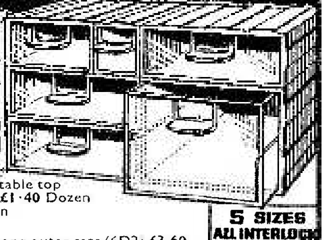

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PHOTOGRAPHY

Photographic film (even so called panchromatic) is most sensitive in the blue region and for this reason blue tubes are best suited to making photographic records. However, fast film (400ASA) together with a wide aperture, f2·8 or better, can give reasonably short exposures from a green tube.

When using single lens reflex cameras, best suited to this type of work, it is important to remember that the image on the film is scanned from right to left (lens inversion) and the direction of motion of the blind could well be from left to right, giving a small vertical exposure if the scope sweep speed is slow. The average shutter takes 1/30 or 1/60 of a second to scan the film and so one must be aware of these difficulties when dealing with fairly slow sweep speeds at fast shutter speeds. For single shot photography it is best to have the shutter completely open before the appearance of the trace.

ABERRATIONS

The ideal characteristics of a cathode ray tube are not always realised in practice due to assumptions in the theory, or plain constructional error (anodes off axis, etc.). One of the most important flaws or "aberrations" is that known as "Astigmatism" and this has already been dealt with, together with its cure.

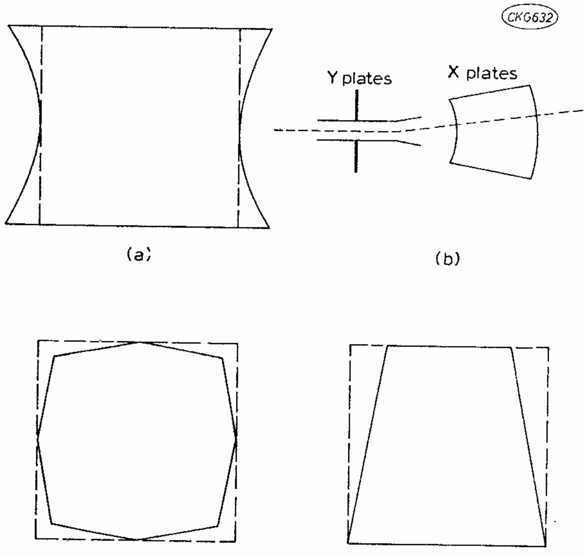

Fig. 8: Pin cushion distortion (a) can be corrected by shaping the plates as in (b). (c) illustrates barrel distortion and (d) trapezium distortion.

Most of the other aberrations are most apparent when the tube is displaying a raster. Ideally such a raster should be capable of being focused into a perfect square of scan lines, all in focus. Some defocusing occurs in deflections due to lens action between the final anode and plates, and between the plates. The effect between the plates is reduced by placing an "interplate shield" between the two sets of plates with a hole for the beam to pass through. This shield is at final anode potential and reduces the defocusing effects.

If the raster takes on the shape of Fig. 8a the distortion is known as pin-cushion distortion and is caused by the deflected beam travelling through a greater distance between the second set of plates thus arriving at an oblique angle. This can be reduced by making the second pair of plates as in Fig. 8b. Fig. 8c shows barrel distortion caused by loss of extreme scanning sensitivity due to the PDA fields. This can only be reduced by careful design of the PDA spiral. Fig. 8d shows trapezium distortion. This is caused by asymmetrical Y deflection accelerating the beam as the driven Y plate goes positive and decreasing the X sensitivity accordingly. Specially designed plates are available for asymmetrical deflection only.

CRT DEFECTS

Other defects occur in specific tubes and it must be realised that any CRT is a compromise between conflicting factors. Consequently the best instrument tubes as fitted in laboratory scopes can cost several hundreds of pounds, but the home constructor can purchase surplus tubes for just a few pounds and many quite good home-made scopes have been built using these tubes.

With age or abuse cathode ray tubes tend to develop faults the most serious of which is likely to occur at virtually any time, is when the mechanical structure of the electron gun fails. The gun is constructed with tiny spot welds and severe shock or vibration can cause an element to be dislodged. If this happens the tube is almost surely destined for scrap.

Also linked to the mechanical structure of the tube is a fault producing what is known as a "soft" tube. This occurs when a small amount of air leaks into the bulb through an imperfect glass-to-metal seal. This may become evident only after many hours of operation and the symptoms are a diffuse display and a blue glow in the gun assembly. As the pressure inside the tube rises further, tracking occurs in the gun and external circuits can be damaged. In order to avoid this fault occurring it is necessary to take great care when handling the tube and making connections to it. Connections should never be soldered directly on to the tube pins as this is almost certain to break a seal or even crack the envelope, with glass flying everywhere at high velocity.

Perhaps the most common fault, linked directly to old age, is low cathode emission. The cathode surface looses emissivity either by the emissive layer evaporating or becoming poisoned by the remaining gas in the tube. The effect is that in order to see a trace at all the brightness control has to be advanced so far that the beam spot goes out of focus and silvery. The silvery effect is due to the cathode emitting in patches and on some scopes, if the focus control has sufficient range (making focus anode nearly the same potential as final anode), it is possible to produce an image of the cathode on the screen. The image looks a little like the full moon, the dark patches representing areas of low emission.

Sometimes a low emission tube can be improved by deflecting the spot off screen and turning brightness full up for a couple of hours. If this does not work a small transformer supplying 6·3V+10% can be used to supply the heater (common practice in TV's). However the insulation of such transformers is doubtful over 1kV and a breakdown would make the tube heater/cathode short or damage it in an even worse manner. A small auto transformer is

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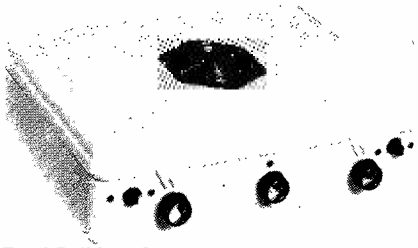

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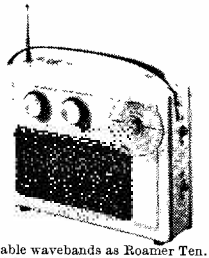

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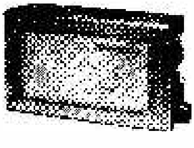

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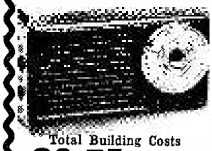

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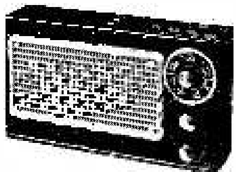

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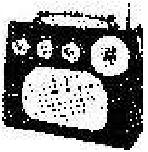

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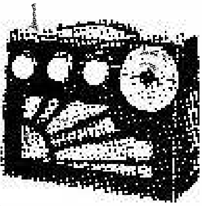

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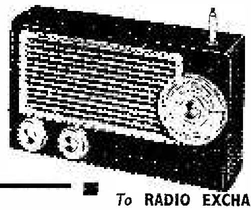

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ASSISTANT EDITOR
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PROJECTS SUB-EDITOR
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Alan Martin
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01-634 4293 Roy Smith
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STAFF CHANGES

Lionel Howes has been appointed Editor of Practical Wireless and of our associate magazine Television. Eric Dowdeswell has been appointed Assistant Editor of Practical Wireless.

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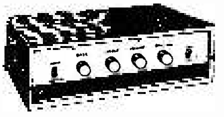

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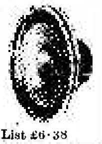
FANE 807T HIGH FIDELITY SPEAKER



A full range 8in. 10 watt unit for excellent sound quality, in suitable enclosure. Cast chassis 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 3 or 8-15 Ω.

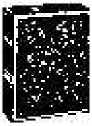
PLEASE STATE IMPEDANCE REQUIRED List £4·42 **£3·99**

MODEL 803T 8" 15w. with parasitic Tweeter.
Response 25 Hz to 15 KHz. Gauss 13,000 Imp 3 or 8–15Ω. **£5·50** List £6·38

HI-FI 8" x 5" 7 watt SPEAKERS

with parasitic Tweeter 8 ohm imp. P.p. 20p **£1·25**

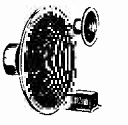
HI-FI SPEAKER ENCLOSURES



Teak veneer Sizes approx. **Carr. 50p. per enc.**

JE8	16 × 11 × 9in.	Cut for 8in. spkr.	**£5·95**
SE10	25 × 16 × 9in.	Cut for 10in. and Tweeter	**£8·95**
SE12	25 × 16 × 9in.	Cut for 12in. and Tweeter	**£8.95**

AUDIOTRINE HI-FI SPEAKER SYSTEMS



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. **£7·50** Carr. 45p

OR SENIOR 15 WATT INCLUDING HF126 15,000 GAUSS SPEAKER **£7·95** Carr. 50p

R.S.C. TA6 6 Watt HI-FI AMPLIFIER

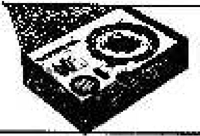
200-250v. AC mains operated. Response 30-20,000 c.p.s. —2dB. Separate Bass and Treble 'lift and cut' controls. 3 input sockets for Mike, Gram, Radio or Tape. Input selector switch. Output for 3–15 ohm spkrs. Max. sensitivity 5mV. O/P rating I.H.F.M. Enclosed enamelled case 9¼ × 2¾ × 5¼in. Silver finish facia 10¼ × 3¼in. **Complete kit, wiring diagrams and instructions.** **£7·95** Carr. 40p. **FACTORY BUILT £10·95**

R.S.C. TA12 MKIII 6·5+6·5 WATT STEREO AMPLIFIER

Fully Transistorised. Hi-Fi o/p of 6·5 watts per channel. Optimum performance with any crystal or ceramic P.U. Cartridge, Radio Tuner, Tape Rec. etc. Input Sel. Switch, Bass, Treble, Vol. & Bal. Controls. **COMPLETE KIT OF PARTS WITH FULL WIRING DIAGRAMS & INSTRUCTIONS** **£12·95** Carr. 40p.

Factory built with 12 mths guarantee **£16·61** **Or in Teak Veneer housing** **£19·55** Dep. **£2·50** & 8 mthly pymts **£2·50** (Total **£22·50**).

AUDIO FIDELITY FR1 SPEAKER KIT



Response 30Hz-15KHz. 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. **£10·78** each, Carr. Free.

SPECIAL OFFER £14·99 Pair Carr. 50p

R.S.C. MkIII SUPER 30 HIGH FIDELITY STEREO AMPLIFIER

BUILD AN AMPLIFIER WORTH APPROXIMATELY DOUBLE THE KIT PRICE INCLUDING CABINET
Only high grade components by leading manufacturers

- **Push Button Selector Switching**
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- **Neon Indicator**
- **Satin Silver Finish Metal Fascia**
- **Solid State Circuitry**
- **Twenty Silicon Transistors**
- **Four Diodes, Four Rectifiers**

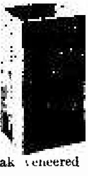
Send S.A.E. for full descriptive leaflet.

For Magnetic or Ceramic Pick-Ups regardless of Price. Output (per channel) 15 watts RMS into 8Ω. Frequency Response 7 Hz to 70 KHz ± 1½ dB.

COMPLETE KIT (less cabinet). Carr. 70p. Cabinet if req. £4·90 extra. **£22·50**

Assembled unit in cabinet **£42·50**

'YORK' HIGH-FIDELITY 3 SPEAKER SYSTEM



★ Moderate size only 25 × 14 × 10in. approx.
★ Response 30-20,000 c.p.s. Impedance 15 ohms

Performance comparable with units at twice the cost

COMPLETE KIT £25·95 Carr. 75p

Deposit £4·71 and 8 monthly payments **£3·12** (Total **£29·67**) Consists of (1) 12in. 15w Bass unit with cast chassis. Roll rubber cone surround for ultra low resonance. (2) 3-way quarter section series cross-over system. (3) 8 x 5in. high flux middle range speaker. (4) Dome Pressure Tweeter. (5) Quantity acoustic damping material. (6) Handsome Teak veneered cabinet. (7) Circuit and full instructions.

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

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250v., 60mA, 6·3v. 2a	**£1·50**
250-0-250v., 60mA 6·3v 2a	**£1·60**

FULLY SHROUDED UPRIGHT MOUNTING

250-0-250v. 60mA, 6·3v. 2a., 0-5-6·3v. 2a.	**£2·25**
250-0-250v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	**£3·75**
300-0-300v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	**£3·75**
300-0-300v. 130mA, 6·3v. 4a. c.t., 6·3v. 1a. For Mullard 510 Amplifier	**£4·50**
350-0-350v. 100mA, 6·3v. 4a., 0 5-6·3v. 3a.	**£3·75**
350-0-350v. 150mA, 6·3v. 4a., 0-5-6·3v. 3a.	**£4·50**
425-0-425v. 200mA, 6·3v. 4a., c.t., 5v. 3a.	**£8·50**
425-0-425v. 200mA, 6·3v. 4a., Twice 5v. 3a.	**£8·70**
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250-0-250v. 100mA, 6·3v. 2a., 6·3v. 1a. ..	**£2·75**
350-0-350v. 80mA, 6·3v. 2a., 0-5-6·3v. 2a.	**£2·75**
250-0-250v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	**£3·75**
300-0-300v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	**£3·75**
300-0-300v. 130mA, 6·3v. 4a., c.t. 6·3v. 1a. Suitable for Mullard 510 Amplifier......	**£4·50**
350-0-350v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	**£3·75**
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Push-Pull 15-18 watts, sectionally wound 6L6, KT66, etc., for 3 or 15 Ω	**£3·20**
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All 6/12v. D.C. output. Max. A.C. input 18v. 1a, **38p.** 2a, **49p.** 3a, **65p.** 4a, **81p.** 6a, **97p.**

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150mA, 7-10H, 250 Ω **£1·10**; 100mA, 10H, 200 Ω **95p**; 60mA, 10H, 400 Ω **35p.**

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50 WATT SPEAKER

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Complete with lid

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(c) MATCHING DYNAMIC 'MIKE' (attached to h'phone)

(d) PAIR 50 WATT SPEAKERS Black Rexine covered Cabinets Size approx. 18″×18″×8″

(a) (b) (c) & (d) Carr. £3·00 **£149·95**

DEP. £19·95 & 19 fortnightly. payments of £7·87 (Total £169·48).

RSC TDI DISCO CONSOLE

Incorporating twin Garrard SP25 or BSR MP60 type turntables and Sonotone or Acos Cartridges with diamond stylii. Separate Vol. controls for each turntable. Also MONITORING FACILITIES, plus Treble and Bass Controls. Separate input for 'mike' with vol. control switch. Black Vynide covered Cabinet with lid, see illustration on left. Or Dep. £9·00 and 18 fortnightly pymts. £4·22 (Total £84·96) **£75·00** Carr. £1·50

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Garrard SP25 or McDonald MP60 turntables. Sonotone or Acos cartridges with diamond styli. Facilities as TDI Console but with built-in 100 watt Power Amplifier, complete with lid. Or Deposit £11·48 and 18 fortnightly payments £5·74 (Total £114·80) **£99·95** Carr. £2·50

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IDEAL FOR VOCALISTS AND PUBLIC ADDRESS

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FOR BASS GUITAR, ELECT. ORGAN, ETC.

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50w with rec. filter for improved vocal sound **£5·95**

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PR. FANE POP 50 L/SPEAKERS £25·90
£69·85
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PACKAGE PRICE **£63·95** carr. £1·10

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★Two Fane heavy duty high flux 12in. spkrs.

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15 ohms (List £33) Carr. 75p **£25·95**

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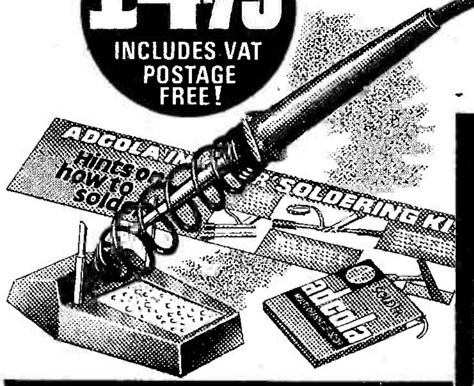

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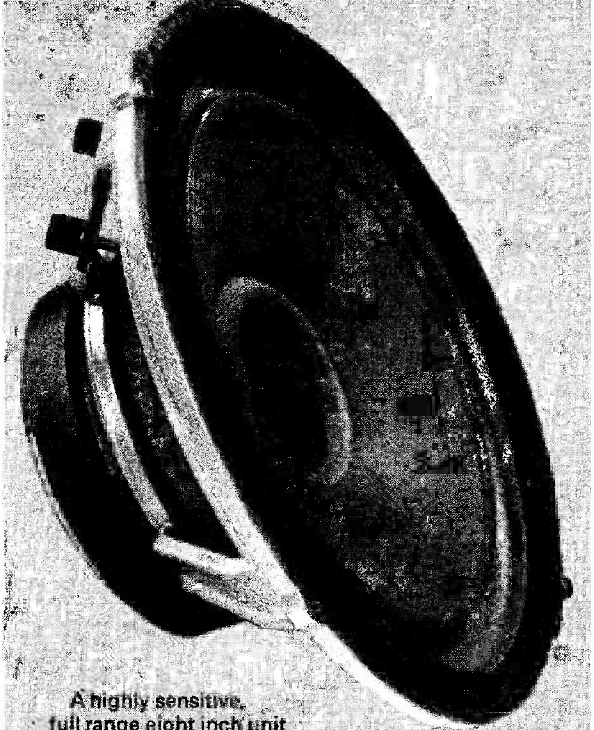

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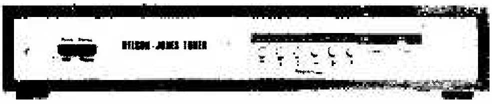
THE NEW NELSON-JONES FM TUNER



PUSH-BUTTON VARICAP DIODE TUNING (6 Position)
('WW' JUNE '73)

Exclusive Designer Approved Kits

What are the important features to look for in an FM tuner kit? Naturally it must have an attractive appearance when built, but it must also embody the latest and best in circuit design such as:—

- **MOSFET** front end for excellent cross modulation performance and low noise.
- **3 GANG** tuning for high selectivity.
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- **PHASE LOCKED** Stereo decoder with Stereo mute, see below
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- **PUSH BUTTON** tuning (with AFC disable) over the FM band (88-104)
- **IC STABILISED** and S/C protected power supply.
- **CABINET** double veneered against warp.

The Nelson-Jones Tuner has **all** of these features and many more, and more importantly the design is fully **proven** not just with a few prototypes but with many thousands of working tuners spread across the world.

Typ. Specn: 20 dB quieting 0·75uV. Image rejection —70dB.I.F. Rejection —85 dB.

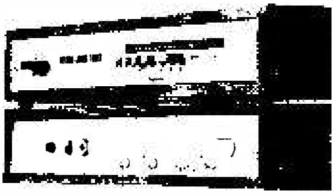
Basic tuner module prices start as low as **£12·31**, with **complete** kits starting at **£26·95** (mono) + P.P. 65p, and of course all components are available separately.

Our low cost **alignment service** is available to customers without access to a signal generator. Please send large SAE for our latest price lists which details all of the many options and special low prices for complete kits. All our other products remain available.

PORTUS AND HAYWOOD PHASE LOCKED DECODER (W.W. Sept. '70). Still the lowest distortion P.L. decoder available. THD typically 0·05% (at Nelson-Jones Tuner O/P level)! Supplied complete with Red LED.
Price **£7·02** when bought with a **complete** N-J tuner kit or **£8·29** if bought separately (P.P. 21p).

PLEASE NOTE. Existing tuners are readily convertible and kits/parts are available for this purpose.

TEXAN AMPLIFIER. We have designed the tuner case and metalwork to match the Texan amplifier (see photograph). Complete designer approved Texan kits are available at **£30·78** plus P.P. 65p including Teak Sleeve.



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Available as basic or complete kits

Basic stereo tuner **£15** post free.
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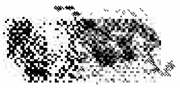
6 position push button units with integral pots **£2·92**.



No alignment required. Mullard LP1186 front end module used with Ceramic IF and IC amplifier. Push button tuning (6 position) with **Interstation Mute**, restricted range **AFC**, single **LED** tuning indicator, phase locked IC decoder, and complete metalwork and veneered cabinet. Complete with IC regulated PSU and full assembly instructions. (Mechanically identical to N-J Tuner.)

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Image rejection 40dB
IF rejection 65dB

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2N3053	1[illegible]
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2N3708/9	8[illegible]
2N3710/11	[illegible]
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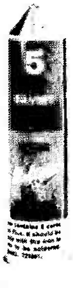

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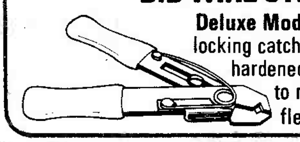

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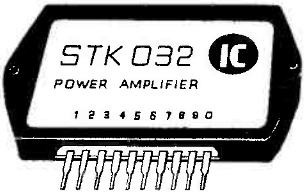

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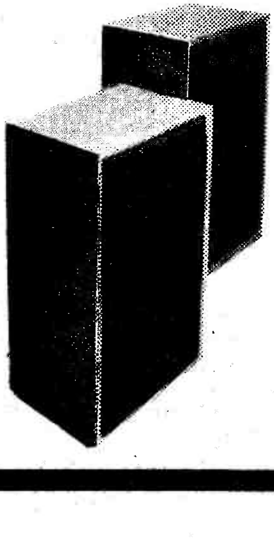

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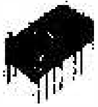
7447	£1·45	74154	£1·82
7447A	£1·80	74192	£2·15
7448	£1·50	74193	£2·53
7470	33p	74196	£1·73



LIGHT EMITTING DIODES

Til 209 (Red) With Clip	22p each
Til 209 (Green) With Clip	38p each
Til 209 (Yellow) With Clip	90p each
Mled 500 T092 Type	16p each

LED READOUTS

Litronix

DL707 .3 Character 14 Pin Dil.	£2·00
DL701 as above but ± 1	£2·00
DL747 ·6 Character	£2·62

Minitron

3015 7 Segment 16 Pin Dil	£1·18
3015G as above but ± 1	£1·18

Clock Chip

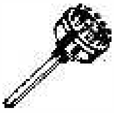
CT7001 MOS/LSI Digital Clock/Calendar Chip Plus full Circuits and Information leaflet £8·95

Circuits and Information Sheet 15p

Lit 704 Led Display for above £1·35

Or 4 for £5·25

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

22p each

POTENTIOMETERS

All types 1" and less diameter

Singles		Dual	
5K	Log or	5K	
10K	Lin Less	10K	
25K	Switch	25K	Less
50K	15p each	50K	Switch
100K		100K	45p each
250K	Double	250K	
500K	Pole	500K	
1M	Switch	1M	
2M	30p each	2M	

PRE SETS

Sub Miniature Skeleton Type 0·1 Watt Horizontal Mounting 100, 250 and 500 ohm, 1k, 2·5k, 5k, 10k 25k, 50k, 100k, 250k, 500k, and 1M ohm 6p each

MAINS TRANSFORMERS

Open Type Double Wound Continuously Rated, two hole fixing clamp with colour coded flying leads, varnish impregnated. Approx. size: 1¾" × 1¼" × 1½" high Fixing centres: 2$^{5}/_{32}$".

TR1	20–0–20v 100 m/a	
TR2	12–0–12 v 100 m/a	All
TR3	9–0–9 v 100 m/a	240 Volt
TR4	6–0–6 v 100 m/a	Primary
TR5	3–0–3 v 100 m/a	

Our Price £1·28 each

200/250v MAINS RELAY

Heavy duty contacts 2·500 ohm coil. All new and unused D.P.D.T. mains relays 50p, Carr. Free. Special quantity £40 per 100 off.

MINIATURE RELAYS

Brand new range of British made Relays, Size 1¼" × 1" × ¾". 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	All
21/A	12v	28M/A	430	80p
12/A	6v	33M/A	185	each

DOUGLAS TRANSFORMERS

All types are standard 240 volt primary.

MT 102 ct. 0 = 19 = 25 = 33 = 40 = 50 at 500M/A £2·00 each

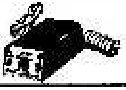
MT237cs 20–0–20 at 150M/A	£1·25
MT241cs 20–0–20 at 30M/A	£1·05
MT240cs 15–0–15 at 30M/A	£1·05
MT239cs 12–0–12 at 50M/A	£1·05
MT238cs 3–0–3 at 200M/A	£1·05

POWER PACKS

PP1 Switched 3 – 6 – 7½ – 9 volt 400M/A Transistor and Zener Stabilised On/Off Switch and Polarity Reversal Switch, in a black metal case £5·25 each.

PP2 Switched 6 – 7½ – 9 volt Battery Eliminator. Approx. size 2¾" × 2¼" × 3¼". Ideal for cassette recorders £2·75 each (philips type £3·00).

PP3 Car converter. From 12v Pos. or Neg. to = 6 – 7½ – 9 volt. Easy to fit and transistor regulated £2·50 each



VEROBOARD

	·1	·15	Plain ·15
2½ × 3¾	32p	24p	15p
2½ × 5	34p	34p	18p
3¾ × 3¾	34p	34p	
3¾ × 5	39p	45p	
17 × 2½	1·06p	77p	60p
17 × 3¾	1·45p	1·16p	75p
17 × 5	1·85p		1·10p

Pin insertion tool	72p
Spot face cutter	52p
Pkt. 36 pins (state ·1 or ·15)	25p

LOUDSPEAKERS

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
7" × 4" 8 ohm	ceramic	£1·60
8" × 5" 8 ohm Permanent Magnet		£1·60
*EMI 13" × 8" 450 Kit 3 — 8 — 15 ohm		£3·75
*EMI 13" × 8" 350 Kit 8 ohm		£7·50

FANE ULTRA HIGH POWER LOUDSPEAKERS

*Pop 25/2 30 watt 150 ohm 12"	£8·18
*Pop 55 60 watt 8/15 ohm 12"	£14·50
*Pop 50 50 watt 15 ohm 12"	£11·81
*Pop 60 60 watt 8/15 ohm 15"	£15·40
*Pop 100 100 watt 8/15 ohm 18"	£27·00

* Carr. on L/S over 13 × 8 and 12" 50p per L/S.

ALUMINIUM CHASSIS

Four-sided with corner plates. All are 2½" deep.

6" × 3"	42p	12" × 5"	66p
6" × 4"	45p	12" × 8"	87p
8" × 3"	48p	14" × 3"	63p
8" × 6"	57p	14" × 9"	99p
10" × 7"	70p	16" × 6"	90p
12" × 3"	57p	16" × 10"	£1·15

ALUMINIUM BOXES

Metal project boxes give your work a professional finish

	L	W	H	
AB7	2¾	5¼	1½	40p
AB8	4	4	1½	40p
AB9	4	2¾	1½	40p
AB10	4	5¼	1½	46p
AB11	4	2½	2	40p
AB12	3	2	1	35p
AB13	6	4	2	55p
AB14	7	5	2½	66p
AB15	8	6	3	85p
AB16	10	7	3	96p
AB17	10	4½	3	85p
AB18	12	5	3	95p
AB19	12	8	3	£1·26

ABS PLASTIC BOXES

Handy boxes for construction projects. Moulded extrusion rails for P.C. or chassis panels. Fitted with 1mm front panels.

1005 = 105mm × 73mm × 45mm = 51p
1006 = 150mm × 75mm × 47mm = 66p
1007 = 184mm × 124mm × 60mm = 96p
1021 = 106mm × 74mm × 45mm (sloping front) = 50p

BARGAIN BOARDS

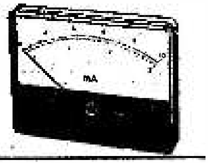
Components galore for the experimenter Ex Computer boards with Resistors, Capacitors and useful Transistors—at least 4 transistors per board. Five boards £1·00.

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 Full Scale
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 A.C. Full Scale
ME17 =0 to 300 volts A.C. Full Scale
ME12 ="S" Meter
ME13 ="VU" Meter

OUR PRICE £3·00



Q—MAX. SHEET METAL PUNCHES

The easiest and quickest way of punching holes in sheet metal (up to 1·625mm Mild Steel)

SIZE	PRICE	
⅜"	68p	Key "T" 6p
$\frac{7}{16}$"	75p	
½"	83p	Key "A" 6p
$\frac{9}{16}$"	83p	
⅝"	83p	
$\frac{11}{16}$"	88p	
¾"	88p	
$\frac{13}{16}$"	90p	
$\frac{15}{16}$"	98p	Key "B" 10p
1"	98p	
1$\frac{1}{16}$"	98p	
1⅛"	£1·08	
1¼"	£1·05	Key "B" 10p
1$^{7}/_{32}$"	£1·10	
1½"	£1·25	
1⅝"	£1·43	
1¾"	£1·50	
2"	£2·05	Key "C" 13p
2$^{3}/_{32}$"	£2·30	
2⅝"	£4·10	Key "E" 20p
2¾"	£5·25	
3"	£8·10	

DECON DALO 33PC ETCH RESIST PEN

The Decon Dalo 33PC is a unique instrument for the professional and amateur electronics engineer, enabling him to prepare in minutes a perfect printed circuit board

OUR PRICE 80p

ADD LUXURY TO YOUR CAR

with a motor driven car aerial

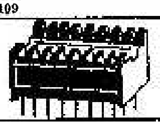
SPEC:-
★ 5 section
★ extended length 100cm
★ Length under fender 40cm
★ Cable length 120cm

Supplied complete with fixing bracket and control switch £6·75

1" SQUARE PUNCH complete with key £2·10

STOP PRESS

BHA0002	15 watt Amp Module	£2·50
NE555	Timer I.C.	78p
MC1310P	Stereo Decoder I.C.	£2·00
7805	Regulator	£1·49
TIP 29A		55p
TIP 30A		63p
BC107		10p
BC 108		10p
BC109		10p



I.C. SOCKETS

D.I.L.
8 pin
14 pin 14p
16 pin

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 (spare bits are available)

BARGAIN BOX

Loud buzzer mounted in a metal box complete with two U2 battery size holder.

Designed and can be used as a fire alarm but is ideal as a door or morse code practice buzzer.

Approx. size—2¾" × 6½" × 1½".

OUR PRICE—50p.

U.K. POSTAGE 15p
UNLESS OTHERWISE
STATED

V.A.T. Please add
8% to all Totals

CRESCENT RADIO LTD.

All mail to 11 MAYES ROAD,
WOOD GREEN, LONDON N22 6TL
Phone: 01-888 3206

Callers Welcome at
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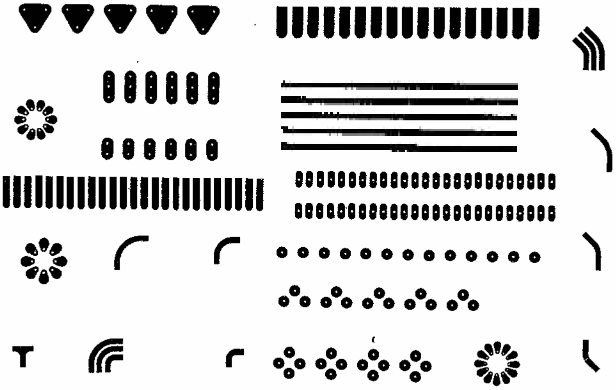
You should
own one.

CRESCENT
CATALOGUE

Price 20p.

PRINTED CIRCUIT BOARD TRANSFER SYSTEMS



Acid resistant transfers for direct application to P.C. Board. This is a new approach to printed circuit board manufacture, giving a professional finish with all details that an electronics engineer would require, including all drilling positions automatically marked.

Ideal for single unit boards or small quantities. All at a very low cost—for example an average 6" x 4" layout would cost less than 30p, and the time taken under one hour, including etching to complete.

The system is simple, briefly it consists of 10 sheets of self adhesive acid resistant transfers made in required shapes—i.e. edge connectors, lines, pads, dual in line I.C.'s, 8-10-12. T.O.S Cans, 3-4 lead transistors, etc., etc., which only require pressing into the required positions on the printed circuit board before etching.

The printed circuit transfer system is a genuine offer to the public and industry. A full money back guarantee is sent with each order, trade prices on application.

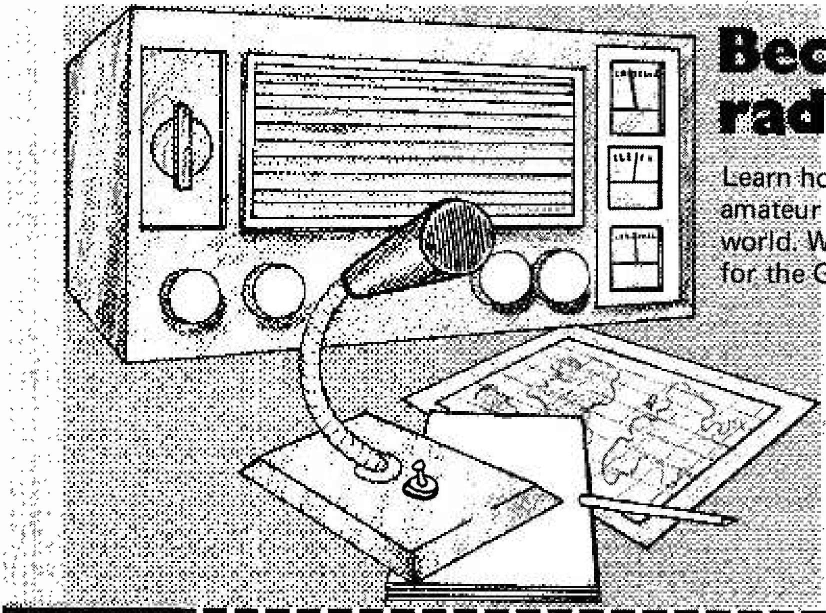
List of Prices

Complete system including post and VAT	£2·00
Individual sheets	22p
Sample sheet	22p
Copper laminate (boards) size 6" x 4½" 6 sheets (with six months guarantee)	50p

Printed circuit board PCB transfer systems patent applied for.

E. R. NICHOLLS, 46 LOWFIELD ROAD, STOCKPORT, CHESHIRE

TELEPHONE NUMBER: 061-480-2179



Become a radio amateur.

Learn how to become a radio-amateur in contact with the whole world. We give skilled preparation for the G.P.O. licence.

Free!

Brochure, without obligation to:

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

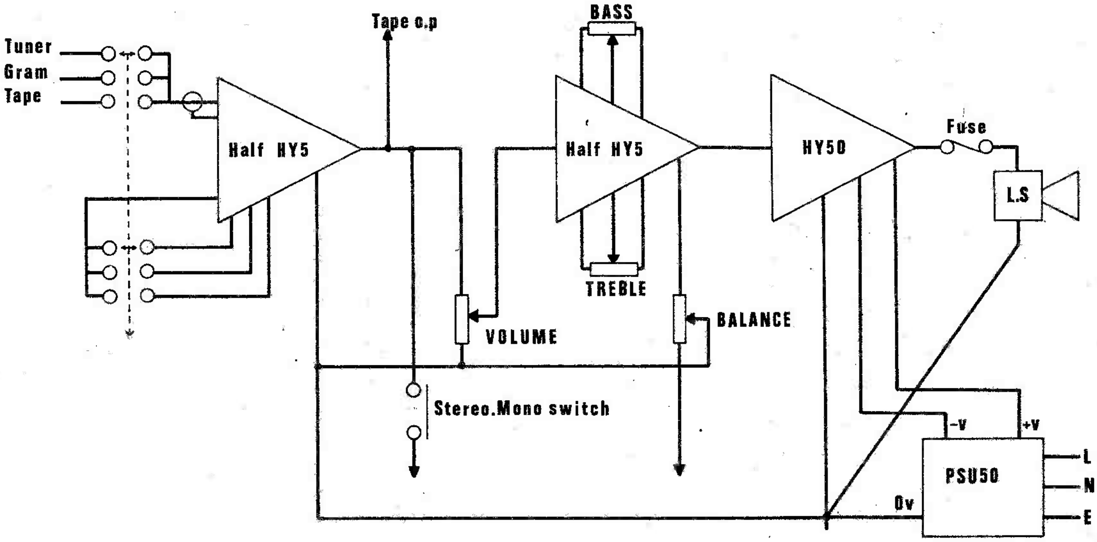
NAME ______________________

WB 114

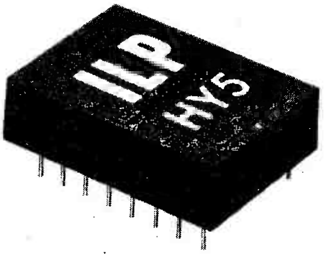
ADDRESS ______________________ Block caps please

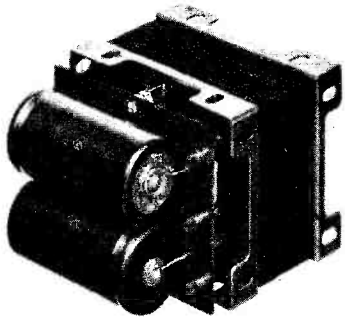
I.L.P. (Electronics) Ltd

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; Auxiliary 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 £4·50 +36p VAT
P. & P. free

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 8kΩ. **Load Impedance:** 4–16kΩ. **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 × 50 × 25mm.

PRICE £5·98 +48p VAT
P. & P. free

The PSU50 can be used for either mono or stereo systems.

TECHNICAL SPECIFICATIONS
Output voltage: 25V. **Input voltage:** 210–240V. **Size:** L.70, D.90, H.60mm.

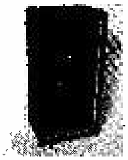
PRICE £5 +40p VAT
P. & P. free

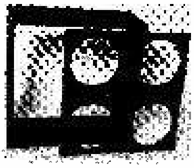
TWO YEARS' GUARANTEE ON ALL OUR PRODUCTS

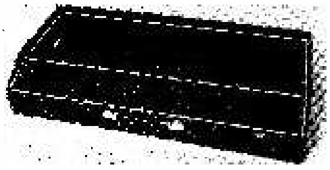
CROSSLAND HOUSE · NACKINGTON · CANTERBURY · KENT
CANTERBURY (0227) 63218

CUSTOM CABINETS, 331 High Street, Rochester, Kent. Tel: Medway (0634) 404199

Speaker Cabinets in kit form represent HUGE SAVINGS


2′ x 12″ Cabinet


4′ x 12″ Cabinet


Disco Console (includes lid not shown)
Takes two slaves

For a long time now a large number of customers have asked us to produce cabinets in kit form, and above we show examples of cabinet styles and these are now available either fully built or in kit form ready for you to produce a professional finish in a very short time!

Kits are available in all specifications and all the kits contain everything you need as follows:-

1) 4 sides with handle cutouts, front edges rounded, 1 back with jack socket hole, and 1 baffleboard with speaker cutout
2) P.V.C. cut to size for frame and back, plus false front and back timbers, white front piping and speaker cloth
3) Recessed handles with fixing screws, jack socket, all fixing screws, corner plates, glue, and full instructions!

PRICE & TYPE LIST

Type	*Size*	*Price manufactured*	*Kit price*
2 x 12″ (illustrated above)	36″ x 18″ x 13″ x ¾	£19.50	£12.50
4 x 12″ (illustrated above)	31″ x 31″ x 13″ x ¾	£24.50	£17.50
4 x 12″ P.A. Column	48″ x 27″ x 13″ x ¾	£30.00	£21.50
1 x 18″	31″ x 31″ x 13″ x ¾	£24.50	£17.50
1 x 15″ with two top horn cutouts	36″ x 20″ x 13″ x ¾	£21.00	£13.50
Mini Disco (state deck cutout BSR, GARRARD etc.)	33″ x 20″ x 10″ x ½	£20.00	£13.00
Maxi Disco (illustrated) (state deck cutout BSR, GARRARD etc.)	42″ x 20″ x 10″ x ½	£25.00	£18.50

Please ask for quotation on any other type or size of cabinet you may require.

ALL OUR PRICES INCLUDE VAT AND UK DELIVERY

PC ETCHING KIT
Contains 1lb Ferric Chloride, 100 sq. ins. copper-clad board, DALO etch-resist pen, abrasive cleaner, etching dish & instructions, all for only £3.30

RESISTORS & CAPACITORS
500 assorted resistors £1.35. 2500 £4.70. 150 poly. ceramic, mica etc capacitors 80p.

VEROBOARD
100 sq. ins. assorted sizes and pitches (no tiny pieces) £1.10.

3W TAPE AMPLIFIERS
Polished wooden cabinet 14 x 13 x 9″ containing a sensitive (20μV) 4 valve amplifier with tone & volume controls. Gives 3 watts output to the 7 x 4″ 3Ω speaker. Also a non-standard tape deck. Supplied in good working condition with circuit. Standard mains operation. £4.50. Suitable cassette £1.10. Spare head 33p. Tape (ex-computer) 75p. Amplifier chassis only, complete and tested (2xECC83, EL84, EZ80) and speaker £3.

VERSATILE POWER UNIT
Contains mains transformer, 2A thermal cut-out and bridge rectifier. Will give 1·7-10·5V output with 2 extra capacitors (supplied) £1.20. Also available as model garage with switch, lamp, jack plug etc. (Used for 'Hot Wheels') £1.70.

LEO III COMPUTER
Arriving late-October. All parts available, including 3000 reels tape, ½″ decks, power units, etc.

FERRIC CHLORIDE
Anhydrous technical quality to Mil Spec in 1lb double sealed packs. 1lb 80p, 3lbs £1.65, 10lbs £4.45, 100lbs £35.

PO AMPLIFIER UNIT
Contained in steel case 5¾ x 5 x 3¾″ are 2xGET116 transistors on heat sinks, 3 pot cores, 2 30V zeners, 4 audio transformers, 1% resistors & caps. With circuit diagram £1.

7lb BARGAIN PARCELS
Hundreds of new components—Pots, resistors, capacitors, switches, + PC boards with transistors and diodes, and loads of odds and ends. Amazing value at only £2.30.

COMPUTER PANELS
3lbs asstd £1.40, 7lbs £2.65, 56lbs £15. Pack containing 500 components with at least 50 transistors 95p. 12 High quality panels with power transistors, trimpots, IC's etc £2.50. Thousands of boards at shops for callers from 5p.

SLOTMETER
Ex-Pay TV, takes 10p pieces, has 3 digit mechanical counter, coin counter, Sangamo-Weston impulse movement, nylon gearing, switch, etc. Only £1.20.

MISCELLANEOUS
Transformer, Mains pri 16-0-16V with 9V tap sec 1½A £2. Post office 4 digit counters 60p. Balanced armature earpieces, use as mic or spkr 20Ω impedance 30p. 2N3055 38p. 80 + 80 + 20μF 350V 15p, 10 for £1.15. Multimeters: good range in stock from £3·50.

All prices shown include 8% VAT and postage (mainland only)
SAE list, enquiries.

GREENWELD ELECTRONICS (PW8)

Mail order dept., wholesale/retail shop **51 SHIRLEY PARK ROAD, SOUTHAMPTON. Tel 0703 772501.** Other retail shops at 21 Deptford Broadway SE8, Tel 01-692 2009 and 38 Lower Addiscombe Road, Croydon. Callers Welcome.

NEW

ALL SILICON!

PRACTICAL WIRELESS

ELECTRONIC IGNITION SYSTEM

This Capacitor-Discharge Electronic Ignition System was described in *Practical Wireless*, and has proved extremely popular.

The kit is supplied with a ready-drilled roller-tinned printed-circuit board and fully machined die-cast case with AMP Electrical Spade Connector Block together with a custom wound transformer, first grade components and full constructional details.

The original circuit employed Germanium Power Transistors for the negative earth version. WE OFFER SILICON P.N.P. POWER DEVICES AT NO EXTRA COST! All components are available separately. Case size 4¾″ x 3¾″ x 2″. Complete assembly and construction manual free with kit, available separately 25p.

SUITABLE FOR 12V SYSTEMS WITH NEG. OR POS. EARTH.

PRICE: **£9·50** **U.K. ORDERS PLEASE ADD VAT**

Quantity Discounts:

Trade and Overseas	1–5 Nett	6–9 less 10%
Enquiries Invited	10–49 less 15%	50–99 less 20%
Mail Order Only.	100–999 less 25%	1000 up less 30%

PLEASE STATE POS. OR NEG. EARTH WHEN ORDERING

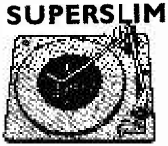
DABAR ELECTRONIC PRODUCTS

Buy it with Access
98 LICHFIELD STREET
WALSALL, Staffs WS1 1UZ
BARCLAYCARD

ALL OUR PRICES INCLUDE V.A.T.

BSR LATEST SUPERSLIM

STEREO AND MONO



Plays 12", 10" or 7" records. Auto or Manual. A high quality unit backed by BSR reliability with 12 months' guarantee. AC 200/250v.. Size 13½ × 11¼in. Above motor board 3⅜in. Below motor board 2¼in. With STEREO and MONO XTAL **£6·75** Post 45p.

PORTABLE PLAYER CABINET

Modern design. Black rexine covered Silver front grille. Chrome fittings. Motor board cut for BSR deck. **£4·50** Post 45p.

COMPACT PORTABLE STEREO HI-FI

Two full size loudspeakers 13¾ × 10 × 3¾in. Player unit clips to loudspeakers making it extremely compact. Overall size only 13¾ × 10 × 8½in. 3 watts per channel, plays all records 33 rpm, 45 rpm. Separate volume & tone controls. 240v AC mains.

Attractive
Teak finish
Weight 13lbs.

Bargain Price
£25
85p carriage

SPECIAL OFFER

SMITH'S CLOCKWORK 15 AMP TIME SWITCH 0–60 MINUTES

Single pole two-way. Surface mounting with fixing screws. Will replace existing wall switch to give light for return home, garage, automatic anti-burgular lights, etc. Variable knob. Turn on or off at full or intermediate settings. Makers last list price £4·50. Brand new and fully guaranteed. Fully insulated. OUR PRICE £1·95 Post 25p

WEYRAD P50—TRANSISTOR COILS

RA2W Ferrite Aerial . . 85p	Printed Circuit. PCA1 . . 65p
I.F. P50/2CC 470 kc/s. . 40p	J.B. Tuning Gang . . £1·20
3rd I.F. P50/3CC 40p	Weyrad Booklet 10p
Spare Cores 3p	OPT1 . . . . 65p
P50/IAC 60p	Driver Trans. LFDT4 . . 65p

Ferrite Rod 8 × ⅜in. 20p 6 × 5/16in. 20p 3 × ⅜in. 10p

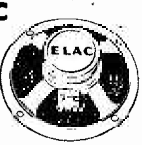
VOLUME CONTROLS

5 K. ohms to 2 Meg. LOG or LIN. L/S 20p. D.P. 35p. STEREO L/S 55p. D.P. 75p. Edge 5K.S.P. Transistor 25p

80 Ohm Coax 5p. yd.

BRITISH AERIALITE AERAXIAL-AIR SPACED 40 yd. £2; 60 yd. £3. FRINGE LOW LOSS Ideal 625 & colour **10p** yd.

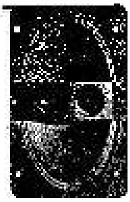
8in & 10 x 6in ELAC
HI-FI SPEAKER



Dual cone plasticised roll surround. Large ceramic magnet. 50–16,000 c/s. Bass resonance 55 c/s. 8 ohm 10 watt. **£3·75** Each Post 52p

10 inch 12 watt Twin Cone, 8 ohm £4:50

E.M.I. 13½ × 8in.
SPEAKER SALE!



With twin tweeters and crossover, 10 watt. State 3 or 8 or 15 ohm. (As illustrated) **£4·50** Post 25p

With flared tweeter cone and ceramic magnet. 10 watt. Bass res. 45–60 c/s. Flux 10,000 gauss. State 3 or 8 or 15 ohm. Post 25p **£2·75**

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SPECIAL OFFER

100 ohm 20W Rheostat 2½in. diam. Ceramic Former, screw terminals, ¼in. diam. spindle. 95p, post 25p.

ANOTHER RCS BARGAIN!

ELAC 9 × 5in. HI-FI SPEAKER. TYPE 59RM. THIS FAMOUS AND WIDELY USED UNIT NOW AVAILABLE AT BARGAIN PRICE 10 WATT. 8 OHM. CERAMIC MAGNET. **£2.95**

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Woofer 10¾ × 6½in. Ceramic Magnet, 44oz. 13,000 lines. Tweeter 3¼in. square, 10,000 lines. Crossover condenser full instructions supplied. Impedance 8 ohms. Power 12 watts. **£5·75** Post 45p.

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3 amp. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 £6·00
5 amp. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 £9·75
5, 8 and 13V 5 amp £1·20. 8 amp, 3, 5, 8, 10, 13 and 5-0-5V £1·30. Ditto 5 amp. £1·50; 6-0-6V 500mA 90p 9V 1 amp 95p 12V 300mA 75p 12V 500mA 85p 12V 750mA 95p. 12. 36. 48V 2 amp £2. 20V 3 amp £2.
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BATTERY CHARGERS. Ready built with leads and clips 1½ amp £2; 4 amp £4; 5 amp. £4·50.
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Can be used as 800W auto transformers 240-110V.

IDEAL FOR COLOUR T.V. OR GARDEN TOOLS.

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2/350V . .	14p	100/25V . .	10p	50 + 50/300V . .	50p
4/350V . .	14p	250/25V .	14p	350 + 50/325 . .	85p
8/350V . .	22p	500/25V .	20p	32 + 32/350V . .	40p
16/450V	25p	1000/25V . .	35p	32 + 32/450V . .	60p
32/450V	35p	1000/50V . .	47p	32 + 32 + 32/350V	65p
32/500V	50p	8 + 8/450V . .	22p	32 + 32 + 32/450V	85p
25/25V . .	10p	8 + 16/450V	25p	900/350V . .	95p
50/50V . .	10p	16 + 16/450V	40p	4700/63V . .	95p

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500mF. 12V. 15p; 25V. 20p; 50V. 30p.
1000mF. 12V. 20p; 25V. 35p; 50V. 47p; 100V. 70p.
2000mF. 6V. 25p; 25V. 42p; 50V. 57p.
2500mF. 50V. 62p; 3000mF. 25V. 47p; 50V. 65p.
5000mF. 6V. 25p; 12V. 42p; 25V. 75p; 35V. 85p; 50V. 95p.

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CERAMIC 1pF to 0·01mF, 4p. Silver Mica 2 to 5000pF, 4p. PAPER 350V–0·1 4p, 0·5 13p; 1mF 15p; 2mF 150V 15p. 500V-0·001 to 0·05 4p; 0·1 5p; 0·25 8p; 0·47 25p. TWIN GANG. "0–0" 208pF + 176pF, £1·20; 500pF standard 75p; 365 + 365 with 25 + 25pF Slow motion drive 50p. SHORT WAVE, SINGLE. 10pF 30p; 25pF 55p; 50pF 55p. NEON PANEL INDICATORS. 250V AC/DC Amber 25p. RESISTORS. ¼W, ½W, 1W, 20% 1p; 2W, 5p. 10 Ω to 10M. HIGH STABILITY. ½ w. 2% 10 ohms to 6 meg., 10p. Ditto 5% Preferred values 10 ohms to 10 meg., 4p. WIRE-WOUND RESISTORS. 5 watt, 10 watt, 15 watt 10 ohms to 100K 10p each. TAPE OSCILLATOR COIL. Valve Type 35p.

NEW MODEL "BAKER LOUDSPEAKER" 12in. 50 watt GROUP 50/12 8 or 15 ohm high power full range. Professional quality. **£12·95**

BAKER MAJOR 12" £8·50

Post free

30-14,500 c/s, 12in. double cone, woofer and tweeter cone together with a BAKER ceramic magnet assembly having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 40 c/s Rated 20 watts. NOTE: 3 or 8 or 15 ohms must be stated.

Module kit, 30-17,000 c/s with tweeter, crossover, baffle and instructions. Post free **£10·95** Please state 3 or 8 or 15 ohms.

BAKER "BIG-SOUND" SPEAKERS Post free

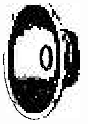
'Group 25'	**'Group 35'**	**'Group 50'**
12 inch 25 watt **£7·75**	12 inch 35 watt **£8·50**	15" 50 w **£17·80**
3 or 8 or 15 ohm	3 or 8 or 15 ohm	8 or 15 ohm

TEAK VENEERED HI-FI SPEAKER CABINETS

For 12in. or 10in. dia. speaker	20 × 13 × 9"	£10·50 Post 25p
For 13 × 8in. or 8in. speaker	16 × 10 × 9"	£6·60 Post 25p
For 8 × 5in. speaker	16 × 8 × 6"	£4·95 Post 25p
For 6in. and tweeter	12 × 8 × 6"	£4·00 Post 25p

LOUDSPEAKER CABINET WADDING 18in. wide, 20p ft

EMI 6½in. HI-FI WOOFER



8 ohm, 10 watt. Large ceramic magnet. Special Rubber cone surround. Frequency response 30-12,000 c/s. Ideal P.A. Columns, Hi-Fi Enclosure Systems, etc. Suitable cabinet 12 × 8 × 6 £4·00. Suitable Tweeter £2·00. **£4**

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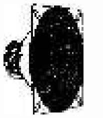

The moving coil diaphragm gives a good radiation pattern to the higher frequencies and a smooth extension of total response from 1,000 c/s to 18,000 c/s. Size 8½ × 3½ × 2in. deep. Rating 10 watt, 3 ohm Suitable Crossover £1·30 **£1·90** Post 20p

SPEAKER COVERING MATERIALS. Samples Large S.A.E. Horn Tweeters 2–16kc/s, 10W 8 ohm or 15 ohm £1·95. CROSSOVERS TWO-WAY 3000cps 3 or 8 or 15 ohm £1·30 LOUDSPEAKERS 3 OHMS. 7 × 4in. £1·25; 6½in. £1·50. 8 × 5in. £1·60 8in. £1·75; 10 × 6in. £1·90; 10in. £2·00. SPECIAL OFFER: 80 ohm, 2¼in.; 2⅝in. 35 ohm. 2in., 3in., 25 ohm. 2½in. dia., 5in. dia. 6" × 4" 15 ohm, 3½in. dia.; 6 × 4in.; 7 × 4in.; 8 × 5in. 3 ohm, 2½in.; 2⅝in.; 3½in.; 5in. dia. (6 × 4in. 8 ohm £1·50) **£1** EACH TYPE RICHARD ALLAN TWIN CONE LOUDSPEAKERS. 8 in. diameter 4 watt £2·50. 10in. diameter 5 watt £2·50; 12 in. diameter. 6 watt £2·95. VALVE OUTPUT TRANS. 40p; MIKE TRANS. 50:1 40p. Mike trans. mu metal 100:1 £1·25.

MAJOR 100 WATT ALL PURPOSE GROUP OR DISCO AMPLIFIER

All purpose transistorised. Ideal for Groups, Disco and P.A. 4 inputs speech and music. 4 way mixing. Output 8/15 ohm. a.c. Mains. Separate treble and bass controls. **£49** Carr. £1·00

MAJOR 50 WATT 4 INPUTS. 2-WAY MIXING £39

3-WAY CROSSOVER 950 CPS and 3000 CPS with leads ready assembled **£1·95**

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BARGAIN 3 WATT AMPLIFIER. 4 Transistor Push-Pull Ready built, with volume, treble and bass controls 18v. DC operation. **£3·95**

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1,400 r.p.m. Reversible 42 Watt. Post 25p spindle 1¼" × 7/32", size 3½" × 3". As illustrated. With Cooling Fan 240V A.C.

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SAFETY MAINS ISOLATING TRANSFORMERS
Prr. 120/240 V Sec. 120/240 V Centre Tapped and Screened

Ref. No.	VA (Watts)	Weight lb	oz	Size cm.	P & P £	p
07	20	1	8	7·0 × 6·0 × 6·0	2·55	38
149	60	3	12	9·9 × 7·7 × 8·6	3·79	45
150	100	5	8	9·9 × 8·9 × 8·6	4·17	45
151	200	8	0	12·1 × 9·3 × 10·2	7·39	53
152	250	13	12	12·1 × 11·8 × 10·2	9·45	73
153	350	15	0	14·0 × 10·8 × 11·8	11·35	73
154	500	19	8	14·0 × 13·4 × 11·8	13·30	91
155	750	29	0	17·2 × 14·0 × 14·0	21·05	*
156	1000	38	0	17·2 × 16·6 × 14·0	27·20	*
158	2000	60	0	21·6 × 15·3 × 18·1	50·25	*

AUTO TRANSFORMERS

Ref. No.	VA (Watts)	Weight lb	oz	Size cm.	Auto Taps	P & P £	p
113	20	1	0	5·8 × 5·1 × 4·5	0-115-210-240	1·34	30
64	75	2	4	7·4 × 6·7 × 6·1	0-115-210-240	2·64	38
4	150	3	4	8·9 × 7·7 × 7·7	0-115-200-220-240	3·29	45
66	300	6	4	9·9 × 9·6 × 8·6	,,	5·29	53
67	500	12	8	12·1 × 11·2 × 10·2	,,	8·02	67
84	1000	19	8	14·0 × 13·4 × 14·3	,, ,,	13·50	91
93	1500	30	4	14·0 × 15·9 × 14·3	,, ,,	17·50	*
95	2000	32	0	17·2 × 16·6 × 14·0	,, ,,	25·35	*
73	3000	40	0	21·6 × 13·4 × 18·1	,, ,,	32·80	*

CASED AUTO TRANSFORMERS

115V mains lead input and U.S.A. 2-pin outlets. 20VA £2·64 pp 38p 500VA £9·50 pp 80p 1000VA £15·92 via B.R.S.

TRANSFORMERS

PRIMARY 240-250 VOLTS 12 AND OR 24 VOLT RANGE

Ref. No.	Amps. 12V	24V	Weight lb	oz	Size cm.	Secondary Windings	P & P £	p
111	0·5	0·25		8	4·8 × 2·9 × 3·5	0·12V at 0·25A × 2	1·34	23
213	1·0	0·5	1	4	6·1 × 5·8 × 4·8	0·12V at 0·5A × 2	1·58	30
71	2	1	1	12	7·0 × 6·4 × 6·1	0·12V at 1A × 2	2·09	38
18	4	2	2	12	8·3 × 7·7 × 7·0	0·12V at 2A × 2	2·60	38
70	6	3	3	8	8·9 × 8·0 × 7·7	0·12V at 3A × 2	3·52	45
108	8	4	5	8	9·9 × 8·9 × 8·6	0·12V at 4A × 2	3·96	45
72	10	5	6	4	9·9 × 9·6 × 8·6	0·12V at 5A × 2	4·67	53
116	12	6	6	12	9·9 × 10·2 × 8·6	0·12V at 5A × 2	5·61	53
17	16	8	8	12	12·1 × 9·9 × 10·2	0·12V at 8A × 2	6·62	60
115	20	10	11	8	14·0 × 9·6 × 11·8	0·12V at 10A × 2	10·20	73
187	30	15	15	8	14·0 × 12·1 × 11·8	0·12V at 15A × 2	13·70	85
226	60	30	32	0	17·2 × 15·3 × 14·0	0·12V at 30A × 2	22·50	*

30 VOLT RANGE

Ref. No.	Amps.	Weight lb	oz	Size cm.	Secondary Taps	P & P £	p
112	0·5	1	4	6·1 × 5·8 × 4·8	0-12-15-20-24-30V	1·58	30
79	1·0	2	4	7·0 × 6·7 × 6·1	,, ,,	2·18	38
3	2·0	3	4	8·9 × 7·7 × 7·7	,, ,,	3·18	38
20	3·0	4	8	9·9 × 8·3 × 8·6	,, ,,	4·12	45
21	4·0	6	4	9·9 × 9·6 × 8·6	,, ,,	4·67	53
51	5·0	6	12	12·1 × 8·6 × 10·2	,, ,,	5·83	53
117	6·0	8	0	12·1 × 9·3 × 10·2	,, ,,	6·94	60
88	8·0	12	0	12·1 × 11·8 × 10·2	,, ,,	9·00	67
89	10·0	13	12	14·0 × 10·2 × 11·8	,, ,,	9·80	73

50 VOLT RANGE

Ref. No.	Amps.	Weight lb	oz	Size cm.	Secondary Taps	P & P £	p
102	0·5	1	12	7·0 × 6·4 × 6·1	0-19-25-33-40-50V	2·09	30
103	1·0	2	12	8·3 × 7·4 × 7·0	,, ,,	3·08	38
104	2·0	5	8	9·9 × 8·9 × 8·6	,, ,,	4·26	45
105	3·0	6	12	9·9 × 10·2 × 8·6	,, ,,	5·79	53
106	4·0	10	0	12·1 × 10·5 × 10·2	,, ,,	7·41	67
107	6·0	12	0	14·0 × 10·2 × 11·8	,, ,,	11·00	67
118	8·0	18	0	14·0 × 12·7 × 11·8	,, ,,	13·40	85
119	10·0	25	0	17·2 × 12·7 × 14·0	,, ,,	17·60	*

60 VOLT RANGE

Ref. No.	Amps.	Weight lb	oz	Size cm.	Secondary Taps	P & P £	p
124	0·5	2	4	7·0 × 6·7 × 6·1	0-24-30-40-48-60	2·12	38
126	1·0	3	4	8·9 × 7·7 × 7·7	,, ,,	2·97	38
127	2·0	6	4	9·9 × 9·6 × 8·6	,, ,,	5·40	45
125	3·0	8	12	12·1 × 9·9 × 10·2	,, ,,	7·11	60
123	4·0	13	12	12·1 × 11·8 × 10·2	,, ,,	9·20	67
40	5·0	12	00	14·0 × 10·2 × 11·8	,, ,,	10 83	73
120	6·0	15	8	14·0 × 12·1 × 11·8	,, ,,	13·35	85
121	8·0	25	00	14·0 × 14·7 × 11·8	,, ,,	15·01	*
122	10·0	25	0	17·2 × 12·7 × 14·0	,, ,,	19·60	*
189	12·0	29	00	17·2 × 14·0 × 14·0	,, ,,	21·60	*

MINIATURE TRANSFORMERS WITH SCREENS

Ref.	MA.	Weight		Size cm	VOLTS	P & P £	p
238	200		2	2·8x2·6x2·0	3-0-3	1·40	10
212	1A 1A	1	4	6·1x5·8x4·8	0-6 0-6	1·67	30
13	100		4	3·9x2·6x2·9	9-0-9	1·28	13
235	330,330		4	4·8x2·9x3·5	0-9, 0-9	1·42	19
207	500, 500	1	00	6·1x5·4x4·8	0-8-9, 0-8-9	2·23	30
208	1A, 1A	1	12	7·0x6·4x6·1	0-8-9,0-8-9	3 00	38
236	200, 200		4	4·8x2·9x3·5	0-15, 0-15	1·30	19
214	300, 300	1	4	6·1x5·8x4·8	0-20, 0-20	1·76	30
221	700 (D.C.)	1	8	7·0x6·1x6·1	20-12-0-12-20	1·98	38
206	1A, 1A	2	12	8·3x7·7x7·0	0-15-20, 0-15-20	3·78	38
203	500,.500	2	4	8·3x7·0x7·0	0-15-27, 0-15-27	3·06	38
204	1A, 1A	.3	4	8·9x7·7x7·7	0-15-27, 0-15-27	3·27	38

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PAIR OF 4 × 150A VALVES complete with bases ex-equip not tested. Good condition **£3**, P. & P. 30p.

BARGAIN PARCELS 14lb at **£1·60** plus 35p p.p.; 28lb at **£3·00** plus 57½p p.p.; 56lb at **£4·95** plus £1·37½ p.p. Contains pots, Res. Valves, Diodes. Tagboards, Chassis, Valveholders, etc. Good value save £££s. Lucky Dip Service.

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Also 7BP7. All unused as new. Price **£2** post paid.

TRANSISTOR BOARDS—consisting of transistors, diodes and resistors etc. Long leads. Good value 12 for **£1·00** (min. order) **P. & P. 30p.** Quotations for quantity.

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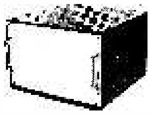

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Model 120 all aluminium two part construction. Top and sides, blue hammer finish, front, rear and base: white. Others: mild steel three part construction.

Top, base, sides and detachable rear panel, blue hammer. Detachable aluminium front panel finished in white.

Dimensions in inches.

Model	W	H	D	Price.
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220	8	6	3½	**£3·78**
221	8	6	6	**£4·07**
320	12	8	12	**£8·42**

Chassis for model 320 **£2·34** extra.

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CAPACITORS

Sub-miniature
Axial lead electrolytic

Mfd	V	Price	Mfd	V	Price	Mfd	V	Price
1	63	6p	68	6·3	6p			
1·5	63	6p	68	16	6p			
2·2	63	6p	68	63	14p			
3·3	63	6p	100	4	6p			
4·7	63	6p	100	10	6p	470	6·3	6p
6·8	40	6p	100	25	6p	470	10	14p
6·8	63	6p	100	40	6p	470	25	16p
10	25	6p	100	63	16p	470	40	25p
10	63	6p	150	6·3	6p	680	6·3	14p
15	16	6p	150	16	6p	680	16	16p
15	40	6p	150	25	6p	680	25	25p
15	63	6p	150	40	14p	680	40	28p
22	10	6p	150	63	16p	1000	4	14p
22	25	6p	220	4	6p	1000	10	16p
22	63	6p	220	10	6p	1000	16	25p
33	6·3	6p	220	16	6p	1000	25	28p
33	16	6p	220	25	14p	1500	6·3	16p
33	40	6p	220	40	16p	1500	10	25p
47	4	6p	220	63	25p	1500	16	28p
47	10	6p	330	4	6p	2200	6·3	25p
47	25	6p	330	10	6p	2200	10	28p
47	40	6p	330	16	14p	3300	6·3	28p
47	63	6p	330	63	28p	4700	4	28p

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PP3, 6 etc. battery clip dual min.	**9p**
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Pair crocodile clips 1 red, 1 black insulated sleeve.	**10p**
Solder Multicore 22swg 10 metres	**25p**
Silicone grease in special dispenser 20ml.	**54p**
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Lacing Cord Strong rayon cored PVC 25m.	**51p**
Panel fuse holders 20mm **20p**; 1¼″	**35p**

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LT700 min. output transformer Pri. 1·2k Ω Sec. 5 Ω 200mW	**50p**
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12-0-12V 50mA	**95p**

Size: Both approx. 30 × 27 × 25mm.

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Mains transformer MT3AT Pri. 200-220-240V, Sec. 12-15-20-24-30V 2A	**£3·31**
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Plastic	**13p**
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Single gang Lin or Log 5k, 10k, 25k, 50k, 100k, 250k, 500k, 1M, 2M (and 1k Lin) **16p**

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Dual gang (Stereo) without switch Log or Lin 5k to 2M as above **49p.**

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Sub-miniature 0·1W Vert or Horiz. 100, 250, 500, 1k, 2·5k, 5k, 10k, 25k, 50k, 100k, 250k, 500k, 1M **6p**

NE555V 8-pin DIL 69p

RESISTORS

Carbon Film ½W 5% 1 Ω to 1M; 10% 1·2M to 10M	E12	1p
Carbon Film ¼W 5% 1 Ω to 10Ω; 10% 1·2M to 10M	E12	1p
Carbon Film ¼W 5% 11 Ω to 910k	E12 & E24	1p
Carbon Film 1W 5% 10 Ω to 10M	E12	3½p
Metal Oxide ½W 2% 10 Ω to 1M	E12 & E24	4p
Wirewound 2½W 10% 0·22ohms to 0·47ohms	E12	14p
Wirewound 2½W 5% 1ohm to 270ohms	E12	12p

E12 values 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and decades
E24 values 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 75, 91 and decades

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CA3046	**69p**
LH0042C. TO99 (TO5). FET i/p Op Amp	**£4·25p**
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Rotary with adjustable stop 1 pole 2 to 12 way; 2 pole 2 to 6 way; 3 pole 2 to 4 way; 4 pole 2 or 3 way. each **36p.**
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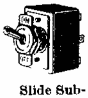
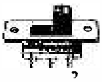
Push to make non-locking **14p**



Toggle 250V 1·5A with ON/OFF plate **25p.**



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2″ and 4″ PANEL METERS

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4″: SIZE: 110mm Wide × 82mm High × 43mm Deep.

2″ Movement	I.R. Ohms	4″ 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 AMP	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.
Price 2″ **£2·95** Post 10p. Price 4″ **£3·95** Post 10p. Lamps **55p** per set.

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.

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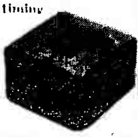

A reliable unit ideal for timing
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Gives up to 30 mins delay before switching off.
Delay 1–30 mins. adjustable. Max Load 400VA or 1000 watts resistive. White Case 3¾″ × 3¾″ × 2″. Fitting instructions included.

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VA (watts)	Ref No.	Price Cased £	Price Plugs 2 Pin + 1 Earth	Price Open £	Post £
60	149	7·35	0·80	4·00	0·38
100	150	8·22	0·80	4·60	0·52
200	151	10·20	0·80	7·40	0·52
250	152	11·68	0·80	8·88	0·65
350	153	14·10	0·80	10·80	0·80
500	154	15·68	0·80	12·38	1·00
750	155	24·63	1·00	18·72	1·20
1000	156	32·19	1·00	26·50	1·20
1500	157	38·18	1·00	30·34	O.A.
2000	158	45·20	2·40	34·68	O.A.
3000	159	66·50	2·40	53·35	O.A.

12 & 24 Volts Prim. 200–240V.

Amps 12V	24V	Ref. No.	Price £	Post £
0·3	0·15	242	1·34	0·22
0·5	0·25	111	1·38	0·22
1	0·5	213	1·58	0·22
2	1	71	2·09	0·22
4	2	18	2·58	0·38
6	3	70	2·80	0·42
8	4	108	4·20	0·52
10	5	72	4·80	0·52
12	6	116	5·01	0.52
16	8	17	6·22	0·52
20	10	115	9·47	0·69
30	15	187	11·95	0·97
40	20	232	13·26	1·00
50	30	226	15·30	1·10

30 Volts

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

Amps	Ref. No.	Price £	Post £
0·5	112	1·72	0·22
1	79	2·31	0·38
2	3	3·26	0·38
3	20	4·10	0·42
4	21	4·68	0·52
5	51	5·80	0·52
6	117	6·50	0·52
8	88	8·50	0·67
10	89	8·97	0·67

50 Volts

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

Amps	Ref. No.	Price £	Post £
0·5	102	2·33	0·30
1	103	3·00	0·38
2	104	4·57	0·42
3	105	5·20	0·52
4	106	5·89	0·52
6	107	11·17	0·67
8	118	14·19	0·97
10	119	15·47	0·97

60 Volts

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

Amps	Ref. No.	Price £	Post £
0·5	124	2·08	0·38
1	126	2·96	0·38
2	127	4·63	0·42
3	125	6·84	0·52
4	123	7·84	0·67
5	40	8·86	0·67
6	120	10·15	0·82
8	121	13·58	1·00
10	122	18·15	1·00
12	189	16·00	1·10

MINIATURE AND EQUIPMENT

Prim. 240V with screen.

Volts Sec. 1	Sec. 2	Milliamps Sec. 1	Sec. 2	Ref. No.	Price £	Post £
3–0–3	—	200	—	238	1·28	0·10
0–6	0–6	500	500	234	1·30	0·10
0–6	0–6	1000	1000	212	1·93	0·22
9–0–9	—	100	—	13	1·28	0·10
0–9	0–9	330	330	235	1·48	0·10
0–8–9	0–8–9	500	500	207	1·75	0·22
0–8–9	0–8–9	1000	1000	208	2·30	0·36
15–0–15	—	40	—	240	1·28	0·10
0–15	0–15	200	200	236	1·30	0·10
20–0–20	—	30	—	241	1·28	0·10
0–20	0–20	150	150	237	1·30	0·10
0–15–20	0–15–20	500	500	205	2·47	0·38
0–20	0–20	300	300	214	1·72	0·22
0–20		3500	NO SCREEN	1116	3·00	0·40
20–12–0–12–20	—	700 (D/C)	—	221	2·31	0·30
0–15–20	0–15–20	1000	1000	206	3·22	0·38
0–15–27	0–15–27	500	500	203	2·73	0·38
0–15–27	0–15–27	1000	1000	204	3·52	0·38

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Cased versions are 240 Volt Mains to 115 Volts, smart steel cased units coated in tough resin with power lead, fuse and 115 Volt American type socket up to 500VA. above 500VA cable entry.

VA Watts	Ref. No.	Price Cased £	Price Plugs 2 & 3 pin	Price Open £	Post £
Tapped at 115, 220, 240 Volts					
20	113	3·00	0·15	1·55	0·30
Tapped at 115, 200, 220, 240 Volts					
150	4	5·80	0·15	3·98	0·39
200	65	6·40	0·15	4·50	0·40
300	66	7·27	0·15	5·28	0·52
500	67	9·99	0·15	8·29	0·67
750	83	12·56	0·75	9·76	0·82
1000	84	-15·70	0·75	12·40	0·82
1500	93	19·88	0·75	16·58	1·50
2000	95	30·10	1·44	22·05	1·50
3000	73	43·58	1·90	32·00	1·90

PLEASE ADD 8% FOR V.A.T.

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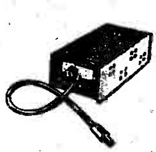
Output switched 3, 4·5, 6, 7·5 9 and 12 volts at 500 mA D.C Operates from 240 V mains suitable for Radios, Tape. Recorders, Record Players etc Size 7·5 × 5·0 × 14·0cm. Price **£3·95.** Post 25p.



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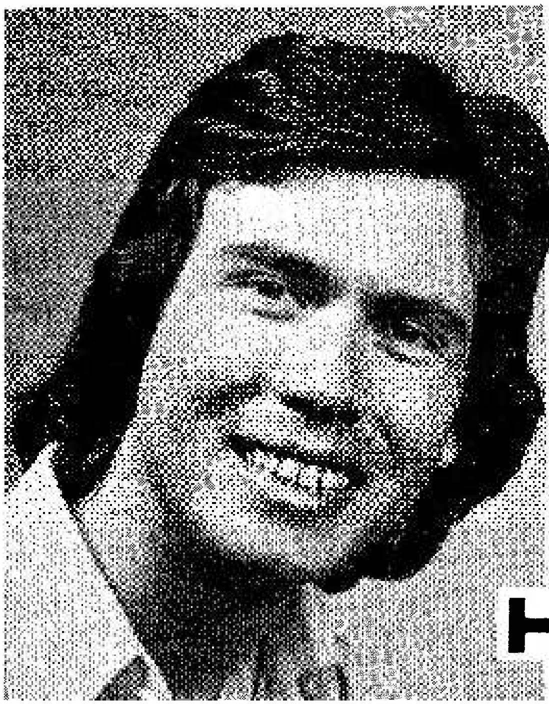


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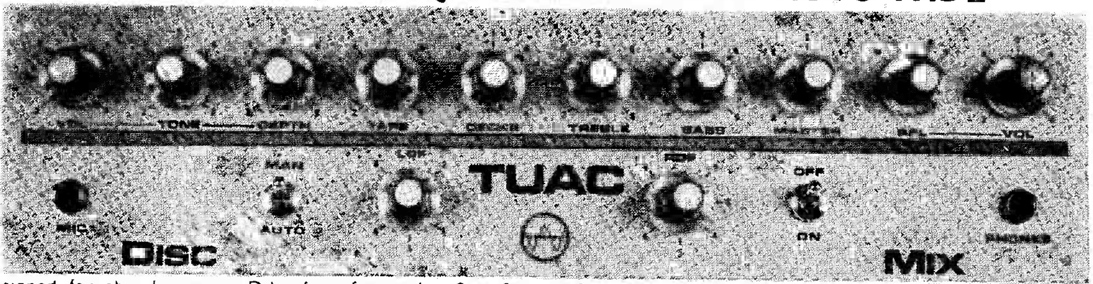

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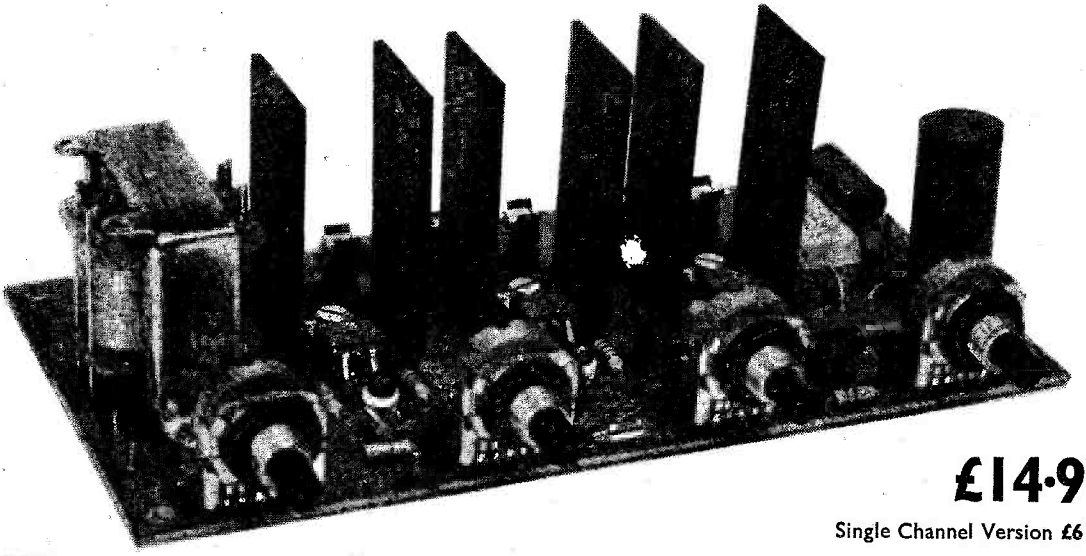

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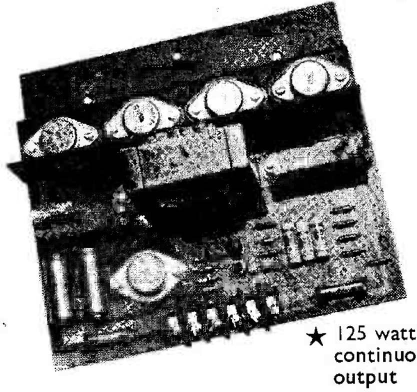

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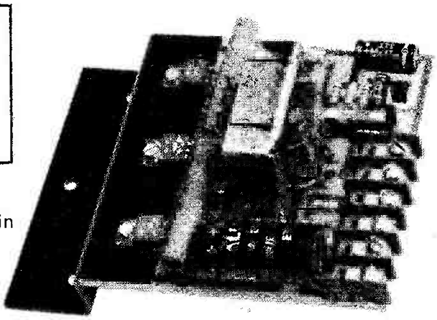
★ 4 R.C.A. 150 watt 15 amp output transistors



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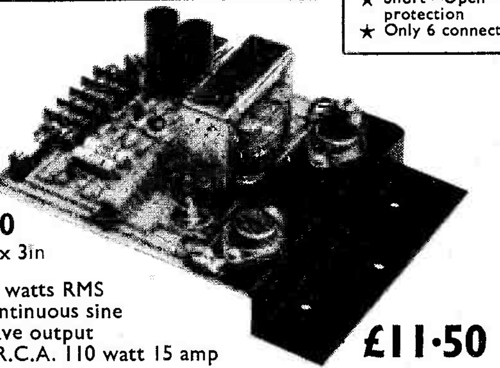

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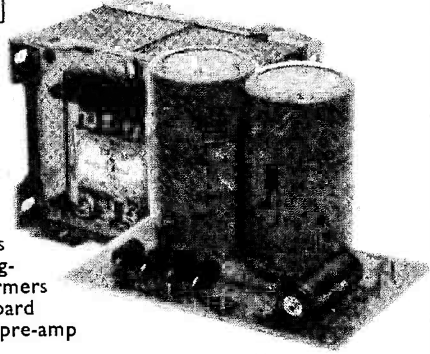

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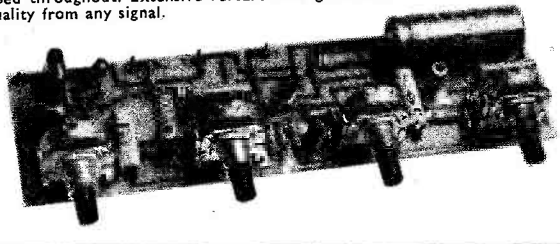

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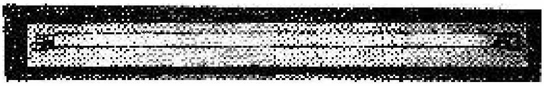

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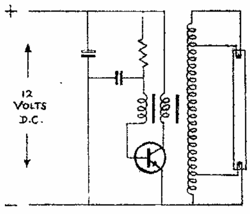

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H8/9A	20μF	70V	4p
H8/10	22μF	50V	4p
H8/11	25μF	12V	4p
H8/12A	30μF	10V	4p
H8/13A	32μF	50V	4p
H8/14	40μF	25V	5p
H8/14A	40μF	16V	4p
H8/15A	40μF	35V	4p
H7/1A	50μF	10V	4p
H7/2A	64μF	2·5V	2p
H7/4	64μF	15V	4p
H7/9A	125μF	4V	4p
H7/10A	160μF	2·5V	3p
H7/11	160μF	25V	6p
H7/11A	150μF	16V	5p
H7/14	220μF	50V	10p
H7/14A	220μF	16V	6p
H7/15	220μF	25V	5p
H7/15A	220μF	35V	10p
H6/1A	250μF	4V	3p
H6/3A	320μF	2·5V	3p
H6/4	320μF	10V	4p
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8·5AMP ISOLATED TAB

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NAS0852W	200V	·67
NAS0852X	200V	·64
NAS0854W	400V	·97
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10AMP ISOLATED TAB

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NAS1002W	200V	·78
NAS1002X	200V	·74
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4 AMP ISOLATED TAB

NAS106P	50PIV	·26
NAS106Q	100PIV	·30
NAS106R	200PIV	·36
NAS106S	400PIV	·57

6 AMP ISOLATED TAB

NAS206P	50PIV	·37
NAS206Q	100PIV	·42
NAS206R	100PIV	·50
NAS206S	100PIV	·77

8 AMP ISOLATED TAB

NAS306P	50PIV	·41
NAS306Q	100PIV	·47
NAS306R	200PIV	·59
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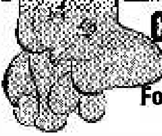

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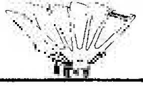

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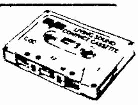

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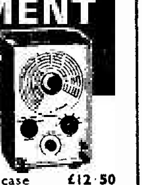

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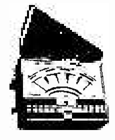

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*C3025 Deluxe meter 1–300 MHZ	**£6·95**
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*SE400 Mini-lab all in one tester	**£15·50**
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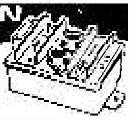

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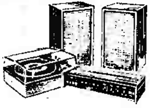

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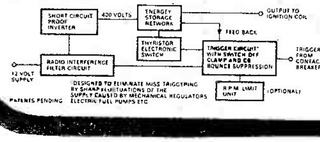

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C	3/4	4·7–10M	1·5	1·2	0·97 nett
C	1	4·7–10M	3·2	2·5	1·92 nett
MO	1/2	10–1M	4	3·3	2·3 nett
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2·2	—	—	—	—	11p	—	8p	9p
4·7	—	—	—	11p	—	8p	9p	8p
10	—	—	—	—	8p	9p	8p	8p
22	—	—	8p	—	9p	8p	8p	10p
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220	8p	8p	9p	10p	10p	11p	17p	28p
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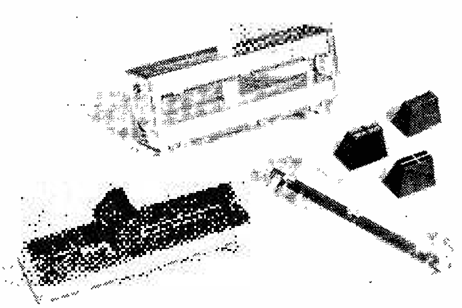

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DT33	Dome Tweeter Freq. 2000–18000Hz Crossover freq 3000Hz Imp 8 ohms. Suitable for systems up to 40 watts	£5·70
FF27	Dome Tweeter. Freq 2000–20000Hz Crossover freq. 3000Hz Imp. 8 ohms Suitable for systems up to 30 watts RMS	£6·80
FF28	Horn Tweeter Freq 3000–20000Hz. Crossover freq 3000Hz Imp 8 ohms Suitable for systems up to 20 watts RMS	£8·20
HT15	Horn Tweeter Freq. 2000–18000Hz Crossover freq 3000Hz Imp 16 ohms. Suitable for systems up to 30 watts RMS	£4·00
HT21	Horn Tweeter. Freq 2500–20000Hz Crossover freq 3000Hz Imp 8 ohms. Suitable for systems up to 40 watts RMS	£6·20
MHT10	Horn Tweeter Freq. 2000–18000Hz Crossover freq 3000Hz. Imp 8 ohms. Suitable for systems up to 30 watts RMS	£4·00

CROSSOVERS

PRICES INC. VAT

CN23	2 Way Crossover Network. Imp 3 ohms. Crossover 3000Hz. Suitable up to 15 watts RMS	£1·70
FF5	3 Way Crossover Network Imp 8 ohms Crossover freqs 1000 and 5000Hz. Suitable up to 25 watts RMS	£3·30
FF30	3 Way Crossover Network Imp 8 ohms Crossover freqs 1000 and 5000Hz Suitable up to 25 watts RMS	£9·20
SN75	2 Way Crossover Network Imp 8 ohms Crossover 3000Hz. Suitable for systems up to 15 watts RMS	£4·60

CASSETTES

PRICES INC VAT

	C60	C90	C120
BASF LH	88p	£1·21	£1·78
MEMOREX			
MROX2 Oxide	99p	£1·32	£1·76
CROX2	£1·47	£1·91	—
PHILIPS	85p	£1·19	£1·75

QTY Discounts 12–10%, 24–15%, 36–20%, 60–25%

SPEAKER CLOTH

Available in Black or Green; Approx width 54in **£1·75 yd.**

HEADPHONES

Type H–202 Features Mono/stereo switch, Volume controls on each channel Freq response 20–20,000Hz Impedance 4–16 ohms **£4·50.**

TEAK VENEERED SPEAKER CABINETS

For 8×5in Speaker	Size 9½ × 13½ × 5¼	£3·50
8in + Tweeter	7¾ × 11¾ × 5¼	£5·00
13 × 8in	10½ × 17 × 6	£5·75
13 × 8in. + Tweeter	12 × 18½ × 8¾	£7·50
12in. + Tweeter	15¾ × 18 × 8¾	£9·00

VALVE AMPLIFIERS

PRICES INC. VAT

Robust units suitable for most PA/Disco uses

5 watt 2 inputs, Vol, Treble, Bass Controls	£12·50
15 watt 4 inputs, Vol, Treble, Bass Controls	£24·50
30 watt 4 inputs, Vol, Treble, Bass Controls	£29·50
50 watt 4 inputs, Vol, Treble, Bass Controls	£36·25
150 watt 4 inputs with separate vol controls plus master vol, treble, bass	£75·90
500 watt 4 inputs each with independent vol, treble and bass controls plus overall master vol. control	£124·50

MICROPHONE MIXERS

PRICES INC. VAT

FF1	4 Channel Mono Mixer and Preamplifier with individual slide controls Battery operated	£26·00
FF10	7 Channel Stereo Mixer and Preamplifier with individual slide controls Battery operated	£34·00
FF11	Stereo Frequency Controller and Preamplifier, uses five slide controls Battery operated	£34·00

All mail order and enquiries to 270 Acton Lane Tel. 01-994 6275

EXHIBITIONS ?!

WHAT is happening to the R.S.G.B. National Mobile Rally? This annual event, as many readers will be aware, took place in the grounds of Woburn Abbey during the month of August.

It was not the day of continuous rain that made the exhibition part of the rally a wash-out—attendance was good despite the climatic conditions. Apathy on the part of the organisers and many exhibitors resulted in dismal displays on nameless stalls.

Who were these nameless exhibitors? These people were, in effect, representatives of one of our greatest national activities—Amateur radio and the amateur electronics constructor. The question being asked was, "surely this is not the R.S.G.B. National Mobile Rally? I must have taken the wrong turning!"

Exhibitors displaying new equipment and those displaying 'surplus' gear were intermixed. Yours truly spent a considerable amount of time trying to find the whereabouts of various exhibitors, without avail. Little information was forthcoming—even from the R.S.G.B. stand itself! Well-established and respected manufacturers and distributors were conspicuous—by their absence. Who can blame them?

Someone had better pull up their socks or we may see the rapid demise of what should be, as the title implies, our *National Mobile Rally.*

Do you remember the Radio Communications or Hobbies Exhibitions sponsored by the Radio Society of Great Britain? They were held annually in the London area and were extremely popular. What happened to them.

Practical Wireless and other major organisations, gave their support on numerous occasions and we are justly proud of the part that we contributed by showing our flag, on behalf of the radio and electronic constructor.

This hobby of ours encompasses an exceedingly wide sphere in the field of electronics and it is the responsibility of the Editor and his staff—as a team—to balance the editorial contents of each issue—to cater for many tastes. The satisfaction that the constructor derives from 'switching it on' is extremely gratifying and indeed therapeutic. We are indeed fortunate in that we live in an era of component plethora. Of course, there are shortages in many areas, but we suggest that the pessimists cast a careful eye over the pages of our *1974/5 PW Buyers' Guide to Radio and Electronic Components.*

Many new items are included, each month by advertisers in their respective columns. Take a good look at the small print, you could be pleasantly surprised!

We shall be exhibiting at the 1974 International Audio Festival and Fair, Olympia, London. Many *PW* constructional projects will be on show, including unique constructional designs not yet published in this country. A further exciting development in the *PW Tele-Tennis* constructional project will also be unveiled.

Members of the editorial and advertising departments will be in attendance to deal with enquiries. We shall also have a limited number of free 'give-aways' to visitors.

Don't forget the *PW* slogan—*Stay tuned to PW* for full coverage of the finest and up-to-the minute constructional projects.

A date for your diary—*Practical Wireless*, Stand B12, International Audio Festival & Fair, Olympia, 28th October—3rd November inclusive.

LIONEL E. HOWES—Editor.

NEWS...

Crofton move

CROFTON ELECTRONICS have moved. Their new address is: 124 Colne Road, Twickenham, Middlesex. (Tel: 898 1569).

A foolproof Electric Lock

SOME quite clever ideas have appeared in journals for electronic locks. But our vote goes to a professional approach recently announced which, as far as we can see, is almost fool-proof. The code for this lock is carefully stored in a CMOS shift register memory. When the "electronic" key is inserted, the code in the key is interrogated by the lock which compares it with the code in its memory. If the two codes are identical the lock will open. The key itself contains another shift register with the identical code in its memory banks. Even a small 32-bit memory would provide a possible four million combinations.

When the key is inserted into the lock it activates a microswitch. This causes the lock to transmit a series of pulses which in turn make the "key" enter its code into the lock for comparison.

Because the key does not emit signals (i.e. magnetic or sonic or anything else) it is impossible to "read" the code from the key. Again, any exploratory signals sent into the lock would immediately alter or destroy its memory (fail safe).

One last cunning asset. The speed of operation of the memory circuits in the lock is fast when opening the door with the correct. key. But slow by "logic" standards. If you were to permutate all combinations possible by plugging some sort of pulsing device into the lock instead of the key—it would take well over a year to run through all the possible combinations. Sorry—not available on the market yet and that's all the information we can get at present.

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

Not to be missed –

THE LATEST Heathkit Catalogue is now available free from: Heath (Gloucester) Limited, Bristol Road, Gloucester, GL2 6EE. Write, or phone Gloucester 29451, for a copy. Or if you happen to be in London or Gloucester, call in and collect one. The London Heathkit Centre is at 233 Tottenham Court Road. and the Gloucester showroom is next to the factory in Bristol Road.

The catalogue contains details of the very large range of electronic kits, many available for the first time in this country.

It talks in detail about kit building "The Heathkit Way" and shows how easy it is to build a Heathkit. Even a complete novice need have no worries as the instruction manual, with the aid of large pictorials and step-by-step instructions, leads you every step of the way.

Its 64 pages give details of many exciting models for home construction, ranging from a large selection of audio and Hi-Fi equipment through electronic calculators, digital electronic clocks, electronic thermometers, an ultrasonic burglar alarm, to test instruments for the electronic hobbyist and home car servicer. Even a 12 inch black and white portable television kit is available.

Heathkit's Catalogue

New kit models include an f.m. tuner with digital readout and computer tuner, a 4 channel SQ amplifier, a battery powered electronic thermometer and a de-luxe digital electronic clock with alarm. All models are available for cash or on extended credit terms through the very popular Heath Money Budget Plan. A free technical consultation service is in operation both before and after purchase.

You have been warned! Don't forget to order your copy of the December issue of *Practical Wireless* . . . look for your Free PW Miniature Screwdriver.

Start building the PW Kempton with our December issue. This is a quality stereo cassette player for your car; build yourself an inexpensive capacitance bridge that really works, and the third section of our 1974/5 PW Buyers Guide to Radio and Electronic Components will also be included in our December issue.

In the January 1975 issue of PW, we start the New Year with constructional series on radio control. Don't forget to place a permanent order with your newsagent, or write to our subscription department.

Further details of the December issue on page 609.

Hi-Fi Accessories by Bib

BIB HI-FI Accessories Limited announce the publication of a comprehensive 16-page full colour catalogue, which illustrates and describes their very large range of hi-fi accessories which now comprises more than 70 products.

The catalogue has been designed so that it can be easily reprinted in foreign languages and arrangements are already in hand to print it in French, German and Italian.

For the UK market a single sheet retail price list is inserted in the catalogue.

Bib Hi-Fi Accessories Ltd., PO Box 78, Hemel Hempstead, Herts, HP2 7EP.

Wolsey's Colour King at sea

WOLSEY ELECTRONICS equipment is now being increasingly used on marine installations and the most recent of these, through Aerialwork Limited of Southampton, their agents for Southern England, has been the installation of a communal TV and radio system to the officers and crews quarters on the car ferry "Eagle". In order to receive various transmitters whilst at sea, a Wolsey Broad Band "Colour King" u.h.f. aerial and FM411 array were erected with a rotator motor and remote control unit. The aerials and mast were specially treated to withstand exposed sea conditions. The well-proved Wolsey "Mercury" amplifier was fitted and provision was made for a monochrome video cassette recorder and additional outlet points to public rooms should this be required at some future date.

The 11,500 ton "Eagle" which is controlled by one of the P & O Group of Companies—Southern Ferries—is the largest on/off car ferry to use the port of Southampton and operates a regular service to Lisbon, Algeciras and Tangier.

FM AERIAL pre-amplifier

KEITH CUMMINS

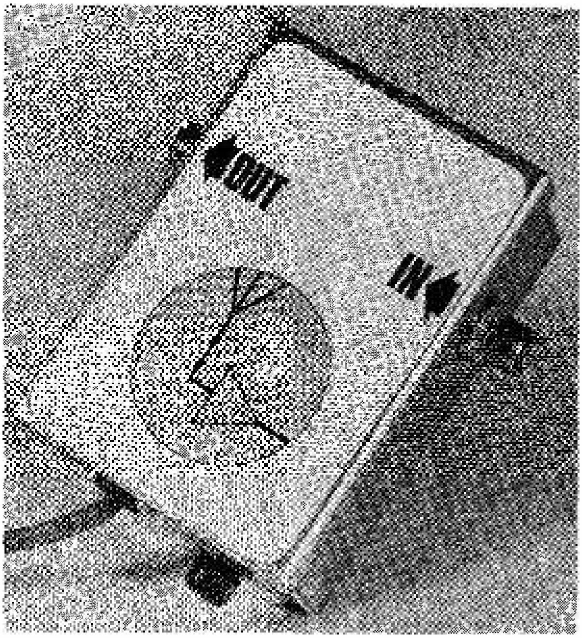
LONG-DISTANCE reception of weak FM signals is possible provided that a high gain aerial is used and that the receiver has high sensitivity. Some older types of receiver lack the sensitivity of their modern counterparts and the use of an aerial amplifier can improve reception considerably.

We have to be careful in the use of such an amplifier however, since high gain is not the only pre-requisite. If the amplifier adds as much noise as it increases the signal, then we are no better off. The amplifier must have a good noise factor, that is, it increases the signal by a much greater amount than it increases the noise.

Another aspect we have to consider is the type of reception we expect, having provided the amplifier. If the incoming signal is very weak indeed than we may be able to improve it, but if it fades away to nothing, no amount of amplification will bring it back again. This situation can exist during fading conditions, when total cancellation of the signal at the aerial occurs because of multipath reception. An amplifier can be useful, however, since it shortens the time during which the signal is unusable. Imagine a threshold level below which the signal must not fall if a satisfactory signal-to-noise ratio is to be maintained; if the amplifier lifts the entire incoming signal, this can fall to a lower level before becoming unsatisfactory.

CROSS MODULATION

The VHF FM band is becoming quite crowded and the weak signals we wish to amplify may be situated very close to a strong local transmission. Unless our amplifier is correctly designed, a strong possibility exists that cross-modulation will occur between the various signals present, due to the high amplitude of the local signals. The signals we wish to receive may then become completely lost in the mess which results. Once this has happened, it is impossible to separate the signals again, so we must prevent such a thing happening in the first place.



Cross-modulation can not only occur in the amplifier but also in the input stages of the receiver. A valve receiver is far more tolerant of high input levels than its transistor counterpart. Too much amplification before the receiver's RF stage can therefore cause intermodulation and it will be seen that excessive gain can be a real disadvantage. Any aerial amplifier used for FM work should therefore not have so much gain that the local signals will cause cross modulation, have enough gain to substantially improve weak signals, and, itself, have

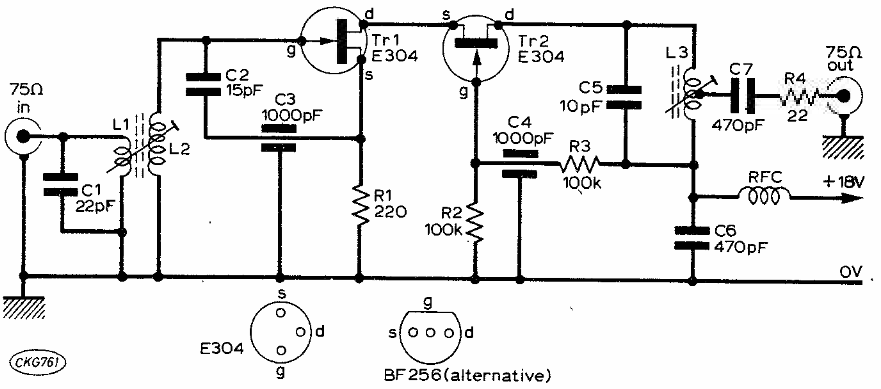


Fig. 1: The two FETs are connected in a cascode circuit, the first being an amplifier while the second is a buffer or isolating stage.