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JULY 1977

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7403	14p	7417	30p	7440	15p	7472	25p	7493	40p	74125	50p	74143	270p	74161	90p	74177	100p	74192	120p
7404	14p	7420	15p	7441	65p	7473	30p	7495	60p	74126	50p	74144	270p	74162	90p	74178	140p	74193	120p
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7409	20p	7427	25p	7448	70p	7485	100p	74107	30p	74136	80p	74151	65p	74167	325p	74184	150p	74198	185p
7410	15p	7428	40p	7450	15p	7486	30p	74109	50p	74137	100p	74153	65p	74170	200p	74185	150p	74199	185p
7411	20p	7430	15p	7451	15p	7489	250p	74118	90p	74138	125p	74154	120p	74173	150p	74188	350p		
7412	20p			7453	15p			74120	90p			74155	70p						

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by MULLARD, TEXAS, MOTOROLA, SIEMENS, I.T.T., R.C.A.

AA113	10p	BA138	16p	BC168B	14p	BC548C	14p	BF123	45p	BF336	35p	BY164	50p	OC140	150p	TIP35A	230p	2N1305	30p
AA144	10p	BA148	16p	BC168C	15p	BC549B	13p	BF125	45p	BF337	35p	BYX94	8p	OC171	40p	TIP35C	280p	2N1306	38p
AAZ17	30p	BA154	12p	BC169C	15p	BC549C	14p	BF127	50p	BF363	60p	C1120	30p	OC200	80p	TIP36A	350p	2N1308	50p
AC121	30p	BA157	15p	BC171	12p	BC557	13p	BF166	30p	BFS94	30p	C1164	20p	ORP12	70p	TIP41A	70p	2N1711	22p
AC126	19p	BA173	15p	BC172C	12p	BCY34	80p	BF167	25p	BFW58	20p	E100	42p	R1039	150p	TIP41B	75p	2N2219A	25p
AC127	19p	BA216	16p	BC178A	16p	BCY70	15p	BF173	25p	BFX29	30p	E300	47p	TIP29	45p	TIP41C	80p	2N2483	30p
AC127/01	25p	BA316	16p	BC182	10p	BCY71	20p	BF179	35p	BFX81	130p	E430	125p	TIP29A	47p	TIP42A	80p	2N2906	18p
AC128	18p	BAX13	5p	BC182L	12p	BCY72	15p	BF179C	40p	BFX84	25p	MJE340	45p	TIP29C	75p	TIP42B	85p	2N2907	20p
AC151	25p	BAX16	5p	BC183	10p	BD121	85p	BF180	30p	BFX85	30p	MPSA06	25p	TIP30	55p	TIP2955	70p	2N3053	20p
AC153K	40p	BB105A	35p	BC183L	12p	BD123	100p	BF181	35p	BFX87	25p	OA10	40p	TIP30A	58p	TIP3055	55p	2N3054	50p
AC176	20p	BB110	45p	BC184	10p	BD124	85p	BF182	30p	BFX88	25p	OA47	15p	TIP30B	65p	TIS90	25p	2N3055	60p
ACY17	35p	BC107	10p	BC184L	12p	BD131	36p	BF183	30p	BFY50	20p	OA90	6p	TIP30C	80p	TIS91	25p	2N3439	50p
ACY21	30p	BC108	10p	BC186	24p	BD132	39p	BF186	25p	BFY51	20p	OA91	6p	TIP31	55p	IN914	5p	2N3702	11p
AD149	60p	BC108C	15p	BC205	14p	BD133	45p	BF194	10p	BFY52	20p	OA202	8p	TIP31A	58p	IN3754	10p	2N3703	12p
AD161	40p	BC109	10p	BC212	11p	BD135	40p	BF195	10p	BFY90	125p	OC23	200p	TIP31B	65p	IN4001	5p	2N3704	11p
AD162	40p	BC109C	14p	BC212L	12p	BD136	40p	BF196	10p	BR101	35p	OC25	100p	TIP31C	70p	IN4002	5p	2N3705	12p
AD161/2MP	90p	BC113	12p	BC213L	12p	BD137	40p	BF197	10p	BRY39	35p	OC28	75p	TIP32	60p	IN4003	5p	2N3706	11p
AF114	22p	BC117	19p	BC214	13p	BD139	38p	BF198	25p	BRY56	35p	OC35	75p	TIP32A	65p	IN4004	5p	2N3711	12p
AF115	22p	BC125	20p	BC214L	14p	BD140	40p	BF199	25p	BSX20	20p	OC42	35p	TIP32B	85p	IN4005	5p	2N3715	300p
AF116	22p	BC126	15p	BC258	13p	BD181	80p	BF200	30p	BSY40	25p	OC43	35p	TIP32C	90p	IN4006	6p	2N3772	175p
AF117	22p	BC146	12p	BC294	35p	BD182	80p	BF224	20p	BSY95	20p	OC45	35p	TIP33	100p	IN4007	7p	2N3819	25p
AF118	50p	BC147	10p	BC303	55p	BD207	70p	BF225	20p	BT100A	80p	OC71	25p	TIP33A	105p	IN4148	4p	2N3866	95p
AF125	25p	BC148	10p	BC317	15p	BD233	50p	BF241	16p	BU105	150p	OC72	30p	TIP33B	115p	IS44	4p	2N3904	15p
AF139	35p	BC148C	14p	BC323	60p	BD263	65p	BF244B	35p	BU133	75p	OC75	30p	TIP33C	130p	2N456A	90p	2N4062	14p
AF239	45p	BC149	10p	BC328	13p	BDY10	100p	BF257	26p	BU208	220p	OC81	30p	TIP34	115p	2N697	15p	2N4126	20p
ASY26	40p	BC157	10p	BC338	12p	BDY62/01	90p	BF258	26p	BY100	20p	OC81D	25p	TIP34A	118p	2N929	20p	2N5061	35p
BA114	9p	BC158	10p	BC547	12p	BF120	50p	BF259	30p	BY126	15p	OC83	50p	TIP34B	145p	2N930	20p	2N5163	35p
BA121	9p	BC159	10p	BC547B	13p	BF121	45p	BF274	15p	BY127	15p	OC84	50p	TIP35	225p	2N1302	25p	2N6027	50p
		BC167A	12p	BC548	12p			BF324	30p	BY133	22p							2SD234	50p

BZX61 Zeners 1·3W
6V8 15p, 9V1 15p, 11V 15p, 13V 15p, 15V 15p, 22V 15p, 30V 15p, 39V 15p, 43V 15p, 47V 15p, 51V 15p, 56V 15p, 68V 15p, 72V 15p, 160V 15p

BZY88
12V 10p, 13V 10p, 15V 10p, 18V 10p, 20V 10p, 22V 10p, 27V 10p, 30V 10p, 33V 10p
100 Mixed Zeners 850p
BZY88 Zeners 850p

BZY88 400M.W. Zeners
OV7 10p, 2V4 10p, 2V7 10p, 3V0 10p, 3V3 10p, 3V6 10p, 3V9 10p, 4V7 10p, 5V1 10p, 5V6 10p, 6V2 10p, 6V8 10p, 7V5 10p, 8V2 10p, 9V1 10p, 10V 10p, 11V 10p

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Type 7AD £4 1000
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Assorted Types

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LM301AM 8Pin Dil 65p
LM308N 8 DIL 130p
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LM723 14P DIL 75p
LM741 8P DIL 25p
LM741 14P DIL 30p
LM747 14P DIL 80p
LM748 8P DIL 45p
NE555 8P DIL 35p
ME556 14P DIL 100p
TAA300 150p
TAA350 190p
TAA550 50p
TAA570 220p
TAA700 390p
TAD100 250p
TAD110 200p
TBA120 125p
TBA540Q 300p
TBA550Q 400p
TBA560C 400p
TBA720 230p
TBA990Q 250p
TCA 270Q 250p
TCA270S 250p

ELECTROLYTIC CAPACITORS µF/V
·47/25 5p, 1/16 5p, 1/25 5p, 1/50 5p, 2·2/25 5p, 2·2/35 5p, 3·3/25 5p, 4·7/10 5p, 4·7/16 5p, 4·7/25 5p, 4·7/50 5p, 6·8/25 5p, 10/10 5p, 10/16 5p, 10/25 5p, 10/35 5p, 10/50 5p, 22/6V3 5p, 22/10 5p, 22/16 5p, 22/25 5p, 22/35 5p, 22/50 6p, 33/6V3 5p, 33/16 6p, 33/25 6p, 33/40 6p, 33/50 7p, 47/10 6p, 47/16 6p, 47/25 6p, 47/35 6p, 47/50 7p, 100/10 6p, 100/16 6p, 100/25 6p, 100/50 8p, 100/63 10p, 125/15 6p, 220/16 10p, 220/25 12p, 220/50 20p
330/25 15p, 330/35 16p, 330/50 18p, 470/10 12p, 470/25 16p, 470/35 18p, 470/50 22p, 680/25 25p, 1000/16 25p, 1000/35 30p, 2200/10 28p, 2200/16 35p, 2200/63 60p, 2200/100 120p, 3300/16 40p, 3300/25 42p, 3300/63 80p, 4700/25 45p, 4700/40 50p, 4700/63 120p

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1K Lin 30p, 5K Lin 30p, 10K Lin 30p, 25K Lin 30p, 50K Lin 30p, 100K Lin 30p, 250K Lin 30p, 500K Lin 30p, 1 Meg Lin 30p, 2 Meg Lin 30p, 5K Log 30p, 10K Log 30p, 25K Log 30p, 50K Log 30p, 100K Log 30p, 250K Log 30p, 500K Log 30p, 1 Meg Log 30p, 2 Meg Log 30p

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1P 12W 40p, 2P 6W 40p, 3P 4W 40p, 4P 3W 40p

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4023 20p, 4024 100p, 4025 20p, 4026 200p, 4027 85p, 4028 155p, 4029 130p, 4030 60p, 4032 150p, 4043 220p, 4046 150p, 4047 115p, 4049 70p, 4050 50p, 4054 130p
4055 140p, 4056 145p, 4060 130p, 4066 55p, 4069 30p, 4071 30p, 4072 30p, 4081 20p, 4082 30p, 4510 145p, 4511 200p, 4516 140p, 4518 110p, 4528 130p

BRIDGE RECTIFIERS
1A 50V 25p, 1A 100V 30p, 1A 200V 30p, 1A 400V 35p, 1A 600V 40p, 2A 50V 35p, 2A 100V 50p, 2A 200V 55p
2A 400V 60p, 4A 100V 65p, 4A 400V 80p, 6A 50V 75p, 6A 100V 75p, 6A 200V 85p, 6A 400V 95p

SKELETON PRE-SET POTENTIOMETERS
0·1W 50N–5M mini vert & horiz 7p
·25W 100N–3·3M horiz. 7p
·25W 200N–4·7M vert. 8p

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35V: 0·1µF, 0·22, 0·33, 0·47, 0·68, 1·0, 2·2, 3·3, 4·7, 6·8, 25V 1·5, 10, 16V 4·7, 10, 22, 47, 10V 4·7, 15, 25, 33 Price 14p each

LATE EXTRA
TBA 800 100p, TBA 641 A12 250p, SU7653op 185p, TAA661B 175p, TAA 790 250p, CA3085 55p, CA3090AQ 400p, Filter CFT455B 80p, 3817I.C. 750p, FND500 130p, MM5314 430p, LM317K 385p, LM309K 180p, LM3900N 90p, TBA120T 120p

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RED ·125 15p, GREEN ·125 25p, YELLOW ·125 25p, RED ·2 15p, GREEN ·2 25p, YELLOW ·2 25p, DL747 Display 200p

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PRACTICAL WIRELESS

VOL. 53 NO. 3

ISSUE 845

JULY 1977

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

PLEASE NOTE: We do not operate a Technical Query Service except on matters concerning constructional articles published in PW. We do not supply service sheets or information on commercial radios, TV's or electronic equipment.

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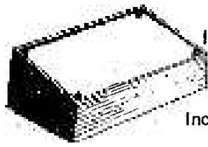
● NEWS & COMMENT

● CONSTRUCTIONAL

● OTHER FEATURES

MINI CONSOLES



Ideal for small desk control panels and consoles. Moulded in orange, blue, black and grey ABS. Incorporates slots for holding 1.5mm thick pcb's
Aluminium panel sits recessed into front of console and held by screws running into integral brass bushes.

MC 161 x 96 x 58mm	£1.53	(1-9)	£1.50	(10+)
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Add 25p per £1 order value for Post & Packing

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Mixed bags, all sizes, various colours

FULL SPECIFICATION LED's

Red (specify size) 75p per pack
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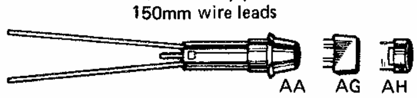
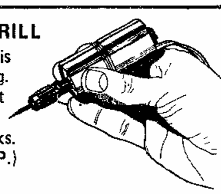
TYPE A NEON INDICATORS

Supplied with resistor for 240 Volts operation
Held in 8mm hole by plastic bezel
150mm wire leads



Red, Amber, Clear, Opal	19p each	
Green	28p each	

12 VOLTS MINI HAND DRILL

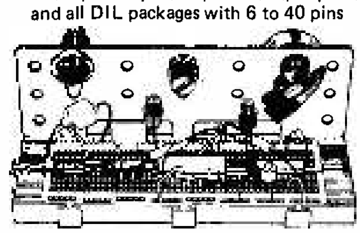


Ideal for drilling pcb, chassis etc as well as model making. Supplied with 2 collets that accept tools and drills with 3/32" and .050" dia. shanks.
£7.56 (Includes VAT & P.P.)

Stop wasting time soldering

The NEW MW BREADBOARD accepts

Transistors, LED's, Diodes, Resistors, Capacitors and all DIL packages with 6 to 40 pins



Includes slot-in Component Support Bracket and has over 400 individual sockets, plus Vcc and Ground Bus Strips
Price £9.72 (includes VAT & P.P.)

TYPE MP NEON INDICATOR

Supplied with resistor for 240 Volts operation
150mm leads, held in 6.4mm hole by nut

Red, Amber, Clear, Opal 20p each

SEVEN SEGMENT DISPLAYS

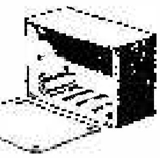
Economy Quality
Common Anode – 0.3" – Left Decimal
Red, Yellow and Green @ 45p each

Full Specification
Common Anode – 0.3" - Left Decimal
Red @ 98p each
Green and Yellow @ £1.35 each
(Data supplied with Full Spec. displays only)

Quantity quotations on request

P.P. Note Unless included in price add 25p Post & Packing for orders totalling under £10. **All** prices include VAT and are valid in UK only for 2 months from journal issue date

SC BOXES (square corners)

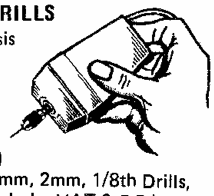


Easily drilled or punched, orange, blue, black and grey ABS. Incorporate slots for holding 1.5mm thick pcb's. Aluminium panel sits recessed into front of the box and held by screws running into integral brass bushes.

SC 85 x 56 x 35mm	80p	(1-9)	77p	(10+)
SC 111 x 71 x 48mm	£1.07	(1-9)	£1.04	(10+)
SC 161 x 96 x 59mm	£1.49	(1-9)	£1.46	(10+)

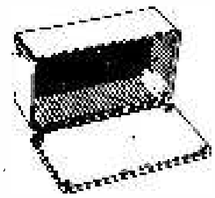
Add 25p per £1 order value for Post & Packing

240 VOLTS MINI HAND DRILLS



Ideal for drilling pcb's, chassis etc as well as model making. Supplied with 3 collets that accept tools and drills with 1mm, 2mm and 1/8" dia shanks.
£9.72 (includes VAT & P.P.)
Accessory tools... 5 Burrs, 1mm, 2mm, 1/8th Drills, 3/32" Collet Price £1.75 (Includes VAT & P.P.)

RC BOXES (round corners)



Easily drilled or punched, orange, blue, black and grey ABS. Incorporate slots for holding 1.5mm thick pcb's. Close fitting flanged lids held by screws running into integral brass bushes.

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RC 120 x 65 x 40mm	68p	(1-9)	62p	(10+)
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RC 190 x 110 x 60mm	£1.33	(1-9)	£1.30	(10+)

Polystyrene version
in grey only with no slots, no integral brass bushes

RC(P) 112 x 61 x 31mm	35p	(1-9)	32p	(10+)

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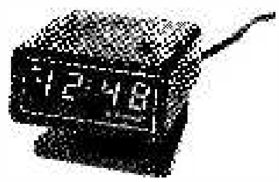
TIMEBAND C500 DIGITAL ALARM CLOCK (Illustrated) **£14.35**



Can be set to the exact second. Will display last minute digit and seconds. Solid state silence. Nine minute snooze and other sophisticated features. Black or White.
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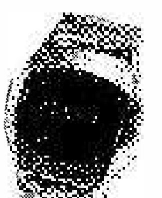

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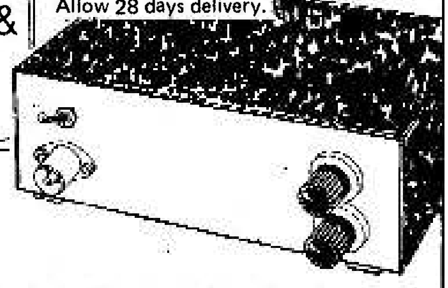

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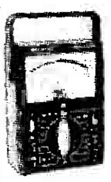
50,000 o.p.v.



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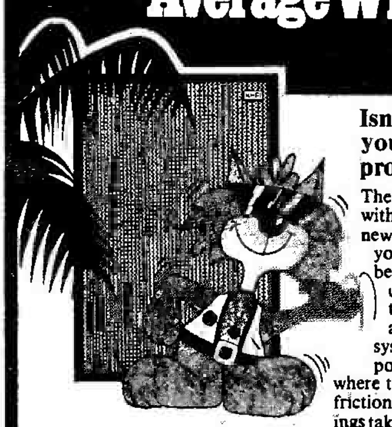

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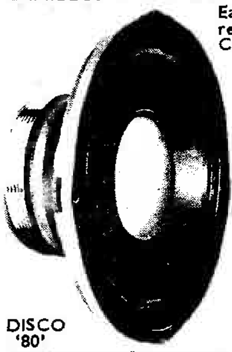

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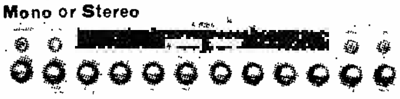

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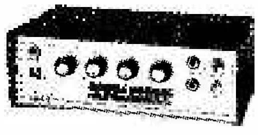

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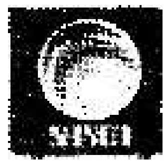

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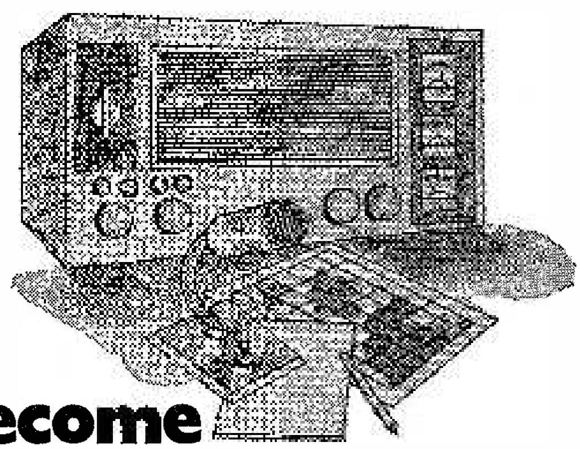

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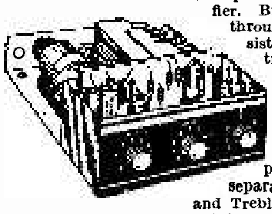

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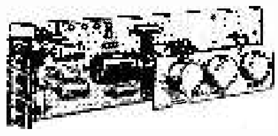
HARVERSONIC STEREO 44



A solid state stereo amplifier chassis, with an output of 3-4 watts per channel into 8 ohm speakers. Using the latest high technology integrated circuit amplifiers with built in short term thermal overload protection. All components including rectifier smoothing capacitor, fuse, tone control, volume controls, 2 pin din sockets & 5 pin din tape rec./play socket are mounted on the printed circuit panel size approx. 9½" × 2¾" × 1" max. depth. Supplied brand new & tested, with knobs, brushed anodised aluminium 2 way escutcheon (to allow the amplifier to be mounted horizontally or vertically) at only **£9·00** plus 50p P & P. Mains transformer with an output of 17v a/c at 500m/a can be supplied at **£1·50** + 40p P & P if required. Full connection details supplied.

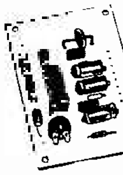
VYNAIR & REXINE SPEAKERS & CABINET FABRICS app. 54 in. wide. **Our Price £1·50 yd. length.** P. & P. 50p per yd. (min. 1 yd.). S.A.E. for samples.

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

MAINS TRANSFORMER. For power supplies.
Pri. 200/240v. Sec. 9–0–9 at 500 mA. **£1·50.** P. & P. 60p.
Pri. 200/240v. Sec. 12–0–12 at 1 amp. **£1·65.** P. & P. 60p.
Pri. 200/240v. Sec. 10–0–10 at 2 amp. **£2·35.** P. & P. 90p.
Pri. 200/240V Sec. 23V at 1·5amp, 6V at ·6 amp, 8V at 50mA. **£2·00** + 65p P. & P.

ALL-PURPOSE POWER SUPPLY UNIT 200/240v. A.C. input. Four switched fully smoothed D.C. outputs giving 6v. and 7½v. and 9v. and 12v. at 1 amp on load.
Fitted insulated output terminals and pilot lamp indicator. Hammer finish metal case overall size 6" × 3½" × 2¾". Ready built and tested Price **£6·75** P. & P. 85p.

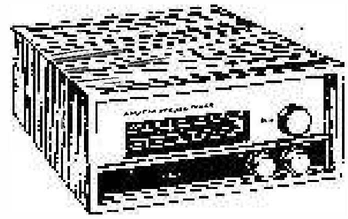
STEREO-DECODER



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

QUALITY RECORD PLAYER AMPLIFIER MK. II A top quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. wide × 3in. deep × 6in. high. Ready built and tested. **PRICE £7·00.** P. & P. 90p.
ALSO AVAILABLE mounted on board with output transformer and speaker. **PRICE £8·00,** P. & P. £1.

MAINS OPERATED SOLID STATE AM/FM STEREO TUNER

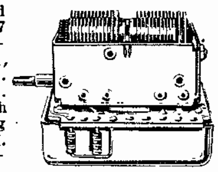


200/240V Mains operated Solid State F/M A/M Stereo Tuner. Covering M.W. A.M. 540-1605KHz VHF/FM 88-108MHz.
Built-in Ferrite rod aerial for M.W. Full AFC and AGC on AM and FM. Stereo Beacon Lamp Indicator. Built in Pre-amps with variable output voltage adjustable by pre-set control. Max o/p Voltage 600m/v RMS into 20K. Simulated Teak finish cabinet. Will match almost any amplifier. Size 8½"w x 4"h x 9½"d approx.

LIMITED NUMBER ONLY at £28·00 + £1·30 P. & P.

SPECIAL OFFERS

Mullard LP1159 R.F.-I.F. Double Tuned Amplifier Module for nominal 470 KHz. Size approx. 2¼" × 1¼" × ½" 7·6 Volt + earth. Brand new pre-aligned. Full specification and connection details supplied. **£2·25.** P. & P. 12p



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

PRECISION MADE
Push Button Switch bank. 8 Buttons giving 16 S/P C/O interlocked switches plus 1 Cancel Button Plus 3 d/p c/o. Overall size 5" × 2⅛" × 1". Supplied complete with chrome finished switch buttons. **2 for £1·50** + 20p P & P.

HI-FI LOUDSPEAKER SYSTEM MK II

Beautifully made, simulated teak finish enclosure with attractive slatted front. Size 16½" high × 10½" wide × 9" deep (approx.). Fitted with E.M.I. Ceramic Magnet 13" × 8" bass unit, H.F. tweeter unit and crossover. **AVAILABLE IN NOMINAL 4 Ohm, 8 Ohm or 16 Ohm impedance (state which).** Handling power 10 watts R.M.S.
OUR PRICE £12·80 each. Carr. £1·90 ea.
Cabinet Available Separately £7·60, Carr. £1·40 each.
Also available in 8 ohms with EMI 13" × 8" bass speaker with parasitic tweeter **£11·10,** Carr. £1·90 ea.

LOUDSPEAKER BARGAINS
5in. 3 ohm **£2·00,** P. & P. 35p. 7 × 4in. 3 ohm **£2·35,** P. & P 48p. 10 × 6in. 3 or 15 ohm **£3·30,** P. & P. 75p. 8 × 5in. 3 ohm with high flux magnet **£3·00,** P. & P. 50p. Tweeter. Approx. 3½". Available 3 or 8 or 15 ohms, **£2·00** + 25p, P. & P. 2" Plastic Cone HF Tweeter 4 ohm £3·50 per matched pair + 50p P. & P.

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

"POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER
Size 11½" × 14⅝" × 1⅛" deep. Weight 19oz. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40Hz–20kHz. Can be mounted on ceilings, walls, doors, under tables, etc., and used with or without baffle. Send S.A.E. for full details.
Only **£8·40** each + p. & p. (one 75p, two 90p).
Now also available 8". – 8 ohm 10 watts, r.m.s. 20 watt peak 40 Hz-20,000 Hz. Overall depth 1". Ideal for Hi-Fi or for use in cars **£5·10** + p. & p. (one 35p, two 65p).

SPECIAL LINES

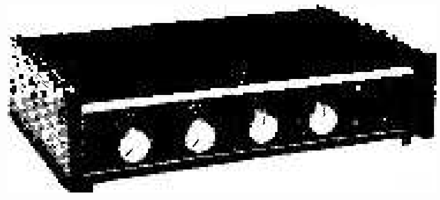
OFFERED SUBJECT TO STOCK AVAILABILITY

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

25 watt RMS Solid state power amplifier module. Fre. Resp. 35 Hz.–20 KHz. Power requirements 40 volts @ 1·5 amps. Full c/d & connection details supplied. **£6·20** + 30p P/P.

Prices include VAT at Current Rate

HARVERSONIC SUPERSOUND 10 + 10 STEREO AMPLIFIER KIT



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

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

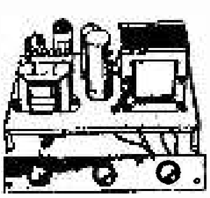
AMPLIFIER KIT .. .. **£13·50** P. & P. 65p
(Magnetic input components 33p extra)
POWER PACK KIT .. .. **£5·50** P. & P. 85p
CABINET .. .. .. **£5·50** P. & P. 85p

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

Full after sales service

Also available ready built and tested **£31·25.** P. & P. £1.

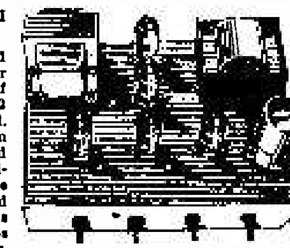
3-VALVE AUDIO AMPLIFIER HA34 MK II



Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½"w. × 4"d. × 4½"h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only **£8·20.** P. & P. £1·00.

HSL "FOUR" AMPLIFIER KIT. Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc **£7·60** P. & P. £1·00.

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other.
Fully shrouded section wound output transformer to match 3-15 Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 25p + SAE (Free with parts). **All parts sold separately.** ONLY **£12·00** P. & P. £1·35. Also available ready built and tested **£16·50** P. & P. £1·35.

GENERAL PURPOSE HIGH STABILITY TRANSISTOR PRE-AMPLIFIER
For P.U., Tape, Mike, Guitar, etc. and suitable for use with valve or transistor equipment. 9-18v. battery or from H.T. line 200/300v. Frequency response 15Hz—25KHz. Gain 26dB. Solid encapsulation size 1¾" × 1½" × ½". Brand new complete with instructions. Price **£1·80** P.& P. 15p.

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

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SEMICONDUCTORS—COMPONENTS

DIODES

Type	Price	Type	Price	Type	Price		
AA129	£0·08	BY100	£0·16	BYZ11	£0·31	OA91	£0·07
AAY30	£0·09	BY107	£0·12	BYZ12	£0·31	OA95	£0·07
AAZ13	£0·10	BY105	£0·18	BYZ13	£0·26	OA182	£0·07
AAZ17	£0·10	BY114	£0·12	BYZ16	£0·41	OA200	£0·08
BA100	£0·10	BY124	*£0·12	BYZ17	£0·36	OA202	£0·08
BA102	£0·32	BY126	*£0·15	BYZ18	£0·36	SD10	£0·06
BA148	£0·15	BY127	*£0·16	BYZ19	£0·28	SD19	£0·06
BA154	£0·12	BY128	*£0·16	OA10	£0·35	IN34	£0·07
BA155	£0·14	BY130	*£0·17	OA47	£0·07	IN34A	£0·07
BA156	£0·14	BY133	*£0·21	OA70	£0·07	IN914	£0·06
BA173	£0·15	BY164	£0·51	OA79	£0·07	IN916	£0·06
BB104	£0·15	BY176	*£0·75	OA81	£0·07	IN4148	£0·06
BAX13	£0·07	BY206	£0·00	OA85	£0·09	IS44	£0·05
BAX16	£0·08	BYZ10	£0·36	OA90	£0·07	IS920	£0·06

SILICON RECTIFIERS

Type	Price	Type	Price	Type	Price	Type	Price
IS920	£0·06	IN4003	£0·07	IS020	£0·10	IS031	£0·25
IS921	£0·07	IN4004	£0·08	IS021	£0·11	IN5400	£0·13
IS922	£0·08	IN4005	£0·09	IS023	£0·13	IN5401	£0·15
IS923	£0·09	IN4006	£0·10	IS025	£0·14	IN5402	£0·16
IS924	£0·10	IN4007	£0·11	IS027	£0·16	IN5404	£0·17
IN4001	£0·05	IS015	£0·09	IS029	£0·20	IN5406	£0·21
IN4002	£0·06					IN5407	£0·25

TRIACS

2 AMP TO5 CASE

Volts	No.	Price
100	TR12A/100	£0·31
200	TR12A/200	£0·51
400	TR12A/400	£0·71

10 AMP TO48 CASE

Volts	No.	Price
100	TR110A/100	£0·77
200	TR110A/200	£0·92
400	TR110A/400	£1·12

6 AMP TO66 CASE

Volts	No.	Price
100	TR16A/100	£0·51
200	TR16A/200	£0·61
400	TR16A/400	£0·77

10 AMP TO48 CASE

Volts	No.	Price
100	TR110A/100	£0·77
200	TR110A/200	£0·92
400	TR110A/400	£1·12

THYRISTORS

600mA TO18 CASE

Volts	No.	Price
10	THY600/10	£0·13
20	THY600/20	£0·13
30	THY600/30	£0·19
50	THY600/50	£0·22
100	THY600/100	£0·25
200	THY600/200	£0·38
400	THY600/400	£0·45

7 AMP TO48 CASE

Volts	No.	Price
50	THY7A/50	£0·48
100	THY7A/100	£0·51
200	THY7A/200	£0·57
400	THY7A/400	£0·62
600	THY7A/600	£0·78
800	THY7A/800	£0·92

1 AMP TO5 CASE

Volts	No.	Price
50	THY1A/50	£0·26
100	THY1A/100	£0·27
200	THY1A/200	£0·28
400	THY1A/400	£0·36
600	THY1A/600	£0·45
800	THY1A/800	£0·58

10 AMP TO48 CASE

Volts	No.	Price
50	THY10A/50	£0·51
100	THY10A/100	£0·57
200	THY10A/200	£0·62
400	THY10A/400	£0·71
600	THY10A/600	£0·99
800	THY10A/800	£1·22

3 AMP TO66 CASE

Volts	No.	Price
50	THY3A/50	£0·25
100	THY3A/100	£0·27
200	THY3A/200	£0·33
400	THY3A/400	£0·42
600	THY3A/600	£0·50
800	THY3A/800	£0·65

16 AMP TO48 CASE

Volts	No.	Price
50	THY16A/50	£0·54
100	THY16A/100	£0·58
200	THY16A/200	£0·62
400	THY16A/400	£0·77
600	THY16A/600	£0·90
800	THY16A/800	£1·39

5 AMP TO66 CASE

Volts	No.	Price
50	THY5A/50	£0·36
100	THY5A/100	£0·48
200	THY5A/200	£0·50
400	THY5A/400	£0·57
600	THY5A/600	£0·69
800	THY5A/800	£0·81

30 AMP TO94 CASE

Volts	No.	Price
50	THY30A/50	£1·18
100	THY30A/100	£1·43
200	THY30A/200	£1·63
400	THY30A/400	£1·79
600	THY30A/600	£3·50

5 AMP TO220 CASE

Volts	No.	Price
400	THY5A/400P	£0·57
600	THY5A/600P	£0·69
800	THY5A/800P	£0·81

No.	Price
BT101/500R	£0·80
BT102/500R	£0·80
BT106	£1·25
BT107	£0·93
BT108	£0·98
2N3228	£0·70
2N3525	£0·77
BTX30/50L	£0·33
BTX30/400L	£0·46
C106/4	£0·60

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SUPER UNTESTED PAKS

Pak No.	Qty.		Order No.	Price
U50	100	Germ. gold bonded OA47 diode	16130	£0·60
U51	150	Germ. OA70/81 diode	16131	£0·60
U52	100	Silicon diodes 200mA OA200	16132	£0·60
U53	150	Diodes 75mA 1N4148	16133	£0·60
U54	50	Sil rect top hat 750mA	16134	£0·60
U55	20	Sil rect stud type 3 amp	16135	£0·60
U56	50	400mW zeners DO7 case	16136	£0·60
U57	30	NPN trans BC107/8 plastic	16137	*£0·60
U58	30	PNP trans BC177/178 plastic	16138	*£0·60
U59	25	NPN TO39 2N697/2N1711 silicon	16139	£0·60
U60	25	PNP TO59 2N2905 silicon	16140	£0·60
U61	30	NPN TO18 2N706 silicon	16141	£0·60
U62	25	NPN BFY50/51	16142	£0·60
U63	30	NPN plastic 2N3906 silicon	16143	*£0·60
U64	30	PNP plastic 2N3905 silicon	16144	*£0·60
U65	30	Germ. 0071 PNP	16145	£0·60
U66	15	Plastic power 2N3055 NPN	16146	£1·20
U67	10	TO3 metal 2N3055 NPN	16147	£1·20
U68	20	Unijunction trans IIS43	16148	£0·60
U69	10	1 amp SCR TO39	16149	£1·20
U70	8	3 amp SCR TO66 case	16150	£1·20

Code Nos. mentioned above are given as a guide to the type of device in the pak. The device themselves are normally unmarked.

COMPONENT PAKS

Pak No.	Qty.		Order No.	Price
C1	200	Resistor mixed value approx. (count by weight)	16164	*£0·60
C2	150	Capacitors mixed value approx. (count by weight)	16165	*£0·60
C3	50	Precison resistors. Mixed values	16166	£0·60
C4	80	⅛W resistors mixed preferred values	16167	*£0·60
C5	5	Pieces assorted ferrite rods	16168	*£0·60
C6	2	Tuning gangs. MW/LW VHF	16169	*£0·60
C7	1	Pack wire 50 meters assorted colours single strand	16170	£0·60
C8	10	Reed switches	16171	*£0·60
C9	3	Micro switches	16172	*£0·60
C10	15	Assorted pots	16173	*£0·60
C11	5	Metal jack sockets 3×3·5mm 2×standard switch types	16174	*£0·60
C12	30	Paper condensers preferred types mixed values	16175	*£0·60
C13	20	Electrolytics trans. types	16176	*£0·60
C14	1	Pak assorted hardware—nuts/bolts, gromets, etc.	16177	£0·60
C15	5	Mains slide switches ass.	16178	*£0·60
C16	20	Assorted tag strips and panels	16179	£0·60
C17	15	Assorted control knobs	16180	*£0·60
C18	4	Rotary wave change switches	16181	*£0·60
C19	2	Relays 6-24V operating	16182	*£0·60
C20	1	Pak. copper laminate approx. 200 sq.in.	16183	£0·60
C21	15	Assorted fuses 100mA-5 amp	16184	£0·60
C22	50	Metres PVC sleeving assorted size and colour	16185	£0·60
C23	60	½ watt resistors mixed preferred values	16188	*£0·60
C24	25	Presets assorted type and value	16186	*£0·60
C25	30	Metres stranded wire assorted colours	16187	£0·60

SLIDER PAKS

Pak No.	Qty.		Order No.	Price
S1	6	Slider potentiometers, mixed values	16190	*£0·60
S2	6	Slider potentiometers. all 470 ohms	16191	*£0·60
S3	6	Slider potentiometers, all 10k Ω lin	16192	*£0·50
S4	6	Slider potentiometers, all 22k Ω lin	16193	*£0·60
S5	6	Slider potentiometers, all 47k Ω lin	16194	*£0·60
S6	6	Slider potentiometers, all 47k Ω log	16195	*£0·60

CERAMIC PAK

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Pak No.	Qty.		Order No.	Price
MC1	24	miniature ceramic capacitors, 3 of each value—22pF, 27pF, 33pF, 39pF, 47pF, 68pF, and 82pF	16160	*£0·60
MC2	24	miniature ceramic capacitors, 3 of each value—100pF, 120pF, 150pF, 180pF, 220pF, 270pF, 330pF and 390F	16161	*£0·60
MC3	24	miniature ceramic capacitors. 3 of each value—470pF, 560pF, 680pF, 820pF, 1.000pF, 1,500pF 2,200pF and 3,300pF	16162	*£0·60
MCA	21	miniature ceramic capacitors, 3 of each value—4,700pF, 6,800pF 0·01μF, 0·015μF, 0·022μF, 0·033μF and 0·047μF	16163	*£0·60

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BI-PAK

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Something for nothing

A GREAT deal has been written in the last few years on major undertakings such as the building of the supersonic Concorde and the American space programme. While our spending on Concorde is trivial compared to the untold millions of dollars spent on space research nevertheless the lesson seems to be that we earthlings can achieve almost anything given nearly unlimited funds. But where do we draw the line? And who is going to draw it for us? Who is there big enough to say "No" to a particular project because it will mean an intolerable burden on the taxpayer? Only now is money in reasonable amounts being allocated to research on solar energy problems. It may not be too little but it may be too late!

If this matter had been tackled 20 years or so ago we might not be so beholden to overseas countries for our oil supplies. Next time you pop down the road in your car to see Auntie Flo just think about how that petrol you are using got into the tank. Someone drilled a hole in the earth, took out tons and tons of horrible, gooey, slimy sludge, put it into a boat and sent it to our shores where it was put through a complicated process of refining, adding this and that chemical, then put it back into the ground in a tank until you came along with your hard-earned lolly and bought a couple of gallons. But what did you do with it, when you had got it??? You burnt it! You sent out clouds of poisonous fumes into the air for the rest of us to breathe. Just to go to Auntie Flo's! You could have walked, anyway.

But seriously, it is all rather daft, isn't it, when there is that great ball of fire in the sky that pours more energy on to our Earth than we can ever hope to use, and all for free, relatively speaking. The Japanese, and possibly others, are already producing solar "cells" in strip form. Soon we will be able, with a bit of luck, to decide how many kilowatts of energy we need for our house and then pop out and buy the necessary length of strip from the local DIY shop! All those nasty bills that arrive each month from the electricity, coal and gas bods would disappear! Think of the money we'd save and all the nice new hi-fi gear you could buy, or that transceiver you've always wanted. All those nice people who prepared those nasty bills could do something really useful, for a change. Like building a barrage across the River Severn and taking advantage of the free energy to be got from the roaring tide.

But in the past, whatever the bonanza, be it oil or butter, the ordinary man-in-the-street never seemed to benefit from them in the form he can best appreciate—lower prices. As soon as something is given with one hand it is snatched away by another. Is it too much to hope that things might be different with solar energy when it becomes an everyday source of power?

Amateur experimenters could lead the way, as they have done in the past, by designing electronic projects using the sun as a primary source of power. Radio amateurs are already employing microwaves in the region of 10GHz (10,000MHz) for communication over quite respectable ranges, using only milliwatts of power, which could be derived from solar cells. Secondary batteries charged from the sun could provide a continuous source of power but at the moment our methods of converting solar energy are pretty crude.

No doubt space scientists have one or two useful practical ideas up their sleeves which could be adapted for use in our field of interest so we must keep our ears and eyes open. In due time it ought to be a matter of principle that we do not obtain any of our power requirements, for electronic equipment at least, from the public mains supply.

Eric Dowdeswell *Assistant Editor*

NEWS...

Atten—TION!

THE RNARS will be holding their annual mobile rally at HMS Mercury on Sunday, June 19th, 1977, from 1100 onwards. The site is situated on the South Downs between the villages of Clanfield and East Meon and signs are to be seen along the A3 south of Petersfield and on the A272 west of Petersfield.

In addition to trade stands for amateurs, there will be arena events from 1400 onwards, with displays by the Cowplain NTC Band, Petersfield Aero Club flying display (weather permitting), volunteer Boy Cadet Corps field gun display and a display by Kelly Squadron of HMS Mercury. A static show will be given of pre-1963 racing cars.

Refreshments will be available on site and a grand raffle will take place with the draw being made about 1530. Talk-in facilities on 2m via GB3SN, 4m and 80m (3660kHz). People are most welcome to picnic on the site, so why not make it a family day out, taking in the wonderful Hampshire scenery as well as the RNARS mobile rally.

Further details from *M. Puttick G3LIK, 21 Sandyfield Crescent, Cowplain, Portsmouth, Hants PO8 8SQ.*

Sounds tough

A NEW syllabus has been prepared for the Radio Amateurs Examination, which sets out the new Home Office requirements. It also indicates the number of questions likely to be asked on each group of topics. The first examination of this new type will be in May/June 1979, while the last in the present series will be in December 1978.

The papers will take a multiple choice format and will comprise a 1-hour Licensing Conditions and Transmitter Interference paper (765-1-01), and a 1¾-hour Operating Practice, Procedures and Theory paper (765-1-02). Both papers will be taken on the same day with a short break in between. Certificates will be issued to successful candidates of both papers, although if only one paper were failed, the candidate would be required to retake only this one at a later date, to qualify for a full certificate.

Copies of the new syllabus, together with specimen questions, will be available from the Sales Section from July 1977, price 40p.

City and Guilds of London Institute, 76 Portland Place, London W1N 4AA.

Free advice

OVER the past few months a new type of shop has sprung up in the High Streets which offer equipment and advice to the general public, that previously had only been available to professional customers.

The shops—Electronic and Time Centres, are run by a group of professional Electronics Engineers and offer electronic digital clocks, treasure tracers, TV games, electronic car ignition systems, as well as a large range of Swiss and American LED and LCD quartze watches, DIY kits and spare parts. All products are guaranteed, as is the promise that if any orders are received by post before 2pm, dispatch will take place that same day. There are two shops open at present, one in Daventry High Street and the other in Uxbridge High Street. Further shops are now being planned for Deal, High Wycombe and Northampton.

Metac International, 16 Nightingale Close, Hazelmere, Bucks.

Show time

THE Birmingham International Ideal Homes Show is due to open at the National Exhibition Centre on Thursday, August 4th, and run through until Saturday, August 20th (excluding Sundays).

There will be hundreds of stands where some of the leading British manufacturers and retailers and many from overseas, will be displaying some of the latest goods for the home. Apart from these stands there will be a full programme of holiday features, fashion parades, cookery demonstrations, musical events, games and competitions.

The show will be open from 10 am to 10 pm. Any enquiries concerning the show should be addressed to *ITF and BPM Exhibitions Ltd. Radcliffe House, Blenheim Court, Solihull, West Midlands. Tel: 021-705 6707.*

Jubilee callsigns

THE use of a special prefix GE for UK amateurs has been approved and will be effective from 4 June to 12 June inclusive ONLY. The facility is available to Class 'A' and 'B' licensees. For example, G4AR can use GE4AR, G8XYZ becomes GE8XYZ, GW4ZZZ uses GE4ZZZ. Although this means that the individual countries of the UK lose their identities for a brief period, to the chagrin of the prefix hunters, I suppose one could always add /GW etc!

Castle rally

THE 8th Elvaston Castle Mobile Radio Rally is scheduled to be held in the grounds of the castle on Sunday, the 12th June. The castle is located on the B5010, about 5 miles south-east of Derby.

Opening at 11 a.m., there will be a talk-in by G8KGC/P on 2m, G3EEO on 160m and G3ZBI/P will be on the air as an exhibition station from the site. To please the rest of the family, the organisers have arranged for a bring-and-buy stall, prize draw, refreshments, sideshows and childrens entertainments. An added attraction will be the presence of the EMI Tape hot air balloon. Entrance is free, although there is a car parking fee of 25p.

Any further information from Ian Cage G4CTZ, Nunsfield House, Boulton Lane, Alvaston, Derby DE2 0FD.

RT-VC have asked us to correct some pricing errors that occurred in their advertisement on page 5 of the May 1977 issue of *PW*. The correct prices are:—

Sinclair IC20/PZ20 kit, £5·95.
Speakers, DuoIII, pair, £52.
Turntable, BSR MP60, £29.
Portable Disco Console, £64.

BACK NUMBER SERVICE

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

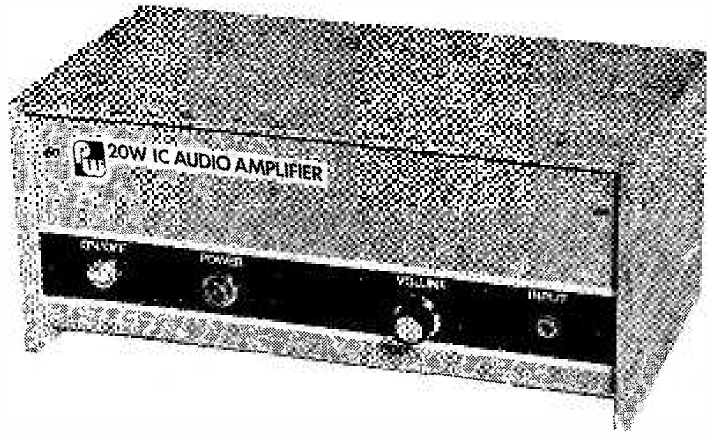
Send your orders to:—Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF.

20W IC AUDIO AMPLIFIER

F. G. RAYER G3OGR

THIS amplifier uses a single high power integrated circuit; the power supply is included for direct operation from the mains. Maximum output is up to 20W into a 4Ω speaker, or about 13·5W into an 8Ω speaker.

The use of an IC greatly simplifies construction of the amplifier section of the equipment, and comparatively few other components are necessary here. The IC features internal protection, so that no damage arises if the output (speaker) circuit is shorted. It also incorporates thermal protection. This is a valuable feature, since it avoids thermal runaway when dissipating excess power in relation to the heat sinking used. High temperatures cause the IC to shut down with normal working restored when the temperature has fallen.



CIRCUIT

Fig. 1 shows the complete circuit using the TDA2020. VR1 is the gain or volume control, and coupling is by C1 to the input pin 7. Negative feedback from the output pin 14 is by R3 to the inverting input 8, feedback also being set by R2 and C2. C3 is a frequency-compensation capacitor.

IC1 needs no speaker coupling capacitor but requires bipolar supply lines. The power supply makes provision for this.

The amplifier is assembled on its own printed circuit board which also carries the heat sink.

The mains transformer T1 has a 12-0-12V secondary; the centre tap provides the chassis line. Two of the rectifiers, with C8, give the positive supply for pin 1 of the IC. The remaining two rectifiers, with C9, produce the negative line supply for pins 3 and 5 of the IC. R6, C7 and R5 provide an auxiliary positive supply of about 12-14V for a pre-amplifier or suitable radio tuner although these may be left out if not required. C5 and C6 are HF by-pass capacitors fitted near to the IC.

The rectifiers, R5, R6, C7, C8 and C9 are assembled on a piece of tagboard adjacent to T1. R7 and the neon comprise an indicator. If a panel neon with resistor included is used, R7 will not be necessary.

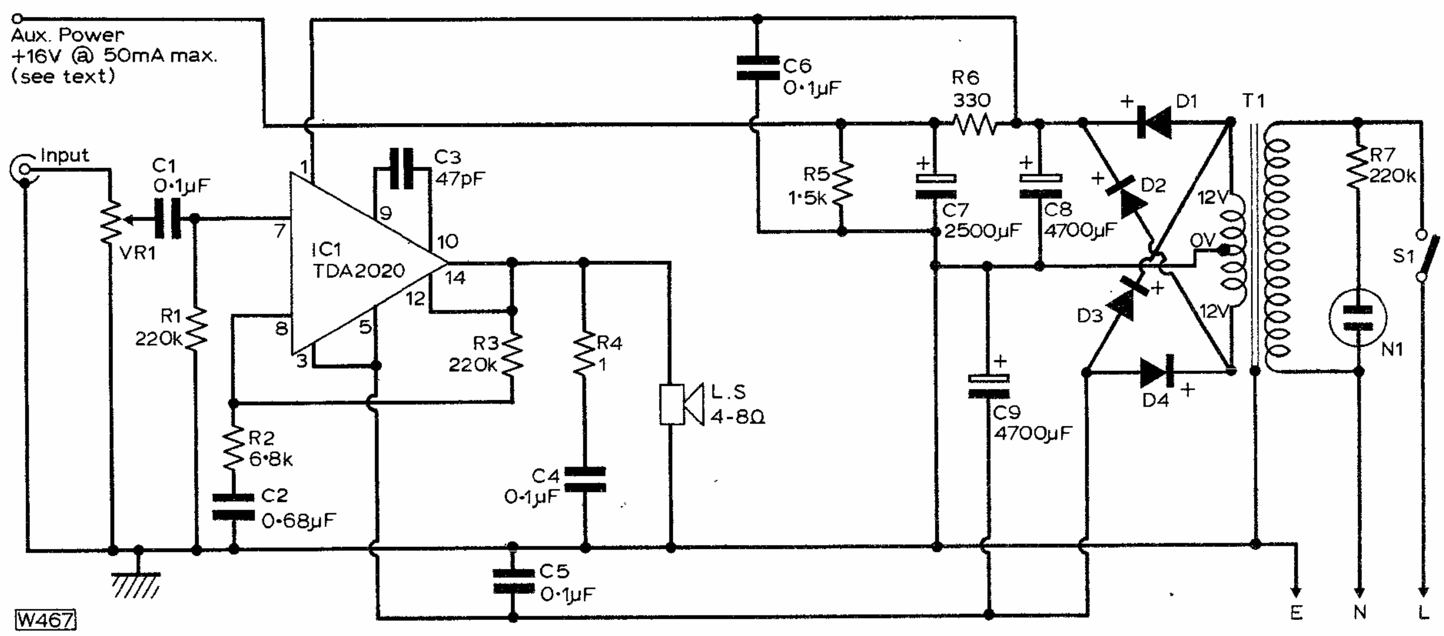


Fig. 1: Circuit diagram of amplifier and power supply. R5, R6 and C7 may be omitted (see text).

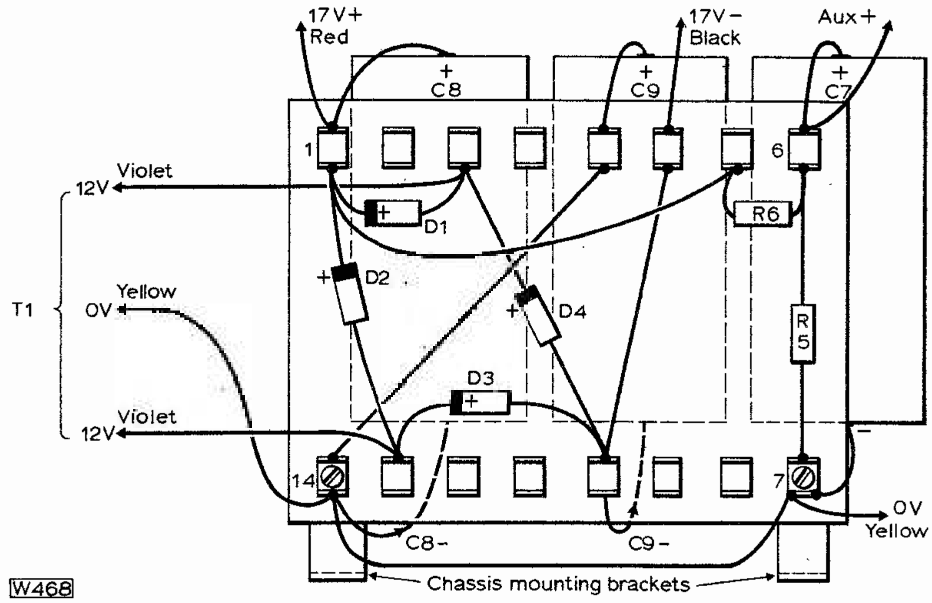


Fig. 2: Power supply tagboard layout. If tagboard cannot be obtained, the circuit may be constructed using a standard matrix pin board and printed circuit pins in which case the layout can remain the same. Alternatively, veroboard may be used with suitable re-arrangement of components. C7, R6 and R5 may be left out if an auxiliary power supply (to drive a pre-amplifier or tuner, etc) is not required

Fig. 2 shows wiring of the tagboard. Colour coding of the leads will be helpful here. Violet was used for the 12V leads for T1; with yellow for the centre-tap, chassis, and 0V amplifier line. Red is used for 17V positive and black for 17V negative supply.

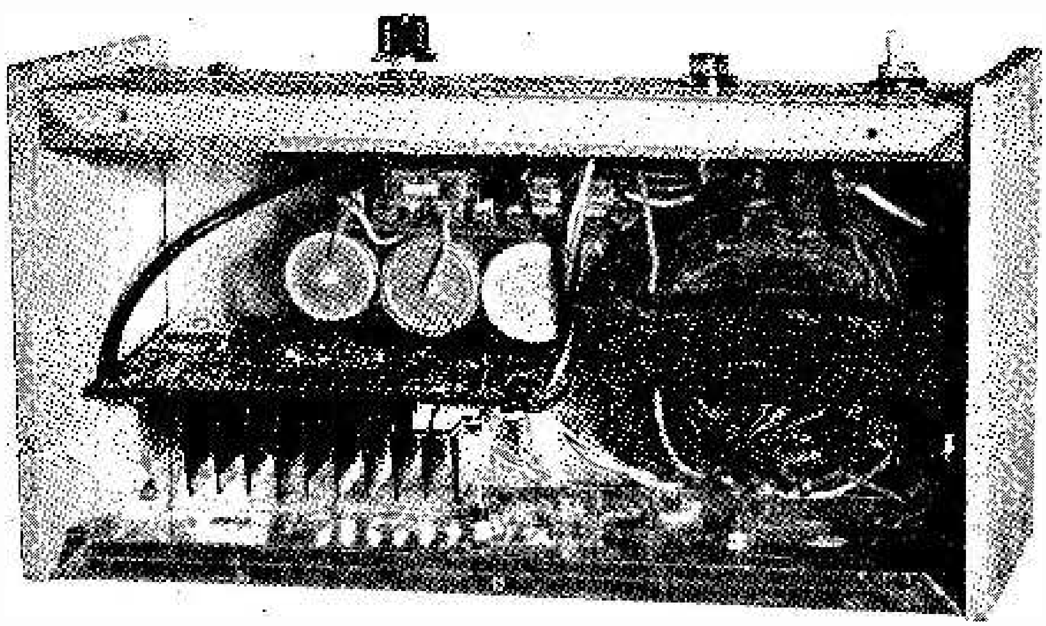
The capacitors may be of the type with two tags one end. Two brackets mount the board vertically. These were fixed by 6BA bolts through the tags which must also be in contact with the chassis and act as earth returns and anchor points for C7 and C8. The capacitors can be held by fastening string round them looping this through holes in the board, as well as by their connections. As an alternative the power supply card may be constructed from veroboard if tagboards aren't to hand. Flexible leads run from the points shown to the amplifier board. These can be unsoldered at top tags 1 and 6 if it is wished to check current as mentioned.

The transformer fits to the left of the tagboard. Use a 3-core cord, and plug with 2A or other low rating fuse. The chassis should be earthed (Fig. 1). L and N mains conductors go to the transformer primary, with the switch in the L circuit.

POWER OUTPUT

There is latitude in both the speaker load and supply voltages when maximum power is not required. The circuit given in Fig. 1 was found to provide 17-0-17V, and with this up to 20W can be obtained with a 4Ω speaker. With 12-0-12V, output is 11·5W, rising to 15W with 14-0-14V, and 18·5W with 16-0-16V. For 8Ω speakers, ratings are 7W for 12-0-12V, 9·5W for 14-0-14V, 12W for 16-0-16V, and 13·5W for the 17-0-17V supply. The maximum supply is 20-0-20V, but this is not recommended as the IC may be damaged if higher voltages should arise, and power output is not a great deal more than with the 17-0-17V supply.

For high output while leaving some latitude for safety, the 12-0-12V rms secondary is probably best. A check across C8 and C9 should be made, and each reading should not be more than about 18V, with no signal. The tag-board is arranged so that a meter may, if wished, be placed in series with positive or negative supply lines, for an initial test; the current drawn will peak up to about 1A in each case.



Plan view of prototype amplifier showing mains transformer (right) amplifier board/heatsink assembly and power supply tagboard. The actual layout used will depend to a large extent on the size and shape of the mains transformer used (see section of text headed POWER OUTPUT).

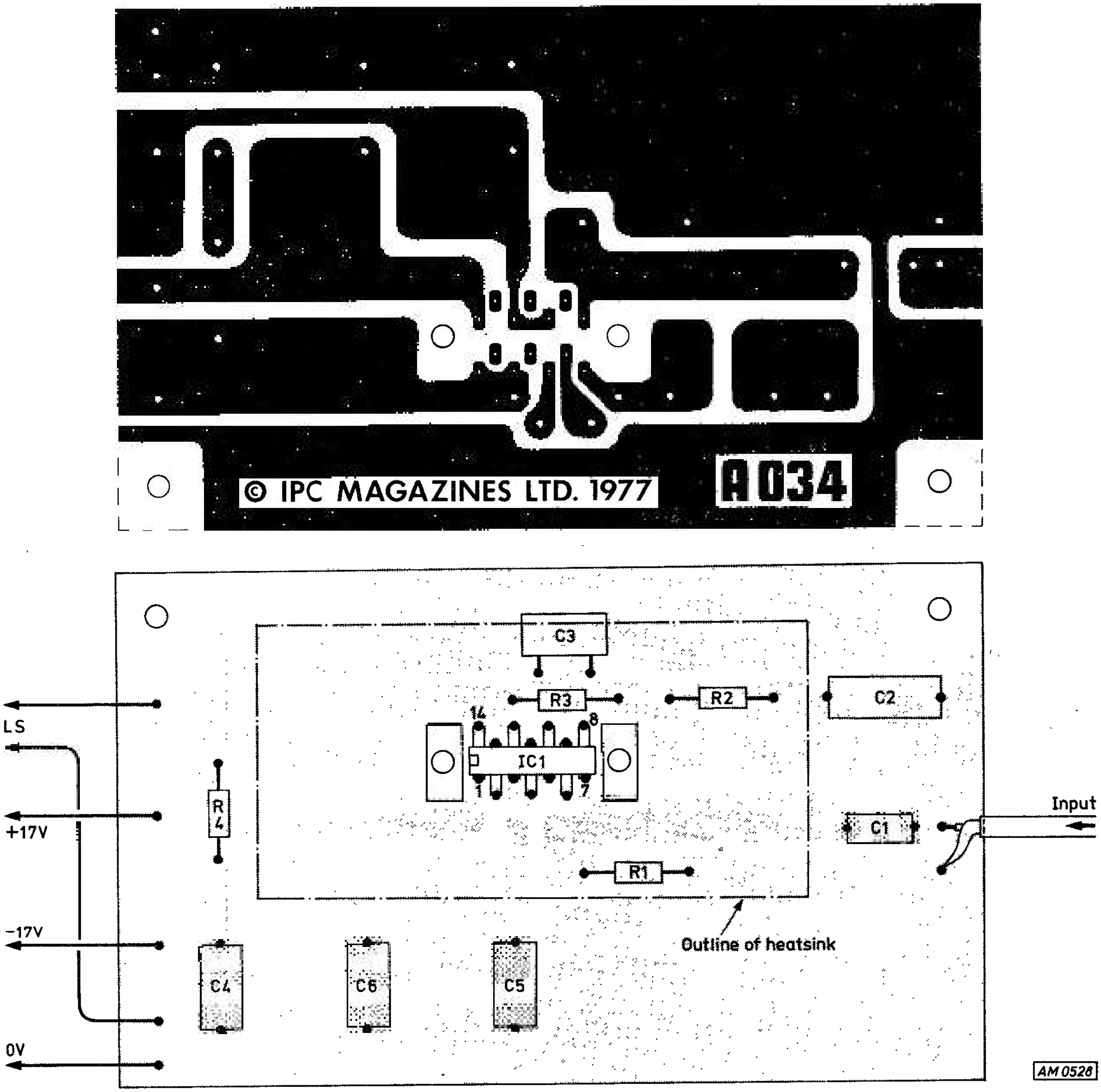


Fig. 3: (above) PCB copper side to actual size. Component side (lower) showing positions. During assembly of the board, care should be taken to ensure that components underneath the heatsink do not foul it in any way—the heatsink is electrically in contact with the substrate of the IC via the copper slug on the top of the IC.

AMPLIFIER BOARD

Fig. 3 shows the underside of this, and the positions of components. The board is relatively simple, and was made from Print-A-Kit adhesive foil, but can be prepared in the usual way and etched. Alternatively, a board may be purchased from the PCB service—see p 190. It is important to note that C3 and the resistors lie under the sink, so that they may be near the IC, but that the other capacitors must be outside the area occupied by the sink.

Input is via a screened lead, which runs to C1 and the PCB 0V line, as shown in Fig. 3. Flexible leads are soldered on for the speaker connections. Also holes should be drilled so that the red, yellow and black power supply leads can be soldered to the appropriate foils as per Fig. 3.

The heat sink is 80 x 40 x 30 mm and its thermal rating is 2·75°C/W, for 20W operation. A smaller sink is available for 12W maximum. It has threaded holes to take two 6BA bolts. If other sinks are improvised, they should be of quite generous size. If the IC thermal cut-out operates, it indicates that the amplifier must be run at a lower power level, or the sink must be improved.

The IC has a mounting spacer which fits underneath it. Semiconductor mounting compound must be spread on top of the IC before fitting the sink. Be certain that the holding screws do not touch adjacent foils; insulating washers may be put under their heads if needed. The sink must not touch the

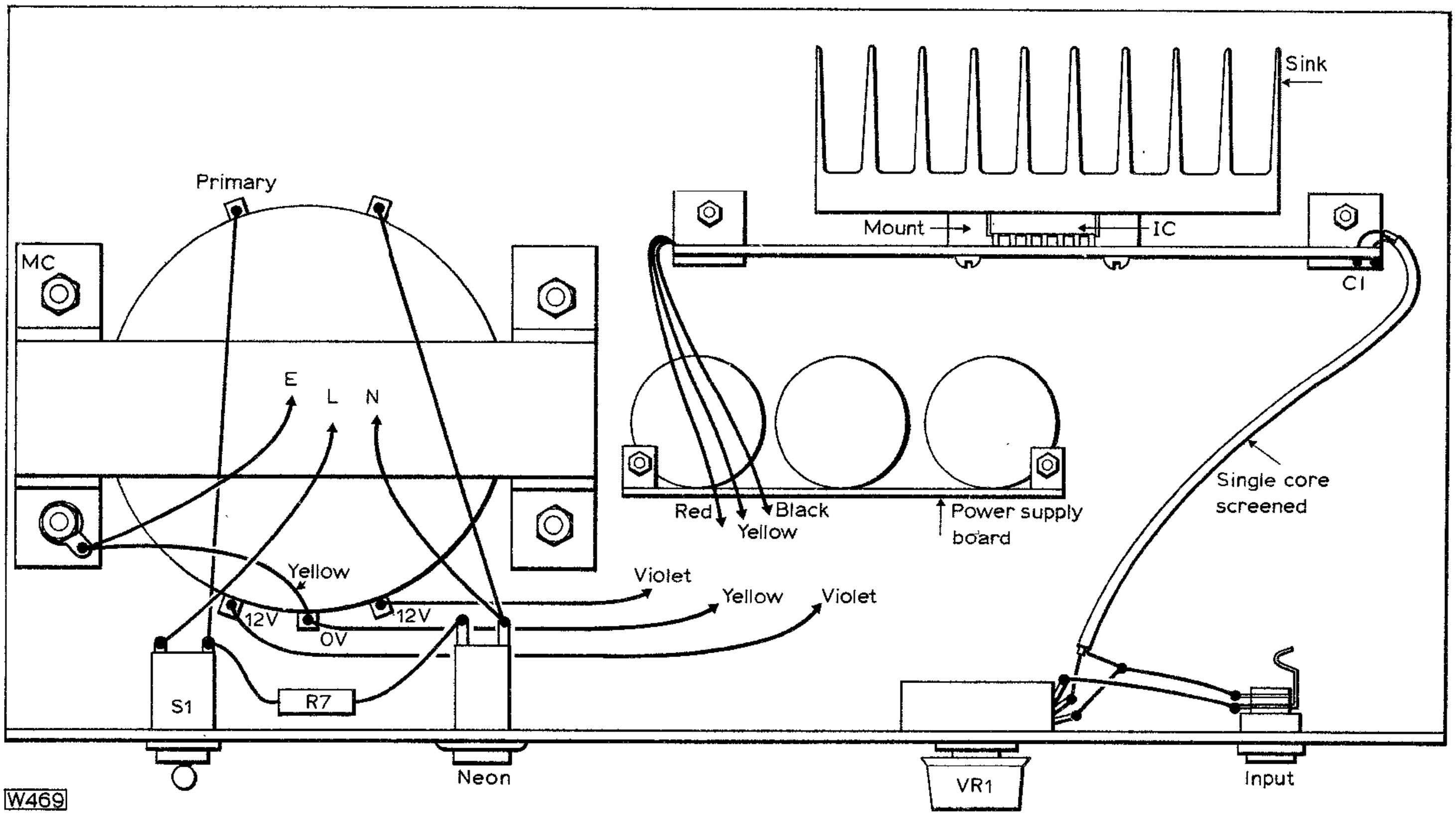


Fig. 4: Detailed wiring and assembly of the amplifier. Particular attention should be paid to the mains wiring; the live tags on S1 and the panel neon are depicted unhealthily near the 12V secondary of the mains transformer. The latter should be shown slightly further back from the front panel.

case or any other metal items. Two brackets hold the board vertically, and in this position the sink fins are also vertical.

★ components list

Capacitors
C1 0·1μF
C2 0·68μF
C3 47pF
C4 0·1μF
C5 0·1μF
C6 0·1μF
C7 2500μF 15v may be omitted—see text.
C8 4700μF 25v
C9 4700μF 25v

Resistors
R1 220kΩ
R2 6·8kΩ
R3 220kΩ
R4 1Ω
R5 1·5kΩ } may be omitted—see text.
R6 330Ω
R7 220kΩ (see text). All resistors 5% ¼W.
VR1 10kΩ log pot

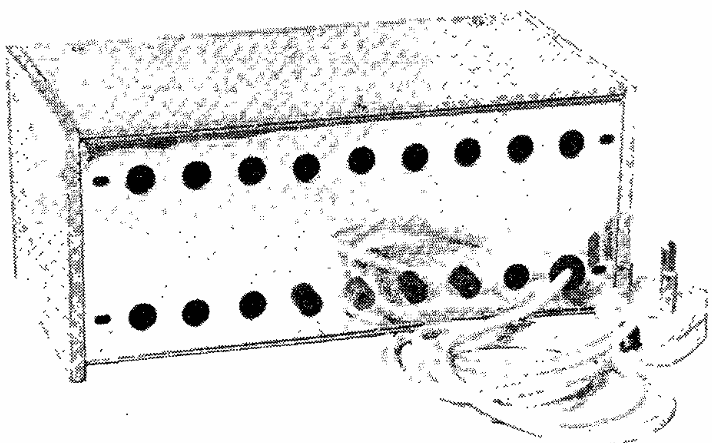
Semiconductors
IC1 TDA2020
D1 to D4 1N4001.

Miscellaneous
T1 12-0-12V 2A mains transformer. Indicator neon, on-off switch, 3·5mm jack socket, knob tagboard. Speaker sockets, etc. Heatsink: 3·15 E.18. Chromasonic Electronics.

ASSEMBLY

Fig. 4 shows how the transformer, tagboard and amplifier are fitted and interconnected. The yellow or 0V line is continued from the mains earth tag to transformer, capacitor assembly, and amplifier, so that reliance is not placed on chassis earth returns.

It is convenient to use a metal panel and bottom, but it is not essential to have metal sides, top or



back. The least expensive assembly is to use a 25 x 10 cm (10 x 4″) flanged "universal chassis" for the front, with a flat plate about 25 x 12·5 cm (10 x 5″) for the bottom. The whole unit can then be completed as in Fig. 4. Subsequently, top, sides and back can be added. Appearances can be improved by making the sides of wood, large enough to give a front and bottom projection of about 1 cm (⅜″). A number of holes, or a slot or cut-out, must be arranged near the heat sink, to allow air circulation. The back should also be fitted with sockets for the speaker, and for the 12-14V positive supply outlet, including a chassis return.

Measuring with OP AMPS

A.SHARPE

AN operational amplifier is so called because it can perform specific mathematical operations such as multiplication and division; the actual parameters of the operating mode are entirely dictated by the choice of external components in the feedback loop. In the following circuits the op. amp is shown in the multiplying mode. The differential op. amp usually makes a better DC amplifier than the equivalent single ended version. To explain the reasons for this, it requires some comprehension of DC amplifier theory.

Single end

Fig. 1 shows the basic single ended circuit. It exhibits two major deficiencies: the first is that the output voltage is offset to the input voltage by a fixed value equal to the normal collector base voltage; further the collector can swing only marginally below the base.

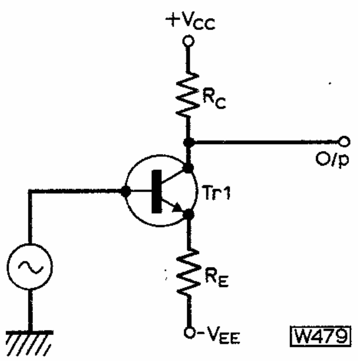


Fig. 1: A notional representation of a single ended DC amplifier. It is unbalanced in every respect.

Second objection concerns the base emitter voltage which will be typically about 0·6V for a silicon transistor. The exact voltage depends on the junction temperature. Since the base emitter junction constitutes the input circuit any error in this department will be magnified by a factor proportional to the amplifier gain. In the circuit shown this relates to the ratio between Rc and Re. For instance if Rc=10kΩ and Re=1kΩ then the gain will be 10 providing one neglects the internal emitter resistance of the transistor. In practice, this invisible resistance would reduce the stage gain to slightly less than 10. By the same token, if the base emitter voltage changed by a hypothetical 3 units per C° then the output would change by slightly under 30 units.

Long tailed pair

Adding a further transistor produces the well known "long tailed pair" circuit shown in Fig. 2. In this case, Re no longer controls the amplifier gain: it simply serves to provide both transistors with current which will usually be split equally between the two.

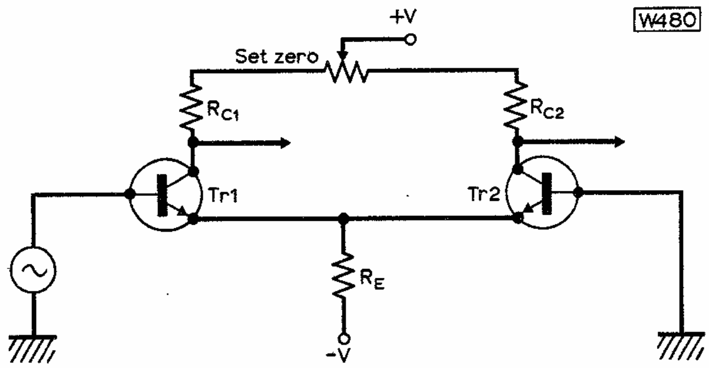


Fig. 2: Long tailed pair. The circuit primarily responds to signals applied differentially between the bases of Tr1 and 2.

The *real* Re is the other transistor; the emitter output impedance of each transistor presents the emitter load to the other since both emitters are connected together. If the Re shown in Fig. 2 were replaced by a constant current source, then the amplifier would only respond to a differing voltage between Tr1 and Tr2 bases. A voltage common to both has no effect on either output since the supply current remains equally split between the two. However if one input is held at earth potential and the other is varied, then the supply current will vary unequally between the pair although the total value will remain the same. This will result in differing voltage drops across the collector resistors.

For instance, suppose that an input signal caused a current of 10μA to flow in the base circuit of Tr1 but not Tr2. Assume that both transistors have a gain of 100. Then the emitter current of Tr1 will be 1mA higher than Tr2. Since both transistors are supplied by a source of constant current, then Tr2 will have to pass 1mA less if Tr1 is passing 1mA more. The current difference will be reflected in the voltage drops across the collector resistances: if Rc1=Rc2=10kΩ then the drop will be an extra 10V across Rc1 and 10V less across Rc2, a difference of 20V total between the two collectors.

Provided that both transistors of the pair are maintained at identical temperatures then temperature error signals will be common mode (applied equally to each base) and thus not appear in the output. Integrated circuits enable easy fabrication of thermally and electrically matched long tail transistors. However the simple circuit of Fig. 2 requires a few more components to back off the standing output voltage and enable output swings below the input voltage.

The true op. amp.

Fig. 3 shows how the addition of a further transistor may be used to back off the output voltage while retaining all the benefits of a *differential* input. Note that, although only one collector load resistor has been used, the current is still equally split between the input pair in the quiescent state. The value of R1 is chosen so that the current flowing in the collector circuit of Tr1 produces a voltage drop across R1 proportionate to the base emitter voltage of Tr3, i.e. about 0·6V. This means that Tr3 just conducts producing an output voltage across R2. As with the last example, the amplifier will only produce an output signal in response to a differential input signal between Tr1 and Tr2. Further the output can swing from supply rail to supply rail without any fixed reference to the common mode (common to each) input voltage on Tr1 and 2.

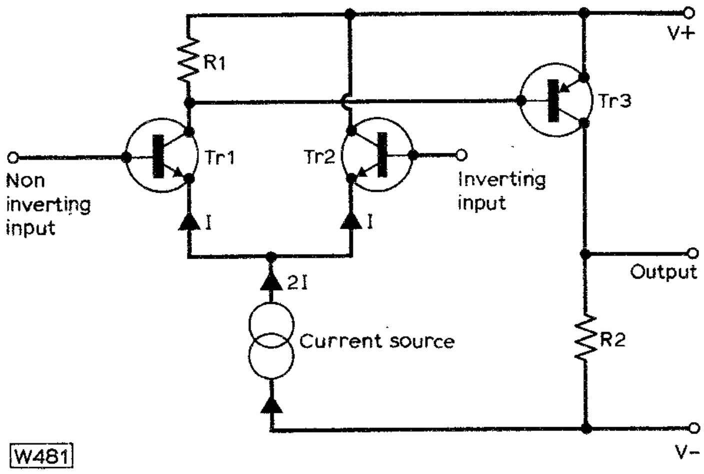


Fig. 3: This circuit has all the requirements for an operational amplifier. Principally, the output can swing below the common mode input voltage.

Whereas the gain of the single sided circuit shown in Fig. 1 could be adjusted by varying the ratio of collector to emitter resistance, that cannot be done with the circuit shown in Fig. 3. The latter, having a fixed gain of over 10,000 (80dB), relies totally on the way it is connected to external components to control this parameter—a true operational amplifier.

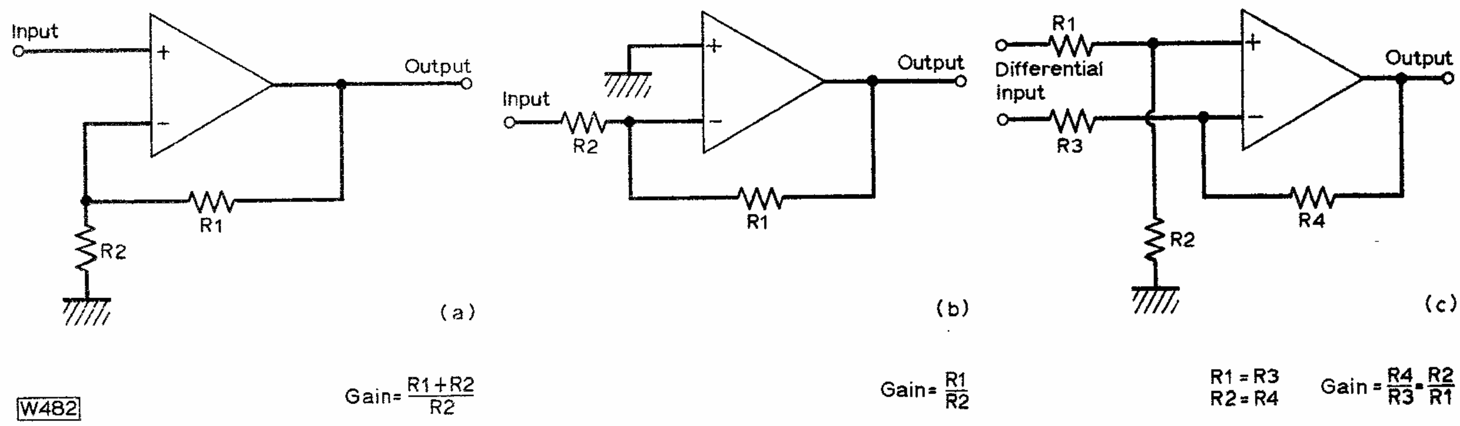
Operational modes

The classic circuit configurations to obtain controlled gain are shown in Fig. 4. The circuit block of Fig. 3 has been replaced by the well known op. amp symbol. In the non-inverting mode (drawing A) the output is in phase with the input. If R1 and R2 were equal, the amplifier would exhibit a voltage gain of 2. For unity gain in the non-inverting mode, the inverting terminal of the op. amp must be connected directly to the output terminal; this arrangement is known as a voltage follower since the output signal precisely follows the input signal. However the output is at a very low impedance, a factor which usually provides the motive for implementing such a circuit.

Fig. 4(B) shows the inverting mode connection. The input impedance will approximate to the value of R2. The input and output waveforms will be out of phase by 180°. In this connection, the op. amp inverting terminal acts rather like a mechanical fulcrum of a see-saw—when one end goes up, the other comes down. Further, the gain of the circuit can be likened to the mechanical advantage obtained with a lever system; in this case, the value of the circuit resistors are analogous to the lever lengths. Because of the gain in the op. amp, very little signal is present at the inverting terminal—the output always tries to counteract the effect of the signal—hence this is known as a virtual earth point.

Fig. 4(C) is a combination of A and B circuits. This arrangement gives a true differential input, i.e. rejecting voltages which are common to both inputs, by maintaining the relationship R2/R1 = R4/R3. This ensures that a common mode signal will raise both the inverting and non-inverting inputs to the same level. This circuit is used extensively in electromedicine where very small skin differential potentials need to be measured in the presence of high level mains hum and other interference.

Fig. 4: Controlling gain in (a) the non inverting (b) the inverting and (c) the differential mode.

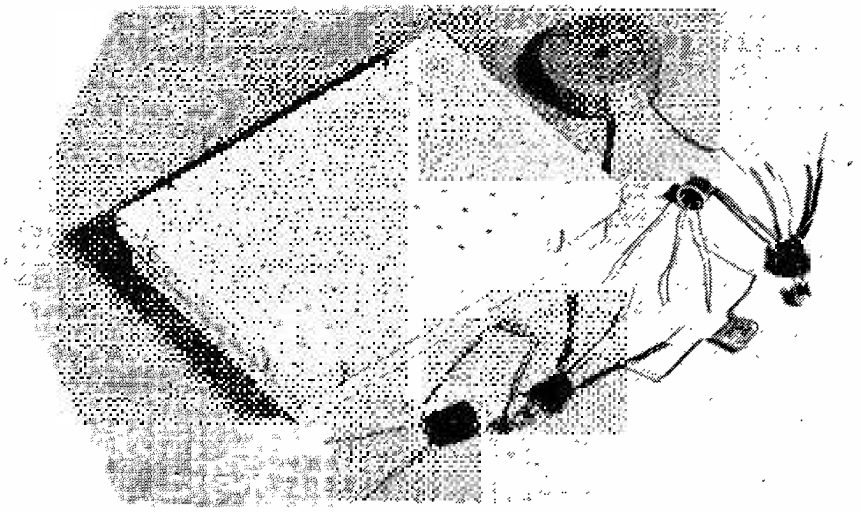


An op. amp millivoltmeter

Fig. 5 shows a typical DC application of the well known op. amp 741 integrated circuit: a high impedance DC voltmeter. The op. amp works in the voltage follower mode in such a way as to render the resistance of the meter movement totally non-critical.

Resistors R4 to R9 provide the switchable top section of a resistive divider; R2 forms the bottom half having one end connected to earth and the other connected to the top half. The junction voltage is applied via R3 to the non-inverting terminal of the IC. Resistor R3 and diodes D1 to D4 simply serve to protect the input of the IC and the meter movement; they do not contribute in any part to the normal operation of the circuit.

S-DeCnology



DAVID GIBSON

8

THIS MONTH

Ultra Simple Audio Amplifier'

THIS month's S-DeCnology project is an audio amplifier which should prove useful as an add-on unit to last month's two-transistor radio receiver. The amplifier performs efficiently from only 3V, the voltage used with the receiver.

Fig. 1 shows the complete circuit. It uses the absolute minimum number of components; excluding the microphone and loudspeaker only three transistors, one resistor and one capacitor are used. The circuit comprises three transistors wired as a Darlington triple, a configuration which exhibits a very high gain. The actual gain is a product of the gains of the individual transistors. The base of Tr1 is biased by a 2MΩ resistor R1 which also provides DC stabilisation. Input is via capacitor C1.

The circuit works very well with a crystal microphone plugged into S-Dec holes 41 and 66. The loudspeaker used in the prototype was a 75Ω 63mm component—a larger size speaker would give more volume. Note that the loudspeaker must be 75 to 80Ω: lower values (such as 3, 8 or 16Ω) should not be used.

Construction

Building the amplifier on S-Dec should present no problems—the prototype was "rebuilt" in less than 90s once circuit and values had been settled! When inserting the transistors, note that the leads are not in the sequence: emitter, base, collector (except for Tr3). This is made clear in the S-Dec layout diagram of Fig. 2.

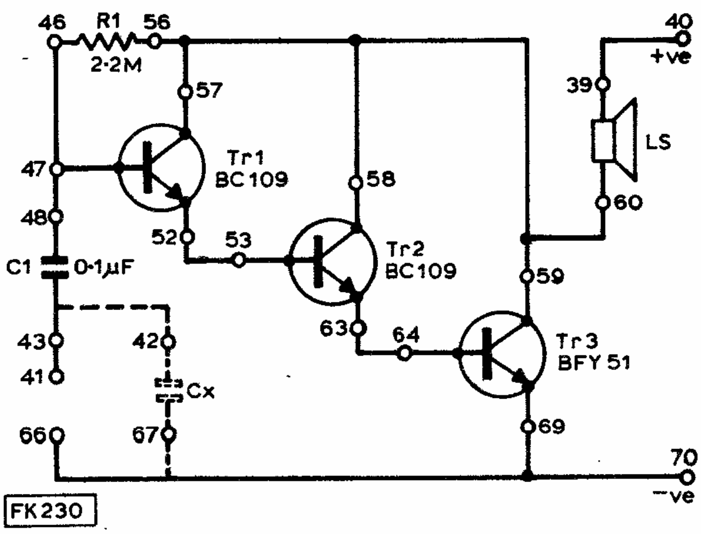


Fig. 1: Circuit diagram. Cx provides bypass for RF when used with last month's radio receiver. See section 'Radio amplifier'.

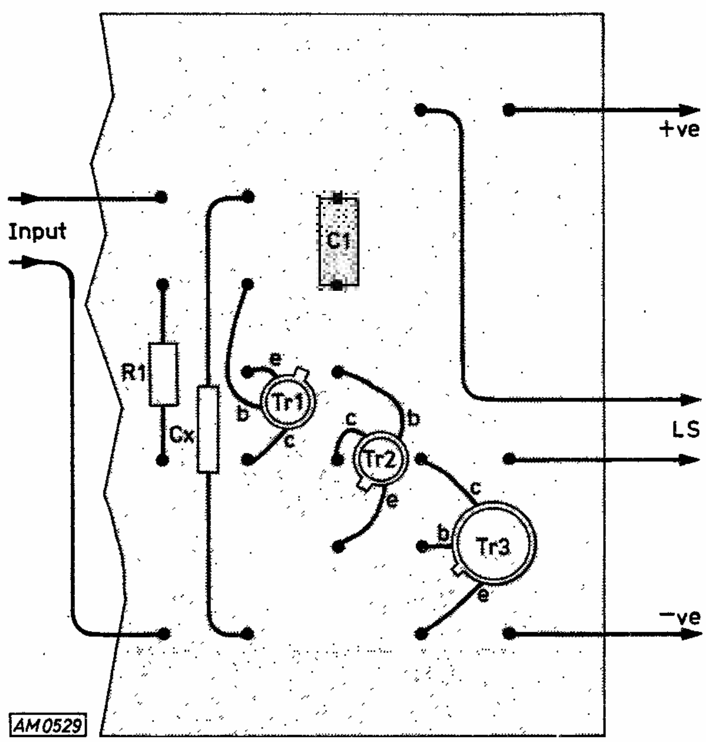


Fig. 2: Component layout. Note that Tr1 and 2 leadouts are plugged into the S-DeC out of order.

you will need . . . . .

Tr1 BC109	R1 2·2MΩ
Tr2 BC109	C1 0·1μF
Tr3 BFY 51	LS1 75 or 80Ω loudspeaker

One S-DeC, 3V battery, crystal microphone. Cx small value capacitor (see text).

Supply voltage

Using a 3V battery, the amplifier draws some 16mA of current. At 4·5V, this rises to 26mA; at 6V the current drawn is around 50mA. The amplifier was left running on test where it was found that Tr3 became barely warm. If, however, the voltage was raised to 9V (current then about 86mA), Tr3 got warm quite quickly.

When used in conjunction with the radio receiver described last month, there will be ample volume at 3V. For greater sensitivity, a higher voltage may be used. In view of the experiments described above, it is suggested that 6V be considered the maximum unless intermittent operation is envisaged.

Radio amplifier

Connecting the amplifier to the S-Dec receiver presents no problems. Simply plug in a 4·7kΩ resistor in place of the earpiece on the receiver, and then connect the amplifier to the receiver as shown in Fig. 3. The circuit diagram of Fig. 1 shows a "phantom" capacitor Cx across the input (S-Dec holes 42 and 67). This prevents RF from the receiver blocking the sensitive AF amplifier. It need be used

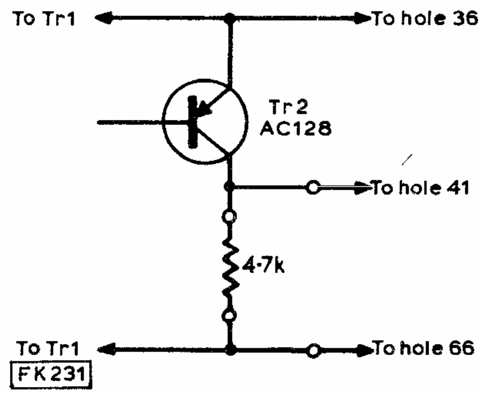


Fig. 3: Radio interface. In this drawing Tr1 and 2 refer to the transistors in last month's radio receiver.

only in this application. Its value should be between 350 and 500pF (390pF used in prototype).

Other applications

The unit can also be used as a simple record player amplifier providing the pick-up is a crystal type. A screened lead is a must here. In some applications such as this one a volume control might prove useful. For this, connect the slider of a 1MΩ potentiometer to hole 41. Connect the earth end of the pot to hole 66. The signal source is connected across the volume control.

As it stands, the unit might be used as an audio signal tracer. A 3V supply should be ample for this application. It might be prudent to connect a 0·1μF capacitor in series with the earth lead.

The S-Decnology project for next month is another circuit which will work well from only 3V (it even functions on 1·5V). It has various applications but sufficient to say it could be used to play blind-mans bluff! PW

Measuring with Op. Amps.—*continued from page 187.*

Since the output impedance of the resistive divider is 10kΩ, any voltage measuring circuit connected to it must present an impedance many times higher than this. The voltage follower configuration of the IC typically offers an input impedance rather greater than 2MΩ and thus will not effect the voltage reading. The meter movement is connected between the output of the IC and the inverting input. A further resistor, R1, connects between the inverting terminal and earth.

The circuit shown does this by sending a current through the meter movement of exactly the right amplitude to equalise the voltage between inputs, even though this means passing extra current to counteract the effect of R1.

Since the input current to the amplifier is so small that it can be ignored, the sum total of the meter current is that which is required to reproduce the resistive divider output voltage across R1; in other words the voltage across R1 exactly mirrors that

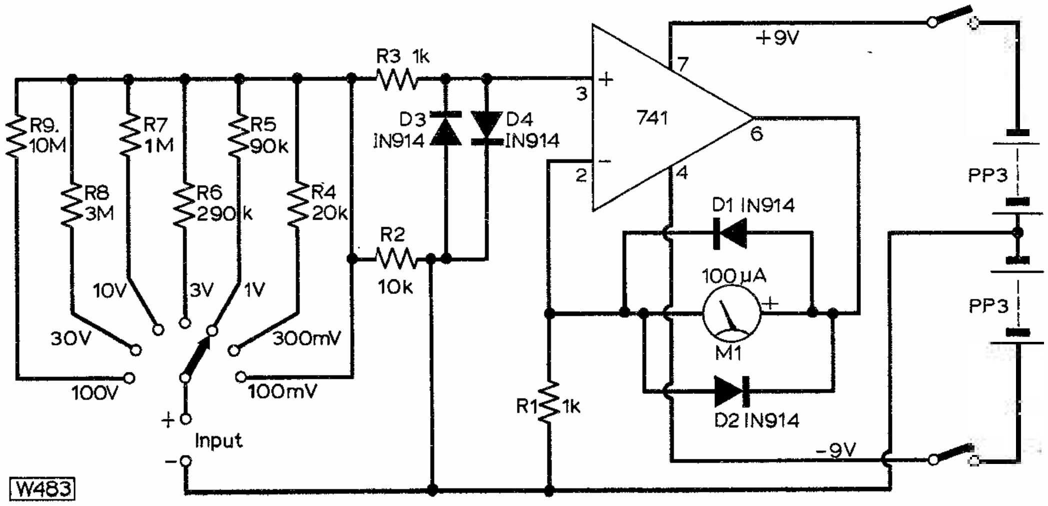


Fig. 5: Circuit diagram for a 100kΩ/Volt millivoltmeter. The diodes included in the circuit are purely intended for meter movement protection; they serve no normal operational function. Within very wide limits, the resistance of meter movement M1 has no bearing on the accuracy of the instrument. The actual sensitivity is controlled by R1; this component may be made variable for calibration purposes.

When an op. amp circuit uses negative feedback (i.e. with at least part of the output signal fed back in some manner to the inverting terminal) the actual output voltage will behave in such a way as to minimise and in most cases completely cancel out all voltages existing between the differential inputs.

across R2. This makes it very easy to work out the FSD voltage for the meter circuit. When R1 = 1kΩ then the voltage required to pass 100μA is 100mV. If the value of R1 were 500Ω then the circuit FSD would be 100mV for a 200μA meter movement or 50mV for a 100μA meter. PW

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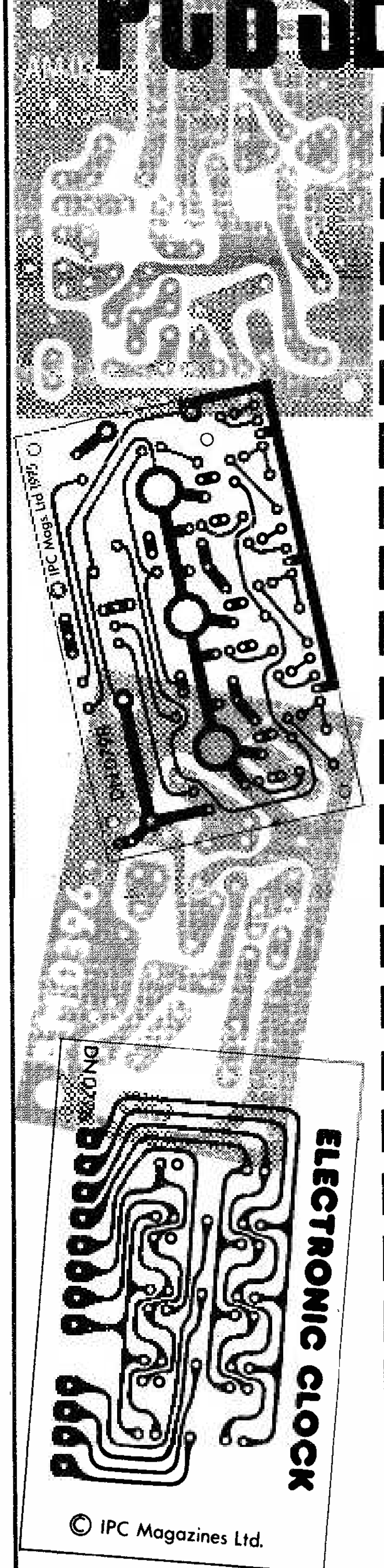

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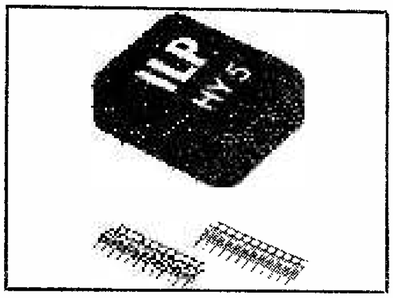
HY5
Preamplifier



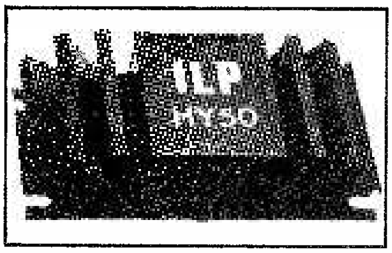
The HY5 is a mono hybrid amplifier ideally suited for all applications. All common input functions (mag Cartridge, tuner, etc) are catered for internally. The desired function is achieved either by a multi-way switch or direct connection to the appropriate pins. The internal volume and tone circuits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

HY30
15 Watts into 8Ω

Available June '76

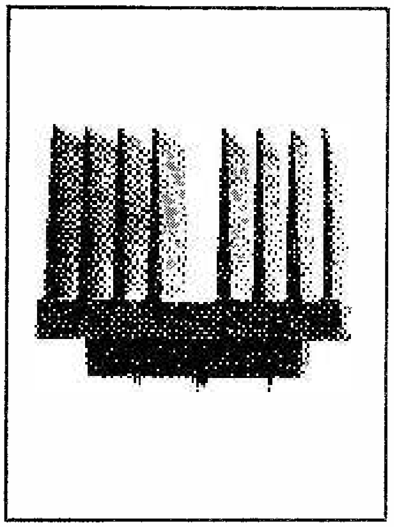
The HY30 is an exciting New kit from I.L.P. It features a virtually indestructible I.C. with short circuit and thermal protection. The kit consists of I.C., heatsink, P.C. board, 4 resistors, 6 capacitors, mounting kit, together with easy to follow construction and operating instructions. This amplifier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

HY50
25 Watts into 8Ω



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

HY120
60 Watts into 8Ω

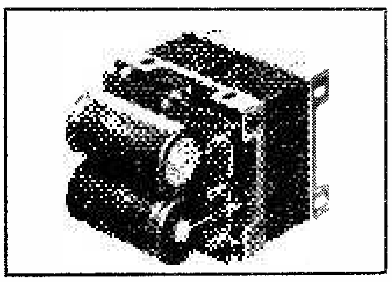


The HY120 is the baby of I.L.P.'s new high power range. Designed to meet the most exacting requirements including load line and thermal protection this amplifier sets a new standard in modular design.
FEATURES: Very low distortion—Integral heatsink—Load line protection—Thermal protection—Five connections—No external components
APPLICATIONS: Hi-Fi—High quality disco—Public address—Monitor amplifier—Guitar and organ
SPECIFICATIONS
INPUT SENSITIVITY 500mV.
OUTPUT POWER 60W RMS into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·04% at 60W at 1kHz
SIGNAL/NOISE RATIO 90dB FREQUENCY RESPONSE 10Hz-45kHz —3dB SUPPLY VOLTAGE ±35V
SIZE 114 50 85mm
Price £15·84 + £1·27 VAT P&P free.

HY200
120 Watts into 8Ω

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

HY400
240 Watts into 4Ω



The HY400 is I.L.P.'s "Big Daddy" of the range producing 240W into 4Ω! It has been designed for high power disco address applications. If the amplifier is to be used at continuous high power levels a cooling fan is recommended. The amplifier includes all the qualities of the rest of the family to lead the market as a true high power hi-fidelity power module.
FEATURES: Thermal shutdown—Very low distortion—Load line protection—No external components.
APPLICATIONS: Public address—Disco—Power slave—Industrial
SPECIFICATIONS
OUTPUT POWER 240W RMS into 4Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·1% at 240W at 1kHz
SIGNAL NOISE RATIO 94dB FREQUENCY RESPONSE 10Hz-45kHz —3dB SUPPLY VOLTAGE ±45V
INPUT SENSITIVITY 500mV SIZE 114 x 100 x 85mm
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A 741 SIGNAL TRACER

W. MOONEY G3VZU

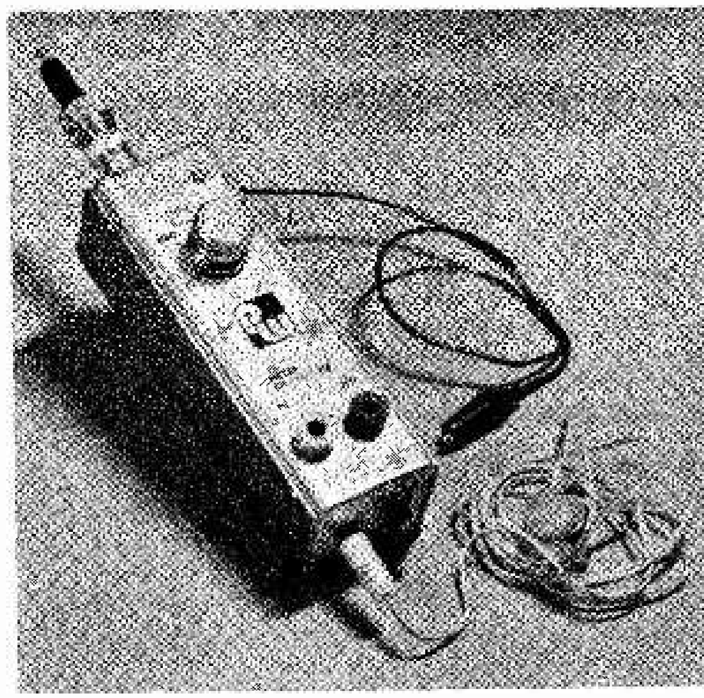
WHEN greeted with silence from the output of a radio receiver or audio amplifier the problem of finding whether the signal is getting to the input or not and if so where it is lost can be difficult without some form of signal tracing device. Whilst a millivoltmeter is useful it only gives a voltage reading which could be noise or a highly distorted signal. Even with an oscilloscope one does not actually hear the signal. Using the tracer described here, the signal can be monitored with the aid of a small earpiece and a rough estimate made of its amplitude. The quality of the tracer amplifier is quite good, allowing noise and most common forms of distortion to be traced to a particular stage.

Design considerations

Although signal tracer designs abound there is always room for improvements or different design approaches. Many tracers are bench standing units in large cabinets housing a loudspeaker and mechanically offer a challenge to the beginner or those to whom time is at a premium. The device described here is in the form of a hand-held probe and the usual loudspeaker is therefore eliminated. No attempt has been made at miniaturisation, the size being kept reasonable to simplify construction.

The loss of the loudspeaker results in a number of advantages. The audio feedback occurring with some circuits is unlikely without the loudspeaker and the need for a fair amount of driving power is removed. The quality of the usual tracer amplifier/speaker combination is not very good mainly as a result of the speaker and its mounting. The audio heard through the earpiece is therefore at least as good as that which would be heard through a speaker-type tracer and the use of a pair of stethoscope earphones would improve matters. The lower power requirements makes probe-like construction possible and a long life can be expected from a small internal 9V PP3 battery.

The tracer should not load the circuit under examination and to this end an input impedance of 2MΩ has been the aim. To cope with the wide range of signal levels likely to be encountered in practice a range of well over 60dB can be accommodated, from several volts downwards. Signals of 100μV were easily readable on the prototype and signals of only a few μV could be detected under quiet conditions. The 200kHz BBC transmission could be heard quite well using a tuned winding/ferrite rod and a simple diode detector. The requirements of high sensitivity and wide input range have therefore been met. Further requirements are that the device should be inexpensive and of reliable design, with little setting-up required. The circuit uses the cheap 741 operational amplifier IC along with a single 2N3819 FET input stage. On completion no adjustment is required other than the optional step of roughly calibrating the input attenuator.



The 741 Signal Tracer ready for use. The crocodile clip earths the Tracer to the equipment under test, the audio signal being heard in the earpiece.

Protection against accidental connection to a large input signal whilst the gain is set to maximum is provided by the use of a high impedance earpiece and by the limited output voltage swing of about ±3V. With a normal earpiece impedance of 500Ω the power input is about 10mW. The FET is protected by the usual back-to-back diodes across the input.

The circuit

The circuit is shown in Fig. 1, high frequency roll off and most of the gain is provided by the 741 op. amp, the output being sufficient to drive the earpiece directly. An FET input stage provides the required high input impedance and operates at a small gain of about 8dB. This input stage was necessary since an overall gain of 50dB was the aim and using the 741 alone the maximum input impedance achievable is too low unless abnormally high value feedback resistors are used. Also, at the required gain of 50dB, the bandwidth is too narrow due to the internal compensation. The prototype had a measured gain of 50dB at 1kHz. The gain is determined by the feedback and input components, C3, R5, R6 and R1 feeding the inverting input, and giving an upper frequency limit of about 10kHz in this circuit. A single supply rail is used and the non-inverting input is connected

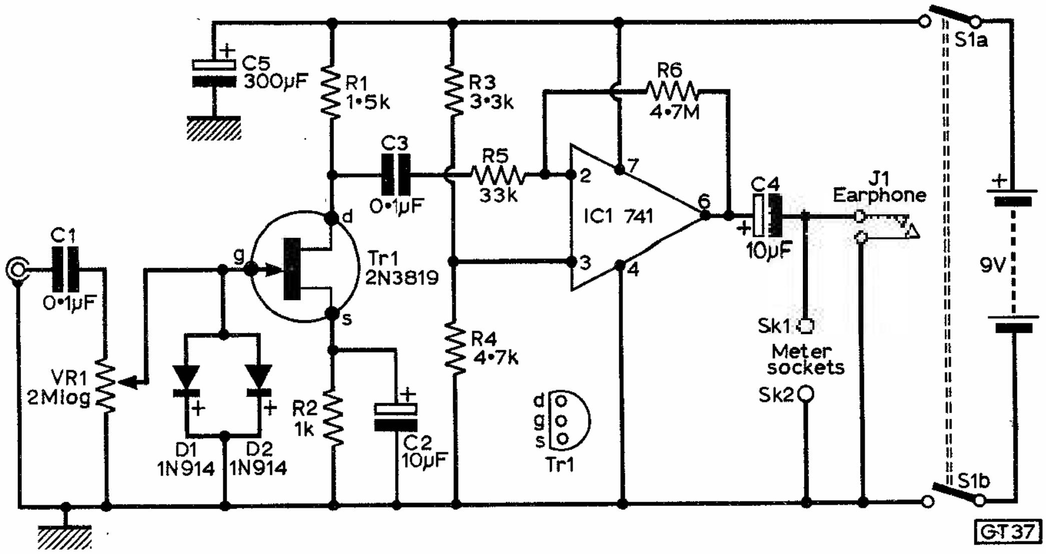


Fig. 1: Complete circuit of the Signal Tracer. The knob of the input potentiometer VR1 can be calibrated to give an indication of the signal level.

★ components list

Resistors
R1 1·5kΩ R4 4·7kΩ
R2 1kΩ R5 33kΩ all ⅛ or ¼W
R3 3·3kΩ R6 4·7MΩ 5 or 10%
VR1 2MΩ log. potentiometer

Capacitors
C1 0·1μF 250VW polyester C4 10μF 10V
C2 10μF 10V C5 300μF 10V
C3 0·1μF polyester

Semiconductors
Tr1 2N3819 IC1 741 8-pin DIL D1-D2 1N914

Miscellaneous
J1, 3·5mm jack socket. S1, double pole, miniature slide switch. Coaxial socket. SK1-2, wander plug sockets. Aluminium box 135 × 70 × 40mm (5¼ × 2¾ × 1½in) approx. Veroboard 44 × 22mm.

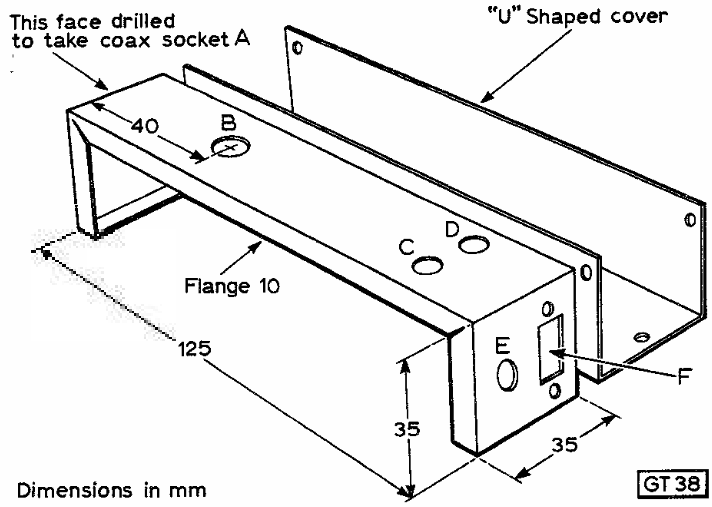


Fig. 2: Dimensions of the case as used by the author. These can be changed to suit the sizes of components actually used.

to a potential divider such that the output pin is at 5·6V. This is the middle of the range over which the output can swing. Here the voltage at the non-inverting input determines the virtual earth point into which the input and feedback operate. The output is taken through a 10μF capacitor C4. The earpiece should be a high impedance type, that used in the prototype had a measured impedance of about 500Ω at 1kHz. The output voltage at pin 6 is a little over 2V RMS at the commencement of clipping.

The FET input stage uses the readily available 2N3819 and operates at a drain current of 3mA and a gate bias of −3V. The component values represent a compromise between available gain and reasonable drain current at this rather low supply voltage of 9V. The AC voltage at the drain of the FET will be about 20mV maximum so with this method of biasing most 2N3819 samples will fall in operating range. The input impedance of the amplifier is approximately the value of the input potentiometer VR1 2MΩ. The frequency response of the unit was 50Hz to 8kHz at the −6dB points and this was considered adequate. Since the gain control is situated at the input, the amplifier is operating at constant gain and the noise generated within the amplifier is therefore present at all settings. The signal-to-noise ratio is however about 50dB and therefore this is not of any importance.

Construction

The unit is built in a small case made of light aluminium as shown in Fig. 2. A 10mm flange is bent in all around and to this is attached the "U" shaped cover using self-tapping screws. The mounting holes A, B, C and D are for the probe input socket, potentiometer and the two output wander plug sockets. The input socket is a normal protruding type coax socket. Mounting holes E and F are for the output jack socket and the slider on/off switch. Dimensions of these holes should suit the particular components used. The circuit board is held in position by a long 6BA bolt.

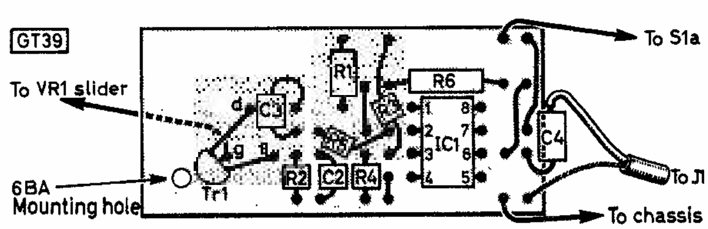


Fig. 3: Layout of components on the 17 × 8 hole Veroboard. If the horizontal holes are numbered 1 to 17 and the vertical holes lettered down A to H then the breaks in the strip are made at C14, D4, D10, D14, E6, E9, E14, F3, F5, F9, F14 and G14, looking from the components side.

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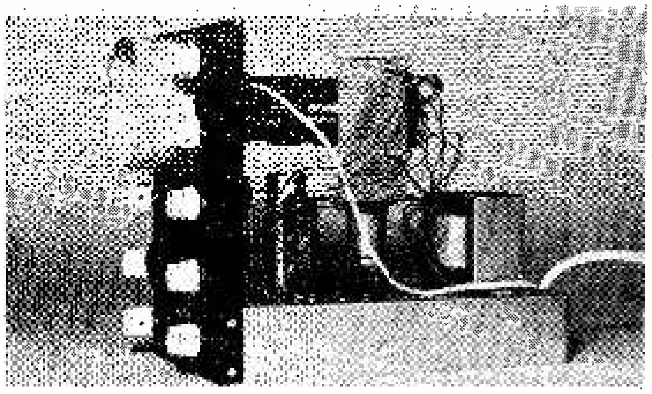

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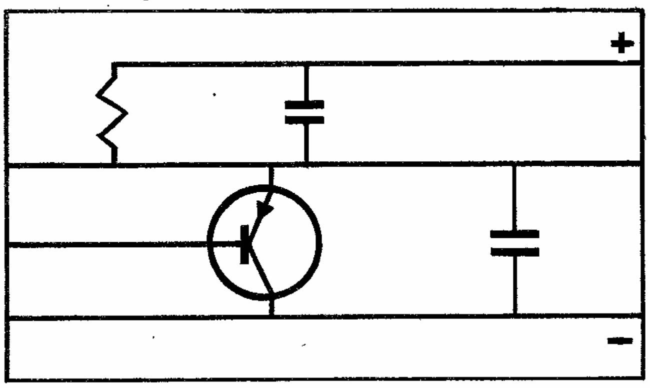

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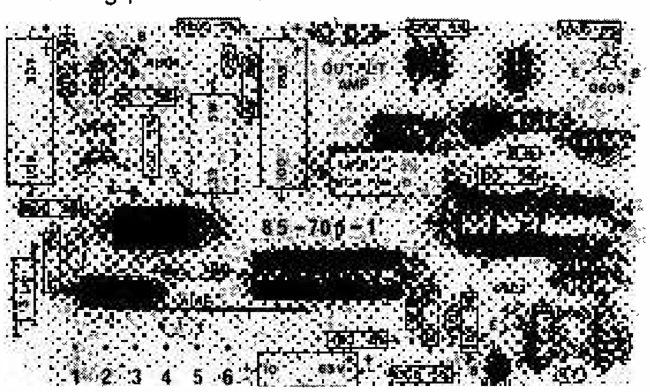

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View of the general layout of the Tracer with the cover removed. Note that C5 is wired direct to the on-off switch, and that the diodes are wired across the input potentiometer.

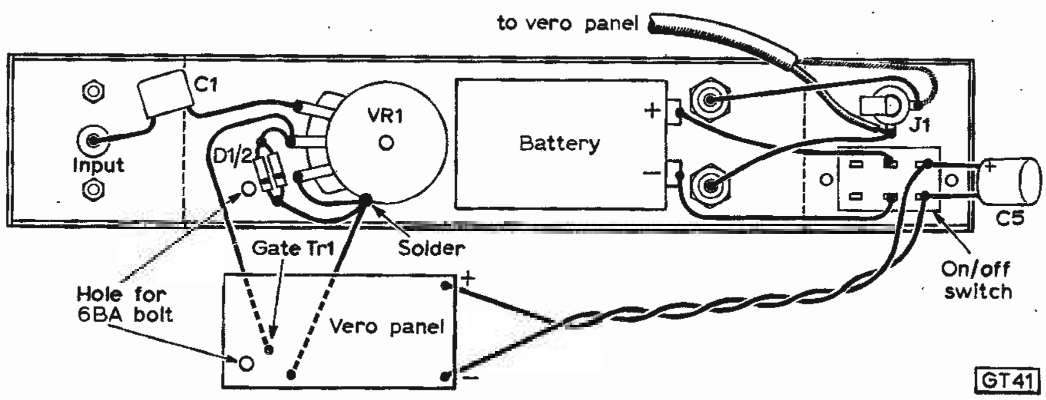


Fig. 4: Details of the wiring between the board and the components fitted to the case. For clarity, the ends of the case are shown folded flat.

Most of the amplifier components are mounted on a piece of 0·1in Veroboard measuring 45mm by 22mm (17 holes by 8 holes), as in Fig. 3. Deviation from the layout given should not prove hazardous provided the output and input wiring is kept apart. The input capacitor C1, protection diodes D1 and 2 and the decoupling capacitor C5 are wired in point to point. If the jack is of the shorting type it should be wired so that the output is not shorted when the jack is removed as this would also short the wander plug sockets. The wiring to the output sockets should be made with a screened lead. The battery is held in position by a piece of foam rubber glued to the cover. When setting up without the cover the battery can be held to the main chassis by double-sided Sellotape, Fig. 4.

The use of a coax input socket allows a permanent connection to be made to the equipment under test with a short length of screened lead and two miniature crocodile clips. A suitable probe may be plugged into this socket for normal tracing operations. The construction of such a probe is shown in Fig. 5. This probe is made from a good quality aluminium coax plug. Without the small tinplate screen the mains hum pickup will be considerable due to the high impedance. The insulating sleeve is cut from a potentiometer shaft, perhaps VR1 if it is bought new. A $\frac{1}{16}$in hole is drilled down the centre of the sleeve so that the brass contact makes a tight fit. The contact used in the original was cut from a brass welding rod, filed to a point at one end and the other end filed to a smaller diameter so as to fit down the centre of the coax plug to which it was soldered.

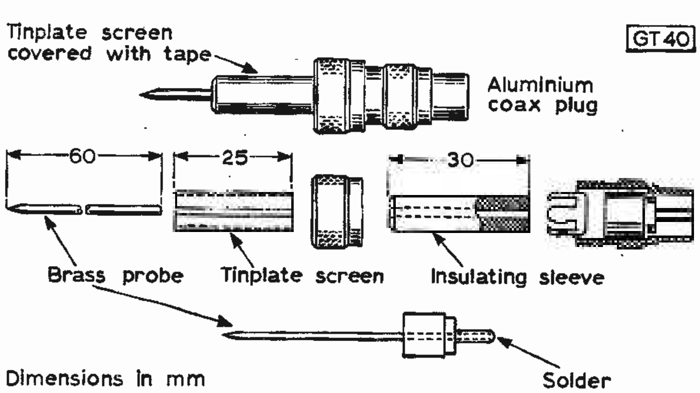


Fig. 5: One probe can be made from a coaxial cable plug as shown here.

Setting up

Before switching on for the first time a meter should be connected in series with the battery supply to check the current which should be 5 to 6mA. If everything is functioning correctly a slight hiss will be heard in the earpiece and possibly some mains hum. If possible a check on the gain should be made when an input of 3mV should give an output of 1V RMS at about 1kHz with the gain turned up fully. The input attenuator can be calibrated in several ways. A voltmeter can be connected to the output and a signal generator to the input through a suitable attenuator. The gain control then being marked in millivolts input for 1V out. The prototype was calibrated in a similar way to this except that the scale was marked 0, −20, −30, −40dB etc. for an output

continued on page 199

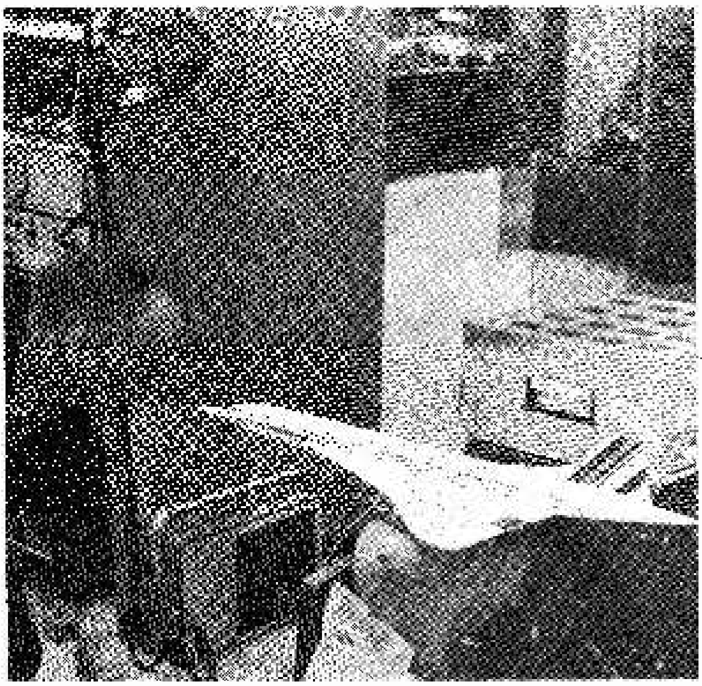
The PARIS SHOW

Salon International des Composants Electroniques 77

A report from DAVID GIBSON

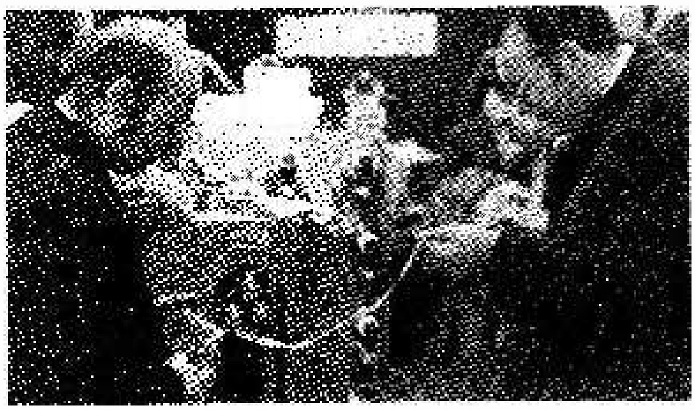
THE Exposition Park at the Porte de Versailles in Paris covers an area of 65,346m². It is the home of a major annual electronics exhibition and this year some 1,200 exhibitors displayed a diverse range of electronic goods. With 30 different countries displaying their wares, the exhibition can fairly claim to be international!

Exhibits varied from old friends seen last year, to the novel and curious. For example, one stand boasted an ionograph which might be loosely described as an electronic device which measures cleanliness! In certain areas of electronics it is necessary to know that the PCB is clean since it picks up all kinds of solvents and greases on its route through the production lines. The ionograph flushes the PCB in a fluid which then passes through a chamber, and the ionisable particles of dirt in the fluid are measured and displayed on a dial. This gives a measure of the dirtiness/cleanness of the particle content in the fluid and hence the cleanliness of the PCB. Just the thing in this modern age for checking on the state of little boys' necks (could probably be calibrated in tidemarks).



This model of Concorde looks steady enough but it's really being vibrated at varying rates on different parts of its body. A nearby stroboscope, when switched on, "freezes" the vibrating model making it appear stationary.

The cordless soldering iron has been on the market for some time, but one company has gone a stage further. They are offering a miniature drill which plugs on to the contacts of the heating element and runs from the internal rechargeable batteries in the body. The drill measures only 7·8cm x 3·2cm and weighs 65g. Definitely a hot little number! If you have $400 under the mattress you could consider buying an MCP-1, a radio receiver with no tuning knob. Inside, the MCP-1 has just about everything; a microcomputer, phase-lock loop, digital frequency synthesiser, just to name a few. They combine to give a small calculator-type keyboard and a digital readout window. Touch a button and the receiver will start to scan. When it comes to the first occupied frequency it will stop. If you want that station, touch another key and the exact frequency is entered into memory. Then carry on scanning. To recall any station, merely touch in the frequency. Just a thought—the memory has sufficient capability to store 12,000 separate stations! An unusual feature is that no crystal is used; the receiver relies on phase-locked loop and digital frequency synthesiser techniques.



Two visitors can hardly believe it. This machine winds foil-film capacitors, and the foil is only 2 microns thick.

Some items were so new that they were only talked about in low voices. One novel IC was described as a driving circuit for analogue displays. This turned out to be a chip which has outputs suitable for driving LEDs. The novelty is the number and arrangement of these outputs. There are 10 outputs and 3 "lines" selection. Thus, if one imagines 30 LEDs arranged in three rows of ten, it is possible to address or illuminate any one (or more) LED in the matrix. Possible applications suggested were digital voltmeter where lit diodes would indicate voltage and eliminate the need for a meter. The device operates from 9V and it is possible to cater for two alarm points i.e. when (say) the voltage went above or below certain preset limits in the digital voltmeter application described above. It would seem to offer some interesting possibilities in the area of electronic games although this is not its prime function. Development samples only are available at present.

Most people have seen or heard of a teleprinter. This is a keyboard like a typewriter but which can send signals over the telephone lines which are subsequently printed out by another teleprinter at the receiving end. Trouble is that the keyboard is rather large and so invariably fixed in some office. That was until this year's Paris show. A company called Technology Resources exhibited a pocket TTY. This measures only 25 x 75 x 155mm and comprises a complete pocket teletypewriter terminal. It allows both transmission and reception of signals and has a 36-button keyboard. Each button has two sets of characters and a small switch at the top dictates which is sent, depending upon whether this switch is set to the left or right. The standard ASC11 code is used and the speed is 110 bauds. The terminal requires two power supplies: +5V at 500mA, and −12V at 100mA.

One unexpected stand was that of REF, Reseau Emetteurs Francais, the French RSGB. The Society had a station on the air using a 144MHz transceiver under the callsign F8REF. The rig was a Kenwood 2-metre all-mode transceiver with 10W of SSB, FM and CW, and 3W of AM. he society offered for sale a "Hams Interpreter" which gave equivalent phrases in most languages. While your scribe searched diligently, there was no polite phrase which could be used for those Iron Curtain T3 notes which still haunt 14MHz!

For readers who find the soldering iron has a nasty habit of burning through its own lead: good news. A Scandinavian firm which specialises in wires and cables has one which can withstand enormous temperature differentials. Available in a variety of sizes it will work over the temperature range minus 100°C up to plus 300°C.

And so the show drew to a close for another year with snippets still ringing in the visitors ears: GIM has sold eight million games chips which "play" tennis, squash, football, a sort of "four-rule" games chip; AEG Telefunken showing a 5cm rectangular flat CRT with heating power only 35mW and an accelerating voltage of 1·5kV described as suitable for pocket TV sets. With an average of over 10,000 visitors a day, the show will rest now until April 1978, when we'll find another 1,200 exhibitors showing new devices even more wonderous than this year.

A 741 SIGNAL TRACER—*continued from page 197*

of 0dB or 0·774V. A less accurate method is to use a low frequency input of say 200Hz and note the input level required to cause clipping as heard in the earpiece, at various gain control settings. However it should be noted that this is not intended as a measuring instrument and that any calibration can only be approximate, as the gain is to some extent dependent on the supply voltage and the frequency since the response is not perfectly flat.

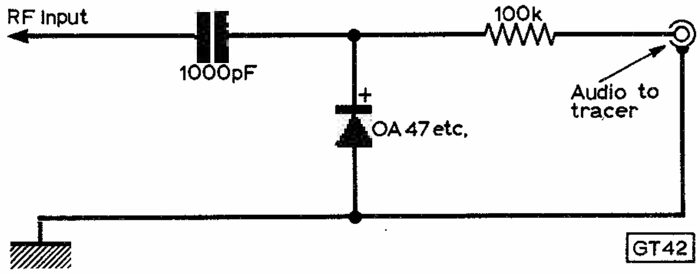
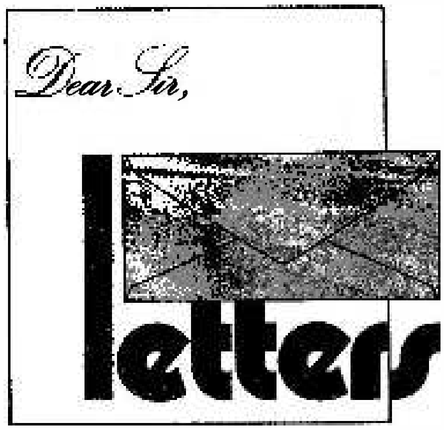


Fig. 6: For tracing modulated RF signals a probe incorporating the above circuit can be constructed.

An RF probe, as such, was not constructed for the prototype, a diode detector as in Fig. 6 being set up when required, keeping all "hot" leads as short as possible. The prototype worked well on supply voltage as low as 7V although the gain decreased. PW



New style R.A.E.

Candidates for the R.A.E. will probably be aware that it is intended to change the format of the examination.*

My students have taken part in a City & Guilds Protest, and if their reactions are typical there seems to be no relaxation of the standard. The multiple choice method enables the entire syllabus to be covered, probably with 150 questions. There is a sophisticated method of eliminating the chance of success by guesswork. My basic method is to subtract the wrong ones from the right ones.

Past experience in *other* C. & G. examinations having a syllabus including some Regulations, some recognition and interpretation with elementary calculations, has demonstrated to my satisfaction that the competent candidates succeed.

I have been able to monitor the performance of these students in the College and at work and I maintain that the gradings achieved reflect as accurate an assessment as any other method which does not require a display of practical, manual ability.—**Name and address supplied.**

* See News Item on page 180.

Out of this world!

I write in answer to the letter by Mr. G. L. Manning, G8JBH, titled "High Power Interference" published in the May issue of *Practical Wireless*.

The transmission that is referred to is undoubtedly that of the AMSAT-OSCAR 6 command station, located at the University of Surrey, the purpose of which is to control the satellite's periods of utilisation, hence the battery state and continued function, as a part of a world-wide command group in phase with similar stations in Hungary, New Zealand, Australia, Canada and the USA. The British section of the command network has been active for over two years and the project is now developed to a fully automatic az-el real-time computer controlled status, that has performed its part in keeping the satellite "alive" for the one thousand plus Oscar communicators around the world.

Thus, in real terms, one cannot claim that "minority groups are being given absolute priority over other groups" especially when one considers that we are dealing with some 30kHz of a band 2MHz wide. The actual bandwidth is considerably less than the 100kHz stated, although I would agree that the nature of the transmission would make it appear to be of a much wider bandwidth in many types of receivers close to the source.

The reason that the transmission is greater in its spread is in part so that any interfering signals do not accidentally command, and because it has to overcome the Doppler shift during an orbit. The selection of the particular part of the band used is because it is one of the two "all modes" sections, and also to cause the minimum possible inconvenience to other band-users, it being on a little-used section of the two metre spectrum, to which many alternatives exist. It also needs to be a frequency that is internationally available on a mutual basis for such sophisticated functions.

Our regret is that apparently this section of the band is employed in the more densely amateur populated areas, and that it would obviously be better to have the station situated at a more remote and less inhabited area, but, the considerable technical resources and cost of the installation limited its placement to the only position where the competence and allocation was available.

The periods of transmission are restricted solely to those times when Oscar 6 is in line-of-sight to the command, this being some two hours total time daily, varying from transmission times of a few minutes in the early morning and late evening hours, to a maximum of 25 minutes on overhead passes, at a rate frequency of 100 minutes. The actual times are dictated by the orbital constants, which are available from GB2RS, BARTG Teletype bulletins, CEEFAX, ORACLE, TELETEXT, AMSAT and many other sources, thus permitting those interested to know the exact times when to expect the transmission. Although AMSAT have strong links with the RSGB, the Society cannot be held responsible for the difficulties encountered by stations also using this part of the two metre band.

The particular choice of frequency of any user of the band employing it for normal QSO's is up to the user, having regard to the band-plan, and if an operator chooses to employ a section allocated for mixed modes, he still has the choice of 700kHz unaffected by the command signal, with the complete freedom to move, unrestricted by international requirement. AMSAT were not unaware of the problems being experienced by other users of the section convered, and had a valuable dialogue with G3HTP, representing the affected other users, at the last AMSAT-UK meeting at the University of Surrey, resulting in a good mutual understanding. As a result a letter explaining and outlining the problem was sent to every club Secretary of amateur radio groups within a 75 mile radius of the command station. The bandwidth was reduced, power also, to the very minimum capable of commanding the spacecraft, and azimuth control was added to reduce the groundwave signal level.

On a more optimistic note (from the point of view of those who wish to use this particular section, if not from AMSAT's) the OSCAR-6 satellite has now lost four of its Ni-Cad cells, and despite careful nursing by the command network, is unlikely to be with us for much longer. OSCAR-7 is in the main self-controlled, and is not commanded by the British section of the international network. Further, future satellites should only need short bursts of a few seconds duration to "hold" the information fed, and this only a few times per week.

On a more personal note, I do not feel that the presence of a few amateurs holding QSO's on a particular frequency is likely to justify the continued allocation of this greatly envied spectrum at WARC in 1979. On the other hand, the knowledge and know-how of satellite operation multi-access and the development of the means of satellite command auto-control systems is an activity that is likely to be of value to those who will decide as to whether the amateur service maintains its current band availability.—**Pat Gowen G3IOR** (Norwich). Chairman and Co-ordinator AMSAT-UK.

April fool

With reference to your informative article 'Surefire' in your April 1977 issue, I must congratulate you on a most marvellous and comely piece of prose. However, when I commenced the fabrication of said circuit, in situ, I was perturbed to discover the absence, to wit the total lack, of an APR 77 transistor in my collection. Fortunately, I perchanced to recall my ownership of a multiplicity of Unitrons —of which much has been penned in your illustrious magazine.

Whereupon, on inserting said Unitron, an imaginary current was perceived to flow. Could this be the first contact with an alien universe?—Yours laboriously, **Prof. T. Pott.** (Whataripoff Institute of Parapsychology, Moscow.)

A complaint

I am writing to you to complain about the lack of valve designs in your magazine. Many people have written asking for valve designs and I think you should have some. Surely, if you ignore what the readers are asking for, then people will stop buying your magazine!

After all a valve radio is simple to design; no complicated regulated power supplies are needed or heatsinks. In my opinion, people don't build radios any more. They just get a couple of integrated circuits, a ferrite rod, a printed circuit board and there you are, instant noise maker! In the old days, to build a radio was a major task. A chassis had to be punched, transformers had to be mounted. Valve holders, coils, large variable capacitors and tag strips all had to be thought about before the soldering iron was plugged in.

I am only fifteen and I recently built a four-valve TRF to my own design using Denco coils. This had a good tone and a high output. The selectivity and sensitivity were good even though no reaction was used, and it wasn't a superhet. Valves are still in use in many TV and amplifier applications all over the country and I think you should include them in your magazine. Apart from this I find your magazine excellent!—**Andrew Redding** (Rotherham).

We would welcome such designs from readers. How about you, Andrew, submitting an article on your receiver?—Asst. Editor.

2kW from a PP3?

Having constructed my own style of Disco Unit, using some of the circuits in *Practical Wireless*, I found that I had omitted to build any form of pre-fade amp into the unit. I rushed out and purchased a small half-watt module and fitted this into the unit as a temporary fitting, powering it from a PP3 battery neatly clipped on the side of the cabinet.

A few weeks later I was booked for a party in our local public house and during the course of the evening a rather merry gent staggered up to me and asked to have a look at my 'gear'. I told him that I had built the majority of it myself and he remarked that it looked and sounded very good. He noticed the PP3 battery strapped to the side and remarked, "and it all runs off that wee battery, magic stuff" and staggered away!

I must write to a certain battery company and ask if they have found anyone else using PP3s to power a 50 watt amp, two turntables and 1800 watts of flashing lights!—**P. C. Glen** (Glasgow).

Who's he kidding?!

I am writing to you in connection with the article SUREFIRE published in the April issue of your magazine.

I would first like to agree with Mr. D. Jones theories and explanations. I would also like to point out that when VR1 is in fact acting as a Kenotron not only will all present positrons undergo adiabatic contraction, but it can also be proved that photon entering the magnetic field will actually gain energy, this energy is then converted into ultra violet light. It was also found in the atomic research laboratory that adiabatic contractions in positrons changes the charge of a given electron by exactly $1{\cdot}37549865 \times 10^{-20}$C., this was measured with an atomic operational amplifier very similar to the good 'ol 741. This amplifier can be made to detect charges as small as 10^{-12}e.

The circuit in the article also helped to prove beyond any question the Lorentz-Fitzgerald contraction and also helped with the measurement of the time dilatation between two given events in a frame of reference travelling at twice the speed of light.

May I take this opportunity to congratulate Mr. D. Jones in the achievement of achieving Nothing.—**N. Nazoa** (London).

Look behind you!

Some time ago I constructed a 6 transistor radio for the short-wave bands in a metal case with an open "rear". A few days ago I noticed that regeneration had become somewhat "fierce" and decided to investigate as the radio is in a shack in the garden! I duly took the set out of its case and then noticed that a small spider had built a "web" around the regen-control (a variable capacitor of an open type) and as the weather was damp tiny globules of water had formed along the strands and in between the fixed and moving vanes of the capacitor *and* in addition there was also a web built around the volume control and I suspect shortening the life of the 9V battery, when the web became damp! So watch out boys if your equipment is in a damp or humid shack or "spidery" attic, batteries *are* expensive and also *transistors* could be damaged!—**J. Owens** (Dolgellan).

HOTLINES

ON RECENT DEVELOPMENTS

Microprocessors —new uses

Great news for Teletext/Viewdata addicts. I hear that a British company is to turn to microprocessor technology to produce what amounts to a very low cost TTV (teletext/Viewdata) module. Price quoted in the US is 20 dollars—that's around £11. The same company hopes to add another module later which will offer on-screen channel number, time, remote control, and digital tuning. This latter device will cost around 30 dollars.

Speaking of microprocessors, I hear that these components will play a major role in motor cars of the 1980s; and that's less than 3 years away. Fuel injection by electronic means has already appeared on many vehicles, but the motor manufacturers are now working on fuel management. A sensor in the exhaust system feeds back information to the electronics which in turn can control all the major adjustments possible in the engine—like fuel injection, fuel/air mixture, throttle, engine speed, etc. The electronics is so designed as to ensure that the engine is always running at maximum efficiency. One can imagine the ultimate in auto electronics—just sit in the car and say to it, "Home, James".

½ inch switch . . . almost

Let's switch to a different subject—switches! Imagine a ten-way single pole switch. Quite a large affair; until Micro-Dip came along. This switch will operate over the temperature range −10° to +60°C and can switch 5V at 100mA. Its size is truly remarkable—just half a 14-pin DIL package. In inches, that's only 0·38 × 0·4 × 0·24in. The contacts are gold plated and the switch is also available in codes, such as BCD and complemented BCD. It is rotated by the blade of a small (very small!) screwdriver.

I was interested to learn of some power MOS FET devices just on the market. These give a minimum gain of 10dB at 200MHz and have a power dissipation rating of 35W. These would seem near ideal for QRP Ham rigs since not only are these devices "thermal runaway-proof", they are also immune to load mis-match burn-out too. Small quantities (in the US) are priced at around 20 dollars.

Magnetic display

Displays are always items of interest especially new ones. The latest to come to the ageing Ginsbergian eardrums (I haven't actually seen these yet) consist of little balls floating in oil. One half of each ball is white, and the other half black. The balls can be rotated by means of an applied magnetic field. Thus a pattern can be shown by simply applying the necessary magnetic fields. Quite true—not a load of ballderdash.

Another display uses a liquid crystal only 10mm by 10mm. Onto this tiny cell, some 40 rows, each with 50 characters can be packed. A laser beam is scanned across this "cell" and the image projected to 10in x 10in. The speed of the system is about 20 characters per second which is very fast.

Hot car

One hears about absent-minded professors, but here's a story about a retired, but very forward-thinking one. He lives in Los Angeles and drives a small Honda motor car. Power is derived from two 3·5 horsepower electric motors. These take their power from six 6V batteries. On the roof of the car is an array of photocells which keep the battery charged. Top speed is around 25 mph with about one hours' driving time before the battery runs down and needs a recharge (free from the sun). The array of cells on the roof manages to produce around 3A/hour in sunlight and an eight - hour "exposure" gives enough battery power for at least one hours drive. But don't start eyeing your mini roof yet; the total cost of the cells was over £1200—and the wise professor has kept the petrol engine part of the vehicle intact!

While the Citizens Band in the UK is still at the idea stage it is interesting to see the volume sales in America for CB radios — particularly from Japan. The 1976 trade figures (for the US) indicate that Japan exported 9,900,000 automobile transceivers alone! And they managed to capture 88% of the US market for this type of equipment. The actual value of these transceivers was put at well over 550 million dollars. There is currently a move afoot to restrict the imports of these equipments by putting up tariffs and setting quotas. I wonder if the UK will learn anything from all this?

Stamp collecting . . . outdated?

How long before computer hobbyists emerge in Britain? Perhaps when the potential to the hobbyists/experimenters is fully understood. Take the things some people are already doing. One man generates music with his computer. He writes electronic songs by playing notes into the memory from a keyboard. These could be read out via a synthesiser to reproduce almost any instrument.

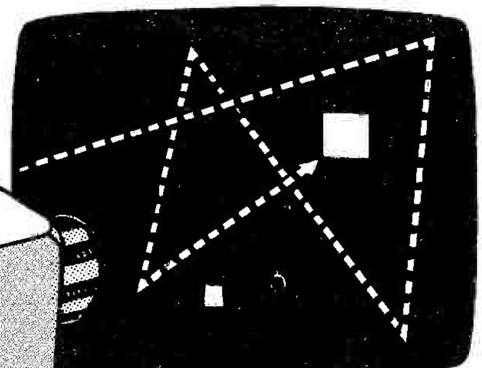
Another computer hobbyist has a wood-burning stove (which helps heat his house) coupled to the computer which has improved efficiency by some 10% on very cold days. In weather above freezing point, the efficiency has been increased by nearly 30%.

Yet another enthusiast keeps all manner of information in his computer's memory banks on things affecting his buying and selling business—could be an idea for those who play the stock market?

Ginsberg

ON TARGET? Shoot!

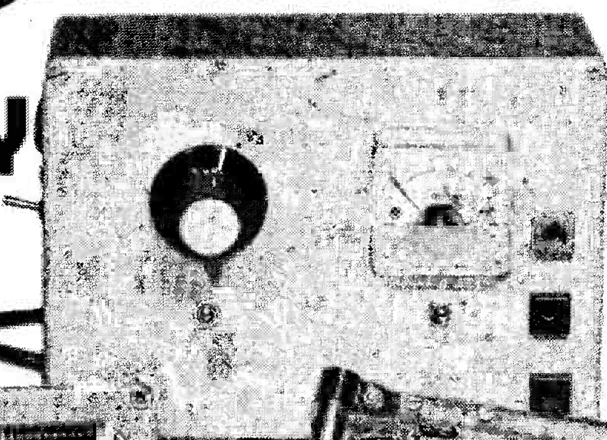
IN NEXT MONTH'S PRACTICAL WIRELESS



ON SALE 1st JULY

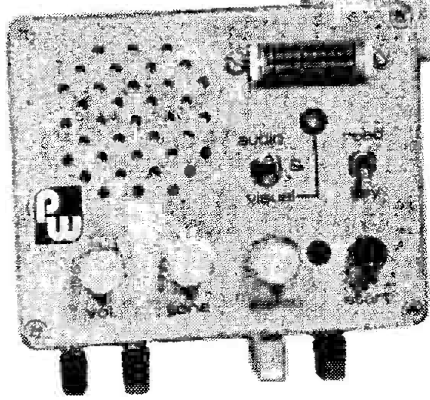
Simple add-on unit for PW's Tele-Games . . . watch for the target on the screen, aim your spot with the joystick control, press the trigger and Fire! If you are on target your score appears on the screen.

Handy~Mini POWER SUPPLY

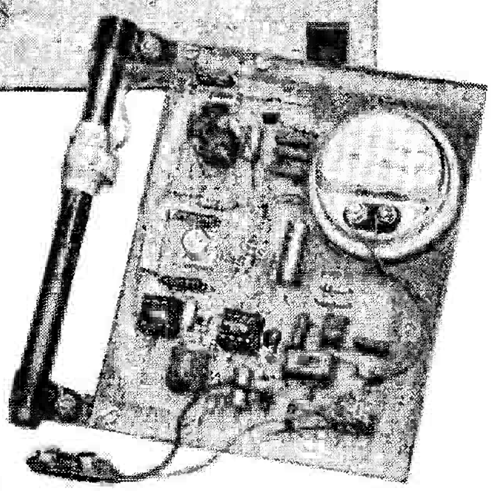


No experimenter can have too many power supply units around! This one will always prove valuable, providing from 0 to 12V at 500mA or 1A as required. It incorporates overload protection and a meter to monitor the output current.

Morse Tutor



Learn Morse the easy way with the PW Morse Tutor. Electronically generated Morse characters produce a perfectly keyed audio or visual signal. Code cards plug into a socket and out comes the code! Plus speed and tone controls. Invaluable for code instructions or just teach yourself.

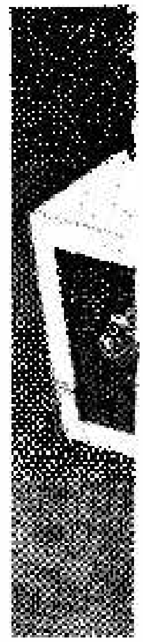


ATOMIC Time Receiver

You won't believe it, but the period of the earth's rotation is just not constant enough these days for some purposes! Build this Atomic Time Receiver, driven from a signal from station MSF at Rugby, and compare instantly the earth's time and atomic time.

24-HOUR DIGITAL CLOCK with PRECISION TIME SWITCH

J. MILLER-KIRKPATRICK



TIME-controlled switches have been with us for many years for switching electric lighting in streets, central heating in homes and offices and in their most complex form as sequence programmers for industrial machinery and such mundane things as washing machines. The original time-switches were run by clockwork with an eight-day movement which meant that, for instance, a council employee had to tour all the streets in the area once a week to rewind all the movements. This type of switch was soon replaced with an electric movement which, although more expensive initially, soon paid for itself in the saving in manpower and in its accuracy.

Most electric time-switches used today have a synchronous motor tied to the mains frequency thus giving very accurate long term stability and requiring little in the way of servicing except after power cuts! One of the major problems left with this type of unit is the fact that the setting or repeat accuracy of the switch itself relies on a cam attached to a drive shaft which rotates once every 24 hours and contacts with switches set on the circumference of the 'dial'. As the dial has a circumference of about 250 mm at most this means that in a 24-hour cycle each hour is represented by some 10mm of movement and thus each minute is represented by something like 0·15mm. On a high quality switch these tolerances could be met and probably bettered but on a mass-produced item the resulting accuracy means that the time switch can only be set to within about 5 minutes of the required time.

W475

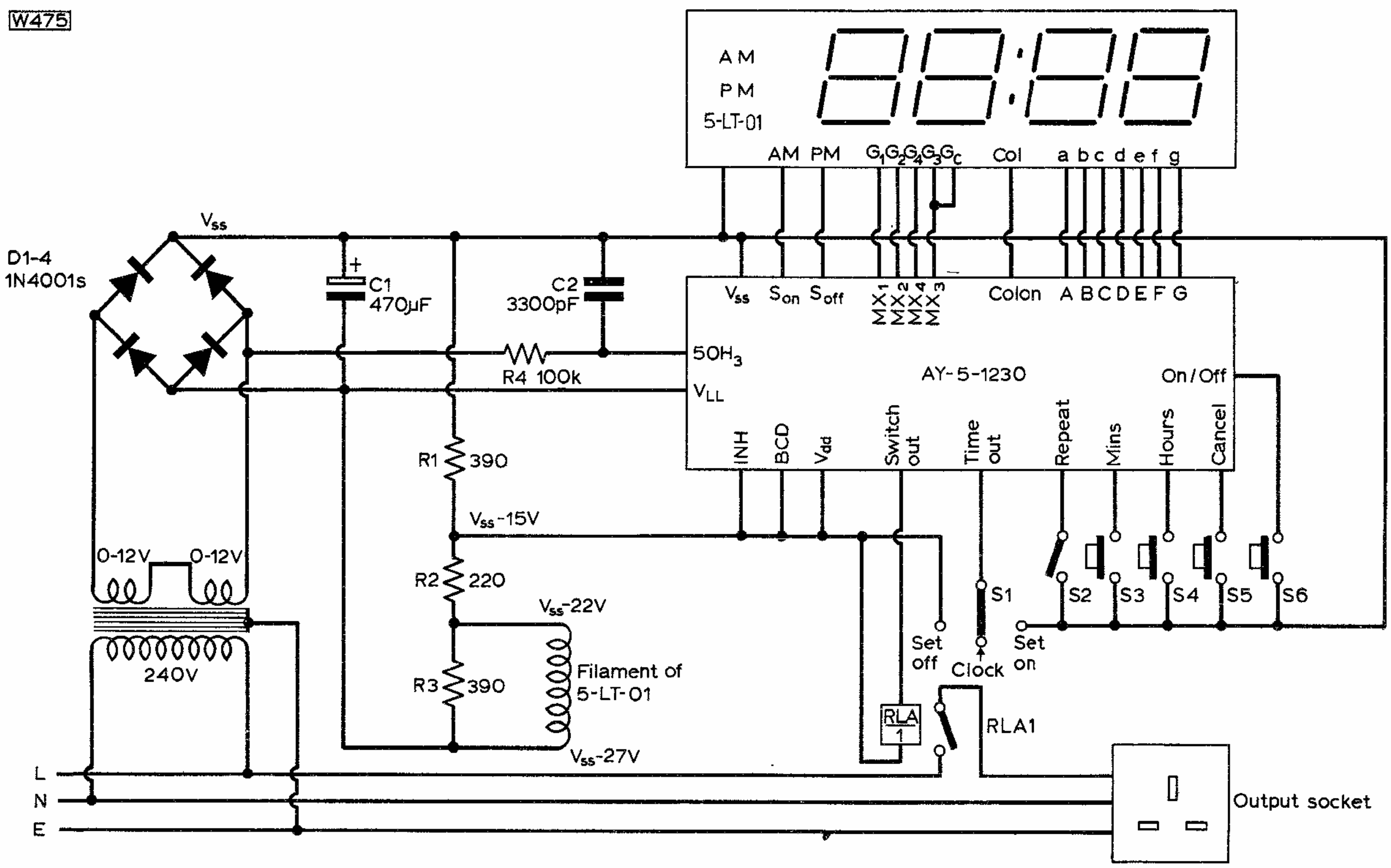
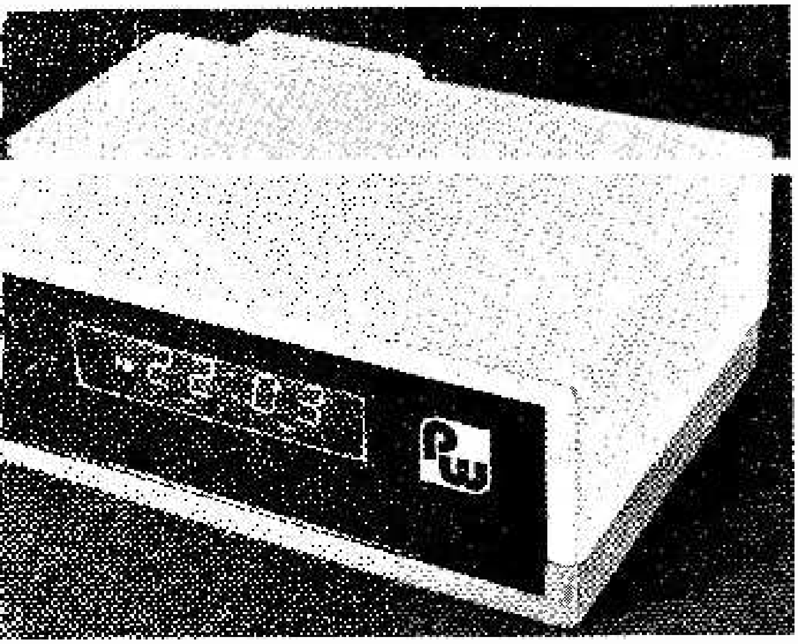


Fig. 1: Circuit diagram. The IC pinout is given on page 209.

This project combines an attractive digital clock with a high accuracy 24 hour timer capable of switching 500W AC. For easy construction the bright fluorescent display mounts directly on the PCB.



In industrial machinery and even in some household appliances such as washing-machines and ovens the switching of the various internal motors and other functions is controlled by dedicated TTL circuits or even microprocessors. This, coupled with quartz crystal timing if required, gives rise to equipment which can be switched on or off at any time during a 24 hour cycle (or even longer) with an accuracy of better than 1/1000th of a second. Although this sort of equipment is probably within the design ability of a lot of readers the applications and high cost would limit the interest.

With the advent of electronic digital clocks the method of timekeeping in many households has now changed from the 'quarter to two' approach to the potentially more accurate '13:43'. Some of the alarm clock chips could be modified to operate as a time-switch with an accurate "turn-on" time but, with only one alarm comparator, the "turn-off" time could not be similarly set (unless two alarm clock chips were used in parallel with the associated problems of synchronising the two chips). The CT7001 clock chip includes an alarm and an elapsed time alarm, these two functions could be linked to give an accurate turn on time and an accurate elapsed time up to a maximum of about ten hours, however, the elapsed time counter has to be set each time it is required and would not repeat in the following 24 hour cycle.

General Instruments have released the AY-5-1230 digital clock chip with a switched alarm output which comes on at the time set in the "on-time" register, goes off at the time set in the "off-time" comparator and also operates as a 24 hour, four digit, clock.

Circuit description

The circuit diagram of the unit is given as Fig. 1.

The transformer drops the mains voltage to about 24 volts which is rectified to DC by diodes D1 to D4 and smoothed by capacitor C1. The resulting voltage across C1 should be within the range 24V to 30V and capable of delivering 100mA. The positive side of C1 is referred to as Vss and all other voltages are referred to as negative with respect to Vss.

If it is assumed that the voltage on C1 is 27V then, under no load conditions, the potential divider chain R1, R2, R3 gives Vss-12V, Vss-18V and Vss-27V. When the load of the chip and the filament of the display are taken into consideration the resulting voltages are nearer Vss-15V, Vss-22V and Vss-27V.

The Vss-15V line is connected to the Vdd input of the chip and with a 50Hz signal being taken from the transformer, via limiting and shaping components C2 and R4, the chip will start to operate. An internal multiplexing oscillator starts to run and sequentially selects the data in the display registers for each digit in turn and presents that data on the segment outputs at the same time as turning on the appropriate digit drive. The data for the next digit is then selected and presented at the outputs and the next digit drive is turned on. The speed at which this happens when connected to the display is too

✶ components list

Resistors

R1	390Ω 5% ½W.
R2	220Ω 5% ½W.
R3	390Ω 5% ½W.
R4	100kΩ 5% ¼W.

Capacitors

C1	470μF 50V.
C2	3300pF disc ceramic.

Semiconductors

IC1	AY-5-1230 G.I. (Metac, Bi-Pak or Watford Electronics)
D1 D2 D3 D4	1N4001

Switches

S1	SPDT, centre-off
S2	SPST, sub-miniature
S3 S4 S5 S6	miniature push button, one pair normally open contacts, non-latching action

Display. Phosphor diode, 5-LT-01, Futaba, (Metac or Watford Electronics)

Miscellaneous.

T1, mains transformer, 24V at 250mA secondary, (MT150) fixing centres 60mm. Case 205mm × 75mm × 140mm, (8″ × 3″ × 5½″), Vero code 75/14112. Front plate, 198mm × 69mm × 2mm, perspex, red or clear. PCB from Readers PCB Service. Output socket to suit use.

fast for the eye to follow and a continuous four digit display is seen.

The AY-5-1230 has facilities for BCD, seven segment or blanked output. In this project the BCD and blanking (INH) inputs are connected to Vdd to give a seven segment output at pins a-g.

The chip is designed to allow it to interface directly with fluorescent (Phosphor-diode) displays. This type of display has a heater which acts as the cathode with the segments being the anodes. Between the two are grids connected to each digit drive.

Display

To light any one segment both the segment drive and the digit drive grid must be at least 15 volts positive to the centre voltage on the filament. In this circuit the centre voltage on the filament is Vss-24·5V and the segment and digit drives switch to Vss to turn on, thus the voltage differential is 24·5 volts. When in the off condition the chip outputs would normally switch to Vdd which is Vss-15V This would result in a voltage differential on the display of about 9 volts and could result in the segment remaining lit. For this reason the chip outputs are internally connected via resistors to a common line referred to as VLL which is connected externally to the negative side of the heater. This ensures that the chip outputs switch off to Vss−27V giving a display differential of zero volts and thus extinguishing the off segments.

The display includes two indicators for AM and PM which cannot be used with this chip (it does not have AM/PM outputs since they are unnecessary on a 24 hour display). The chip does have two output indicators which show that either or both ON and OFF times have been set, and, to save costs, these are connected to the AM/PM indicators on the display.

An alternative is to use two LEDs, as shown in Fig. 2, with the current limiting resistors mounted on the PCB. On the prototype provision was made for these diodes on the back panel but it would probably be more convenient to mount them on the front.

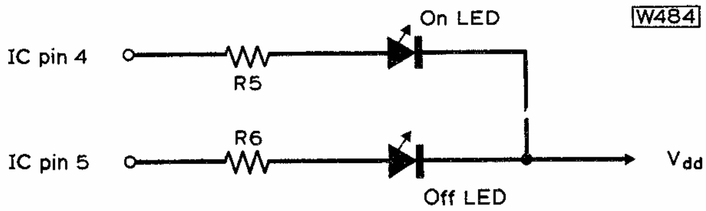


Fig. 2: Alternative alarm status indicator.

The switched output from the chip can be used to drive a relay of the type specified direct. Before using any other type of relay check that the operating current of the relay does not exceed 30mA at 15V. Other switching systems can be used as shown in Fig. 3.

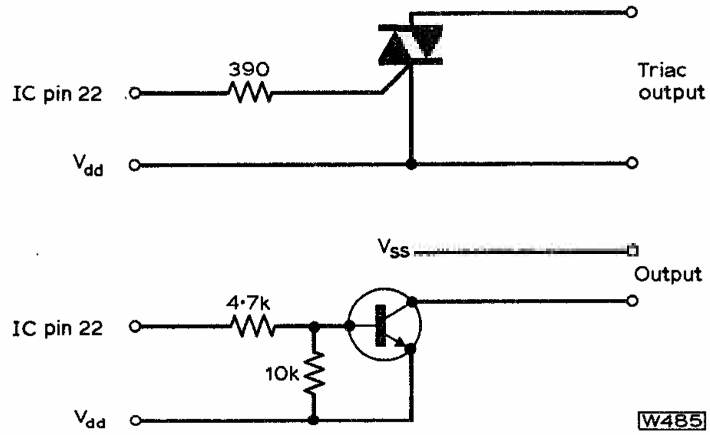


Fig. 3: Alternative alarm output circuitry.

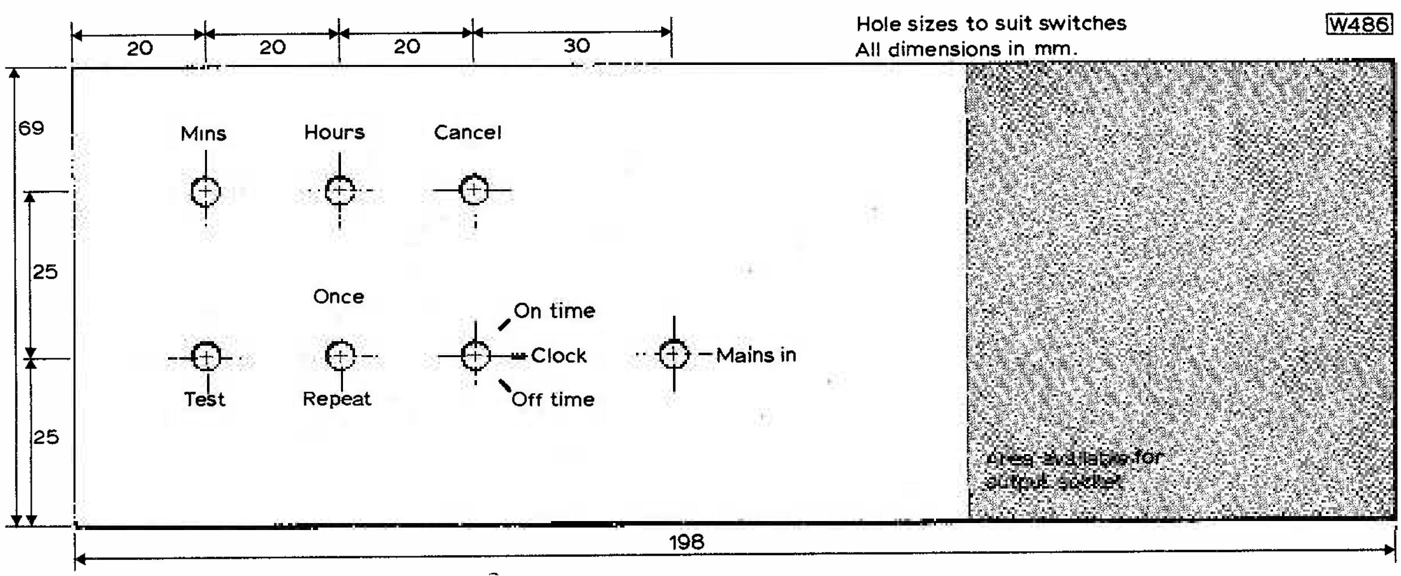
Construction

Construction is reasonably straightforward but two points are worth extra attention.

First, use standard MOS handling procedures with the clock chip.

Second, beware of the mains on the board. The relay specified has its metal body connected to the centre contact of the change-over set. If the mains is being switched it will appear on the body of the

Fig. 6: Rear plate drilling details.



relay. For this reason the track linking it to the mains has been broken and a link inserted. Leave the link out until the preliminary testing has been completed.

Similarly the mains is carried by tracks on the board and it would be better if these tracks are painted with enamel paint or several coats of shellac.

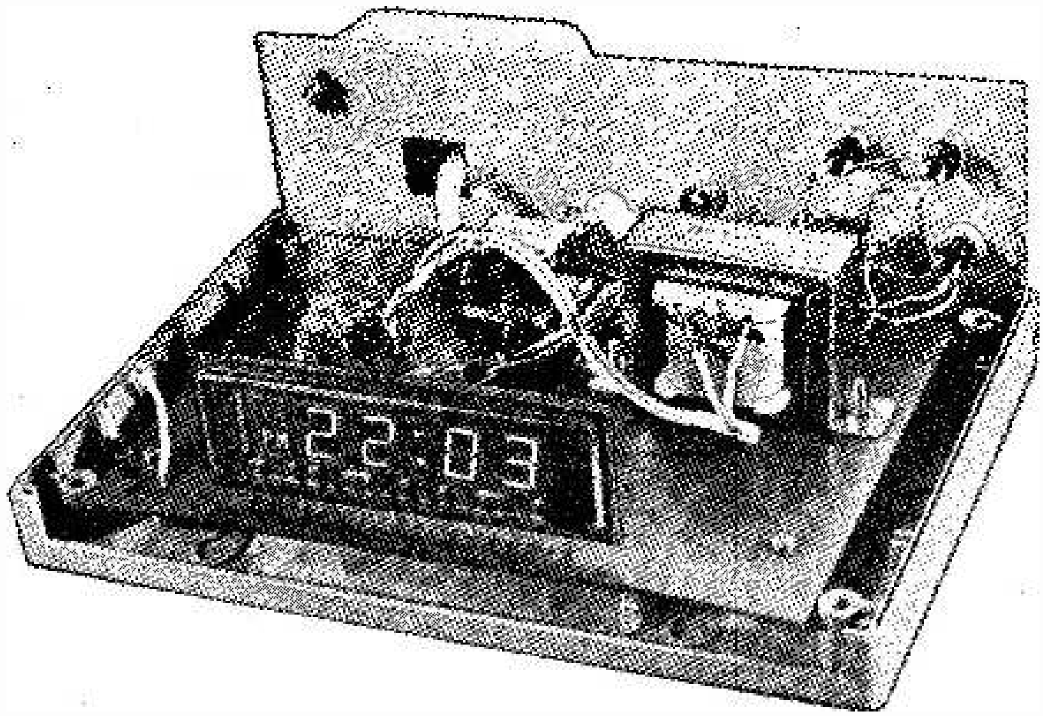
The single PCB used is shown as Fig. 4 and the component locations as Fig. 5. Start the assembly with the transformer, resistors R1, R2 and R3, diodes D1, D2, D3, and D4 and capacitor C1. This will allow the power supply to be checked before the more expensive components are fitted. The voltage readings should be similar to the unloaded figures given earlier.

Assuming the power is correct the remaining components can be inserted (not the link to the relay) and the switches mounted on the rear panel. (see Fig. 6). The use of a socket for IC1 is strongly recommended. If separate LEDs are used on the front panel, leave the leads fairly long.

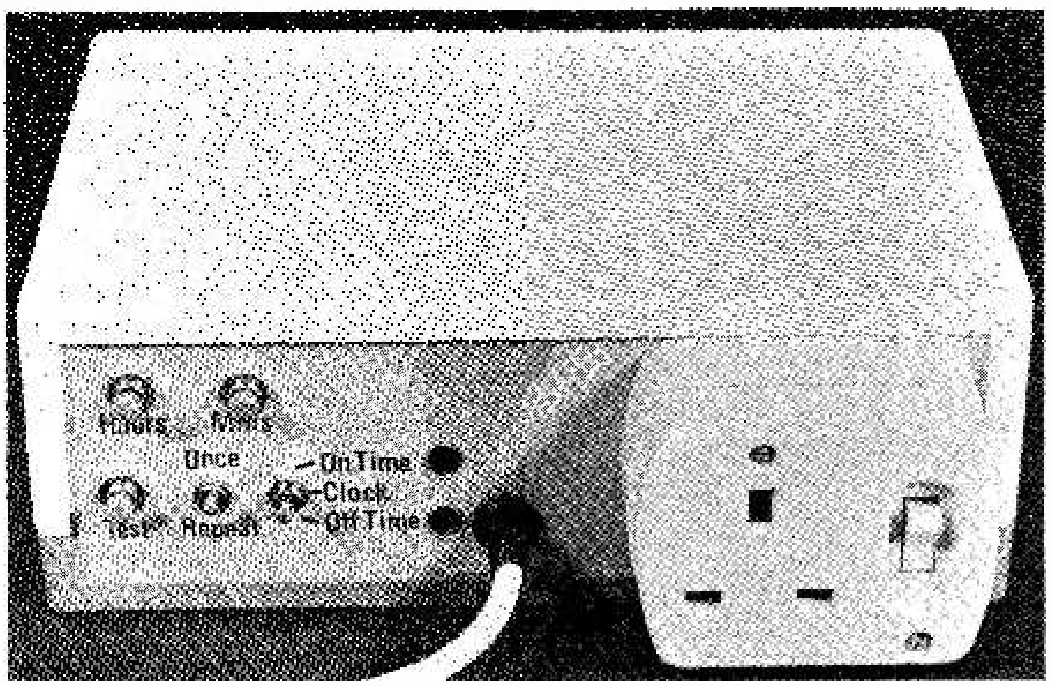
Do not assemble the board, front and rear panel into the box at this stage.

Testing

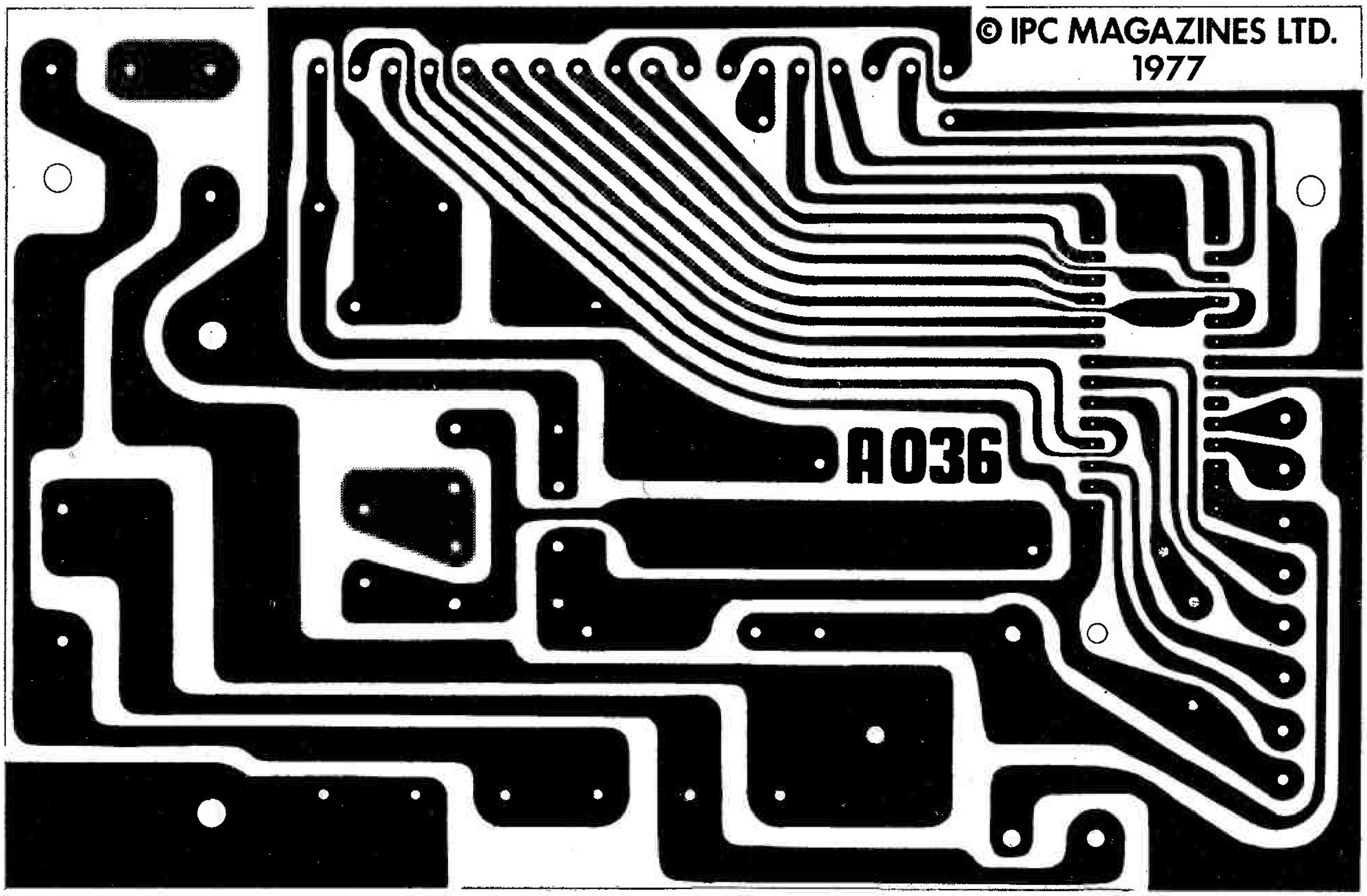
When switched on the display should light up and show 00:00 which is that shown after a power failure. This display will not change until the advance buttons are pressed even though the clock chip is functioning correctly. If the display is correct the remainder of this section can be ignored. If it is not correct then the following checks can be made.



The prototype was built using a single PCB for mounting all the major components. Since the board carries mains wiring, great care must be given when assembling this area. Remember to earth the frame of the mains transformer by using an external wiring strap.



Particular consideration should be given to the handling and soldering of the display strip. Prolonged and excessive heat will crack the metal/glass seal inducing terminal damage. Similarly when handling/soldering the IC, the usual anti-static precautions should be observed.



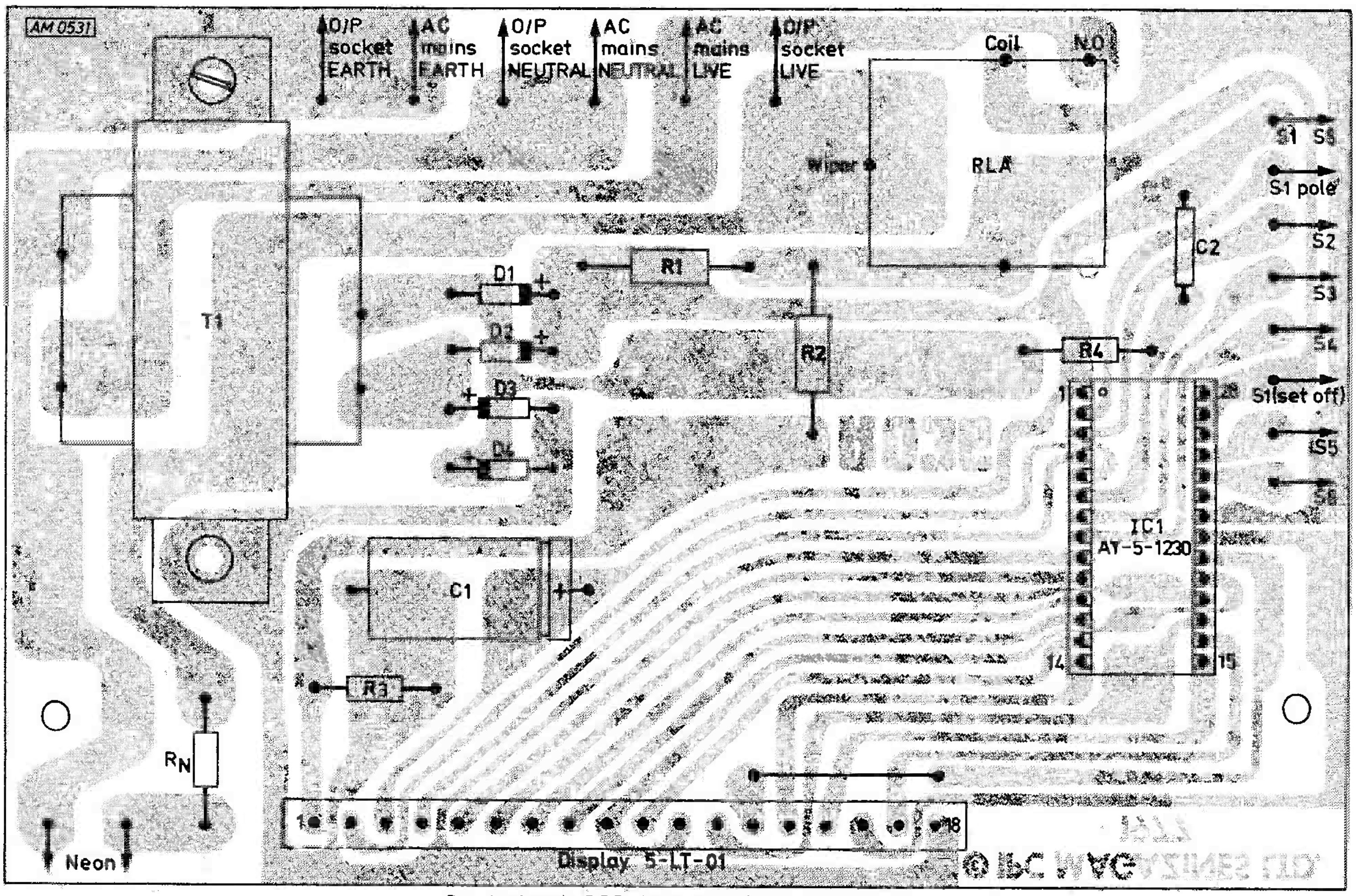


Fig. 4 (above): PCB shown actual size—copper side.
Fig. 5 (below): PCB component side showing locations and leadouts.

1. Switch off. Remove the IC from its socket (put it in its conductive foam) and switch on again. Do not attempt to remove the IC with the power on. The result is almost certain destruction of the device.

2. Measure the voltage between pins 1 and 26 on the IC socket. It should be about 15V.

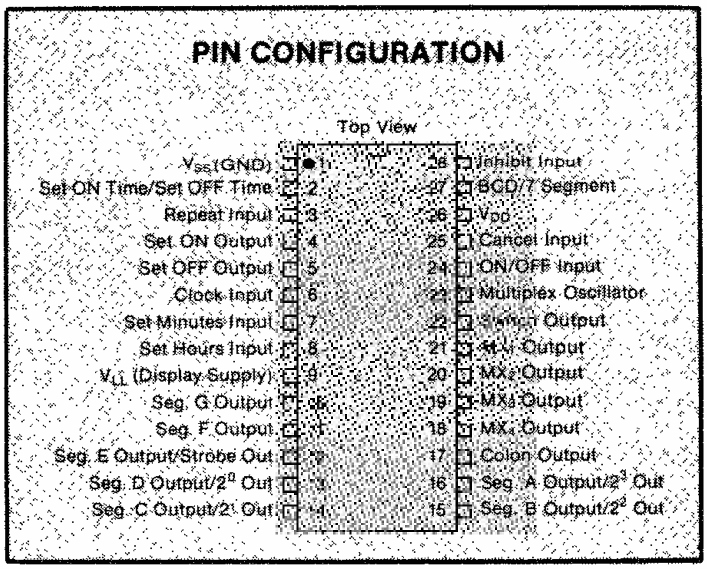
3. Measure the voltage across the filament of the display. It should be about 5V.

4. Check that pin 28 is connected to Vdd.

5. Check that pin 23 is not connected.

6. Check the individual segments of the display as follows, connect pin 18 (the minutes digit, Mx4) and pin 10 (segment G) to Vss. The segment should light. Repeat the other segments on the minute digit, one at a time (pins 11, 12, 13, 14, 15 and 16), then repeat for the 10 minute digit, the hours and 10 hour digits.

If these tests are satisfactory the only remaining area of malfunction is the integrated circuit. Before discarding the IC try it again but ensure that it is inserted correctly. If it still doesn't work, replace it with another.



Setting up

When a suitable display has been arrived at the following procedure should be carried out.

1. Set the switch for setting the 'on' time, 'off' time and 'clock' (S1) to its middle position.

2. Push the 'hours' set button (S3) and hold closed. The hours counter should advance and the colon should start flashing. Set the hours to read 23.

3. With switch S2 set the minutes to 50. (ie. time reads 23.50).

4. Put S1 to the 'set time on' position. The display should read 00:00. The 'time on' indicator (AM or LED) should also light.

5. Use S2 and S3 to set up 23.55.

6. Switch S1 to 'time off'. The display should read 00:00 again and the 'time off' indicator should light (PM or LED).

7. Use S2 and S3 to set up 23.57.

8. Return S1 to 'clock'. The display should have moved on to something like 23.53.

9. At 23.55 the relay should close. This can be checked by observation or with a meter on Ohms.

10. The relay should open at 23.57.

11. Put S5, the 'repeat/once' switch, to the 'repeat' position and advance the clock to 23.55. The relay sequence should repeat.

12. Put S5 to 'once' and again advance the clock to 23.55. The relay should repeat its sequence but the 'set on' and 'set off' indicators should go out.

13. Advance the clock to 23.55. This time the relay should close. Push the switch a second time and the relay should open again.

15. Set any time into the 'on' and 'off' memories and then push the cancel switch, S4. The 'on' and 'off' indicators should both go out.

Having completed the tests satisfactorily the remaining items can now be added including the link to connect the relay switch to the mains input and the connections to the output socket made before final casing up. If required a neon can be connected to the relay output and mounted on the front panel of the case to show that the output circuit is operational. The current which can be taken from the output socket depends on the type of relay used but in the prototype was about 2A maximum.

Options

The basic operation of the clock is outlined in the setting up section but with the following notes:—

1. If an 'on' time is set without an 'off' time the output will stay on for ten minutes then turn off.

2. S6 will change the state of the output each time it is pressed.

3. 'Repeat' will cause the output to switch every day, 'once' will reset the logic after the first operation.

4. Cancel will reset the switch logic to 00.00 when pressed.

Options which can be added easily are a tone alarm output at turn time and display dimming con-

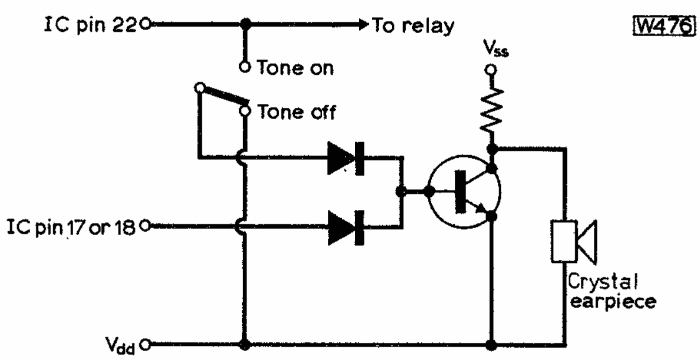
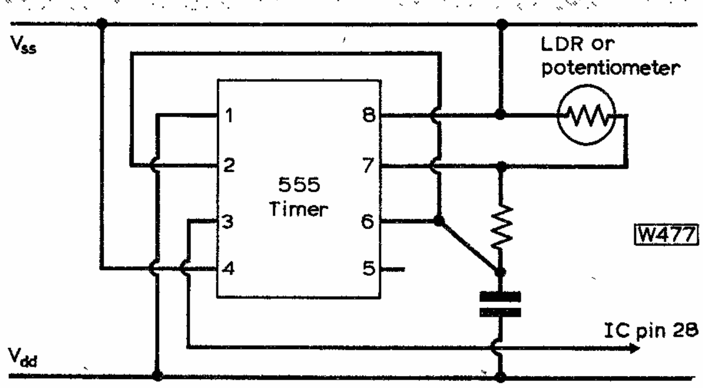


Fig. 7: Above, Fig. 8: Below.



trol (Figs 7 and 8). If a battery operated device is to be switched then this unit could also include a battery eliminator. PW

PRODUCTION LINES

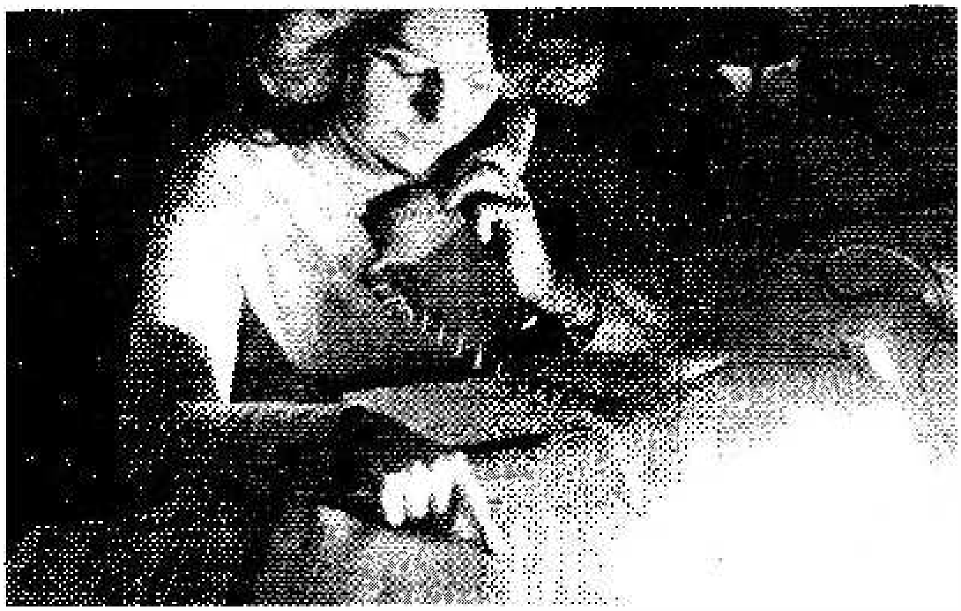
bill tull

Light years ahead

What are the drawbacks to portable emergency lighting? Well, there are several, possibly the most important being the cost, or if we're talking about batteries, then their comparatively short shelf life which means they have to be discarded after a certain time even if they have never been used. Also few systems are completely waterproof (i.e., they can even work UNDER water), are safe to use in or around ignitable vapour, have a shelf life of around four years, and most important of all are very cheap.

Not feasible, do I hear some sceptics say? Prepare to eat your words! A US company has recently invented a device, called a "Lightstick", which tends to make all other forms of portable emergency lighting obsolete. Looking much like a candle and about 5 inches long, the lightstick is activated by bending which allows a chemical action between two liquids sealed inside the plastic tube to take place, and thereby create light.

Claims put forward by the company say that the lightstick will illuminate an average room and give sufficient light for reading, making telephone calls, repairs to equipment, or just generally finding your way about in the dark. Once activated the lightstick will emit light for 10 hours, and since it generates light without heat or flames is suitable in potentially dangerous situations where petrol or gas is concerned. The liquid can also be poured out of the tube (once the tube has been cut) and poured over an object to illuminate it. The colour of the light is a greeny/yellow and can be seen up to 1 mile away.



Initially supplies of Lightsticks will only be available from the sole UK distributor and usually in bulk only. However, by the late autumn of this year they should be in all the shops priced at £1·95 for a pack of three.

Tye Security Ltd., Dolphin Road North, Sunbury-on-Thames, Middlesex.

Music maker

Electronic pianos have come and gone with monotonous regularity since their birth some years ago. They have 'gone' primarily because they just don't have the sound, and more importantly, the 'feel' of a good quality conventional piano. For this reason the market has been eagerly awaiting the new chip which has been the centre of rumours for some time now, and proposes to put an end to the inherent faults found in earlier electronic pianos.

The manufacturer to be first with this new chip is General Instruments Microelectronics, Glenrothes, whose new device—the AY-1-1320 is claimed to 'simulate the sound and touch of hammer action instruments'.

Unlike electronic organs the electronic piano incorporates circuitry which senses the key velocity as the pianist strikes each note, adjusts the output volume accordingly and produces a note which decays in amplitude in a similar manner to a hammer action instrument. Adjustment can be made to simulate the Honky-tonk piano, Harpsicord and the Clavicord.

The AY-1-1320 incorporates 12 separate envelope generation circuits for octave tones and semitones. Thus a five octave instrument would require no more than five 40pin DIL devices of this kind.

General Instrument Microelectronics Ltd., 57/61 Mortimer Street, London, W1N 4TD.

Get kitted out

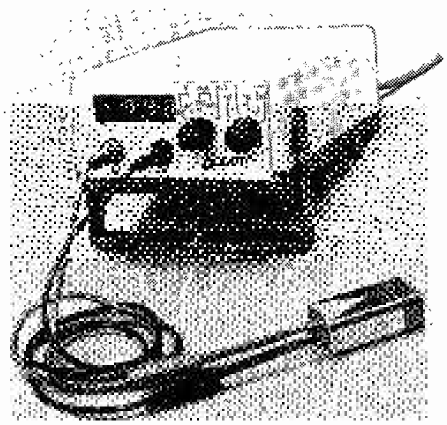
Doram Electronics, the general public's branch of RS Components, have recently announced seven new constructional kits to complement their already growing selection in this particular field.

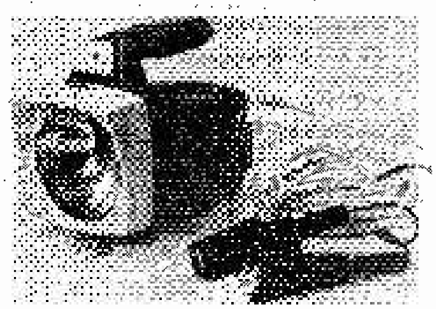
The kits include a quadraphonic resolver to give the effect of surround sound by connecting an existing stereo system to four speakers; a 25W per channel stereo amplifier, called "The Audiomaster", and a phase-locked-loop stereo decoder. The price for these kits, which incidentally are absolutely complete down to the last nut and bolt, are £9·95, £82·50 and £4·45 respectively plus VAT at 12½%.

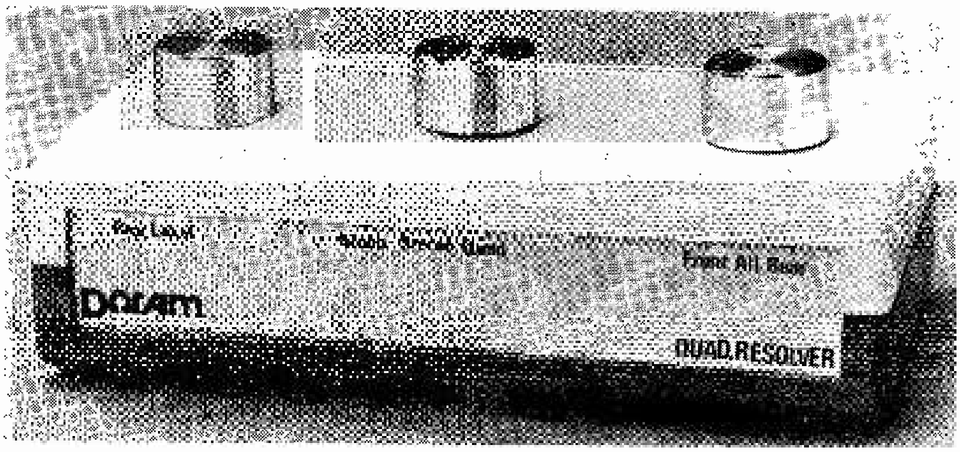
Also in this new range are two test equipment kits comprising a 3½ digit multimeter (100μV to 1000V AC or DC, 100μA to 2A plus resistance) and a matching digital frequency counter which reads from 10Hz to 50MHz. Each kit is complete with case, PSU and full instructions. Both models are priced at £54·50 plus VAT at 8%.

The final two kits are of special interest to the DIY enthusiast, with an accurate ignition timing light utilising a Xenon flash and automatic polarity selection, and a transformer kit which has everything a constructor needs to wind his own 50VA transformer. Price for these two kits is £18·95 and £4·18 respectively. Both plus 8% VAT.

Doram Electronics Ltd., PO Box TR8, Wellington Road Industrial Estate, Wellington Bridge, Leeds LS12 2UF. Tel: 0532 452548.







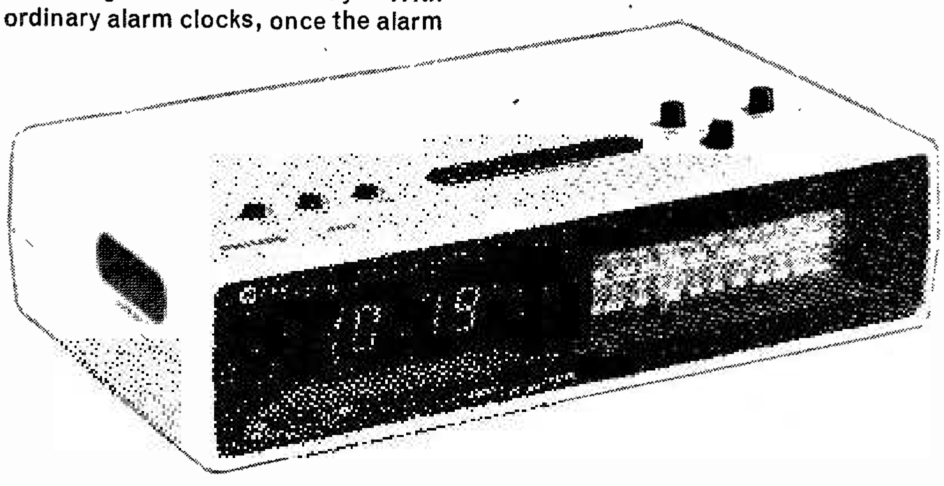
Morning time

Come on, be honest, who doesn't have trouble in getting up in the mornings—specially winters mornings. The answer of course is a clock radio such as the new Philips AS460, with LED display, AM/FM radio and a list of added extras as long as your arm.

One of the novel extras included is an automatic function that allows the display to dim in a darkened room, another is a "Slumber facility", which allows the set to be operated for a period of up to 59 minutes before switching off automatically. With ordinary alarm clocks, once the alarm has been switched off, it stays off, but with the AS460 a touch sensor is used to switch the alarm off, but will automatically sound again in approximately nine minutes. This will happen up to five times, by which time Philips reckon that you'd get up just to get away from the alarm.

Aerials are built in for both AM and FM, there is a choice of either buzzer or radio to wake you up, and if there is a power failure the display flashes to indicate incorrect time.

Philips Electrical Ltd., Century House, Shaftsbury Ave., London, WC2H 8AS. Tel: 01-437 7777.



Amateur chips

Two new low power IF/AF circuits designed for NBFM receiver applications, such as mobile and hand-held radios have now become available from Plessey Semiconductors.

Notated the SL 664 and SL 665, each circuit is a complete IF strip and consists of a pre-amplifier, limiting amplifier, quadrature detector, carrier squelch, DC volume control and audio output stage. The SL 664 incorporates a power output stage (250mW into 8ohms), while the SL 665 has a low level audio output which drives high impedance loads (open collector output). The demodulator and audio amplifier are muted by the squelch output on the SL 664, whilst on the SL 665 the squelch output does not internally mute the demodulator, which means that it can be used for tone decoding.

Both devices are in ceramic DIL packages, but the SL 664 has 18 pins and the SL 665 has 16 pins.

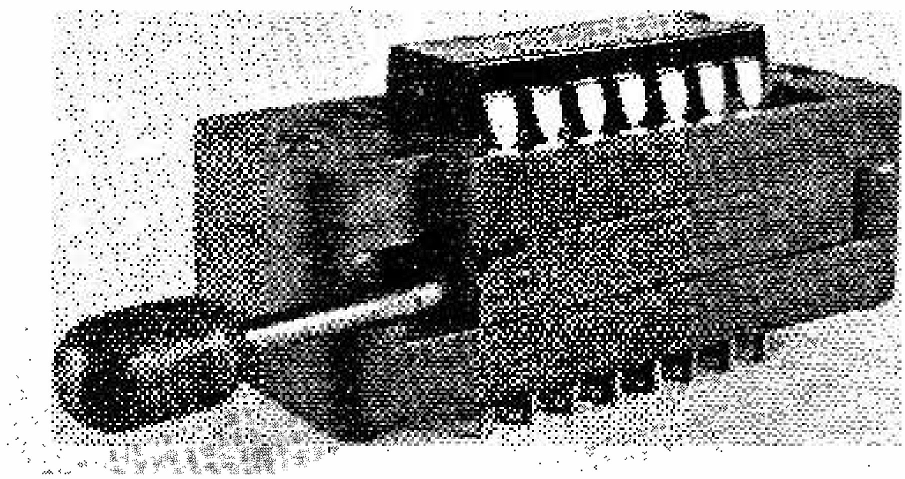
Plessey Semiconductors, Cheney Manor, Swindon, Wiltshire, SN2 2QW. Tel: Swindon (0793) 36251.

Zip dip

A new range of integrated circuit sockets, for use in test equipment or development "breadboards", has been introduced by BFI Electronics Ltd. Called the ZIP DIP range, the sockets accept multi-lead devices with no insertion pressure, thus eliminating lead damage and distortion which often occurs when leads are forced into sockets operating on the spring contact principle.

The ZIP (Zero Insertion Pressure) DIP socket has a tiny lever at one end which is connected to an internal cam. A multi-lead device is simply dropped into the socket and the lever flicked up to positively clamp the leads inside the socket. This protects the leads from damage and ensures a good electrical connection. When the lever is released the device may be removed without force.

BFI Electronics Ltd., Sinclair House, The Avenue, West Ealing, London W13. Tel: 01-998 2113



10 watt amp.

Very often a small audio amplifier is all that is required to complete or repair a record player or radio etc. Not one that claims ultra HiFi specifications, but one that is adequate for good, clear audio reproduction and is compact in size. Module amplifiers usually satisfy this need, and the new one from Bi-Pak—the AL 30A is said to deliver 10W RMS into an 8 ohm load with a supply voltage of 28V.

The total circuit, which measures 90 × 64 × 27mm, is contained on a single board with the power transistors attached to a small heatsink.

The manufacturers recommend that for speech and music applications a total heatsink area of 10 sq.in. be used, and for higher power applications 15 sq.in. These figures are for mono use and should be doubled if two modules are used for stereo reproduction.

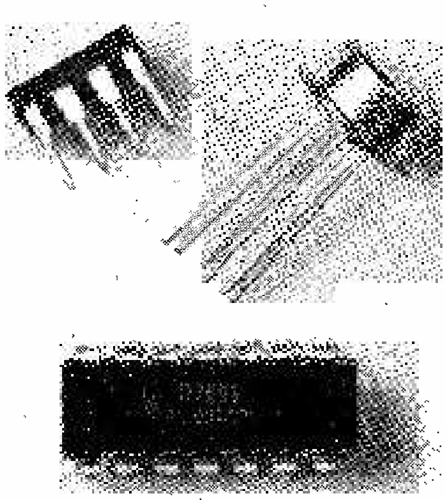
Input sensitivity is 90mV for full output, while frequency response is claimed to be from 60Hz to 25kHz. The cost, when they become available will be £3·60 each, and they can be obtained from *Bi-Pak Semiconductors, The Maltings, 63a High Street, Ware, Herts. Tel: Ware 3442.*

New chips for old

That old faithful, the 741 Op-Amp is shortly to become redundant. The successor to this device has recently been introduced by Mogul Electronics and is manufactured by Texas. Available in either single, dual, or quad BIFET modes, this new Op-Amp can be obtained in 8 pin TO99 as well as 14 pin DIL packages and is capable of operating over a temperature range of −55°C to +125°C.

A few of the parameters of this new Op-Amp family, designated the TL080-4 includes an input impedance of 10^{12} ohms, supply current of 2·8mA, slew rate of 12V/μS, low input bias and offset currents of down to 0·2nA and 0·1nA respectively and a frequency bandwidth of 3MHz.

Mogul Electronics Ltd., 273 High Street, Epping, Essex, CM16 4DA. Tel: 0378 77366.

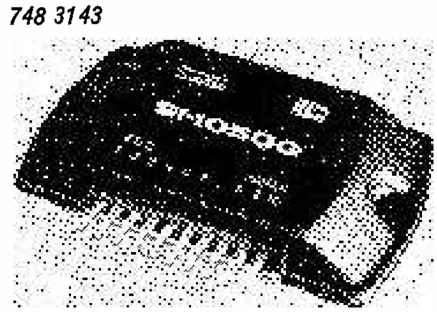


Power module

Audio power Modules, made by *SANKEN*, are available in three models. Very few external components, a heatsink, and a power supply, are all that are required to complete a high quality (harmonic distortion 0·5% Max.) sound system.

Ideally suited to Hi-Fi systems, tape deck, FM tuners, record players, etc., each module has quasi-complimentary class B output, and uses flip-chip transistors in a rugged, compact, lightweight package. The three modules comprise the SI-1010G (10W), SI-1020G (20W) and the SI-1050G (50W).

Further information from *Rastra Electronics Ltd, 275-281 King Street, Hammersmith, London W6. Tel: 01-748 3143*



A Radio 2 Tuner FOR YOUR HI~FI

R.A.PENFOLD

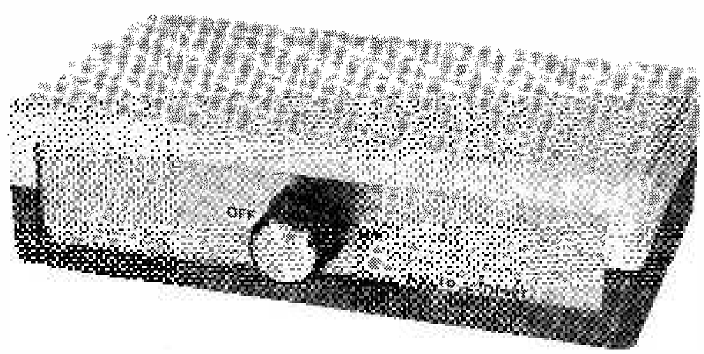
MANY hi-fi tuners and receivers are fitted with an AM section and although this is not a source of true hi-fi signals it is a very practical facility. It removes the necessity for a separate set for listening to sports commentaries, Radio Luxembourg, and other programmes which are not available at VHF.

Unfortunately, a surprisingly large number of tuners and tuner/amplifiers do not provide coverage of the long wave band and cannot receive Radio 2 on 200kHz (1500 Metres). There are frequent occasions when such sets are unable to receive Radio 2 at all, because the Radio 1/2 VHF transmitter is devoted to Radio 1 transmissions. For instance, at the time of writing, this happens late most evenings.

The obvious solution to the problem is to construct a LW Radio 2 tuner unit to feed into an unused input of the amplifier. The author has built such a unit to feed the 'Aux' input of his Rotel RX254 tuner/amplifier and it is this simple tuner unit which forms the subject of this article. The unit can be used successfully with most amplifiers since it has an output amplitude which is adjustable from zero to about 2V peak to peak and the source impedance is fairly low at approximately 5kΩ. It is completely self-contained with an integral battery supply and ferrite rod aerial.

DESIGN

Presumably Radio 2 is the only LW station of interest, and the circuit can therefore use pre-set tuning. Since only one station at the relatively low frequency of 200kHz is required this is one application where a superhet circuit has no advantage over a TRF one. This may at first sight seem to be an obvious place to use a circuit based on the popular ZN414 IC but reference to the appropriate data sheet shows that this device is not at its best on these frequencies. This was borne out in practice when a simple test circuit was tried. For use at the author's location the circuit lacked both sensitivity and selectivity.



The controls on the Radio 2 Tuner are not very complicated! Just an on-off switch. The output level is adjusted by means of an internal potentiometer to suit the amplifier used with the Tuner.

The simple circuit shown in Fig. 1 was then tried and this has proved to be eminently suitable. L1 is the ferrite aerial tuned to 200kHz by means of trimmer TC1. Tr1 is used as a common source amplifier and the aerial circuit couples direct to Tr1

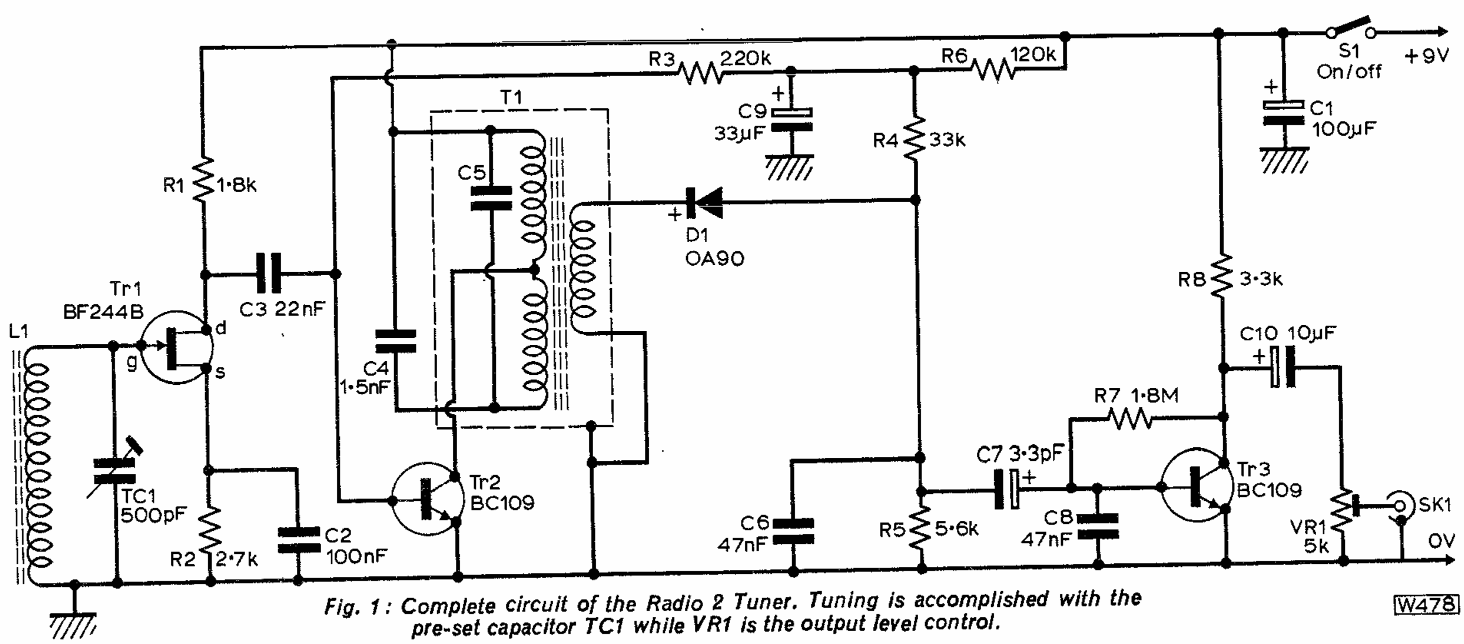


Fig. 1: Complete circuit of the Radio 2 Tuner. Tuning is accomplished with the pre-set capacitor TC1 while VR1 is the output level control.

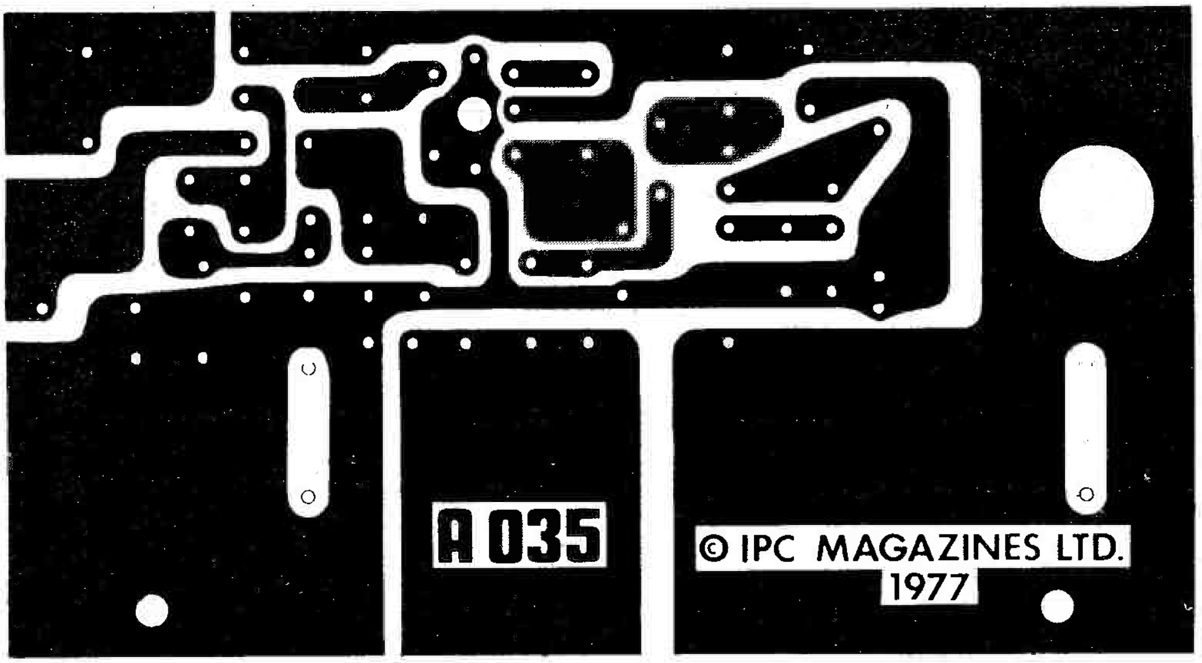
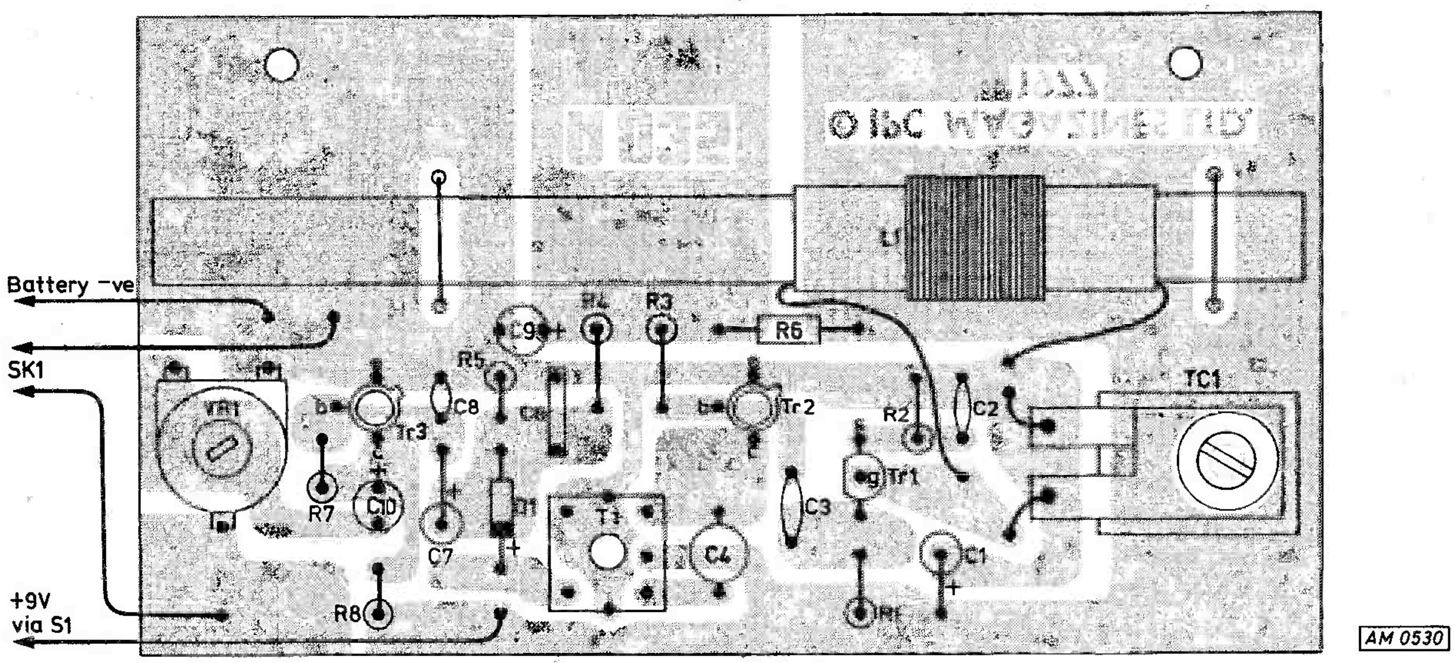


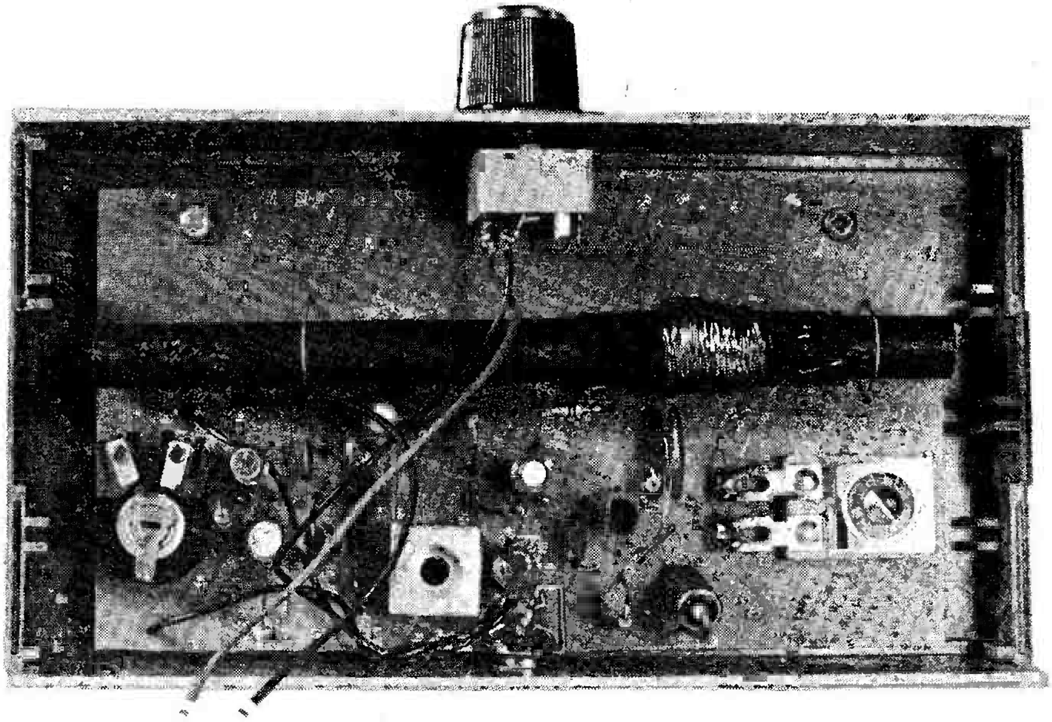
Fig. 2: Above, the printed circuit board is shown full size. Below, the PCB reversed to show the layout of the components on top of the board.



gate. This is quite acceptable as the input impedance of Tr1 is extremely high and no coupling winding on the aerial coil is necessary. R2 is the source bias resistor and C2 its bypass capacitor. The amplified output of Tr1 is developed across drain load resistor R1.

Tr2 provides a second stage of RF amplification, and used as a high gain common emitter amplifier. T1 is a 465kHz last IF transformer and C4 is connected in parallel with its internal tuning capacitor (C5) in order to reduce its operating frequency to about 200kHz. D1 is an ordinary diode detector which is fed from the secondary of T1. C6 provides RF filtering and the audio output signal plus a DC bias are produced across R5, part of a potential divider with R6 and R4, and Tr2 receives its base bias current from the junction of R4 and R6 via R3. If Radio 2 is received very strongly a comparatively large negative bias will be produced across R5 and the voltage at the junction of R4 and R6 will therefore be reduced. This results in a reduction in the base bias current of Tr2, and in consequence its gain is reduced. This provides the tuner with a conventional automatic gain control (AGC) action, ensuring that neither the detector nor the audio stages are overloaded if the tuner is used in a strong signal area. C9 filters out the audio signal from the AGC circuitry.

Tr3 is a common emitter amplifier which is used to provide all the audio amplification. This stage has a response which hardly falls off at all at 200kHz and so it is absolutely essential that the RF signal is not allowed to enter the audio stage. Filter capacitor C8 is therefore used at the input to Tr3. Violent instability would almost certainly result if this component were to be omitted.



General view inside the Verocase which houses the Tuner. The ferrite rod aerial is held on the board with two loops of thin wire. Tuning capacitor TC1 is at the extreme right with output potentiometer VR1 at the extreme left.

The audio output level can be adjusted by means of preset potentiometer VR1. C1 is the only supply decoupling component that is required. The PP3 battery has a very long life as the current consumption of the tuner is only about 2·5mA.

CONSTRUCTION

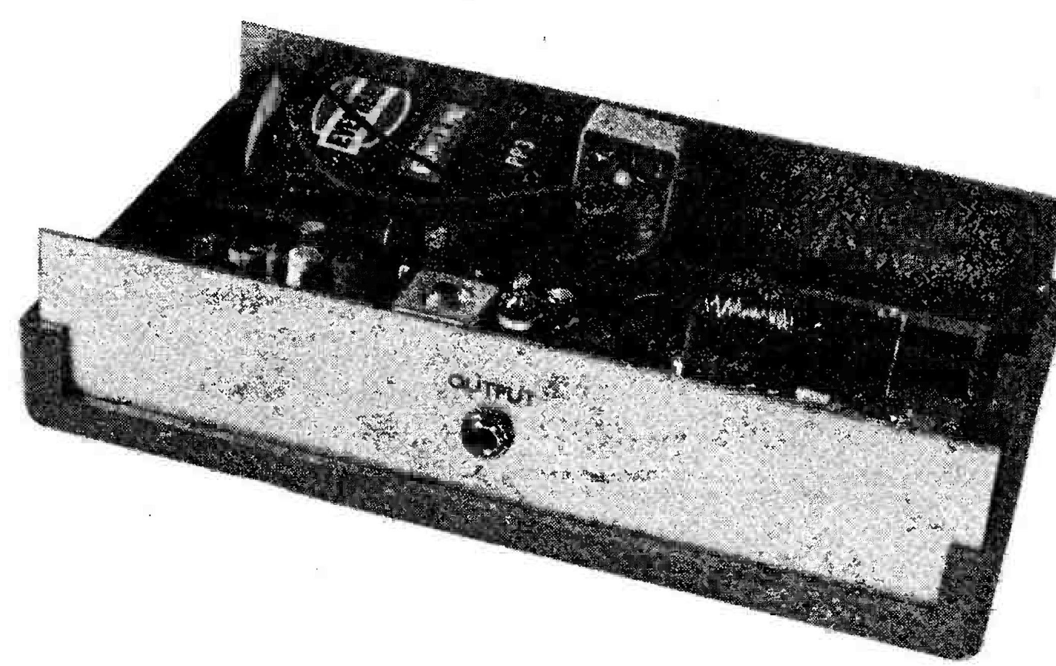
Virtually all the components, including the ferrite aerial, are mounted on a PCB which measures 130 x 70mm illustrated actual size in Fig. 2 together with details of the ferrite rod aerial and other constructional information. Note that the holes for the pins and tags of T1 are slightly larger than for the other components, about 1·8 to 2·0mm in diameter. TC1 requires a 5mm dia. mounting hole while those for the board itself are 3·2mm in diameter.

The ferrite rod aerial is home-made and based on a 127 x 9·5mm (5 x $^3/_8$in.) ferrite rod. This size is readily available from Denco suppliers or direct from Denco. The winding starts 30mm from one end of the rod and consists of 225 turns of 32 SWG enamelled copper wire. Make quite sure that all the turns of the coil go in the same direction. In order to prevent the coil from unwinding, the two leadout wires are taped to the rod. The ferrite aerial is secured to the PCB by two loops of wire which are soldered in place. Try to make these loops fairly tight so that the aerial is provided with a firm mounting.

THE VEROCASE

A small Verocase is used as the housing for the prototype was designed to fit it. S1 is mounted in the centre of the front panel and must be a physically

continued on page 218



Another angle on the Tuner. The output socket can be changed to suit the audio equipment in use with the Tuner. Do not forget that the ferrite rod aerial is very directional, see text.

I.C. OF THE MONTH

by BRIAN DANCE

Number 63 — RCA CA3140 OP. AMPLIFIER

THIS versatile and economical operational amplifier can replace the well-known 741 device in virtually all circuits, but its greatly superior specification also enables it to be used for many other purposes. The input impedance of the CA3140 device is extremely high, namely about $1\cdot5 \times 10^{12}\Omega$ (1½ million megohms), so it will not impose any appreciable load on the circuit feeding it. The typical input current required by the CA3140 is only 10pA with ±15V supplies or 2pA with ±5V supplies.

The CA3140 is somewhat like the CA3130 (see *Practical Wireless*, April 1976), but has certain advantages which extend its range of uses. For example, the CA3140 can be operated from any power supply line voltages in the range ±2V to ±18V (or 4V to 36V if a single supply line is employed). In addition, the CA3140 device has an internal capacitor for frequency compensation fabricated on its silicon chip, so no additional external capacitor is needed for this purpose.

BiMOS

The so-called 'BiMOS' technique is used in the CA3140. This consists of a p-MOS input stage together with high voltage bipolar transistors integrated on the same chip. The p-MOS differential input stage provides a voltage gain of about 10 times (20dB), but the second stage provides most of the device gain (10,000 times or 80dB). The bipolar output stage has a gain of about unity but like the 741 output stage it includes circuitry which provides built-in protection against damage from short circuiting of the output to either of the supply rails or to earth.

Although MOS transistors are used in the CA3140 input stage, these transistors are well protected with bipolar diodes. Whilst the normal precautions used in handling MOS transistors are probably unnecessary when using the CA3140, it is nevertheless good practice to ensure that soldering iron tips are well earthed, that CA3140 devices are not inserted into or removed from a circuit with the power supplies connected and that signals are not applied to the inputs when the power supply is off.

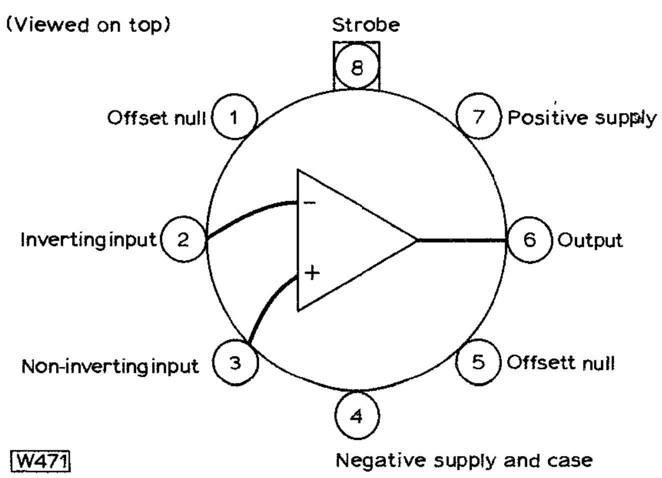


Fig. 1 : Leadout connections for the CA3140 op. amplifier, viewed from the top of the device

TYPES

The CA3140 is also available as the more expensive CA3140A and the considerably more expensive CA3140B; these latter 'premium' types have smaller input currents and lower input offset voltage tolerances than the standard CA3140, but the standard type is quite suitable for almost all applications. All three types are available as the CA3140T with straight leads and as the CA3140S with the leads pre-formed into the dual-in-line configuration.

CONNECTIONS

The CA3140 connections are shown in Fig. 1. It can be seen that offset nulling facilities are provided as well as on/off strobing facilities. If these facilities are not required, no connection need be made to the pins concerned. The normal non-inverting input (marked +) and inverting input (marked −) are provided in this device.

APPLICATIONS

The CA3140 can be used in most circuits for which a normal operational amplifier is required. It can also replace the CA3130 in the impedance transformer circuits discussed in our April 1976 issue, but the greater permissible power supply voltages enable much greater output voltage swings to be obtained. The applications to be discussed below are ones for which the characteristics of the CA3140 are particularly suitable.

BAXANDALL TONE CONTROL

The very high input impedance, relatively wide bandwidth, fairly high slew rate and high output voltage capability are all properties which are very useful in amplifiers used in tone control circuitry. A Baxandall type tone control circuit is shown in Fig. 2(a). It provides a gain of about unity and employs standard linear potentiometers to provide bass and treble boost or cut of ±15dB at 100Hz and 10kHz respectively. The gain of the amplifier falls by 3dB at 70kHz relative to the gain at 1kHz in the 'flat' position of the tone controls.

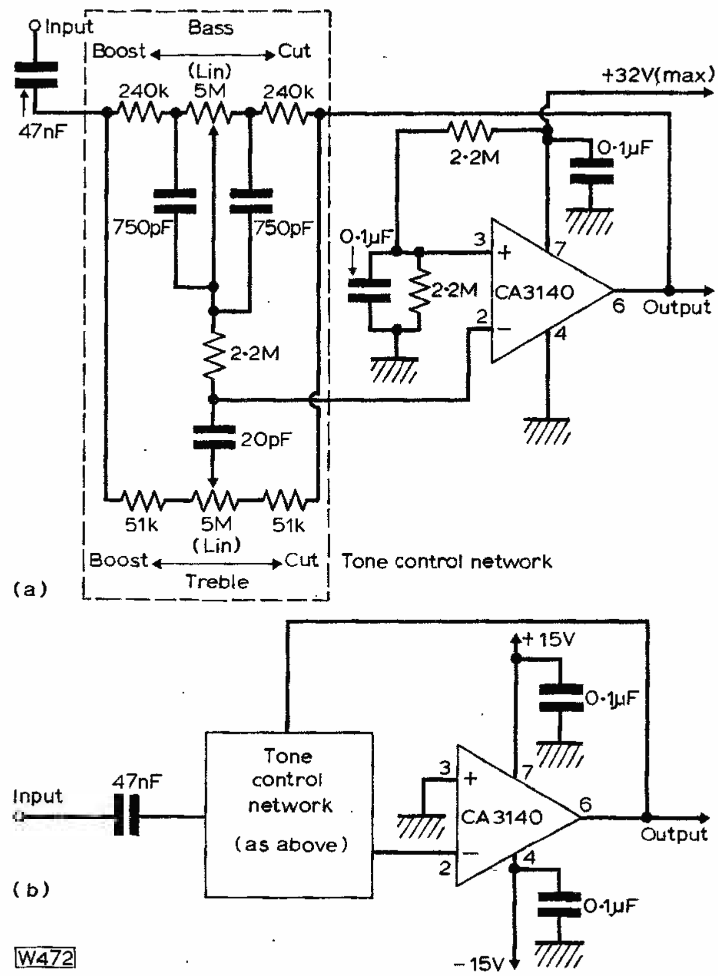


Fig. 2(a) Shows the basic Baxendall tone control circuit where the gain is approximately unity.
Fig. 2(b) is a circuit with the same performance as (a) but it uses a balanced ±15V supply.

The high input impedance of the CA3140 device enables economical low value capacitors to be used in the tone control network. A supply voltage of 32V is shown, but smaller voltages can be used if the maximum output voltage swing required is not very great. If a 32V supply is employed, the full output voltage swings of 25V peak-to-peak are obtainable at frequencies up to more than 20kHz, since the device has a slew rate of about 9V/μs (some 15 to 20 times greater than that of a 741 device).

BALANCED SUPPLIES

The same tone control network can be employed in the circuit of Fig. 2(b) when balanced ±15V supply lines are preferred. The performance is identical with that of Fig. 2(a) except that the output quiescent potential will be almost earth potential whereas the output potential of the Fig. 2(a) circuit will be approximately half the supply line potential.

The biasing components connected to the non-inverting input of Fig. 2(a) are not required when the balanced supplies of Fig. 2(b) are used. However, an additional capacitor is required to decouple the negative supply line. The typical power supply current of either circuit is only 4mA. In both circuits pins 1, 5 and 8 are left unconnected.

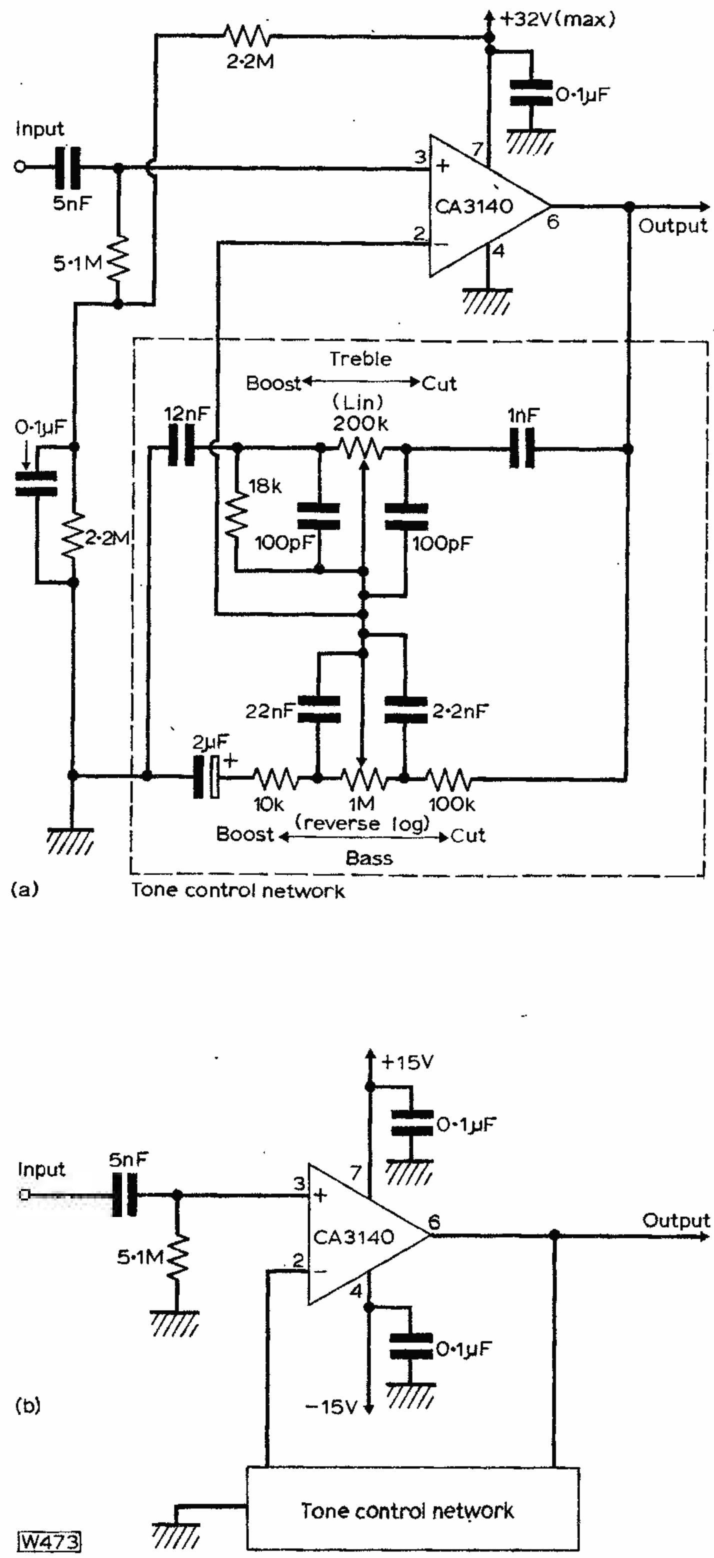


Fig. 3(a) This circuit has a similar performance to those in Fig. 2 but now a voltage gain of about 10 is obtained at the middle of the range.
Fig. 3(b) The circuit of (a) adapted for use with a balanced ±15V power source.

ADDED GAIN

Another tone control circuit is shown in Fig. 3(a); this has a similar performance to that of the Fig. 2 circuits except that it provides a voltage gain of about 10 times (20dB) at mid-frequencies. The bass and treble boost or cut available to about ±15dB at 100Hz and 10kHz respectively. Outputs of up to 25V peak-to-peak can be obtained with the supply voltage shown or smaller outputs at lower supply voltages. The gain falls by about 3dB at 24kHz relative to that at 1kHz with the controls in the 'flat' position.

The same tone control network may be used in the circuit of Fig. 3(b) in which balanced ±15V supplies are used. The performance of the circuits of Figs. 3(a) and (b) is identical but it should not be forgotten that the output from the Fig. 3(a) circuit will be at an average of half the supply voltage, so a coupling capacitor is essential in the output circuit.

CURRENT AMPLIFIER

The circuit of Fig. 4 shows how the CA3140 device can be used as a current amplifier to amplify a very small current passing through the load so that it can easily be measured by the meter. The potential from the point A is connected to the inverting input of the CA3140 and the potential at this point will therefore always be very close to the potential of the non-inverting input.

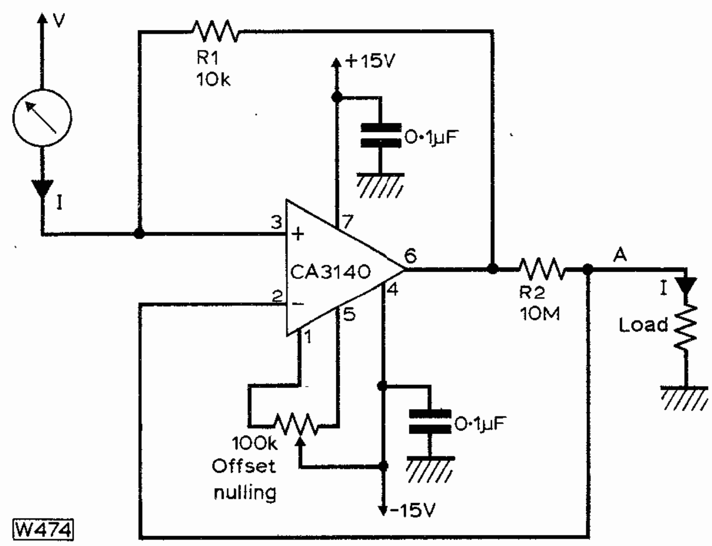


Fig. 4: Here the CA3140 is being used to amplify a very small current thus allowing a conventional meter to be used for measurement.

The voltage V drives a current I through the meter; virtually all this current flows through R1, since the current taken by the CA3140 input is extremely minute. Thus a voltage IR1 appears across R1 and this same voltage appears across R2 (since the potentials at point A and at pin 3 are the same). The current passing through R2 and the load is therefore IR1/R2. If the values of R1 and R2 are as shown the current I is divided by 1000.

This current may be 100nA or even less and when amplified by about 1000 times, this current is easily measured by the meter. The potentiometer enables the offset voltage at the output to be nulled accurately and a similar offset nulling circuit can be used in other applications if desired.

RADIO 2 TUNER—*continued from page 215*

★ components list

Resistors

R1	1·8kΩ	R5	5·6kΩ	
R2	2·7kΩ	R6	120kΩ	All ¼ or ⅓W
R3	220kΩ	R7	1·8MΩ	5 or 10%
R4	33kΩ	R8	3·3kΩ	
VR1	5kΩ horizontal pre-set			

Capacitors

C1	100μF 10V	C6	47nF ceramic
C2	100nF ceramic	C7	3·3μF 6V
C3	22nF ceramic	C8	47nF ceramic
C4	1·5nF polystyrene	C9	33μF 6V
C5	Part of T1	C10	10μF 10V
TC1	500pF compression trimmer		

Semiconductors

Tr1	BF244B	Tr3	BC109
Tr2	BC109	D1	OA90

Miscellaneous

T1, IFT (Denco IFT465/14). Verobox or similar (6 × 3 × 1½in). Ferrite rod 5in × ⅜in dia. 32 SWG enamelled copper wire. PP3 battery and clip. On-off switch, miniature. 3·5mm jack socket. Knob etc.

small component if it is to fit into the available space. SK1 is a 3·5mm jack socket mounted in the centre of the rear panel. All the wiring is completed before the front and rear panels are slotted into the lower case moulding and the PCB is screwed down. The latter is mounted on the two mounting pillars at the front of the case using two of the self-tapping screws provided. The battery fits into the space at the right of the on/off switch, but the lid of the case will not fit into place unless the front, right hand side mounting pillar is removed from the lid. It is easily drilled away using a 10mm diameter drill.

ADJUSTMENT

With the output of the tuner connected to the amplifier by means of a screened cable, it should be possible to tune to a few stations by adjusting the core of T1. Incidentally, a proper trimming tool such as the Denco TT5 should be used to adjust this core. A wedge shaped tool such as the blade of a miniature screwdriver could easily damage the core. Initially TC1 is adjusted for almost minimum capacitance (the plates not very compressed), and then it is adjusted to peak received signals. It should not be difficult to locate Radio 2 as it lies at about the centre of the tuning range and is stronger than the other signals. Once it has been located, tune to it as accurately as possible by adjusting the core of T1, and then set TC1 to the position which provides the best signal.

VR1 is adjusted towards maximum output (fully clockwise) at the outset. Then it is simply given a setting which provides an output level that is commensurate with those provided by the other items of ancillary equipment. Remember that the ferrite rod aerial is quite directional so turn the tuner round in the horizontal plane until the signal from Radio 2 is at a minimum and then turn at 90° to this position for maximum signal.

The case must be of plastic or wood since a metal case would act as a screen round the ferrite rod aerial.

high fidelity 77 report

RICHARD SCHOFIELD

WITH no Olympia hi-fi exhibition this year, the smaller regional shows are now more important to both the trade and the public. High Fidelity 77 was held within a stone's throw of runway 01, Heathrow Airport, on the first floor of the Heathrow Hotel from April 19 to 24. The last three days were open to the public of whom over 18,000 attended. It was quite obvious that the show wasn't really geared to handle this number of people—many had to wait in the foyer in excess of an hour for a lift to the first floor exhibition area—because of strict observance of the fire regulations. As a result of this it is probable that next year's show will be trade only.

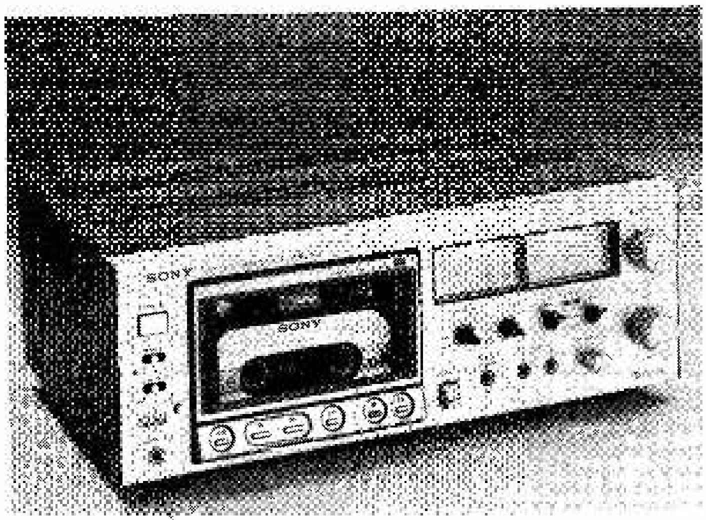
Tape

When people eventually got in, many must have been fairly disappointed with what they didn't see—the number of *interesting* new products could have been counted on one finger . . . perhaps a little unfair but it seemed that way. For instance, due to production problems with chrome-based cassette tape, there has been a veritable rash of new cassette tapes using 'superferrite', 'microferrite', 'gamma ferrite', etc. All these are simply brand names for highly refined ferroso-ferric oxide, Fe_3O_4, with or without a dose of cobalt. Inevitably, all the tapes using this compound are described as being 'low noise, high output'. Similarly the publicised performance figures are measured against a nebulous norm which is different for every manufacturer.

Several new cassette decks were shown but offered no real departure from current design. With so many cassette machines offering such equitable performance the sensible thing is to choose a model by its price and other criteria such as 'does the fascia match the G-Plan?'

Elcasets

Of greater interest were two Sony tape machines using the Elcaset format. Elcasets operate in the same manner as standard cassettes but use a tape width of 6·25mm instead of 3·81mm; the tape speed is 9·5cm/s as against 4·75cm/s. Physically, Elcasets look like overgrown compact cassettes but offer rather better performance as a result of their increased size and tape speed. Substantiated claims indicate a −20 VU frequency response of 20Hz to 20kHz±1dB; the 0 VU response is only 2dB down at 15kHz, an open reel standard of performance.



The Sony EL-5 Elcaset recorder

Similarly wow and flutter performance is improved corresponding to the closer tolerances employed within the internals of the Elcaset transport. For instance, levels below 0·1% are quite commonplace. However, nothing is free. An LC-60 (60 minutes total playing time) cassette is expected to cost about £5 or even more; there are other indications that machines to play them won't be cheap either. Sony and Teac (who are shortly to introduce an Elcaset deck) would not state a final selling price or even when the decks would be available.

Open reel

One worthwhile advance was shown in respect of open reel recorders. The Uher 630SG Logic operates without the use of a capstan/pinch wheel tape drive.

Uher SG630 Logic open reel tape recorder. This machine has no pinch wheel: it uses a convoluted tape path with a capstan at the centre.

Instead, it uses an omega shaped tape loop—the tape is wrapped around a large diameter servo-controlled capstan by closely spaced roller guides—and sensor devices to maintain constant tape tension throughout a 27cm reel of tape. This system, originating from video tape recording technique, claims to significantly reduce scrape flutter while improving both short- and long-term speed stability. In both the spool and play modes, the capstan provides the prime motive force, the reel motors simply creating a 'neutral' tape tension.

Linear phase loudspeaker

Loudspeaker demos at hi-fi shows are nearly always low in objectivity and high in subjectivity for such is the nature of loudspeakers. Since the listening conditions vary from demo room to demo room (in details such as placement of speakers, size of room, choice of music, etc.) it is impossible to offer any verdict on individual units. Generalising, there was one trend in evidence: linear phase.

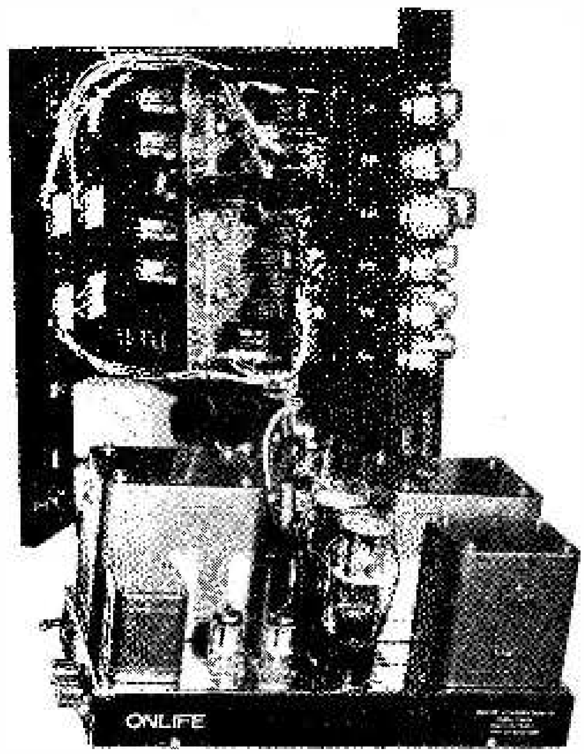
Current thinking suggests that phase relationships are all-important in sound image perception; in recent years, speaker manufacturers have tended to market multiple array units with separate drive units for various sections of the frequency range. Inductive/capacitor crossover networks provide the signal split for the individual drivers. The origin of linear phase is this: The initial point of origin of a radiating wave front from a driver unit is the diaphragm (cone) immediately adjacent to the speech coil. In conventional speaker systems, the speech coils of the various drive units (ie, HF, MF and LF) are not in the same vertical plane due to the varying physical dimensions. Step function transients which contains a mixture of all frequencies due to the Fourier transform, will affect all drive units. If the latter are not in vertical alignment in respect of speech coils, then the reproduced transient will no longer exhibit the same acoustic wavefront of the original. In a nutshell, linear phase means mounting the speech coils in a vertical line.

Technics introduced the first production speaker, the SB700, about two years ago. Since then several more have come on to the market. At this year's show, there were two notable additions. Rank Radio International exhibited the Leak 3030 which was about the smallest linear phase model at the show. It sounded rather bright but never-the-less produced a strong stereo image with a tight bottom end. At a discount price of about £120 a pair, it seems very good value for money. At the other end of the scale KEF were being very cagey about their wedge-shaped linear phase 105. The public weren't allowed to see this one for reasons best known only to KEF. If it sounds anything like the non-linear phase 104 which preceded it, then it will be very good indeed—and cost accordingly.

Equalisers

Manufacturers have been working hard in the room equalisation market: several graphic equalisers were on show including one from JVC which was part of a larger pre-amplifier unit. From experience, once one big Jap company goes in for a product, then all the others will follow fairly soon.

The origins of graphic equalisers are in recording studios. It is essential that producers and engineers should be able to listen to master tapes in an acoustic environment uncoloured by individual room responses. To this end, the output from the studio tape recorders is passed through a bank of filters with overlapping frequency responses enabling small sections of the frequency spectrum to be either boosted or cut. This processed signal is amplified through the studio speakers. If enough frequency



A blast from the past it is not. This is the latest product from Onlife, Japan, opening up new frontiers of technology. Whether the concept of a 'valve sound' was borne of the same wave of nostalgia that resurrected Glen Miller remains to be seen.

bands are provided then the listening characteristics of the room can be cancelled out resulting in a 'flat' room without any colouration. Thus the graphic equaliser is adjusted to produce the inverse characteristic of speaker plus room. PW

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RNARS morse proficiency transmissions

THE Royal Naval Amateur Radio Society runs the popular morse transmissions (QRQ runs) on the 1st Tuesday of each month on about 3520kHz, depending upon QRM, at 2000 local time (UK) from the RNARS HQ station G3BZU. Speeds are transmitted from 15 WPM to 40 WPM in increments of 5 WPM. All speeds are of a 3 minute duration and must be copied 100 per cent correct. Certificates are awarded for the 15 WPM and 20 WPM copied correctly, with endorsement stickers at all other speds. It is necessary to obtain the basic certificate before endorsement stickers can be obtained. A charge of 30p is made for each certificate. A stamped addressed envelope is required for endorsement stickers, if not claimed with the basic certificate. The equivalent in IRC's is acceptable from outside the UK.

The initial scheme was started in December 1962 by Dave Pilley G3HLW (now VK2AYD). The 15 WPM run was only introduced to the runs in January 1975 and has since proved very popular amongst the slower morse readers. At present the manager is Michael Puttick G3LIK, who makes up the texts, operates the transmission, marks the submitted copies and issues certificates and/or stickers to successful applicants. Since the transmission began there has been a total of 859 certificates issued to amateurs from the United Kingdom and all over Europe, where the battle to read through the heavy interference is on the increase. It is not just the amateurs that use the transmissions, as large organisations use them to train their recruits to a high degree of morse capability.

The equipment used for these runs at G3BZU is the KW Viceroy transmitter and Eddystone EA12 receiver with a dipole aerial. With G3BZU sitting on top of the second highest point in Hampshire, it is not surprising that the site is such a good take-off point. Further details of the service can be obtained from Michael Puttick G3LIK, 21 Sandyfield Crescent, Cowplain, Portsmouth, Hants. PO8 8SQ.

KINDLY NOTE!

Tug 'O' War Game April 77

On PCB A030 pin 13 on IC8 should be linked across to the +9V rail. Amend Fig. 5 similarly. If the 'knot' fails to move check that pin 9 on IC6 is joined to pin 10 and that pin 11 is joined to pin 12 as shown on the PCB foil diagram.

CQ! CQ! CQ! CQ!

Tech. info. wanted

..Manual or circuit diagram with component values for Heathkit TV Alignment Generator type HFW-1.—Mike Roberts, 7 Whielden Lane, Winchmore Hill, Amersham, Bucks, HP7 0NF.

..Any information on a Jason JTV2 VHF tuner (originally a kit).—G. Cobb, 89 Eastwick Park Ave., Great Bookham, Surrey.

..Circuits or general information wanted on a Minimitter 10-80m amateur band converter.—T. Smithers, 15 Ferenberge Close, Farnborough, Bath.

..Full manual or circuit details for Swanco/cse receiver type 2AR. Apply R. J. Smith, 42 Woodchurch Close, Sidcup, Kent. Tel: 01-332-0351.

..Information required on an ex. Australian Army A510 transmitter unit. Apply Neil Braeman, 9 Millfield, Southwater, Sussex.

..Valves VY2 and VC11 required for a 1938 German Peoples receiver. Also any surplus pre 1930 literature on radio and electrical communication. Apply C. Matthews, Museum of Communication, University of Edinburgh, Kings Buildings, Mayfield Road, Edinburgh.

..Manual required for Heathkit 10-12U.—H. Toon, 38 Mountfield Ave., Reepham Road, Hellesdon, Norwich.

..Circuit diagram or details of GEC Communications Receiver type BRT 400D—C. J. Gill, 95, Fosterd Road, Newbold-on-Avon, Rugby, Warwickshire.

..Circuit diagram or any information on C. F. Lord FM3-3 Frequency meter and Elipco AC88 amplifier—W. Roebuck 16 Elizabeth St. Newsome, Huddersfield, West Yorkshire.

..Any information on AM/FM 'Juliette' 7-band receiver—J. Pretorius, Jooste Street, 359 PO Kloofsig, Pretoria, South Africa.

..Information on Mullard RF signal generator that used the following valves—DW2, 164V, 2286. Also copy of PW March 1976 and information on communication receiver type R1155A —W. Dibden, 13 Grizedale Road, Woodley, Cheshire.

Back issues and equipment for disposal

..80 issues of PW dating from 1969 for disposal if any reader would care to make an offer. C. G. Warren, 23 Chipstead Way, Woodmansterne, Banstead, Surrey.

..Copies of PW dating back to October 1946 for sale. G. LeFlem, 11 Hillmortan Lane, Lilbourne, Nr Rugby, Warwickshire, CV23 OSS.

..Free gift of back copies of PW to any Radio Club/Boys Club/School.—W. Ferguson, G3KMH, 9 Woodbine Terrace, Hexham, Northumberland.

Back issues and equipment wanted

..June 1971 issue of PW.—Sidney Coles, 2 Cross Farm, Alcombe Road, Alcombe, Minehead, Somerset.

..Morse keys for collector and overseas collector friends—G3IRM, 14 Linton Gardens, Bury St Edmunds, Suffolk, IP33 2DZ.

..October and November 1975 copies of PW wanted.—I. R. Juniper, 28 Rabbett St, French's Forest, NSW 2086, Australia.

HONEYWELL PUSH BUTTON PANEL MOUNTING MICRO SWITCH

1-2-3 Bank, each Bank consisting of the changeover micro switch rated at 10 amps 250 volts. Through panel fixing by 2 lock nuts complete with black 1" diameter knob. Prices:— 1 bank **40p** — 2 bank **55p** — 3 bank **70p**.

12v AUTOMATIC SWITCH

It can sometimes be a problem to find your car or caravan in a big car park or caravan site after dark, so why not fit a light that will come on automatically when it gets dark. We are offering a kit for this, comprises: light sensitive switch, 12v bulb and bulb holder in tubular casing with coloured lens, with wiring diagram.

Price £3·00 + 37½p + 20p + 2p. Main operation switch available £3·95.

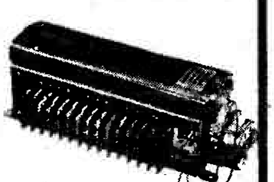
TAPE HEADS ETC.

2 track record/playback **75p**.
4 track record/playback **£1·10**.
Erase head 2 track **50p**, 4 track **90p**.
Mu metal shields and holders **65p** each.
2 track r/p head and 2 track erase head schedule and fixed on mounting plate ready for tape **£1·85**.

INDUCTION MOTORS

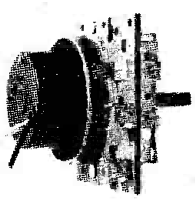
230v mains operated—precision made as used in fans—record players. Tape recorder—heaters etc. etc. ½ stack (as illustrated) **£1·35**. ¾ stack **£1·75**. 1" stack **£2·25**.

MOTORISED DISCO SWITCH



With six 10 amp change-over switches. Multi adjustable switches are rated at 10 amp each so a total of 200w's can be controlled and this would provide a magnificent display. For mains operating **£4·25** post & VAT Paid Ditto 9 switch **£4·95** Post & VAT Paid. DITTO BUT 12 SWITCH **£5·75** POST & VAT PAID.

DELAY SWITCH



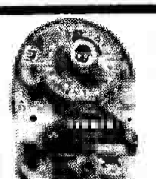
Mains operated—delay can be accurately set with pointers knob for periods of up to 2½ hrs. 2 contacts suitable to switch 10 amps—second contact opens few minutes after 1st contact **95p**.

WAFER SWITCHES

6 pole 2 way	12 pole 2 way	18 pole 2 way
5 pole 3 way	10 pole 3 way	15 pole 3 way
4 pole 4 way	8 pole 4 way	12 pole 4 way
3 pole 5 way	6 pole 5 way	9 pole 5 way
2 pole 6 way	4 pole 6 way	6 pole 6 way
2 pole 8 way	4 pole 8 way	6 pole 8 way
1 pole 10 way	4 pole 9 way	6 pole 9 way
1 pole 12 way	2 pole 10 way	3 pole 10 way
all **£1·32** each	all **£2·41** each	all **£3·12** each

Multi bank switches up to 72 pole 2 way—to 12 pole 12 way quickly made to special order.

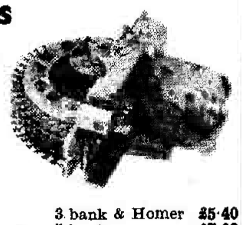
24 HOUR TIMERS



SMITHS
Timer heart similar to Autoset etc. 2 13 amp on/off per 24 hrs. **£4·15**.

TIMAC
Module really miniature (approx 2" cube) but with 2 15 amp on/off per 24 hrs. **£4·50**.

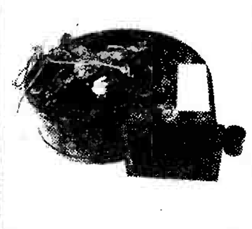
UNISELECTORS



These are pulse operated switches as used in automatic telephone switchboards etc. A 24v pulse moves the switch through one switch way all we have are of the 25 switch full wiper type, the following sizes are in stock:

3 bank **£4·80** + 37p	3 bank & Homer **£5·40**
4 bank **£5·94** +	5 bank **£7·02**
8 bank **£9·72** +	10 bank **£10·80**
12 bank **£12·96** +	

BLOWER FAN



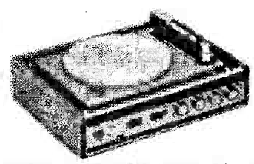
Centrifugal type blower/fans with rectangular outlets designed to fit into trunking for heat blowing etc. will also function as extractors main voltage motors—three sizes available **small** (overall size approx 4½" × 4" × 4") **£4·50**—**medium** (overall size 9" × 8" × 3" approx) **£6·50**—**large** (overall size 12" × 12" × 10" approx) **£13·50**.

CENTRAL HEATING HEARTS

Randal (illustrated) **£6·75**.
HORTSMAN **£6·30**.
SMITHS Controller 10/100 complete in wall mounting case **£7·50**.

THIS MONTH'S SNIP

HI FI RECORD PLAYER

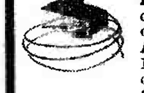


Stereo 5 watts per channel. Russian made but guaranteed repairable. Travel damaged or test line rejects, in need of attention, consist of mains operated record deck — mounted in wooden plinth with super 10 watt amplifier. Controls are "on/off", "Tape/phone", "mono/stereo", "Base", "Treble", "Balance", "Volume". We are offering these at price of record deck only so are a bargain not to be missed only **£6·75p**, post **£2·00p**. Note cartridge and all spares are available at low prices.

MAINS TRANSFORMER BARGAINS

20v ½ amp	£1·25
18v 1 amp	£1·55
6·3v 2 amp	£1·39
25v 1½ amp	£1·75
24v 2 amp	£2·00
50v 2 amp	£4·50
9v 1 amp	£1·25
8·5v-0-8·5v ½ amp	£1·25
10v 20v 30v 40v	
250 watt loading	£5·50
20 watt auto 115v	£1·25
100 watt auto 115v	£1·75

THERMOSTATS



Refrigeration as illustrated with 36" capillary **£1·62**.
Limpet Stat must be mounted in close contact calibrated 90°–190°F 15 amp contacts **£1·62**.
Appliance Stat fix like a volume control—15 amp contact 30°–80°F **85p**.
ditto but for high temps **£1·25**
Over Stat—with Serson and capillary **85p**

TERMS:

Cash with order—despatched same day as order received prices includes VAT and carriage unless stated but orders under £6 must add 50p to offset packing etc.
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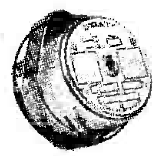
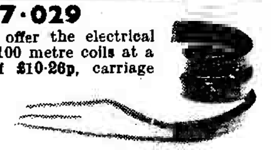
LOW R.P.M. MOTORS



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

		1 rev per day	6 rev per day	
		1 rev per hour	12 revs per hour	
		½ rev per min	1 rev per min	
		2 rpm	1½ rpm	
5 rpm	15 rpm	20 rpm	25 rpm	30 rpm

REMEMBER 7·029



We are still able to offer the electrical equivalent of this in 100 metre coils at a very special price of **£10·26p**, carriage **£2·50p**. Our remaining stock of this is 3 core and earth, this is a little larger physically than twin and earth but if space limited then just remove the unwanted core before taking cable into small socket box.

FREE Telephone line. If you are using the above cable for taking a supply to a shed or remote point then the third core can be used as a telephone line. For lighting we can offer 1·5mm. Three core at **£6·50** carriage £1·60.

MULLARD UNILEX

A mains operated 4 + 4 stereo system. Rated one of the finest performers in the stereo field this would make a wonderful gift for almost any one in easy-to-assemble modular form and complete with a pair of Goodmans speakers this should sell at about **£30**—but due to a special bulk buy and as an incentive for you to buy this month we offer the system complete at only **£14·00** including VAT and postage.

IT'S FREE!

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

SHORTWAVE CRYSTAL SET

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

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Self priming, portable fits drill or electric motor, pumps up to 200 gallons per hour depending upon revs. Virtually uncorrodable, use to suck water, oil, petrol, fertilizer, chemicals, anything liquid. Hose connectors each end. **£2·00** Post Paid.

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All in module form, each ready built complete with heat sinks and connection tags, data supplied. Model 1153 500mW power output **£1·50** including Post & VAT.
Model 1172 1W, power output **£1·85** including Post & VAT.
Model, EP9000 4 watt power output **£2·90** including Post & VAT. EP 9001 twin channel or stereo pre-amp. **£2·90** including Post & VAT.

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

MICRO SWITCH BARGAINS

Rated at 5 amps 250 volts. Ideal to make a switch panel for a calculator and for dozens of other applications.
Parcel of 10 for **£1·00**, VAT and post paid.

ROOM THERMOSTAT

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ON THE AIR

AMATEUR BANDS

by Eric Dowdeswell G4AR

IT IS very nice to get a letter from **Neil Whiteside** G8MXF, formerly A8859, of Hitchin and to know that he has not forgotten the column! Wisely he is working on the code and ought to have his G4+3 in the near future. At present he is active on 2m with a Pye F27 and a Hudson FM208. Among his 700 QSO's so far has been another of our earlier contributors Paul Turner, now G8MWV. I hope all this will act as a spur to those of you who are thinking of taking the RAE!

Alan Doherty BRS34968 of Portrush, Co. Antrim has got back into the listening groove again after his return from New Zealand, and an Eddystone 940, newly acquired, plus a 300ft wire has put things like C21NW on Nauru Is. and HM1IV in Seoul into his log. In Harrogate **Steve Cottis** A8961 has been admiring some recently received QSLs from VP5A, 6W8FZ, WB6EWH/VQ9 and 9X5SM. He comments on the 15m band which has been producing DX from all continents.

Other readers of this column could well emulate **Paul Cowburn** in Leyland, Lancs and spend time copying the RSGB slow morse transmissions. Paul is now up to around 10wpm and mentions that past contributor to this feature Tim Charles G4EZA sends the slow stuff out on 2m. W4BRB/C6A in the Bahamas plus PJ8CO and FG7AR/FS7 might not seem very extraordinary unless I told you that Paul has been copying them on Top Band! Paul has joined the RSGB and started on a one-man course for the RAE. Stick to it, Paul, others have made it on their own, so why not you?

Yet another Paul reports in. **Paul Bradbeer** in Braunton, Devon is also a recruit to the RSGB and to the North Devon Radio Club. His CR70A plus RF amplifier and 33ft wire have been mainly employed on 15m with forays to 20m. If you manage to copy a lot of those Jubilee GE callsigns you might be able to qualify for the Bromsgrove and District ARS Silver Jubilee award. Copy GE3VGG the club station plus another in Bromsgrove plus 23 others and send the log to J. K. Harvey G8KLO, 22 Elm Grove, Bromsgrove, B61 0EH by 31 Dec. Send an SAE to KLO if you have any enquiries or need fuller details.

In Cambridge, **David Peck** BRS37621 complains of the QRM by CW stations on the RTTY channel 14095kHz, David's favourite spot. It is a pity but I doubt whether many op's realise it's significance and probably curse that 'QRM' on the choice bit of DX that they're after! David's FRG7 plus homemade terminal unit, Creed 7B printer and 130ft of wire seem to get him RTTY copy from most parts of the world.

If you happen to be five miles SE of Derby on Sunday 12 June you will be in the middle of the Elvaston Castle Mobile Radio Rally run by G3EEO, G3BZI, G8KGC and others for the Nunsfield House Community Assoc. Trade stands, sideshows and all the fun of the fair. Don't miss it!

The bug has bitten again for **John McFadden** in Belfast who had a Trio 9R59 a couple of years ago but sold it. Now with a 100ft of wire indoors he is active on the amateur bands again, this time with an FRG7. Nothing special to report so far but John is persisting. **Brian Harrison** of Hastings used his AR88 and ATU with a vertical to get such stations as FH8CJ in the Comoro Is. on 20m. Plans for a 300ft wire came to grief with planning permission problems. Following the note in this column **Michael Waller** in Leeds heard from several clubs and then discovered that G3WWF lived only a few streets away! So he is not alone any more.

Long-time correspondent **Robin Bayley** A9203 writes that he copies slow code from G4EYY and with his RAE course starting in September he ought to be well on his way to the RAE. He monitors all bands from 10 to 80m with his EC10 and R1475 plus a Microwaves Module converter for 2m. A warm welcome to **I. Radford** in Derby, who, in a very brief letter indeed, says he is using an Eddystone EC10 plus a whip aerial. We'd like some more info OM. **Alan Doherty,** already mentioned, would like to hear from other SWLs, DX or local. He'd really like to form a local club but the only known amateur in his area is GI3ONZ who is inactive at present. Write to Alan at 21 Romore Street, Portrush.

My thanks to **Edgar Janes** G2FWA for a copy of the Cheltenham RSGB Group newsletter, a nice blend of local news and technical tit-bits. If you happen to live in that very pleasant part of the country why not drop a line to Hon. Sec. Derek Lively G3KII, 26 Priors Road, Cheltenham or drop in at the Old Bakery, Chester Walk, on the first Thursday of any month at around 8pm.

The Worldwide SSTV Contest brought much joy to **Paul Barker** up in Sunderland with HC1BU and JA1PSS providing the best DX pictures. At the White Rose Rally he managed to swop his FRDX500 for a Trio JR599 which proved itself by copying all continents on 15m during one afternoon. Although he has been reading the column for some time, **Philip Ackroyd** in Peterborough at last sent in a letter and log. Glad to have you with us Peter, and I'm sure you will enjoy your membership of the Greater Peterborough ARC. Rig is an FR50B plus 60ft wire.

By the time you read this I hope to be on the air with my Pye 125 transceiver, on 80m to start with, SSB and CW reports will be welcomed.

Log Extracts

P. Bradbeer:— 20m C6AEY (Bahamas - QSL WB8HAK) HR3JJR YV0DL **15m** EA8NO FG7AS PZ1DR 5Z4RG 6W8AK (QSL F6AXP) 7P8BC

P. Ackroyd:— 20m FL8GP KV4MV **15m** KZ5UH

A. Doherty:— 80m HS1BG HV3SJ KA1IYO (Ogasawara Is) KA6YL KH6II PZ9AB ZP5AO **20m** C21NW HM1IV 5T5DY 9D5D **15m** FG7AR/FS7 FR7ZL/T

P. Barker:— 20m SSTV CN8BF FC6EFJ HC1BU JA1PSS K0ZOL LZ1MH OH5BM PY2WE W8DX 9K2DO **15m** K9TQT/CP6 OA8CD ZD7SD ZP5WU 7P8BC 9J2CW 9Y4NP

I. Radford:—80m KH6IIV TY2HKY ZL3NE.

B. Harrison:—20m FH8CJ **15m** TI2SAP VE3AQS/TG9 YN4SP ZS4MZ 5N2AAV

R. Bayley:— 80m KH6PP OA8AF TG9HD **40m** AP2AD EA6BG VK2APD **20m** HK0COP KH6BB VS6DO **15m** DU1DBT JA9CM TG9TY **10m** JA1KSO VK6PP 7Q7BA

J. McFadden:— 20m CT2BB VP9HY

D. Peck:— All RTTY 80m LX1JW **20m** CO2FRC FG7XT JA1ACB N4AL OH0NI WA0CKY YV7DU

P. Cowburn:— 160m W1BB W4BVV K8CCV **FG7AR/FS7 VO1KE W4BVV YV4BK 80m** FM7AQ FG7AR/FS7 HR2BLD TG9KT VP1RS VP2DAD VS6DO ZL1AQF ZL4LM 7P8BE 9J2WR **FR7ZL/T 5X5NK 40m** VK7GK ZL1BIL ZL3ABN ZP5LX **20m** KG6RT KH6BB PJ8CO **9L1NP ZD8TM**

S. Cottis:— 80m JY9HQ **20m** HI8CDS VP2MAQ 6Y5YL **15m** A4XFE AP2P CP6HB FL8KP FR7ZL/T PJ8CO TA1ZB YB2CR 3D6BD 6W8FZ 7P8BE

All SSB except where stated otherwise, CW in bold.

BROADCAST BANDS

MEDIUM WAVE DX

by Charles Molloy

LATIN American DX appears again, this month with a really fine log from Aurich-Sandhorst in West Germany. **Joachim Gutschke,** who is an old-established SW enthusiast came in contact with *Practical Wireless* and this column while on holiday in the UK and he has now been converted to the medium waves. Highlights of his log are Radio Liberacion in Havana Cuba on 640kHz, La Voz de Cuba in Camaguay on 740, Radio Demerara Guyana 760, 4VEH Cap Haitien, Haiti 840, Ondas del Pacifico Ecuador 975, Radio Commercial Santo Domingo on 1010, Radio Conquistador Puerto Rico on 1480. All were heard on a homebrew receiver and two fixed remotely tuned loops located in the loft.

A heterodyne is produced on a signal when two carrier frequencies separated by a few hundred Hz or more, enter a receiver and reach the detector stage. This heterodyne, which is equal to the frequency difference between the two signals, is rectified and heard as an audio tone similar to a tuning note. It can be distracting to the DXer and in some cases it makes reception rather difficult. The writer had experience of this effect recently when listening to the new Nigerian outlet on 945kHz which is separated by only 1kHz from the European channel on 944kHz. At the time 944 was occupied by a Russian station which was somewhat stronger than the African. The result was a strong audio note of 1kHz which made DXing almost impossible. One method of reducing this trouble is to increase the receiver selectivity until speech becomes muffled. Then detune, away from the interference, when the interfering signal and the heterodyne will both be reduced in strength and the desired station will be heard on one sideband only.

A more effective method of dealing with heterodynes is to use an audio notch filter. The writer recently purchased a tunable audio notch filter from Cambridge Kits, who advertise in *Practical Wireless.* This device is connected to the receiver headphone sockets in place of the headphones, the latter being plugged in to the notch filter. The source of power is a PP3 battery and there are two controls, an on/off switch and a tuning control. The result on 945kHz was startling. When the notch filter tuning control was rotated a position was found where the heterodyne disappeared completely, leaving a nice clean signal which was now relatively easy to identify. For the technically minded the notch filter is a band stop filter with a narrow rejection band. It is tunable over the range 350Hz to 6kHz and the sharp "null" ensures that it has little effect on speech.

An interesting situation arises when two stations nominally on the same channel are in fact separated by one or two Hz. When this occurs and the two stations are of comparable strength then the 'heterodyne' becomes a beat of considerable magnitude which can be observed on the 'S' meter. Unfortunately, the receiver's AGC will respond to the beat, adjusting the receiver gain in sympathy with it and producing audio distortion which is most unpleasant to listen to. The remedy of course is to switch off the AGC.

A weak inaudible station will produce a visible beat on top of a much stronger station if there is a slight frequency difference between them, as is often the case. The effect can be very useful to the DXer. He may, as your scribe did some years ago, stay on the channel in the hope that the strong station will fade and the weak one will come up. KOMO Seattle on 1000kHz was heard this way after observing a beat on WCFL. The DXer, if he has a loop, may even take a bearing of the inaudible station by rotating the loop until the beat disappears. This too may be an indication as to whether the inaudible companion is worth waiting for.

A long and interesting letter from **L. W. Spendla** of Basingstoke mentions that he started DXing on the medium waves in 1925 with a one-valve receiver. By 1930 he was operating a four-valve Osram Music Magnet in Buckingham with a good, high wire aerial and a well watered earth. Best DX recorded was Pittsburg (KDKA) and Boston (WBZ). On trying this receiver again in 1975 he logged 50 continental stations plus Algiers and Oran. **Dr. H. S. Brodribb** from St Leonards-on-Sea writes "I am challenged to do all my DXing on vintage radio and I get good results on a 1935 Philips 745 and roof aerial". The good doctor does have a CR100 and a long wire though and with this set-up he pulled-in the 50kW WINS in New York City on 1010kHz.

The committed medium wave DXer will, when on holiday, take a receiver with him just to check out the band from a new location. In Spain, where there are several chains of low power local stations it can be an interesting exercise to try to identify some of the many locals that can be heard. A Philips jack-in car radio/portable and a copy of the *World Radio Handbook* invariably accompany yours truly when on holiday either at home or abroad. DXing Spanish locals from the UK can be an absorbing occupation during the summer months. Listen around midnight, which is sign-off time for many stations, which can be heard leaving the air one after another on some occasions. Channels to watch for local radio outlets are 1106, 1133, 1394, 1412, 1475, 1520 and 1570kHz. Stations logged recently are EFJ19 Radio

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7472	0·36
7473	0·36
7474	0·40
7475	0·59
7476	0·42
7480	0·60
7482	0·85
7483	1·00
7484	1·00
7486	0·40
7490	0·52
7491AN	0·85
7492	0·60
7493	0·70
7494	0·80
7495	0·80
7496	0·90
7497	3·67
74100	1·75
74107	0·45
74109	0·86
74110	0·57
74111	0·86
74116	1·89
74118	0·95
74119	2·00
74120	1·10
74121	0·45
74122	0·60
74123	1·00
74125	0·80
74126	0·80
74128	0·80
74132	0·80
74136	0·68
74141	0·85
74142	3·00
74143	3·00
74144	3·00
74145	1·00
74147	2·45
74148	2·00
74150	1·75
74151	0·90
74154	2·00
74155	0·90
74156	0·90
74157	0·90
74159	2·50
74170	2·60
74172	5·00
74173	1·75
74174	1·57
74175	1·00
74176	1·10
74178	1·65
74179	1·65
74180	1·65
74190	1·48
74191	1·48
74192	1·25
74193	1·25
74194	1·25
74195	1·10
74196	1·20
74197	1·00
74198	2·25
74199	2·25
*76013N	1·75

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Juventud Murcia on 1133kHz, ECS11 Radio Centro Madrid on 1385, EAK6 Radio Popular Zaragoza on 1394, EAJ34 Radio Gijon 1412kHz. EAK9 Radio Popular Valladolid 1430, EAJ20 Radio Sabadell 1475, EAJ48 Radio Vigo 1520 and EFE25 La Voz de Catabria in 1570kHz. Spanish broadcasters are also to be heardy on 809, 953, 1025, 1124, 1259, 1313 and 1358kHz.

SHORT WAVE BROADCASTS

by Derek Bell

LONG-TIME friends of this column will remember our recent quest for information on the oldest working short wave set. A recent letter from **Joe Owens** of Dollegellau in North Wales set me to wondering if it is possible to find the oldest reader of PW; Joe's memories go back to 1929 which is not bad since the first PW saw the light of day on 1932. However, let us hear from someone who can remember PW's first issue which was published weekly and cost 3d!

Peter Grant from Sheffield has rescued a Convair 10 set from a dustbin. After a repair to the case and several new items of electronic "innards" Peter had the set back working. Came the day when, due to an injury at work, he had time on his hands and limited mobility. This time was filled with twiddling the knobs of the set rather than his thumbs and Peter found that the DX bug had really bitten. The net result is the following:—15440 WYFR Mass, at 2050, 6480 VOA to Africa at 1930 and 1700 Radio Kiev at 1945.

Peter is a little confused since the set is calibrated in metres and he wants to know how to convert this to frequency. Well, the simple answer is to use the formula:—Frequency (kHz) = 300000/wavelength in metres. For, say, 19·34m this produces a sum of 300000/19·34 this when resolved gives 15512kHz or 15·512MHz.

More information has come in regarding the HAC problems of reader Tony Cook. **C. M. Lindars** of Wallington has some information that may be of help to other sufferers. It seems possible that Tony has connected the top of the top of the tuning coil to the moving vanes of the tuning capacitor instead of to the fixed vanes. I must admit that I have never had the chance to evaluate the HAC or indeed have I read any test reports so I am in no position to help **Mark Cox** of Stanford le Hope Essex whose letter is rather vague. He has logged as follows:—1178 Radio Sweden at 2300, 9605 Radio Prague at 2015 and 7260 Radio Berlin International at 1945, also on an aforementioned HAC hung on the end of a 35ft wire aerial but the problem is that Mark asks "what do I do when the set stops oscillating?" This statement is so vague that I must ask Mark to supply more details.

Ken Willis of Scarborough has supplied a few items of transmitter news. The first is that FEBC are announcing their address as PO Box 2041, Mahe, Seychelles and not 2141 as printed in WRTH. The second also concerns a WRTH misprint, the Radio Israel DX Show is on Sundays and not Saturdays as printed. Ken seems to have been sucking in quite a few good catches in these days of low sunspot counts namely:—9585 HCJB Quito at 0715, 15120 V. of Nigeria at 0730, 15320 Radio Japan at 0800 and 11740 Radio Australia at 0800.

At the time of writing it is reported that the BBC is to seek a channel for a "Euroservice", to be grafted on to the BBC World Service to cater for the European community. I have not heard any frequencies mentioned but I suspect that it will be in the medium wave band in 'Charles Molloy' country.

A letter that dropped on the mat recently asked me to mention a new DX club that is just getting off the ground so I will therefore crave your attention for the Halstead Youth DX Club. The title does belie its name however, for its spokesman, **Matthew Phillips,** assures me that they welcome members of all ages. So contact him at 4 Nether Court, Halstead, Essex. Our QSL news is by way of **Roy Patrick** of Derby who tells me that HCJB has issued a new series of twelve cards one of which is a diorama while others feature shots of the transmitter equipment.

A happy return to DXing was experienced by **John McFadden** of Belfast recently. He had to give up DXing for some two years but the 'disease' was only dormant and recently he had the symptoms return! The itching forefinger, the twitching ear and the urge to stay awake all night. He used the event as an excuse to purchase a receiver different from his previous one and he ended up with a Yaesu FRG7. For an aerial he wound 100 feet of wire three times round the room; difficult to open the door, if I may say so! The return also brought about a rethink of John's interest and resulted in him taking an interest in the Latin American bands. As a result of this he is surprised that a 1kW station can be heard in Britain. "Is it possible, he asks, for a less powerful station to be heard in the United Kingdom?" I would think not but having said that there will be readers who can prove me wrong since this old hobby of ours is a funny thing. Very often, given the right combination of refraction from the ionosphere or perhaps the right darkness path, a very weak station can propagate with very little attenuation over fantastic distances. To prove this and to put myself well in with the many LA fans I append a handful of John's loggings:—

4800 R. Lara, Venez. at 2345
4823 R. Reloj, Costa Rica at 0615
4920 R. Progreso, Honduras at 0410
4965 R. Santa Fe, Colombia at 0440

John comments that he pulled in eleven LA stations in one night and I can understand the fever that gripped him, but I will comment that he was lucky in getting so many IDs. In my experience LAs tend to let the IDs fall by the wayside.

A four-page broadsheet from Radio Finland frankly admits they can only afford one foreign language service. They announce, however, that the external service will be relayed in future from the Turku and Helsinki medium wave transmitters as well as from the main Pori station. That about wraps it up for this month so I wish you and yours 73s.

Please note that my correct address is Derek Bell, 169 Max Road, Chaddesden, Derby.

VHF

by Ron Ham

ON arrival home at 0045 on April 7th my phone was ringing and Alan Baker G8LGQ Newhaven, was shouting "aurora" in my ear and by then he had already heard a strong signal from Graham Knight GM8FFX in Aberdeen on 2m SSB, plus some tone-A CW. A quick call to Charlie Newton G2FKZ London, (RSGB auroral co-ordinator) who said that the event began around 2200 on the 6th and activity was "very patchy". By 0115 I was back on the landline to G8LGQ in time for us to compare notes, and later, for both of us to record a very clear auroral signal from GM8FFX while he worked LA8WT, SM4DLT and G8JXN. It appears that 2m was not the only band affected as **Mark Turnball,** G4ESA, Southsea, heard auroral CW on 20m during the evening of the 6th and **Andy Mepham** G4CBZ heard the same on 80m. This aurora may well have been caused by a spray of gas and a filament seen by **Cmdr. Henry Hatfield,** Sevenoaks, through his spectrohelioscope around noon on the 3rd. Unfortunately, further visual observation of the sun before the aurora was prevented by overcast skies. However, indication of more solar activity came from the BBC World Service when they reported an ionospheric disturbance at midnight on the 4th. During the afternoon of the 6th, **Roy Bannister** G8LXR Lancing, accompanied by G8LGQ heard solar noise on 2m. Throughout the event, which for us in Sussex ended around 0200, both G8LGQ and myself found that the beam heading (due north) was critical for the auroral signals.

John Smith, Cranleigh, recorded several bursts of solar noise with his 142MHz radio-telescope between the 8th and 13th and the largest of these, during the morning of the 12th, lasted for almost an hour, which ties up nicely with a report from **Cliff Ranft,** Guildford, who was making a routine cosmic noise observation at the time with his home-brew equipment at 30MHz. Cliff recorded a sharp decline in this noise (SCNA Sudden Cosmic Noise Absorption) due to sudden absorption of signals in the D layer. This may well be the first SCNA recorded by an amateur astronomer. **Mark Bennett** G4DIX Sevenoaks is studying propagation at 21 and 28MHz and reports that during the mid-evening on the 8th it was unusual to hear strong signals from north-American stations coming through on 21MHz.

Both Henry Hatfield and John Smith reported seeing a medium size sunspot group appear on the east limb on the 11th and by the 15th Henry had counted 7 spots. On the 16th I recorded solar noise at 136MHz and on the 17th I heard on the "grape vine" that 80m was upset. This was confirmed bv **Nigel Golds** BRS36910 West Chiltington, Sx, who said that signals were very funny and that the band was noisy. Nigel had a job to hear stations which are normally very strong with him.

We are always pleased to hear from readers about their special interests. For the past six months John Smith has been using his 182MHz radio telescope, comprising a 30ft dish aerial, built by Ken Tapping and himself, and a home-brew mosfet front end, Dicke switched and all temperature stabilised for making a radio survey of the Milky-Way. To date John is very satisfied with the results.

The Blackwater Valley Group G8ARO, G8BCO and G8ECO aim to study the relationship between the prevailing weather and microwave propagation while they enjoy QSOs with other amateur stations on 10GHz. Peter Kerry G8ARO Farnham is out with the group most Sundays, subject to weather, at their P location in the Hindhead area using his home-brew wide-band FM equipment. Their best 2-way DX so far is 70km and recently Peter worked G8BDJ/P (50km) who was located on Ditchling Beacon (Nr. Brighton).

Interest in microwave activity is growing and G8ARO says that the Blackwater Valley Group would be pleased to help others get going. There are beacons on 10·1GHz situated on the Isle of Wight GB3IOW and in Romford GB2LBH and it is hoped that GB3ALN will soon be operational from Alderney in the Channel Islands, which will enable 10GHz enthusiasts to study propagation on an oversea path. Arrangements for the group's Sunday activity can be heard by listening to their SSB net at 2200 on Saturday evening on 144·33MHz. They intend to be active on June 5 with a GE call sign to celebrate the Queen's Jubilee. More reports about microwave activity would be welcome.

The Portsmouth repeater GB3PH on 70cms (RB2 Input 434·65MHz and output 433·05MHz) began operation on March 26th and so far **Constance Hall** G8LY Lee-on-Solent has worked mobile stations near Dorset, Salisbury and on the Isle of Wight plus fixed stations in Fareham, Portsmouth and Southampton via PH. More reports are wanted from users east of the repeater.

I observed the first signs of the sporadic-E "season" during the early mornings of the 12th to 19th April when strong bursts of signals from the R1 television system were heard on 49·75MHz and at 1355 on the 16th I received a 599 signal from the German beacon DLOIGI (28·195MHz). Strong Continental broadcast signals interfered with Band II BBC stations in southern England on the 4th and 5th due to a fall in the prevailing high atmospheric pressure system. The AP was just above 30" from April 6 to 14 when it rose to 30·25" and began to fall around noon on the 16th providing a variable VHF opening. During the evening on 2m G8BCO heard GC8AAZ, and G8LGQ periodically heard strong signals from northern G and GW stations. I heard several French broadcast stations in Band II and around midnight, I heard amateur stations commenting about the strange conditions on 2m.

BROADCAST BANDS

Short Wave Reports by the 15th of the month to Derek Bell, 169 Max Rd., Chaddesden, Derby.
Medium Wave Logs to Charles Molloy, 132 Segars Lane, Southport, PR8 3JG.

AMATEUR BANDS

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

VHF

Reports on VHF matters to Ron Ham, Faraday, Greyfriars, Storrington, Sussex RH20 4HE.

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AC128	0·16	BC157	0·09*	BD139	0·58*	BFX89	0·90	OC140	1·30
AC128K	0·25	BC158	0·09*	BD144	2·20	BFY11	1·10	OC170	0·23
AC141	0·22	BC159	0·09*	BD157	0·60	BFY18	0·50	TIP29A	0·44*
AC141K	0·34	BC160	0·32	BD181	0·86	BFY40	0·50	TIP30A	0·52*
AC142	0·18	BC161	0·38	BD182	0·92	BFY41	0·60	TIP41A	0·54
AC142K	0·32	BC168	0·09*	BD183	0·97	BFY50	0·20	TIP32A	0·64
AC176	0·16	BC169	0·12*	BD184	1·20	BFY51	0·18	TIP41A	0·68
AC176K	0·32	BC169C	0·14*	BD232	0·60	BFY52	0·19	TIP42A	0·72
AC187	0·18	BC182	0·11*	BD233	0·48	BFY53	0·25	2N404	0·40
AC187K	0·36	BC182L	0·12*	BD237	0·55	BFY64	0·35	2N696	0·20
AC188	0·18	BC183	0·10*	BD238	0·60	BFY90	0·90	2N697	0·20
AC188K	0·32	BC183L	0·10*	BD410	0·60	BSX19	0·16	2N706	0·15
AD149	0·45	BC184	0·11*	BDX32	2·30	BSX20	0·18	2N1131	0·15
AD161	0·35	BC184L	0·12*	BDY10	1·50	BSX21	0·20	2N1132	0·16
AD162	0·35	BC186	0·20*	BDY11	2·00	BSY52	0·28	2N1302	0·40
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AF139	0·35	BC237	0·16*	BF180	0·30	BU105/02	1·90*	2N2102	0·44
AF239	0·37	BC238	0·18*	BF181	0·30	BU108	3·00*	2N2217	0·30
AL102	1·45	BC300	0·34	BF182	0·30	BU109	2·50*	2N2369	0·14
AL103	1·30	BC301	0·32	BF183	0·30	BU126	1·60*	2N2369A	0·14
AU107	3·30*	BC302	0·40	BF184	0·20	BU133	1·60*	2N2483	0·20
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AU113	1·60*	BCY30	0·55	BF194	0·10*	BU205	1·90*	2N2646	0·50
BC107	0·12	BCY31	0·55	BF196	0·12*	BU206	2·40*	2N2711	0·20
BC107B	0·12	BCY32	0·60	BF197	0·12*	BU208	2·60*	2N2712	0·15
BC108	0·12	BCY33	0·55	BF224J	0·18*	MJ480	0·80	2N2904A	0·20
BC108B	0·12	BCY34	0·55	BF244	0·17*	MJ481	1·05	2N2905	0·18
BC109	0·12	BCY38	0·50	BF257	0·30	MJ490	0·90	2N2905A	0·22
BC109B	0·12	BCY39	1·15	BF336	0·35*	MJ491	1·15	2N2906	0·18
BC109C	0·15	BCY40	0·75	BF337	0·32*	MJE340	0·40*	2N2925	0·14*
BC117	0·19*	BCY42	0·30	BF338	0·45*	MJE520	0·45	2N2926O	0·09*
BC119	0·25	BCY54	1·60	BFW30	1·25	MJE521	0·55	2N2926R	0·10*
BC125	0·18*	BCY70	0·12	BFW59	0·30	OC43	0·95	2N2926Y	0·09*
BC126	0·20*	BCY71	0·18	BFW60	0·36	OC44	0·32	2N2926G	0·10*
BC140	0·32	BCY72	0·12	BFX29	0·26	OC45	0·32	2N3053	0·20
BC141	0·28	BD115	0·55	BFX30	0·30	OC46	0·20	2N3055	0·50
BC142	0·23	BD131	0·36	BFX845	0·23	OC70	0·30	2N3137	1·10
BC143	0·23	BD132	0·40	BFX8	0·25	OC71	0·35	2N3440	0·56
BC147	0·09*	BD135	0·36*	BFX86	0·25	OC72	0·22	2N3442	1·20
		BD136	0·39*					2N3570	3·60

2N3702	0·10*
2N3703	0·10*
2N3704	0 10*
2N3705	0·10*
2N3706	0·10*
2N3707	0·10*
2N3708	0·09*
2N3709	0·09*
2N3710	0·10*
2N3711	0·10*
2N3715	1·70
2N3716	1·80
2N3771	1·60
2N3772	1·90
2N3773	2·10
2N3819	0·28*
2N4347	1·10
2N4348	1·20
2N4870	0·35*
2N4871	0·35*
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4009BE	0·52
4010BE	0·52
4011BE	0·20
4012BE	0·20
4013BE	0·50
4014BE	1·00
4015BE	0·95
4016BE	0·54
4017BE	1·00
4018BE	1·10
4019BE	0·50
4020BE	1·12
4021BE	1·03
4022BE	0·95
4023BE	0·20
4024BE	0·86
4025BE	0·20
4026BE	1·55
4027BE	0·62
4028BE	0·91
4029BE	1·10
4030BE	0·55
4041BE	0·80
4042BE	0·83
4034BE	1·00
4044BE	0·94
4046BE	1·32
4049BE	0·54
4050BE	0·54
4069BE	0·30
4070BE	0·50
4071BE	0·26
4072BE	0·26
4081BE	0·20
4082BE	0·26
4510BE	1·42
4511BE	1·50
4516BE	1·35
4518BE	1·25
4520BE	1·20

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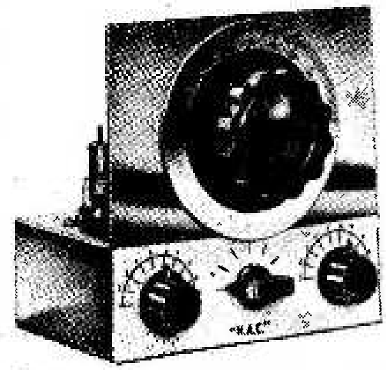

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Detecknow-ledgey

Detecknowledgey ? No, we haven't forgotten how to spell - a number of you thought we had during our 'Tecknowledgey' ad series last year - it is simply an expression of Ambit's specialist topic for Summer 1977: Metal Detectors. In other words, we want you to know that we know about them, not just selling them, but how they work, and why. It is surprising how few people can explain the theory and application of first principles to metal locators. Things like why a bunch of keys can sometimes fail to register, whilst a 2p piece indicates at 8 -10″ or why a lump of iron reacts as if it were non-ferrous. See our new publication on the subject, a consise reference work that sets out to explain from first principles the various phenomena you will encounter. £1.00 inc PP.

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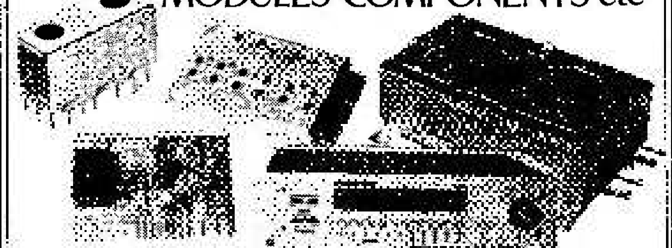
Wireless COMPLETE TUNER KITS MODULES COMPONENTS etc



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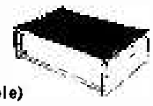

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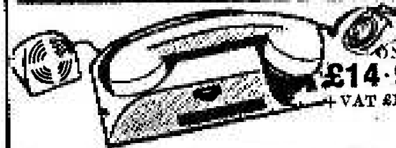

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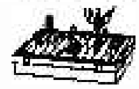

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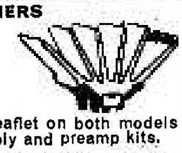

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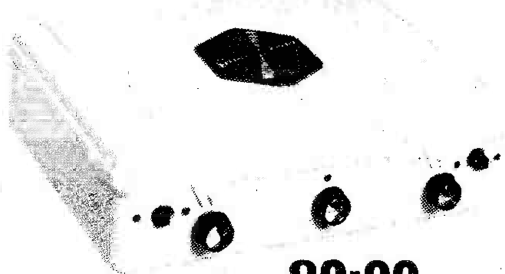

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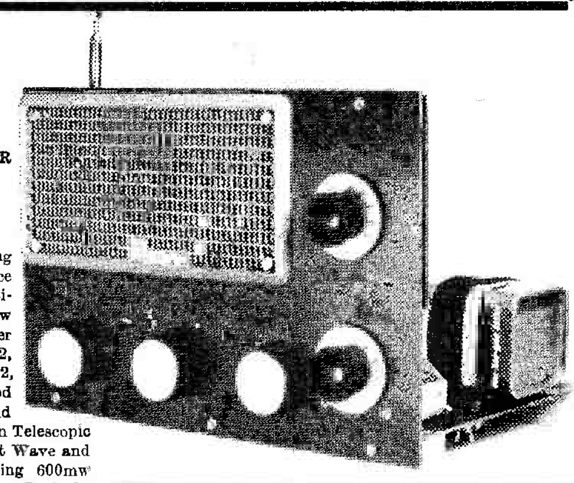

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QUALITY 5" × 3" LOUDSPEAKER

WITH Multiband V.H.F. section covering Mobiles, Aircraft, T.V. Sound, Public Service Band, Local V.H.F. Stations, etc. and Multiband A.M. section with Airspaced Slow Motion Drive Tuning Capacitor for easier and accurate tuning, covering M.W.1, M.W.2, L.W., Three Short Wave Bands, S.W.1, S.W.2, S.W.3, & Trawler Band. Built in Ferrite Rod Aerial for Medium Wave, Long Wave and Trawler Band, etc., Chrome Plated 7 section Telescopic Aerial, angled and rotatable for peak Short Wave and V.H.F. reception. Push Pull output using 600mw Transistors. Gain, Wave-Change and Tone Controls. Plus two Slider Switches. Negative Feedback circuit and **SPECIAL POWER BOOSTER SOCKET AND RESISTOR**, to virtually double gain if required. Powered by P.P.9 9 volt battery.
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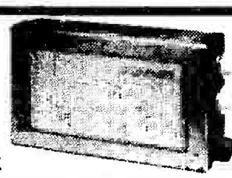
£13·99 Including Post and Packing
Case Enclosure Kit (if required) £1·90 inc. P & P.

POCKET FIVE



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3 Tuneable wavebands. M.W., L.W., and Trawler Band, 7 stages, 5 transistors and 2 diodes, supersensitive ferrite rod aerial, attractive black and gold case. Size 5½" × 1¼" × 3½" approx.
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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.
All parts including Case and Plans.
Total Building costs **£4·95** P & P + Ins. 90p.

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

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ECK2 Self Contained Multi-Band V.H.F. Receiver Kit. 8 Transistors and 3 Diodes. Push/Pull output. 3" Loudspeaker, Gain Control. Superb 9 section swivel ratchet and retractable chrome plated telescopic aerial, V.H.F. Tuning Capacitor, Resistors, Capacitors, Transistors, etc. Will receive T.V. Sound, Public Service Band, Aircraft, V.H.F. Local Stations, etc. Operates from a 9 Volt PP7 Battery (not supplied with kit).
Complete kit of parts including construction plans.
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ECK4 7 Transistors, 6 tuneable wavebands, MW, LW, Trawler Band, 3 Short Wave Bands. Receiver Kit. With 5" × 3" Loudspeaker. Push/Pull output stage, Gain Control, and Rotary Switch. 7 Transistors and 4 Diodes. 6 section chrome-plated telescopic aerial. 8" Sensitive Ready Wound Ferrite Rod Aerial. Tuning Capacitor. Resistors, Capacitors, etc. Operates from a 9 Volt PP7 Battery (not supplied with kit). Complete kit of parts including construction plans. **£7·25** P & P and Ins. 90p.

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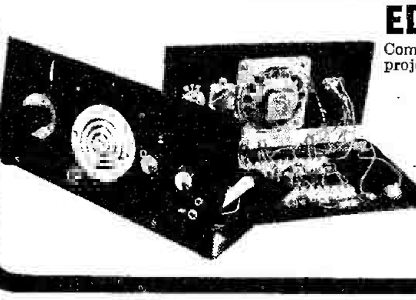

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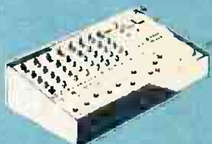
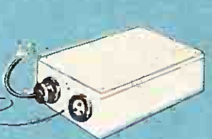
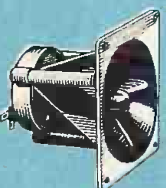


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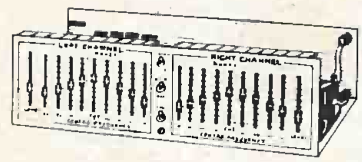

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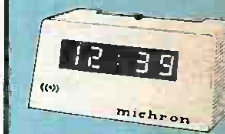

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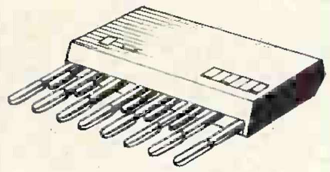

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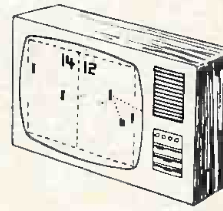

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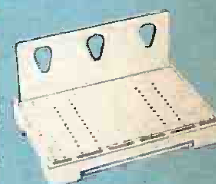





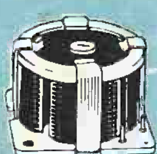
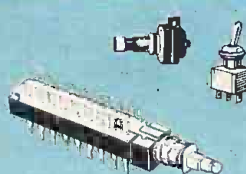

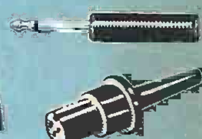

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