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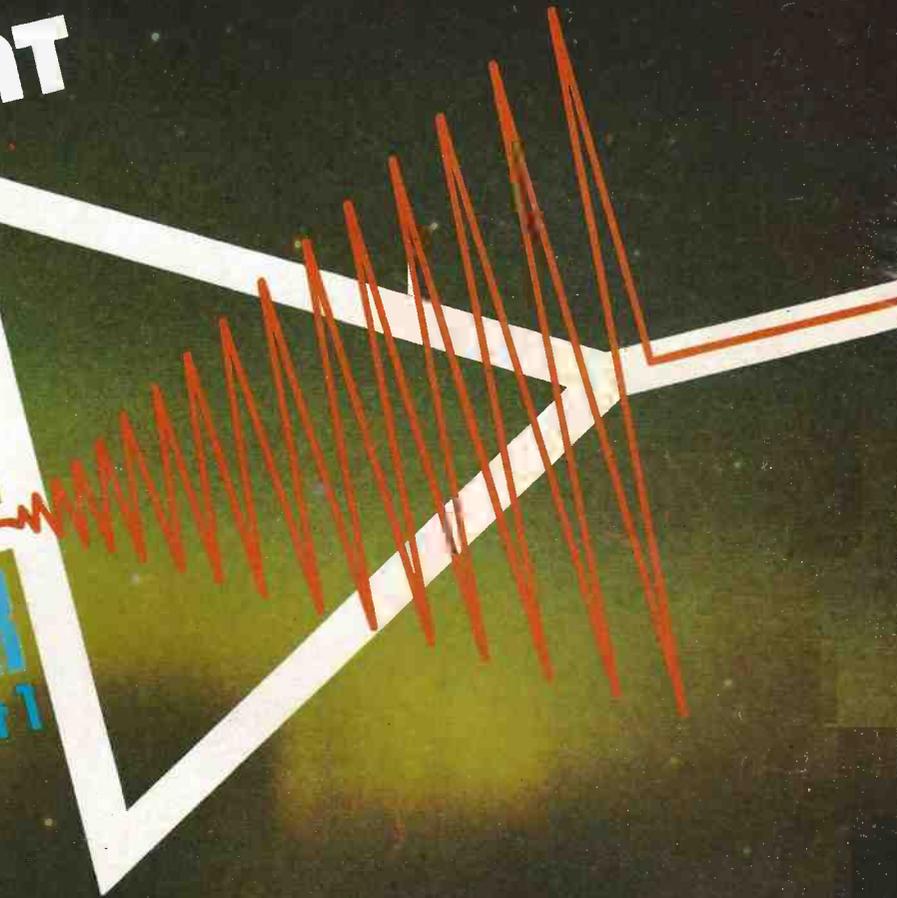
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7414	25p	74136	80p
7415	45p	74138	100p
7416	25p	74141	50p
7420	25p	74142	180p
7421	20p	74143	270p
7422	15p	74144	270p
7423	20p	74145	55p
7424	20p	74147	100p
7425	20p	74148	90p
7426	22p	74150	65p
7427	22p	74151	45p
7428	25p	74152	45p
7430	12p	74153	45p
7432	20p	74154	75p
7433	28p	74156	45p
7437	20p	74157	45p
7438	20p	74160	55p
7440	12p	74161	55p
7441	45p	74162	55p
7442	40p	74163	55p
7443	60p	74164	60p
7444	60p	74165	60p
7445	65p	74166	75p
7446	50p	74167	160p
7447	50p	74170	100p
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7449	10p	74174	60p
7451	12p	74175	60p
7453	12p	74176	50p
7454	12p	74177	50p
7460	12p	74178	75p
7470	25p	74179	120p
7472	20p	74180	90p
7473	25p	74181	130p
7474	25p	74182	50p
7475	25p	74184	120p
7476	25p	74185	100p
7480	40p	74188	320p
7481	85p	74191	70p
7482	75p	74192	60p
7483	75p	74193	60p
7484	70p	74194	55p
7485	60p	74195	50p
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7489	130p	74197	50p
7490	25p	74198	100p
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4016	30p	4070	12p
4017	50p	4071	12p
4018	55p	4072	12p
4019	40p	4081	12p
4020	50p	4082	12p
4022	40p	4083	70p
4023	12p	4510	60p
4024	40p	4511	70p
4025	12p	4516	65p
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3-3/25	7p	100/16	8p
4-7/10	7p	100/25	8p
4-7/16	7p	100/50	8p
4-7/25	7p	100/63	16p
4-7/50	7p	220/16	12p
6-8/25	7p	220/25	14p
10/10	7p	220/50	22p
10/16	7p	330/25	17p
10/25	7p	330/35	18p
22/50	7p	330/50	20p
22/63	7p	470/10	14p
22/10	7p	470/25	19p
22/16	7p	470/35	20p
22/25	7p	470/50	24p
22/35	7p	1000/16	27p
22/50	8p	1000/25	30p
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0-47/10V	14p	6-8/6V3	14p
0-47/35V	14p	6-8/35V	14p
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# practical WIRELESS

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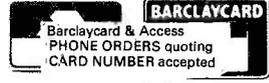
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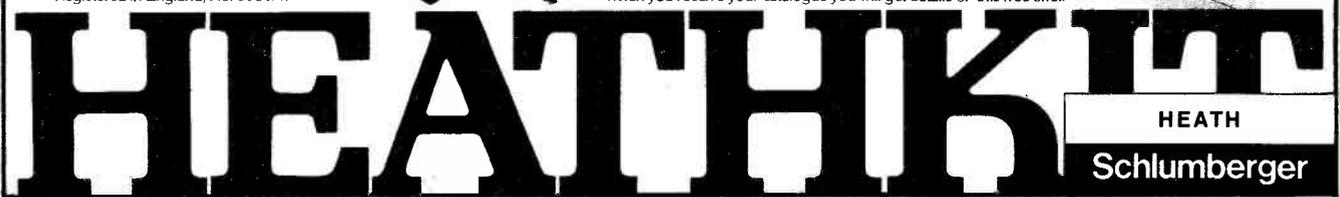


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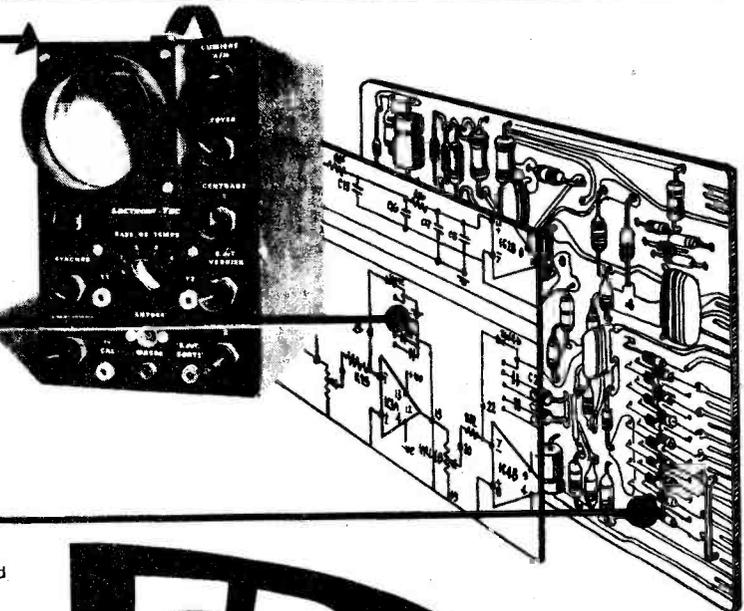
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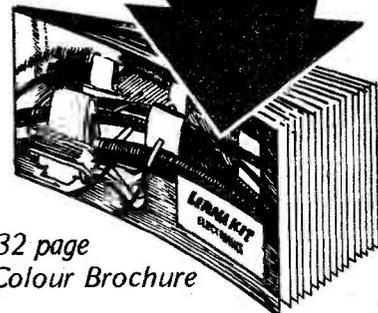
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32 page  
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A SMALL SELECTION FROM OUR HUGE FILE OF TESTIMONIAL LETTERS ON THE JOYSTICK VARIABLE FREQUENCY ANTENNA (-5-30MHz).

G4DJY's COPY LOG shows 68 North Americans worked in the ARRL WVE contest.

W6TYP worked WA6JPR over hundreds of miles on 40m. using the JOYSTICK VFA and MICROWATTS "equivalent to 1,000,000 MILES PER WATT"—A WORLD RECORD—we can supply conclusive evidence!

"I have used Rhombics,  $4 \times \frac{1}{2}$  waves in phase, centre fed dipoles, etc., but the success I have had with the V.F.A. has been AMAZING... only 20ft. high... in front of my mobile home, I NEVER RECEIVE LESS THAN R7 AND MOSTLY R9 ON CWDX WORKING—Bob Green, SUIK/G3APH, W.B.E., W.A.C. Phone and CW.

W7OE, U.S.A. Government Electronics Engr. (ret'd.), claims "VFA 5ft. below ground, same as dipole, elevated 15ft., one "S" point UP on dipole."

**IN USE BY AMATEUR TRANSMITTING AND SWL STATIONS WORLD-WIDE AND IN GOVERNMENT COMMUNICATION**

## JOYSTICK ANTENNAS

**SYSTEM "A" £41.00**

200 w. p.e.p. OR for the SWL

**SYSTEM "J" £47.95**

500 w. p.e.p. (Improved "Q" on receive)

## "PACKAGE DEALS"

COMPLETE RADIO STATIONS FOR ANY LOCATION

All packages include the JOYSTICK VFA (System "A") 8ft feeder, all necessary cables, matching communication headphones. Delivery Secured our risk. ASSEMBLED IN SECONDS. You SAVE £14.16 on each PACKAGE DEAL!

**PACKAGE No. 1. Features R.300 Rx. £222.00**

**PACKAGE No. 2. Features FRG7 Rx. £237.45**

**PACKAGE No. 3. Features SRX30 Rx. £212.45**

**PACKAGE No. 4. Our "Rolls"—Rx. FRG7000. £402.00**

## RECEIVERS ONLY

**R.300 £184.50 FRG7 £199.95**  
**SRX 30 £174.95 FRG 7000 £364.50**

All prices are correct at time of going to press and include VAT at 12½% and carriage.



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or write for details, send 9p stamp



5, Partridge House, Prospect Road, Broadstairs, CT10-1LD. (Callers by appointment).

## VALVES

A1065	1.25	EF80	0.40	PC900	1.25	SP81	0.85	3E29	5.50	6H6	4.20	12SJ7	0.55
AR8	0.60	EF83	1.50	PCC84	0.45	TT21	7.50	3S4	0.50	6J4WA	1.75	12SD7	0.55
ARP3	0.60	EF85	0.55	PCC89	0.55	U25	1.00	3VA	0.85	6J5	0.75	12YA	0.40
ATP4	0.50	EF86	0.55	PC189	0.65	U29	0.85	5B/2544	6.50	6J5GT	0.50	13BE	0.50
B12H	3.00	EF91	0.85	PCF80	0.80	U191	0.75	5B/258M	6.50	6J7	0.75	19A05	0.75
CY31	0.50	EF92	0.75	PCF82	0.40	U281	0.50	5R4GY	1.10	6J7G	0.50	19G3	10.00
DAF96	0.80	EF95	0.45	PCF86	0.65	U301	0.50	5V4G	0.95	6K7	0.70	19G6	6.00
DET22	19.50	EF183	0.65	PCF200	0.90	U801	0.80	5Y5GT	0.65	6K7G	0.35	19H5	17.00
DF96	0.60	EF184	1.60	PCF201	0.90	UABC80	0.60	EZ3	1.00	6K8GT	0.55	2001	0.50
DH76	0.40	EF804	2.00	PCF801	0.55	UAF42	0.75	5Z4G	0.70	6L6GT	0.90	20L1	1.00
DK95	0.80	EF200	0.75	PCF802	0.65	UFB80	0.55	5Z4GT	0.75	6L18	0.60	20P1	0.40
CV32	0.50	EF92	0.75	PCF805	1.80	UBF89	0.50	6AB7	0.60	6L020	0.50	20P3	0.60
DY86/87	0.55	EL32	0.90	PCF808	1.80	UB1	1.00	6AC7	0.80	607G	0.80	20P4	1.10
DY802	0.55	EL34	2.20	PCM200	0.80	UCB84	0.60	6AK5	0.55	607G	0.85	20R1	1.00
E5L	7.50	EL37	3.00	PCL81	0.60	UCC85	0.50	6AK8	0.40	6SG7	0.75	2524G	0.70
E88 CC/01	1.30	EL41	0.80	PCL82	0.65	UCF80	0.80	6AL5	0.40	6SJ7	0.70	30C15	1.00
E180CC	1.30	EL41	1.00	PCL84	1.70	UCH81	0.60	6AL5W	0.65	6J7GT	0.50	30C17	1.10
E180E	6.00	EL82	0.60	PCL85/85	0.70	UCX82	0.75	6AM5	1.60	6SK7	0.60	30C18	see
E182CC	3.50	EL84	0.60			UF41	0.80	6AM6	0.65	6SL7GT	0.75	PCF805	
EAF76	2.00	EL86	0.95	PL82	0.50	UF80	0.45	6AN8	0.85	6SN7GT	0.75	30F5	1.00
EABC80	0.50	EL90	1.30	PL504	1.30	UF85	0.50	6A05	1.30	6S0T	0.80	30F12	1.20
EB91	0.40	EL91	1.60	PL200	1.35	UL41	0.75	6A05W	0.85	6V6GT	0.80	30F12	1.20
EB33	1.00	EL95	0.70	PL36	0.80	UL84	0.75	6A05W	0.85	6X4	0.60	30F14	1.80
EBF80	0.50	EL104	0.60	PL81	0.75	UM8D	0.60	6A78	0.75	6X5GT	0.55	30L15	1.00
EBF83	0.50	EL102	1.50					6A78	0.75	6Y6G	0.95	30L17	1.00
EBF89	0.50	EL122	3.00					6A78	0.40	6Z4	0.65	30P12	1.00
EC52	0.40	EM31	0.75					6AV6	0.50	6-30L2	0.90	30P13	1.10
EC8R1	0.55	EM80	0.60	PL82	0.50	UM84	0.40	6AX5GT	1.00	7B7	0.80	30P13	1.10
EC8R2	0.50	EM81	0.60	PL83	0.50	UV82	0.55	6B07A	0.60	7V4	0.80	30P14	1.10
EC8R3	1.15	EM84	0.40	PL84	0.65	UY65	0.50	6B7	0.75	902	0.60	35L8GT	1.00
EC8R4	0.45	EM87	1.00	PL504	1.30	VR105/30	1.80	6BA6	0.40	906	0.60	35W4	0.60
EC8R5	0.50	EY51	0.45	PL508	1.30	VR150/30	1.25	6BE6	0.50	10C2	0.75	50C5	0.70
EC8R6	1.25	EY81	0.45	PL509	3.25	X66	0.75	6BG6G	1.00	10F18	0.80	50C6G	1.20
EC8R8	0.60	EY88/87	0.55	PL802	2.80	X61M	1.50	6B16	1.10	11E2	1.10	50C7	0.75
EDC189	0.80	EY88	0.55	PL80	1.80	Z800U	3.00	6B07A	0.60	12A6	0.60	75C1	0.80
ED90	0.50	EZ87	0.60	PY33	0.60	Z801U	3.50	6B7	1.00	12A7E	0.45	78	0.80
EDF82	0.45	EZ81	0.60	PY80	0.60	Z900T	1.50	6C4	0.40	12A7I	0.55	60	0.75
ECF801	0.75	GY501	0.90	PY81/800	0.55	1A3	0.60	6C6	0.55	12A7J	0.50	95A2	2.20
EDH34	0.95	GZ32	3.50	Y82	0.45	1R4	0.30	6CL16	3.00	12AV6	0.70	723A/B	11.00
EDH35	1.50	GZ33	3.50	Y88	0.65	1R5	0.55	6CL6	0.75	12BA6	0.50	803	6.00
EDH42	0.85	GZ34	2.00	Y88	0.65	1S4	0.40	6D5	0.90	12BE6	0.60	805	18.00
EDH81	0.45	EZ87	0.50	Y88	0.65	1S4	0.40	6D6	0.50	12BE6	0.60	807	1.00
EDH84	0.95	KT66	4.00	PY500	1.35	1S5	0.40	6D6	0.50	12BM7	0.60	813	10.50
ECL80	0.60	KT88	5.75	PY859	5.75	1T4	0.40	6EAB	0.80	12C8	0.55	823B	1.00
ECL82	0.55	MH4	1.00	PY801	0.60	1U4	0.60	6F66G	0.75	12E1	4.25	832A	4.50
ED83	1.20	ML6	1.00	QV03-10	2.50	1X2B	1.10	6F86	0.75	12J5GT	0.60	866A	2.80
EDL85	0.65	GA2	0.55	QV03-12	5.50	2D21	0.55	6F12	0.65	12K7GT	0.60	831A	6.00
EDL86	0.55	DB2	0.60	QV06-40A	2K25	11.00	1.80	6F14	0.80	12K8GT	0.70	831A	5.50
EP31A	1.50	PAC80	0.40	14.00				6F15	0.80	1207GT	0.50	955	0.95
EP39	2.90	PC85	0.50	0V03-12	2.00	3A4	0.60	6F17	1.00	1207GT	0.50	955	0.95
EP40	0.70	PC86	0.85	SC1/400	4.00	306	0.40	6F24	0.90	12SC7	0.55	956	0.50
EP41	0.75	PC88	0.75	SC1/600	4.00	3021	20.00	6F33	4.20	12SH7	0.70	957	0.90

Add 12½% for V.A.T.

POSTAGE: £1-£2 20p; £2-£3 30p; £3-£5 40p; £5-£10 60p; over £10 free, minimum order £1.  
 A lot of these valves are imported and prices vary for each delivery, so we reserve the right to change prices for new stock when unavoidable.

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Printed Circuit Boards. Add 27p post & packing for 1 to 3 boards. Larger quantities post & packing inclusive

Voltage Tripler P.C.B. contains 40.1 MFD 1000V, 2 pre-sets, 1 bridge rect., 4 IN4007, 9 resistors. 65p.

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P.C.B. contains 2 TIP31 (or equiv.), MJE 340 and over 70 other resistors, diodes, zeners, transistors, bridge rect., and capacitors. 50p.

P.C.B. with 8 x BC107, 8 x BCY70, 4 pre-set pot., and over 70 other components. 75p.

P.C.B. contains 2 x 741, 2N4921 and over 40 other components and multitrn 20k pot. 60p.

Parcel of 1 each of above, 6 P.C.B.'s. £3-30.

P.C.B. contains 2 IP 10W Wafer Switches, 2 x 7490 I/C, 2 x 74141 I/C, various Logic I/Cs, IN4148 and over 50 components. 60p.

Post and packing inclusive. Audio Amplifier Boards containing 2 x BFY50, IBFX29 and output pair of 2N5293 output transistors, rated at 36 watts when heatsink mounted £1.75 or 2 for £3.00. Post and packing inclusive.

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ALL OUR PRICES INCLUDE V.A.T.

**SPECIAL OFFER SEMICONDUCTORS**  
 TB800 50p. LM3400 40p. 741 8 pin 6 for £1.00. NE555 22p. ZN414 75p. IN4005 10 for 35p. 723 REGS 35p. LM340T (6VIA) REGS 40p. BX504 opto isolators 25p. 2N5062 (100V 800MA SCR) 18p.

**MINIATURE TOGGLE SWITCHES.** SPST 8x5x7mm 49p. DPDT 8x7x7mm 53p. DPDT centre off 12x11x9mm 78p. **HEAVY DUTY TOGGLE DPDT** 240V AC 10 amps 35p.

**MINIATURE SOLID STATE BUZZERS.** 33x17x15mm white plastic rectangular case, output at 3 feet 70dB. Low consumption only 15MA, 4 voltage types available, 6-9-12 or 24V DC 75p each. **LOUD BUZZER.** 50mm diameter 6 or 12 volts 60p. **GPO ADJUSTABLE BUZZER.** 6-12V DC 25p.

**DE-SOLDERING TOOL.** Good suction, Teflon nozzle, £4.75p.

**MOTORS.** Miniature model motors 1.5-6V DC 20p. 12V DC 5 pole motors 35p. 8 track replacement motors 12V DC 55p. 'Big inch' tiny precision motor 115V AC 3 rpm 30p. Surplus Clock Motor Synch., 240V AC 1 rev. per hour £1.75p.

**SURPLUS BOARDS.** No. 1 has 14 encapsulated reed relays, 12V £1.95p. No. 2 has 11 50V 2, 5 amp scrs., one relay and various transistors including UJT £1.95p. No. 3 car radio RF/IF boards 2 transistors, LM382 IC trimmers IP's etc. 65p. No. 4 car radio boards with 6 transistors including power output types IP's choke etc. 75p.

**TELEPHONE PICK UP COIL.** Suction type with lead and plug 55p.

Terms - Cash with order (or official orders from schools etc.) Postage 30p. (Overseas at cost) VAT inclusive.

SAE for illustrated lists. **PROGRESSIVE RADIO**  
 93 Dale Street,  
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# 15-240 Watts!

## HY5 Preamplifier

The HY5 is a mono hybrid amplifier ideally suited for all applications. All common input functions (mag Cartridge, tuner, etc) are catered for internally. The desired function is achieved either by a multi-way switch or direct connection to the appropriate pins. The internal volume and tone circuits merely require connecting to external potentiometers (not included). The HY5 is compatible with all I.L.P. power amplifiers and power supplies. To ease construction and mounting a P.C. connector is supplied with each pre-amplifier.

**FEATURES:** Complete pre-amplifier in single pack—Multi-function equalization—Low noise—Low distortion—High overload—Two simply combined for stereo.

**APPLICATIONS:** Hi-Fi—Mixers—Disco—Guitar and Organ—Public address

**SPECIFICATIONS:**

**INPUTS:** Magnetic Pick-up 3mV; Ceramic Pick-up 30mV; Tuner 100mV; Microphone 10mV;

Auxiliary 3-100mV; input impedance 47kΩ at 1kHz.

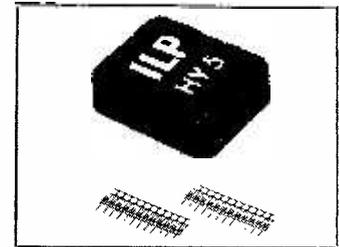
**OUTPUTS:** Taps 100mV; Main output 500mV R.M.S.

**ACTIVE TONE CONTROLS:** Treble ± 12dB at 10kHz; Bass ± at 100Hz.

**DISTORTION:** 0.1% at 1kHz. Signal/Noise Ratio 68dB

**OVERLOAD:** 36dB on Magnetic Pick-up. **SUPPLY VOLTAGE:** ± 16-50V.

Price £6.27 + 78p VAT P&P free.



## HY30 15 Watts into 8Ω

The HY30 is an exciting New kit from I.L.P. It features a virtually indestructible I.C. with short circuit and thermal protection. The kit consists of I.C., heatsink, P.C. board, 4 resistors, 6 capacitors, mounting kit, together with easy to follow construction and operating instructions. This amplifier is ideally suited to the beginner in audio who wishes to use the most up-to-date technology available.

**FEATURES:** Complete Kit—Low Distortion—Short, Open and Thermal Protection—Easy to Build.

**APPLICATIONS:** Updating audio equipment—Guitar practice amplifier—Test amplifier—audio oscillator.

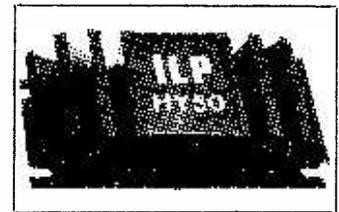
**SPECIFICATIONS:**

**OUTPUT POWER:** 15W R.M.S. into 8Ω; **DISTORTION:** 0.1% at 1.5W.

**INPUT SENSITIVITY:** 500mV. **FREQUENCY RESPONSE:** 10Hz-16kHz—3dB.

**SUPPLY VOLTAGE:** ± 18V.

Price £6.27 + 78p VAT P&P free.



## HY50 25 Watts into 8Ω

The HY50 leads I.L.P.'s total integration approach to power amplifier design. The amplifier features an integral heatsink together with the simplicity of no external components. During the past three years the amplifier has been refined to the extent that it must be one of the most reliable and robust High Fidelity modules in the World.

**FEATURES:** Low Distortion—Integral Heatsink—Only five connections—7 amp output transistors—No external components

**APPLICATIONS:** Medium Power Hi-Fi systems—Low power disco—Guitar amplifier

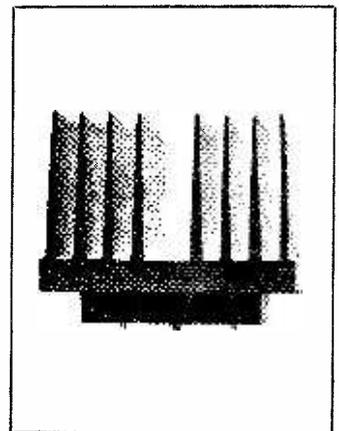
**SPECIFICATIONS:** **INPUT SENSITIVITY:** 500mV

**OUTPUT POWER:** 25W RMS into 8Ω **LOAD IMPEDANCE:** 4-16Ω **DISTORTION:** 0.04% at 25W

at 1kHz **SIGNAL/NOISE RATIO:** 75dB **FREQUENCY RESPONSE:** 10Hz-45kHz—3dB

**SUPPLY VOLTAGE:** ± 25V **SIZE:** 105 50 25mm

Price £8.18 + £1.02 VAT P&P free



## HY120 60 Watts into 8Ω

The HY120 is the baby of I.L.P.'s new high power range. Designed to meet the most exacting requirements including load line and thermal protection this amplifier sets a new standard in modular design.

**FEATURES:** Very low distortion—Integral heatsink—Load line protection—Thermal protection—Five connections—No external components

**APPLICATIONS:** Hi-Fi—High quality disco—Public address—Monitor amplifier—Guitar and organ

**SPECIFICATIONS:**

**INPUT SENSITIVITY:** 500mV.

**OUTPUT POWER:** 60W RMS into 8Ω **LOAD IMPEDANCE:** 4-16Ω **DISTORTION:** 0.04% at 60W

at 1kHz **SIGNAL/NOISE RATIO:** 90dB **FREQUENCY RESPONSE:** 10Hz-45kHz—3dB **SUPPLY VOLTAGE:** ± 35V

**SIZE:** 114 50 85mm

Price £19.01 + £1.52 VAT P&P free.

## HY200 120 Watts into 8Ω

The HY200 now improved to give an output of 120 Watts has been designed to stand the most rugged conditions such as disco or group while still retaining true Hi-Fi performance.

**FEATURES:** Thermal shutdown—Very low distortion—Load line protection—Integral heatsink—No external components

**APPLICATIONS:** Hi-Fi—Disco—Monitor—Power slave—Industrial—Public Address

**SPECIFICATIONS:**

**INPUT SENSITIVITY:** 500mV

**OUTPUT POWER:** 120W RMS into 8Ω **LOAD IMPEDANCE:** 4-16Ω **DISTORTION:** 0.05% at 100W

at 1kHz **SIGNAL/NOISE RATIO:** 96dB **FREQUENCY RESPONSE:** 10Hz-45kHz—3dB **SUPPLY VOLTAGE:** ± 45V

**SIZE:** 114 50 85mm

Price £27.99 + £2.24 VAT P&P free.

## HY400 240 Watts into 4Ω

The HY400 is I.L.P.'s "Big Daddy" of the range producing 240W into 4Ω! It has been designed for high power disco address applications. If the amplifier is to be used at continuous high power levels a cooling fan is recommended. The amplifier includes all the qualities of the rest of the family to lead the market as a true high power hi-fidelity power module.

**FEATURES:** Thermal shutdown—Very low distortion—Load line protection—No external components.

**APPLICATIONS:** Public address—Disco—Power slave—Industrial

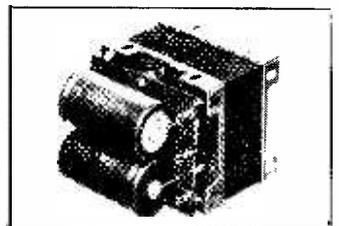
**SPECIFICATIONS:**

**OUTPUT POWER:** 240W RMS into 4Ω **LOAD IMPEDANCE:** 4-16Ω **DISTORTION:** 0.1% at 240W

at 1kHz **SIGNAL NOISE RATIO:** 94dB **FREQUENCY RESPONSE:** 10Hz-45kHz—3dB **SUPPLY VOLTAGE:** ± 45V

**INPUT SENSITIVITY:** 500mV **SIZE:** 114 100 85mm

Price £38.61 + £3.09 VAT P&P free.



## POWER SUPPLIES

PSU36 suitable for two HY30's £6.44 plus 81p VAT. P/P free.

PSU50 suitable for two HY50's £8.18 plus £1.02 VAT. P/P free.

PSU70 suitable for two HY120's £14.58 plus £1.17 VAT. P/P free.

PSU90 suitable for one HY200 £15.19 plus £1.21 VAT. P/P free.

PSU180 £25.42 + £2.03 VAT.

B1 £0.48 + £0.06 VAT.

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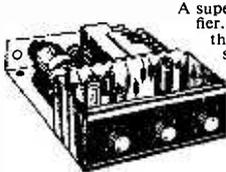
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### SUPERSOUND 13 HI-FI MONO AMPLIFIER



A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohms. Frequency response 12Hz 30KHz  $\pm$  3db. Fully integrated pre-amplifier stage with separate Volume, Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3" high  $\times$  6" wide  $\times$  7 1/2" deep. AC 200/250V. PRICE £16-00, P. & P. £1-20.

### HARVERSONIC MODEL P.A. TWO ZERO



An advanced solid state general purpose mono amplifier suitable for Public Address system, Disco, Guitar, Gram, etc. Features 3 individually controlled inputs (each input has a separate 2 stage pre-amp). Input 1, 15mV into 47k. Input 2, 15mV into 47k. (suitable for use with mic, or guitar etc.). Input 3 200mV into 1 meg, suitable for gram, tuner, or tape etc. Full mixing facilities with full range bass & treble controls. All inputs plug into standard jack sockets on front panel. Output socket on rear of chassis for an 8 ohm or 16 ohm speaker. Output in excess of 20 watts R.M.S. Very attractively finished purpose built cabinet made from black vinyl covered steel, with a brushed anodised aluminium front escutcheon. For ac mains operation 200/240V. Size approx. 12 1/2" w.  $\times$  5" h.  $\times$  7 1/4" d. Special introductory Price £28-00 + £2-50 carr. & p.k.

### "POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER

Size 11 1/2"  $\times$  14 1/2"  $\times$  1 1/2" 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 90p, two £1-10). Now available in 8" round version. 10 watts RMS 60Hz-20KHz £5-25. P. & P. (one 65p, two 75p).

STEREO MAGNETIC PRE-AMP. Sens. 3mV in for 100mV out. 15 to 35V neg. carth. Equ.  $\pm$  1dB from 20Hz to 20KHz. Input impedance 47K. Size 1 1/2"  $\times$  2 1/2"  $\times$  5 1/2" H. £2-60 + 20p P. & P.

### MAINS OPERATED SOLID STATE AM/FM STEREO TUNER



200/240V Mains operated Solid State FM AM Stereo Tuner. Covering MW A.M. 540-1605 KHz VHF/FM 88-108 MHz.

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 600mV RMS into 20K. Simulated Teak finish cabinet. Will match almost any amplifier. Size 8 1/4" w.  $\times$  4" h.  $\times$  9 1/4" d approx.

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

### 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  $\Omega$  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 £15-50, P. & P. £1-40. Also available ready built and tested £20-00, P. & P. £1-40.

### STEREO DECODER

SIZE 2"  $\times$  3"  $\times$  1 1/2" ready built. Pre-aligned and tested for 9-16V neg. earth operation. Can be fitted to almost any FM VHF radio or tuner. Stereo beacon light can be fitted if required. Full details and instructions (including hints and tips) supplied. £6-00 plus 20p P. & P. Stereo beacon light if required 40p extra.

### SPECIAL OFFER

Slightly shop soiled radios by well-known manufacturer for AC Mains or battery use. MW and FM bands. Dynamic M/coil speakers, telescopic aerial and internal ferrite aerial. Earpiece socket for personal listening. Finished in attractive simulated teak. Size 7 1/2" H.  $\times$  9 1/2" W.  $\times$  4" D approx. Fully guaranteed. Bargain Price of only £10-00 + £1-30 p. & p.

### SPECIAL OFFER LIMITED NUMBER ONLY

GOODMANS speakers, 6 1/2" 8 ohm, long throw, ceramic magnet, full range rated 10 watts R.M.S., (when fitted in enclosure). £4-00 each + 80p p&p (p&p on two £1-20).

VYNAIR & REXINE SPEAKERS & CABINET FABRICS app. 54 in. wide. Our price £2-00 yd. length. P. & P. 50p per yd. (min. 1 yd.). S.A.E. for samples.

### 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. Integral 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:  $\pm$  3dB 12-30,000 Hz. Sensitivity: better than 80mV into 1M  $\Omega$ ; Full power bandwidth:  $\pm$  3dB 12-15,000 Hz. Bass boost approx. to  $\pm$  12dB. Treble cut approx. to  $\pm$  16dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1-0 amp.

Overall Size 12" w.  $\times$  8" d.  $\times$  2 1/2" h. Fully detailed page construction manual and parts list free with component identification clearly marked. AMPLIFIER KIT or send 25p plus large S.A.E.

POWER PACK KIT £6-00 P. & P. 95p CABINET £6-00 P. & P. 95p

SPECIAL OFFER—only £25-00 if all 3 items ordered at one time plus £1-25 p. & p.

Also avail. ready built and tested £31-25, P. & P. £1-50.

### 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 speaker sockets & 5 pin din tape rec./play socket are mounted on the printed circuit panel, size approx. 9 1/2"  $\times$  2 1/2"  $\times$  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 £10-00 plus 50p P. & P. Mains transformer with an output of 17v a/c at 500mA can be supplied at £2-00 + 40p P & P if required. Full connection details supplied.

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

PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY. SEND SAE WITH ALL ENQUIRIES.

**HARVERSON SUPRUS CO. LTD.** (Dept. P.W.) 170 MERTON HIGH ST., LONDON, S.W.19. Tel.: 01-540 3985  
A few minutes from South Wimbledon Tube Station. Open 9.30-5.30 Mon. to Fri. 9.30-5 Sat. Closed Wed.

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WHYTELEAF SURREY CR3 0EB

All prices include V.A.T. Add 25p for P&P (Extra for overseas). Discounts over £10 less 5%, over £20 less 10%, over £50 less 15%, over £100 less 20%. Send SAE for complete list of components.

7400 0.12 0.21	7484 0.90	74183 0.80 0.82	74368 0.52	20 pin 0.27
7401 0.12 0.21	7485 0.88 0.97	74164 0.89 1.20	74366 0.56	22 pin 0.28
7402 0.12 0.21	7486 0.26	74165 0.89	74350 1.92	24 pin 0.30
7403 0.12 0.21	7488 1.50	74166 0.99	74353 2.00	28 pin 0.44
7404 0.13	7489 2.08	74167 0.99	73670	40 pin 0.55
7405 0.13 0.21	7490 0.35 0.95	74168 2.70	LM645	
7406 0.28	7491 0.85	74170 1.68 1.94	CA3045 -14 0.45	CMOS
7407 0.28	7492 0.44 0.82	74172 4.00	CA3046 -14 0.70	4000 0.14 4067 3.50
7408 0.14 0.21	7493 0.40 0.96	74173 1.18 1.12	LM3800N -14 0.82	4001 0.16 4068 0.24
7409 0.40	7494 0.80	74174 0.89 1.12	LM3811N -14 1.20	4002 0.18 4069 0.17
7410 0.13 0.22	7495 1.05	74175 0.32 1.12	LM7109N -14 0.32	4006 0.92 4070 0.17
7411 0.18 0.21	7497 2.00	74176 0.80	4007 0.18 4071 0.17	4008 0.92 4072 0.17
7412 0.21 0.21	74100 0.84	74177 0.82	MC1310P -14 1.50	4009 0.45 4073 0.17
7413 0.25 0.46	74104 0.40	74178 1.20	NE555N -8 0.30	4010 0.48 4075 0.17
7414 0.54 1.06	74105 0.82	74179 1.10	NE556N -8 0.65	4011 0.15 4076 1.05
7415 0.21	74107 0.28 0.40	74180 0.90	NE2501B -14 2.00	4012 0.16 4077 0.40
7416 0.27	74109 0.46 0.40	74181 1.75 3.38	SN7202N 0.50	4013 0.42 4078 0.22
7417 0.27	74110 0.46	74182 0.75	SN75110N 0.50	4014 0.80 4081 0.17
7420 0.13 0.21	74111 0.70	74183 2.30	SN76033N 1.35	4015 0.77 4082 0.20
7421 0.21 0.21	74112 0.40	74184 0.98	SN76023N 1.35	4016 0.42 4083 0.72
7422 0.17 0.21	74113 0.30 0.40	74185 1.20	SN76033N 1.35	4017 0.77 4086 0.78
7423 0.25	74114 0.40	74186 1.20	TA9550B 0.35	4018 0.87 4089 0.55
7425 0.20	74116 1.80	74188 2.70	TA6818B 1.40	4019 0.42 4093 1.65
7426 0.25 0.28	74118 0.82	74189 0.85	TBA120S 0.64	4020 0.92 4094 1.80
7427 0.25 0.30	74119 1.25	74190 0.95	TBA641A 1.88	4021 0.82 4095 1.10
7428 0.34 0.40	74121 0.82	74191 0.85	TBA930 0.75	4022 0.82 4096 1.10
7430 0.13 0.21	74121 0.25	74192 0.99	TC2705Q 2.00	4023 0.16 4097 3.50
7433 0.30	74122 0.50 0.58	74193 0.95 1.50	TD2420 3.20	4024 0.86 4098 1.12
7434 0.24 0.26	74124 1.25	74194 0.90 2.00	2N414 1.00	4025 0.15 4099 1.90
7437 0.24 0.28	74125 0.40 0.48	74195 0.84 1.00	OP AMPS	4026 1.28 4404 1.00
7440 0.13 0.21	74126 0.45 0.46	74196 0.80	CA1310 -1089 1.00	4027 0.50 4412 0.30
7441 0.62	74128 0.62	74197 0.90 1.15	LM301A -8 0.30	4028 0.87 4428 0.80
7442 0.55 0.70	74132 0.88 0.82	74198 1.48	LM301A -1089 0.46	4029 1.00 4508 2.25
7443 0.90	74134 0.36	74199 1.48	LM348N -14 1.00	4030 0.48 4449 0.30
7444 0.90	74135 0.68	74201 1.50	LM348N -14 1.00	4031 2.34 4501 0.17
7445 0.70	74136 0.55 0.40	74202 1.05	LM709 -8 0.40	4033 1.25 4502 0.88
7446 0.70	74137 0.94	74203 1.05	LM709 -14 0.42	4034 2.00 4507 0.50
7447A 0.60 0.94	74138 0.62	74204 0.95	LM709 -14 0.42	4035 1.00 4508 2.25
7448 0.60 0.94	74139 0.82	74205 1.00 0.95	LM741 -14 0.20	4036 2.40 4510 1.05
7449 0.13	74141 0.58	74206 1.10	LM741 -14 0.20	4037 0.99 4511 0.98
7450 0.13 0.21	74142 2.00	74207 1.12	LM741 -14 0.20	4038 1.00 4512 0.85
7451 0.13 0.21	74143 2.00	74208 0.95	LM741 -14 0.20	4039 2.80 4514 2.85
7453 0.13	74144 2.00	74209 0.95	LM741 -14 0.20	4040 0.98 4515 2.80
7454 0.13 0.21	74145 0.84 1.20	74210 0.95	LM741 -14 0.20	4041 0.77 4516 1.02
7455 0.26	74147 1.30	74211 1.00 0.95	LM741 -14 0.20	4042 0.72 4518 0.90
7456 0.13	74148 1.15	74212 1.05	LM741 -14 0.20	4043 0.82 4519 1.00
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73574 0.50	74155 0.83 0.98	74217 1.70 1.00	LM741 -14 0.20	4048 0.80 4528 0.82
7475 0.30 0.42	74156 0.82 0.98	74218 1.25 0.85	LM741 -14 0.20	4049 0.92 4529 1.10
7476 0.26 0.38	74157 0.83 0.80	74219 1.25 0.85	LM741 -14 0.20	4050 0.42 4536 3.50
7478 0.26 0.38	74158 0.82 0.82	74220 1.25 0.85	LM741 -14 0.20	4051 0.84 4553 4.20
7481 0.90	74159 1.70	74221 1.25 0.85	LM741 -14 0.20	4052 0.84 4555 0.85
7482 0.90	74160 1.30	74222 1.25 0.85	LM741 -14 0.20	4053 0.84 4556 0.85
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		74224 1.25 0.85	LM741 -14 0.20	4055 1.00 4568 1.40
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		74230 1.25 0.85	LM741 -14 0.20	4061 0.88 4568 1.40
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		74253 1.25 0.85	LM741 -14 0.20	4084 0.88 4568 1.40
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		7		

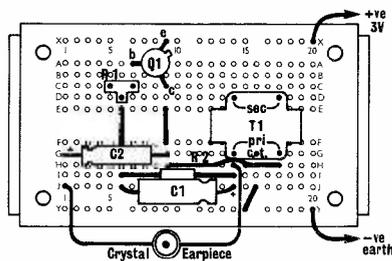
# BUILD TWO FREE PROJECTS ON CSC

ELECTRONICS BY NUMBERS  
FREE PROJECTS  
NO 1 & NO 2

## ELECTRONICS BY NUMBERS FISH'N'CLIKS

Now using **EXPERIMENTOR BREADBOARDS** and following the instructions in "Electronics by Numbers" ANYBODY can build electronic projects. Look at the diagram, this has the same letter/number system as all EXP BOARDS. Look at the "YOU WILL NEED" list and select Q1 this is PNP transistor type HEP-230. This plugs into hole X9, A7 and C9. NOW take C1, a 50 uF capacitor, and put into holes J6 and J14 and do the same with all the components.

NOW YOU HAVE FISH'N'CLIKS



### YOU WILL NEED

- B1, B2 - 2x1.5V AAA batteries
  - C1, C2 - 50 uF, 12-VDC electrolytic capacitor
  - E1 - Crystal earphone
  - Q1 - Motorola HEP-230 pnp transistor
  - R1 - 5000-ohm pot
  - R2 - 27000-ohm, 1/4 watt resistor
  - S1 - Spst switch part of R1
  - T1 - Mini transistor output transformer; 500-ohm center tapped primary to 8-ohm secondary
- EXP - ANY EXP. BREADBOARD.

The anglers dream come true. This electronic marvel emits a CLIK-CLIK sound that makes fish really hungry. Shove the whole works in a watertight container lower it over the side and wait for the fish to grab the hook.

FILL IN THE COUPON AND WE WILL SEND YOU FREE OF CHARGE A COPY OF THE FULL PROJECT FISH'N'CLIKS, AND A COPY OF PROJECT No 1 "TWO TRANSISTOR RADIO".

### PROTO-CLIP TEST CLIPS.

Brings IC leads up from crowded PC boards. Available plain or with cable with clips at one or both ends.



- PC - 16 pin. £2.75.
- PC - 16 pin with cable. £6.00.
- PC - 16 with cable and 16 pin clips at both ends. £10.25.



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Telephone: SAFFRON WALDEN 21682.  
Telex: 817477.

## EXPERIMENTOR BREADBOARDS.

No soldering modular breadboards, simply plug components in and out of letter number identified nickel-silver contact holes. Start small and simply snap-lock boards together to build breadboard of any size.  
All EXP Breadboards have two bus-bars as an integral part of the board, if you need more than 2 buses simply snap on 4 more bus-bars with the aid of an EXP.4B.

**EXP.325.** The ideal breadboard for 1 chip circuits.  
Accepts 8,14,16 and up to 22 pin IC's.  
**ONLY £1.60.**



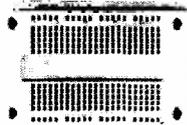
**EXP.350.** £3.15.  
270 contact points with two 20-point bus-bars.



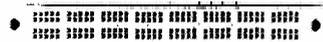
**EXP. 300.**  
550 contacts with two 40-point bus-bars.  
**£5.75.**



**EXP. 650** for Micro-processors. **£3.60.**



**EXP 4B.**  
More bus-bars.  
**£2.30.**



ALL EXP.300 Breadboards mix and match with 600 series.

## PROTO-BOARDS.

THE ULTIMATE IN BREADBOARDS FOR THE MINIMUM COST.  
TWO EASILY ASSEMBLED KITS.



PB.6 Kit, 630 contacts, four 5-way binding posts accepts up to six 14-pin Dips.  
**PROTO-BOARD 6 KIT. £9.20.**



PB.100 Kit complete with 760 contacts accepts up to ten 14-pin Dips, with two binding posts and sturdy base. Large capacity with Kit economy.  
**PROTO-BOARD 100 KIT £11.80.**

### HOW TO ORDER AND RECEIVE FREE COPY OF FISH'N'CLIKS PROJECT WITH BONUS OF FREE TWO TRANSISTOR RADIO PROJECT.

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It's easy. Give us your name and full postal address, in block capitals. Enclose cheque, postal order or credit card number and expiry date. OR telephone 0799 21682 and give us your Access, American Express or Barclaycard number and your order will be in the post that night.

EXPERIMENTOR BREADBOARDS.	CONTACT HOLES.	IC CAPACITY 14 PIN.DIP.	UNIT PRICE INCLUDING POSTAGE AND V.A.T.
EXP. 325	130	1	£ 2.53
EXP. 350	270	3	£ 4.21
EXP. 300	550	6	£ 7.29
EXP. 650	270	use with 0,6 pitch Dip's Bus-Bar Strip	£ 4.69
EXP. 4B.	Four 40 Point Bus-Bars		£ 3.29
<b>TEST CLIPS</b>			
PC. 16.			£ 3.78
PC.16-18.			£ 7.56
PC. 16-18 Dual Clip.			£12.15
<b>PROTO-BOARDS.</b>			
PB. 6.	630	6	£11.01
PB. 100.	760	10	£13.82

NAME .....

ADDRESS .....

FILL IN COUPON & RECEIVE FREE COPY OF  
ELECTRONICS BY NUMBERS PROJECTS No 1 AND No 2

# ambit international

**PARTS FOR CURRENT PW PROJECTS ... FROM AMBIT INTERNATIONAL**  
**VHF FM monitor RX:** A complete kit of parts for this project, which we firmly believe will be an established "standard" for years to come. The kit includes a 5 channel switched crystal oscillator added to the board end, using diode switching. Uses cheaper 3rd OT crystals, employing original oscillator as x3 stage. Price depends on filter selected (we have various types) and whether or not chip capacitors are required. More notes on the kit from our own lab. £25-£35 kit.  
**VMOS POWER TRANSISTORS FOR PW WINTON** £9.95 pair \* 2SK133/J48  
**FULL KITS FOR THE PW SANDBANKS METAL LOCATOR** (should be ex stock)  
**FULL KITS FOR THE PW DORCHESTER**

## Radio ICs

TDA1062	HF/VHF tunerhead	1.95
TDA1083	One chip AM/FM rx	1.95
TDA1090	One chip HiFi am/fm	3.35
TDA1220	One chip am/fm rx	1.75
HA1197W	HiFi AM tuner IC	1.40
CA3123E	AM tuner IC	1.40
TBA851	AM tuner IC	1.81
CA3089E	Famous FM IF system	1.94
CA3189E	As 3089; deviation mute	1.94
HA1137W	AF preamp, adj, agc	2.75
TBA120	Improved S/N 3089	2.20
TBA120S	limiting amp+detector	0.75
MC1350P	high gain	1.00
MC1350P	agc'd IF preamp	1.20
MC1330P	synch AM/video detector	1.35
KB4406	Cascade IF preamp	0.65
uA753	limiting FM preamp	1.95

## Discrete devices: more than ever:

BF960	800MHz/2.8dB nf mosfet	1.60*
BF961	200MHz/2.0dB nf	0.80*
40822	FM RF amp	0.43*
40823	FM mixer	0.51*
40673	Famous MOSFET	0.55*
2S149/2sK133	120V/100W MOSPOWER	10.50*

## LEDs:

the best value today			
Red	3mm	5mm	2.5x5mm
Green	0.14	0.14	0.17
Yellow	0.18	0.16	0.20
Orange	0.22	0.29	0.24
100 off mix, 25% discount. All are AEG first grade types - absolutely no junk. 5mm clips for panel mounting 0.03 each			

## Misc. ICs for radio/audio applications

U237B	5 LED bargraph driver	0.80*
SA56610	4 station touch tune IC	1.48*
SAS6710	adds 4 stations to 6610	1.48
MSM5523/4	LW, MW, SW and FM digital frequency readout plus clock, timers, stopwatch	£14*
MSM5526	LW/MW/FM DFM with direct drive for LCD	£11*
TC A730	DC volume control	3.50
TC A740	DC tone control	3.50
TDA1028	DC input switch	3.50
TDA1029	DC mode switch	3.50

## Radio and Tuner modules

We cannot really list all the details we would like to here - but with advent of the new mark 3 tuner system, the Dorchester and matching AF units, Ambit offers you the widest choice ever, plus hardware and styling that matches the very high standards we have set in this range.

## Communications circuits

SD6000	DMOS RF/Mixer pair	3.75
KB4412	Bal mixers, IF+agc	2.55
KB4413	AM/SSB det. squelch, agc	2.75
KB4417	mic processor	2.55
MC3257	best thing in NBFM yet	3.12
MC1496P	popular double bal mixer	1.25
<b>Multitex decoders + noise blanker</b>		
MC1210P	popular PLL decoder	2.20
uA758	buffered 1310	2.20
CA3090AQ	RCA PLL decoder	3.25
HA1196	improved PLL decoder with stereo preamps	3.95
HA11223	19kHz pilot cancel, low distortion, high S/N	4.35
KB4437	as HA11223 with remote VCO kill facility	4.55
KB4438	stereo MUTING preamp for post decoder mute	2.22
KB4423	impulse noise blanker	2.53

TERMS etc: CWO please, VAT on Ambit Items is generally 12%, except where marked (\*). Catalogue part 1:45p, part 2 50p all inclusive. Postage 25p per order, carriage on tuner kits £3. Phone Brentwood (0277) 216029/227050 9am-7pm. Callers welcome inc. Saturdays.

## At last, DIY Hi Fi which looks as if it isn't.

That's not to say it doesn't look like HiFi - just that it doesn't look like the usual sort of thing you have come to associate with DIY HiFi. The Mk3 Outstrips and outperforms all British made HiFi tuners, and most imported ones too. Certainly at the price, there isn't one near it. But more than that, it looks superb. A small pic here would be an insult, so send an SAE for details on the kit that looks as if isn't. It's something else.....

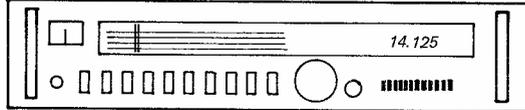
- \* Exceptionally high performance - exceptionally straightforward assembly
- \* Baseboard and plug-in construction. Future circuit developments will readily plug in, to keep the MkIII at the forefront of technical achievement
- \* Various options and module line-ups possible to enable an installation approach to the system

and now previewing the matching 60W/channel VMOS amplifier:

- \* Matching both the style and design concepts of the MkIII HiFi FM tuner
- \* Hitachi VMOS power fets - characterized especially for HiFi applications
- \* Power output readily multiplied by the addition of further MOSFETs
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7404	14	24	7472	28		74136		40	74192	105	74390	140
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**Size 16A £2-61 inc. VAT**

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7400 13p	7497 180p	74221 160p	74LS192 140p	74C157 250p	LM311 19p	*MC1496 100p	AC127/8 20p	BFY51/2 22p	TIP42A 79p	2N3886 90p	1N4001 12p	1N4002 12p	1N4003 12p	1N4004 12p	1N4005 12p	1N4006 12p	1N4007 12p	1N4008 12p	1N4009 12p	1N4010 12p	1N4011 12p	1N4012 12p	1N4013 12p	1N4014 12p	1N4015 12p	1N4016 12p	1N4017 12p	1N4018 12p	1N4019 12p	1N4020 12p	1N4021 12p	1N4022 12p	1N4023 12p	1N4024 12p	1N4025 12p	1N4026 12p	1N4027 12p	1N4028 12p	1N4029 12p	1N4030 12p	1N4031 12p	1N4032 12p	1N4033 12p	1N4034 12p	1N4035 12p	1N4036 12p	1N4037 12p	1N4038 12p	1N4039 12p	1N4040 12p	1N4041 12p	1N4042 12p	1N4043 12p	1N4044 12p	1N4045 12p	1N4046 12p	1N4047 12p	1N4048 12p	1N4049 12p	1N4050 12p	1N4051 12p	1N4052 12p	1N4053 12p	1N4054 12p	1N4055 12p	1N4056 12p	1N4057 12p	1N4058 12p	1N4059 12p	1N4060 12p	1N4061 12p	1N4062 12p	1N4063 12p	1N4064 12p	1N4065 12p	1N4066 12p	1N4067 12p	1N4068 12p	1N4069 12p	1N4070 12p	1N4071 12p	1N4072 12p	1N4073 12p	1N4074 12p	1N4075 12p	1N4076 12p	1N4077 12p	1N4078 12p	1N4079 12p	1N4080 12p	1N4081 12p	1N4082 12p	1N4083 12p	1N4084 12p	1N4085 12p	1N4086 12p	1N4087 12p	1N4088 12p	1N4089 12p	1N4090 12p	1N4091 12p	1N4092 12p	1N4093 12p	1N4094 12p	1N4095 12p	1N4096 12p	1N4097 12p	1N4098 12p	1N4099 12p	1N4100 12p	1N4101 12p	1N4102 12p	1N4103 12p	1N4104 12p	1N4105 12p	1N4106 12p	1N4107 12p	1N4108 12p	1N4109 12p	1N4110 12p	1N4111 12p	1N4112 12p	1N4113 12p	1N4114 12p	1N4115 12p	1N4116 12p	1N4117 12p	1N4118 12p	1N4119 12p	1N4120 12p	1N4121 12p	1N4122 12p	1N4123 12p	1N4124 12p	1N4125 12p	1N4126 12p	1N4127 12p	1N4128 12p	1N4129 12p	1N4130 12p	1N4131 12p	1N4132 12p	1N4133 12p	1N4134 12p	1N4135 12p	1N4136 12p	1N4137 12p	1N4138 12p	1N4139 12p	1N4140 12p	1N4141 12p	1N4142 12p	1N4143 12p	1N4144 12p	1N4145 12p	1N4146 12p	1N4147 12p	1N4148 12p	1N4149 12p	1N4150 12p	1N4151 12p	1N4152 12p	1N4153 12p	1N4154 12p	1N4155 12p	1N4156 12p	1N4157 12p	1N4158 12p	1N4159 12p	1N4160 12p	1N4161 12p	1N4162 12p	1N4163 12p	1N4164 12p	1N4165 12p	1N4166 12p	1N4167 12p	1N4168 12p	1N4169 12p	1N4170 12p	1N4171 12p	1N4172 12p	1N4173 12p	1N4174 12p	1N4175 12p	1N4176 12p	1N4177 12p	1N4178 12p	1N4179 12p	1N4180 12p	1N4181 12p	1N4182 12p	1N4183 12p	1N4184 12p	1N4185 12p	1N4186 12p	1N4187 12p	1N4188 12p	1N4189 12p	1N4190 12p	1N4191 12p	1N4192 12p	1N4193 12p	1N4194 12p	1N4195 12p	1N4196 12p	1N4197 12p	1N4198 12p	1N4199 12p	1N4200 12p	1N4201 12p	1N4202 12p	1N4203 12p	1N4204 12p	1N4205 12p	1N4206 12p	1N4207 12p	1N4208 12p	1N4209 12p	1N4210 12p	1N4211 12p	1N4212 12p	1N4213 12p	1N4214 12p	1N4215 12p	1N4216 12p	1N4217 12p	1N4218 12p	1N4219 12p	1N4220 12p	1N4221 12p	1N4222 12p	1N4223 12p	1N4224 12p	1N4225 12p	1N4226 12p	1N4227 12p	1N4228 12p	1N4229 12p	1N4230 12p	1N4231 12p	1N4232 12p	1N4233 12p	1N4234 12p	1N4235 12p	1N4236 12p	1N4237 12p	1N4238 12p	1N4239 12p	1N4240 12p	1N4241 12p	1N4242 12p	1N4243 12p	1N4244 12p	1N4245 12p	1N4246 12p	1N4247 12p	1N4248 12p	1N4249 12p	1N4250 12p	1N4251 12p	1N4252 12p	1N4253 12p	1N4254 12p	1N4255 12p	1N4256 12p	1N4257 12p	1N4258 12p	1N4259 12p	1N4260 12p	1N4261 12p	1N4262 12p	1N4263 12p	1N4264 12p	1N4265 12p	1N4266 12p	1N4267 12p	1N4268 12p	1N4269 12p	1N4270 12p	1N4271 12p	1N4272 12p	1N4273 12p	1N4274 12p	1N4275 12p	1N4276 12p	1N4277 12p	1N4278 12p	1N4279 12p	1N4280 12p	1N4281 12p	1N4282 12p	1N4283 12p	1N4284 12p	1N4285 12p	1N4286 12p	1N4287 12p	1N4288 12p	1N4289 12p	1N4290 12p	1N4291 12p	1N4292 12p	1N4293 12p	1N4294 12p	1N4295 12p	1N4296 12p	1N4297 12p	1N4298 12p	1N4299 12p	1N4300 12p	1N4301 12p	1N4302 12p	1N4303 12p	1N4304 12p	1N4305 12p	1N4306 12p	1N4307 12p	1N4308 12p	1N4309 12p	1N4310 12p	1N4311 12p	1N4312 12p	1N4313 12p	1N4314 12p	1N4315 12p	1N4316 12p	1N4317 12p	1N4318 12p	1N4319 12p	1N4320 12p	1N4321 12p	1N4322 12p	1N4323 12p	1N4324 12p	1N4325 12p	1N4326 12p	1N4327 12p	1N4328 12p	1N4329 12p	1N4330 12p	1N4331 12p	1N4332 12p	1N4333 12p	1N4334 12p	1N4335 12p	1N4336 12p	1N4337 12p	1N4338 12p	1N4339 12p	1N4340 12p	1N4341 12p	1N4342 12p	1N4343 12p	1N4344 12p	1N4345 12p	1N4346 12p	1N4347 12p	1N4348 12p	1N4349 12p	1N4350 12p	1N4351 12p	1N4352 12p	1N4353 12p	1N4354 12p	1N4355 12p	1N4356 12p	1N4357 12p	1N4358 12p	1N4359 12p	1N4360 12p	1N4361 12p	1N4362 12p	1N4363 12p	1N4364 12p	1N4365 12p	1N4366 12p	1N4367 12p	1N4368 12p	1N4369 12p	1N4370 12p	1N4371 12p	1N4372 12p	1N4373 12p	1N4374 12p	1N4375 12p	1N4376 12p	1N4377 12p	1N4378 12p	1N4379 12p	1N4380 12p	1N4381 12p	1N4382 12p	1N4383 12p	1N4384 12p	1N4385 12p	1N4386 12p	1N4387 12p	1N4388 12p	1N4389 12p	1N4390 12p	1N4391 12p	1N4392 12p	1N4393 12p	1N4394 12p	1N4395 12p	1N4396 12p	1N4397 12p	1N4398 12p	1N4399 12p	1N4400 12p	1N4401 12p	1N4402 12p	1N4403 12p	1N4404 12p	1N4405 12p	1N4406 12p	1N4407 12p	1N4408 12p	1N4409 12p	1N4410 12p	1N4411 12p	1N4412 12p	1N4413 12p	1N4414 12p	1N4415 12p	1N4416 12p	1N4417 12p	1N4418 12p	1N4419 12p	1N4420 12p	1N4421 12p	1N4422 12p	1N4423 12p	1N4424 12p	1N4425 12p	1N4426 12p	1N4427 12p	1N4428 12p	1N4429 12p	1N4430 12p	1N4431 12p	1N4432 12p	1N4433 12p	1N4434 12p	1N4435 12p	1N4436 12p	1N4437 12p	1N4438 12p	1N4439 12p	1N4440 12p	1N4441 12p	1N4442 12p	1N4443 12p	1N4444 12p	1N4445 12p	1N4446 12p	1N4447 12p	1N4448 12p	1N4449 12p	1N4450 12p	1N4451 12p	1N4452 12p	1N4453 12p	1N4454 12p	1N4455 12p	1N4456 12p	1N4457 12p	1N4458 12p	1N4459 12p	1N4460 12p	1N4461 12p	1N4462 12p	1N4463 12p	1N4464 12p	1N4465 12p	1N4466 12p	1N4467 12p	1N4468 12p	1N4469 12p	1N4470 12p	1N4471 12p	1N4472 12p	1N4473 12p	1N4474 12p	1N4475 12p	1N4476 12p	1N4477 12p	1N4478 12p	1N4479 12p	1N4480 12p	1N4481 12p	1N4482 12p	1N4483 12p	1N4484 12p	1N4485 12p	1N4486 12p	1N4487 12p	1N4488 12p	1N4489 12p	1N4490 12p	1N4491 12p	1N4492 12p	1N4493 12p	1N4494 12p	1N4495 12p	1N4496 12p	1N4497 12p	1N4498 12p	1N4499 12p	1N4500 12p	1N4501 12p	1N4502 12p	1N4503 12p	1N4504 12p	1N4505 12p	1N4506 12p	1N4507 12p	1N4508 12p	1N4509 12p	1N4510 12p	1N4511 12p	1N4512 12p	1N4513 12p	1N4514 12p	1N4515 12p	1N4516 12p	1N4517 12p	1N4518 12p	1N4519 12p	1N4520 12p	1N4521 12p	1N4522 12p	1N4523 12p	1N4524 12p	1N4525 12p	1N4526 12p	1N4527 12p	1N4528 12p	1N4529 12p	1N4530 12p	1N4531 12p	1N4532 12p	1N4533 12p	1N4534 12p	1N4535 12p	1N4536 12p	1N4537 12p	1N4538 12p	1N4539 12p	1N4540 12p	1N4541 12p	1N4542 12p	1N4543 12p	1N4544 12p	1N4545 12p	1N4546 12p	1N4547 12p	1N4548 12p	1N4549 12p	1N4550 12p	1N4551 12p	1N4552 12p	1N4553 12p	1N4554 12p	1N4555 12p	1N4556 12p	1N4557 12p	1N4558 12p	1N4559 12p	1N4560 12p	1N4561 12p	1N4562 12p	1N4563 12p	1N4564 12p	1N4565 12p	1N4566 12p	1N4567 12p	1N4568 12p	1N4569 12p	1N4570 12p	1N4571 12p	1N4572 12p	1N4573 12p	1N4574 12p	1N4575 12p	1N4576 12p	1N4577 12p	1N4578 12p	1N4579 12p	1N4580 12p	1N4581 12p	1N4582 12p	1N4583 12p	1N4584 12p	1N4585 12p	1N4586 12p	1N4587 12p	1N4588 12p	1N4589 12p	1N4590 12p	1N4591 12p	1N4592 12p	1N4593 12p	1N4594 12p	1N4595 12p	1N4596 12p	1N4597 12p	1N4598 12p	1N4599 12p	1N4600 12p	1N4601 12p	1N4602 12p	1N4603 12p	1N4604 12p	1N4605 12p	1N4606 12p	1N4607 12p	1N4608 12p	1N4609 12p	1N4610 12p	1N4611 12p	1N4612 12p	1N4613 12p	1N4614 12p	1N4615 12p	1N4616 12p	1N4617 12p	1N4618 12p	1N4619 12p	1N4620 12p	1N4621 12p	1N4622 12p	1N4623 12p	1N4624 12p	1N4625 12p	1N4626 12p	1N4627 12p	1N4628 12p	1N4629 12p	1N4630 12p	1N4631 12p

## MAINS TRANSFORMERS

All these have 230/240V 50Hz  
All these have 230/240V 50Hz Primary

Voltage	Our Ref.	Price	Post
1v	2 amp	<b>£1.96</b>	<b>40p</b>
2-4v	TM 2	<b>£1.62</b>	<b>45p</b>
4v	7 amp	<b>£2.70</b>	<b>60p</b>
6v	1 amp	<b>85p</b>	<b>40p</b>
6-5v	TM 37	<b>85p</b>	<b>40p</b>
6-5v	200 mA	<b>£1.62</b>	<b>40p</b>
6-5v-0-6-5v	100 mA	<b>£1.62</b>	<b>40p</b>
6-5v-0-6-5v	750 mA	<b>£2.16</b>	<b>45p</b>
6-3-0-6-3v	100 mA	<b>£1.62</b>	<b>40p</b>
6-3v	2 amp	<b>£1.89</b>	<b>50p</b>
8-5v	1 amp	<b>£1.62</b>	<b>40p</b>
8-5-8-5v sep. winding	1 amp	<b>£1.62</b>	<b>40p</b>
9v	1 amp	<b>£1.62</b>	<b>45p</b>
9v	1 amp	<b>£1.62</b>	<b>45p</b>
9v	5 amp	<b>£2.70</b>	<b>60p</b>
10v	25 amp	<b>£4.86</b>	<b>£1.25</b>
10v-0-10v	4 amp	<b>£3.78</b>	<b>£1.25</b>
10v-0-10v	12 amp	<b>£4.86</b>	<b>£1.25</b>
12v	1 amp	<b>£1.05</b>	<b>50p</b>
13v	100 mA	<b>£1.62</b>	<b>40p</b>
13v	1 amp	<b>£2.16</b>	<b>50p</b>
12v	1 amp	<b>£1.89</b>	<b>50p</b>
12v-0-12v	50 mA	<b>£1.62</b>	<b>40p</b>
12v-0-12v	1 amp	<b>£2.16</b>	<b>45p</b>
15v tapped 9v	2 amp	<b>£1.62</b>	<b>50p</b>
17v	1 amp	<b>£1.62</b>	<b>50p</b>
18v	1 amp	<b>£1.90</b>	<b>50p</b>
20v	1 amp	<b>£1.62</b>	<b>50p</b>
20v (with 6v 1/2 amp)	2 amp	<b>£3.78</b>	<b>£1.25</b>
20v	6 amp	<b>£4.32</b>	<b>£1.25</b>
20v	12 amp	<b>£4.86</b>	<b>£1.25</b>
20v-0-20v	6 amp	<b>£4.86</b>	<b>£1.25</b>
24v	1 amp	<b>£2.16</b>	<b>60p</b>
24v	2 amp	<b>£2.70</b>	<b>60p</b>
24v+2v 7 amp	2 amp	<b>£2.97</b>	<b>70p</b>
24v	4 amp	<b>£3.78</b>	<b>80p</b>
25v	1 1/2 amp	<b>£2.43</b>	<b>60p</b>
28v	2 amp	<b>£2.88</b>	<b>60p</b>
30v	8 amp	<b>£4.86</b>	<b>£1.25</b>
37v	37 amp	<b>£31.86</b>	<b>enquire</b>
40v	3 amp	<b>£4.32</b>	<b>£1.25</b>
40v	5 amp	<b>£5.02</b>	<b>£1.25</b>
40v	6 amp	<b>£4.86</b>	<b>£1.25</b>
40v-0-40v	2 1/2 amp	<b>£5.02</b>	<b>£1.25</b>
50v & 6-3v	2 amp	<b>£2.70</b>	<b>£1.25</b>
50v	8 amp	<b>£4.86</b>	<b>£1.25</b>
60v tapped 40v & 20v	2 amp	<b>£4.32</b>	<b>£1.25</b>
70v	4.5 amp	<b>£2.70</b>	<b>£2.50</b>
75v and 63v	3 amp	<b>£3.18</b>	<b>£2.00</b>
75v	4 1/2 amp	<b>£2.70</b>	<b>£2.50</b>
80v tapped 70v & 75v	4 amp	<b>£2.70</b>	<b>£2.50</b>
80v centre tapped	2 1/2 amp	<b>£5.02</b>	<b>£1.25</b>
100v	1 amp	<b>£2.70</b>	<b>£1.75</b>
100v-0-100v	1 amp	<b>£2.70</b>	<b>£1.75</b>
200v	1 amp	<b>£2.70</b>	<b>£1.75</b>
250v-0-250v & 6-3v	50 mA	<b>£3.78</b>	<b>£1.00</b>
000v	100 mA	<b>£3.78</b>	<b>£1.00</b>
500v	50 mA	<b>£3.78</b>	<b>£1.00</b>
260v	60 mA	<b>£3.24</b>	<b>£1.00</b>
1000v	60 mA	<b>£6.50</b>	<b>£2.00</b>
4 kv	5 mA	<b>£4.05</b>	<b>70p</b>
5 kv	5 mA	<b>£7.02</b>	<b>£1.00</b>
8 kv	5 mA	<b>£4.05</b>	<b>£1.00</b>
8-5 kv	10 mA	<b>£10.26</b>	<b>£2.00</b>

Full range of Mains to 120v Auto transformers available.  
**Pot Cores.** We have now received our delivery of Ferro pot cores. These are ex unused and are of the bobbin type but of course these have to be wound and you would have to unwind. Three pairs available.

Diameter	Thickness	Price	per pair
FX 2243	4-5 cm	3-0 cm	81
FX 2242	3-5 cm	2-3 cm	70
FX 2240	2-5 cm	1-6 cm	60

Quantity discounts apply.  
**Component Panel Ref. 3055.** Taken from unused P.S.U.'s, these contain 4 x 2N-3055 power transistors with mica insulators all on heat sink and 4 variable pots, preset type with spindle locks. Real bargain at **£1-08** each.

**Component Board 421.** Again from unused equipment, major items on these are two power silicon transistors, Motor Rola ref. SJ 5433 mounted on a heat sink with mica insulators, also behind the panel are two power rectifiers ST NS 100B. Price **98p**.

**E.H.T. Mains Transformer.** With inductance control, normal primary and output voltage approx. 300-350V. Voltage can be varied by applying DC to lower bobbin. Unused, ex P.S.U.'s Price **£4-32**.

**Music Centre Dust Cover.** Size 12" x 10" x 1 1/2" with attachments for hinging. Price **£3-95**. Callers only.

**Telephone Answering Machines.** Used but apparently complete and probably in working order. However, we are allowed to supply these only for breaking up, they should be very suitable for conversion to open reel tape recorder, background music machine, echo chamber, etc. All untested but we guarantee to replace any major item in the machine should it be faulty. Machines less outer case **£7-50**, case slightly broken but substantially whole **£10-26**. Unbroken cases **£12-45**, and finally with new looking cases **£14-50**. Post **£2-50** per machine. Many accessories available for these machines. Please enquire.

**Wall Mounting Thermostat.** The Satchwell room stat. Mains 20 amp settable over normal air temperatures between 30-80°F, suitable also for greenhouse control. Nicely finished in white enamel. Price **£3-25**.

**10 r.p.m. Motor** with 230v mains coil, not like the usual of these geared motors this has a good length of 3/4" shaft. Price **£2-50 + 20p**.

**Rigonda Intermazzo 10** - 10 hi-fi amplifier with belt driven record deck with speed control and auto check. The best hi-fi offered by Rigonda original selling price was in excess of **£125**. We have approx. 50 of these unused but with various faults. Untested, believed complete except for cartridge and speakers. Offered at **£33-50**, less than the price of the very high quality deck incorporated. If cannot collect add **£3-00** to cover the special packing and carriage charge.

## MINI-MULTI TESTER

Amazing, deluxe pocket size precision moving coil instrument—jewelled bearings—1000 opv—mirrored scale.  
11 instant ranges measure:—  
DC volts 10, 50, 250, 1000.  
AC volts 10, 50, 150, 1000.  
DC amps 0-1 mA and 0-100 mA.  
Continuity and resistance 0-150K Ohms.  
Complete with insulated probes, leads, battery, circuit diagram and instructions.  
Unbelievable value only **£6-50 + 50p** post and insurance.

## MULLARD UNILEX

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



## 24 HOUR TIMERS

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

## SHORTWAVE CRYSTAL SET

Although this uses no battery it gives really amazing results. You will receive an amazing assortment of stations over the 19, 25, 29, 31 metre bands. Kit contains chassis front panel and all the parts **£1-94**—crystal earphone **55p** including VAT and postage.

## SOUND TO LIGHT UNIT

Add colour or white light to your amplifier. Will operate 1, 2 or 3 lamps (maximum 450W). Unit in box ready to work. **£9-95**.

## BREAKDOWN PARCEL

Four unused, made for computer units containing most useful components, and these components unlike those from most computer panels, have wire ends of usable length. The transistors for instance have leads over 1" long—the diodes have approx. 1/2" leads.

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

## TANGENTIAL HEATER UNIT

A most efficient and quiet running blower-heater by Solatron—same type as is fitted to many famous name heaters—Comprises mains induction motor—long turbo fan—split 2 kw heating element and thermostatic safety trip—simply connect to the mains for immediate heat—mount in a simple wooden or metal case or mount direct onto base of say kitchen unit—price **£4-95** post **£1-50** control switch to give 2kw, 1kw, cold blow or off available 60p extra.

2 kw. motor made in metal case with control switch **£12-00**

## MOTORISED DISCO SWITCH

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

## FLUORESCENT TUBE INVERTOR

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## J. BULL (ELECTRICAL) LTD

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## IT'S FREE

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

**FM Tuner and decoder**, 2 very well made (Japan) units, nice clear dial, excellent reproduction. **£11-20** the pair.

**12 Volt Heavy Duty Relay**, plug in tape has three pairs of 10 amp changeover contacts. A transparent dust cover, price **£1-08** suitable 11 pin base 45.

**4 Changeover Relay**, upright mounting 4 sets of 10 amps changeover contacts, mains voltage coil **£1-72**.

**12 Volt Pump**. Designed we believe as a bilge pump, this is 12 volt AC/DC motor coupled by a long enclosed shaft to a submersible pump. Suitable for water or most any fluids. Price **£12-50**.

**High Load 24 Hour Clock Switch**, made by the famous Smiths Company for normal mains but with clockwork reserve has load capacity of 50 amps at 240V 50HZ. The reform suitable for dealing with large loads of say shop lighting, water heating, storage heaters, etc., etc. Has triggers for on and off per 24 hours but extra triggers will be available. Price **£1-50** per pair, totally enclosed. Price **£9-50**.

**Enclosed 24 Hour Clock** with contacts for breaking 10-12 amps at 240 volts. This one has two sets of on/off per 24 hours, price **£7-00**.

**Light Dimmer**, our timer module with small motors makes an excellent light dimmer. Contains a 4 amp 400V SCR so it should be suitable for loads approaching 1KV. Price of module and instructions **£2-25**.

**Push Pull Solenoids**, mains operated solenoids which will push as well as or instead of pull. Very heavy duty, estimate this at 20lbs push or pull 1 1/2" x 3 1/4" made Magnetic Devices Co. **£7-50**.

**Flashing Lights**, chasing lights, random finishes, strobe effects etc., etc. can easily be achieved using our disco switches. These switches are ex-equipment but guaranteed perfect and supplied suitable for mains working. To get some idea of loading number, each switch is 10 amp. For the light pipe or Catherine Wheel effect order the 12 switch model with light pipe data model, interconnecting the switches to give fastest speed. 8 Switch model **£5**, 9 Switch model **£9-75**, 12 Switch model **£6-20**.

**Reed Switches**, standard 60 watt glass type. Normal open contacts glass lengths 2" diameter 3/16". 10 for **£1**, 100 for **£8**, 1000 for **£70**.

**Flat Reed Switches**, for stacking, greater quantity in confined space. Price **£5p**.

**Ceramic Magnets**, suitable for operating Reed switches, central fixing hole, 10 for **£1**.

**Music Centre Transformer** 12-0-12 at 1 amp and 9 volt at 1/2 amp. Normal primary, uprighting, impregnated and varnished for quiet operation. Price **£3-50**.

**'W' Shaped Fluorescent Tubes** for porch light, box signs or where you want light evenly spaced over a confined area of approx. 10" x 10". 30 watts made by Philips. Price **£2-24**.

**Extension Speakers**, 8 ohm 4-5 watts handling power. We have 5 or 6 different models in stock, cheapest being the Partytime at **£3-95** each, again only really a bargain for callers as postage is **£1-50** per speaker.

**Auto Transformers** for working American tools and equipment, completely enclosed in sheet metal case with American type flat output socket made for computer so obviously first class 500 watts. With gang handle, offered at about half price only **£15**. These may be a bit solid but are fully guaranteed. Similar but 1000 watt for **£29-50**.

**Car Starter Charge Kit**. New version. We supply two 10 amp rectifiers, 250v transformer and the start charge switch with instructions, price **£9-75**. This is probably one of the most useful pieces of equipment you can have in your garage. Sooner or later you or someone will leave something on and you will have a flat battery, this starter will get you away usually in less than 5 minutes.

**Resetter Counter**, by Veedroot Company, 230/240V mains operated, intended for surface mounting has a fixing flange at the bottom. Price **£2-16**.

**12V Drip proof Relay**. Specially designed for going under the bonnet of a car, made by one of our big manufacturers, this really has a removable semi-hard rubber cover. Contacts look suitable for up to 10 amps so this could be the right one. If you are thinking about making an anti-theft device. Price **£1-8p**.

**High Speed Uniselector**. As many customers know, we have a very comprehensive stock of uniselectors as used in automatic telephone exchanges, light flashing etc., etc. Just arrived however is a high speed model made by famous Plessey, this is 2 pole 32 way with make before break wipers, overall size approx. 4" x 3" x 2 1/2". Price **£3-50 + 28p**.

**Pneumatic Ram** for lifting, thrusting, pulling etc., has 2 1/2" travel, looks large enough to open doors, lift, staircase, ventilators, etc. Price **£7-00**.

**Solder Gun Bargain**. The ETP, this is 100 watt solder gun, a very well made tool with lamp to illuminate work has double insulated mains transformer and is built into the shock proof thermoplastic case. Comes complete with spare tips. Mains operated of course. Price **£4-50**.

**Interested in Tape Control**. American made tape punches, really beautiful units made of sophisticated parts, designed we believe to automatically operate typewriters and they can of course be used to operate other punch tape controlled machines. Reference number is NCR Class 461-2 reference 205 H8 R56. We believe these are 8r bit paper tape punches, powered from 115V 50HZ in very good condition with tape **£16-00**, carriage is **£3-20**.

**Resettable Fuses** (thermal trips). Two new types have come in, one made by ETA is a 6 amp model which is mounted through a single hole rather like a volume control. This is suitable for 250 volts AC or 24 volts DC. Price **54p**. **4-5 Amp Model** made by AEG is held by two screws thus a bank of these could be mounted between metal straps. Price **54p**.

**Disc Motor**, mains operated. This is very thin in fact less than 1 1/2" thick and only approx 2" dia. Spindle revolves at 250 rpm and the spindle which is approx. 1/32" dia. pushes through so motor could be used to drive clockwise or anti-clockwise. The spindle being a friction fit can be pushed completely out and replaced by your own spindle, a knitting needle for instance. Price only **38p**.

**75 rpm Mains Induction Motor** with gearbox. This motor is quite powerful and has 1 1/2" stack and the final 75 rpm drive shaft is 1 1/2" long by 3/8" dia. The motor also has a spindle coming from the opposite end to which could be fitted another pulley. Overall size approx. 3" x 5" x 2 1/2" + spindles. Price **£3-35**.

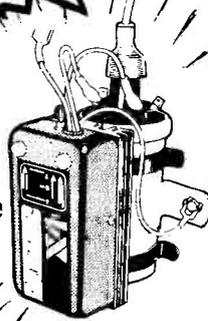
**24 Hour Motor**, beautifully made by Sangamo. This is 200-240v mains driven motor with gearbox together in one housing, size approx. 1 1/2" dia. by 1 1/2" deep. If you are contemplating making a 24 hour switch with a lot of on/off's, then this is obviously the motor. Price **£1-89**.

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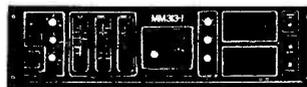
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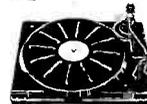
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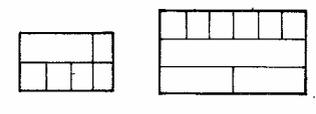
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0.022	£0.06	0.15	£0.08	1	£0.24
0.033	£0.08	0.22	£0.09	1.5	£0.36
0.047	£0.06	0.33	£0.13	2.2	£0.37

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68	£0.13	UF	£0.40	6.8	£0.10
150	£0.16	6.8	£0.10	15	£0.13
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680	£0.50	33	£0.13	150	£0.47
1500	£0.83	150	£0.42	330	£0.78
		680	£0.83		

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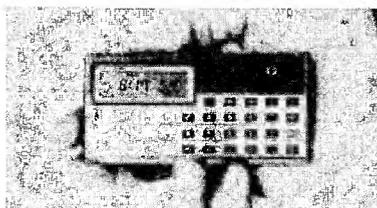
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IS70/1000 1000v		£3-00
BX38/300 6A 300v		£0-45
BX38/600 6A 600v		£0-60
BX38/300 Rev 6A 300v		£0-45
BX38/600 Rev 6A 600v		£0-60

## POTENTIOMETERS

### CARBON POTS (Linear Track)

Single gang with wire end terminations, 6mm x 50mm plastic shaft 10mm bushes supplied with shake proof washer & nut. Tolerance  $\pm 20\%$  of resistance.

1831 1k ohms	£0-28*	1836 47kohms	£0-28*
1832 2k2ohms	£0-28*	1837 100kohms	£0-28*
1833 4k7ohms	£0-28*	1838 220kohms	£0-28*
1834 10kohms	£0-28*	1839 470kohms	£0-28*
1835 22kohms	£0-28*	1840 1Meg	£0-28*
		1841 2M2	£0-28*

### CARBON POTS (Log Track)

1842 4k7ohms	£0-28*	1846 100kohms	£0-28*
1843 10kohms	£0-28*	1847 220kohms	£0-28*
1844 22kohms	£0-28*	1848 470kohms	£0-28*
1845 47kohms	£0-28*	1849 1Meg	£0-28*
		1850 2M2	£0-28*

### DUAL CARBON POTS (Lin Track)

These high quality dual gang pots are fitted with wire end terminations and 6mm x 50mm plastic shaft 10mm, bush and supplied with shake proof washer & nut track tolerance  $\pm 20\%$  but matched to within 2db of each other. VC3.

1851 4k7	£0-85*	1855 100kohms	£0-85*
1852 10kohms	£0-85*	1856 220kohms	£0-85*
1853 22kohms	£0-85*	1857 470kohms	£0-85*
1854 100kohms	£0-85*	1858 1Meg	£0-85*
		1859 2M2	£0-85*

### DUAL CARBON POTS (Log Law)

1860 4k7ohms	£0-85*	1864 100kohms	£0-85*
1861 10kohms	£0-85*	1865 220kohms	£0-85*
1862 22kohms	£0-85*	1866 470kohms	£0-85*
1863 47kohms	£0-85*	1867 1Meg	£0-85*
		1868 2M2	£0-85*

### SINGLE GANG SWITCHED (Lin Law)

These potentiometers are fitted with double pole on-off switches. The switch is incorporated with the rotary action of the pot. Specification of pots as VC1. Switch rating 1.5amps at 250v AC.

1870 4k7ohms	£0-85*	1874 100kohms	£0-85*
1871 10kohms	£0-85*	1875 220kohms	£0-85*
1872 22kohms	£0-85*	1876 470kohms	£0-85*
1873 47kohms	£0-85*	1877 1Meg	£0-85*
		1878 2M2	£0-85*

### SWITCHED POT (Log Track)

Specification as VC2 but track having (log) law.

1879 4k7ohms	£0-85*	1833 100kohms	£0-85*
1880 10kohms	£0-85*	1884 220kohms	£0-85*
1881 22kohms	£0-85*	1885 47kohms	£0-85*
1882 47kohms	£0-85*	1886 1Meg	£0-85*
		1887 2M2	£0-85*

## ANTEX IRONS

O/No. 1943. 15 watt high quality soldering iron totally enclosed element in a ceramic shaft fitted with 3/32" bit. **£3-80**

O/No. 1947. Replacement element for 1943 iron. **£1-90**

O/No. 1944. Iron coated bit 3/32" for 1943 iron. **£0-46**

O/No. 1945. Iron coated bit 1/8" for 1943 iron. **£0-46**

O/No. 1946. Iron coated bit 3/16" for 1943 iron. **£0-46**

O/No. 1948. General purpose 18 watt iron fitted with iron coated bit. **£3-60**

O/No. 1952. Replacement element for 1948 iron. **£1-90**

O/No. 1949. Iron coated bit 3/32" for 1948 iron. **£0-46**

O/No. 1950. Iron coated bit 1/8" for 1948 iron. **£0-46**

O/No. 1951. Iron coated bit 3/16" for 1948 iron. **£0-46**

### DUAL GANG LOG-ANTI-LOG POT

1888 Track specification as dual gang pots VC3 but tracks mounted to log-anti-log action 100kohms **£0-75\***

### SPECIAL VOLUME CONTROLS

A miniature 16mm type replacement volume control incorporating single pole on-off switch. Resistance value 5kohms. Tolerance  $\pm 20\%$  1/8watt rating. **1889 £0-27\* VC8**

### MINIATURE ROTARY VOL CONTROL

5kohms log law with on/off switch, 20mm grooved spindle. Tag connections 17mm dia. Supplied with fixing nut. Used mainly for replacement. **1890 £0-54\* VC9**

### WIRE WOUND POTS

A range of wire wound single gang pots with linear tracks of 1 watt rating, fitted with 10mm bush and supplied with shake-proof washer and nut. VC6

1891 10ohms	£0-80	1895 220ohms	£0-80
1892 20ohms	£0-80	1896 470ohms	£0-80
1893 47ohms	£0-80	1897 1kohms	£0-80
1894 200ohms	£0-80	1898 2kohms	£0-80
		1899 4k7ohms	£0-80

### PRE-SET POTS

Miniature type for transistor circuits. The wiper of the preset is provided with a slot for screwdriver adjustment. The tags of the preset will fit printed wiring boards with a pitch of 2.54mm. All tracks are linear law. VC7

1801 100ohms	£0-09*	1808 22kohms	£0-09*
1802 200ohms	£0-09*	1809 47kohms	£0-09*
1803 400ohms	£0-09*	1810 100kohms	£0-09*
1804 1kohms	£0-09*	1811 220kohms	£0-09*
1805 2kohms	£0-09*	1812 470kohms	£0-09*
1806 4kohms	£0-09*	1813 1kohms	£0-09*
1807 10kohms	£0-09*	1814 2M2ohms	£0-09*
		1815 4M7ohms	£0-09*

### PRE-SET POTS

Miniature type for transistor circuits. Wiper adjustment is made by a screwdriver slot. Designed to fit 2.54mm pitch board. All tracks are linear law. VC8

1816 100ohms	£0-09*	1823 22kohms	£0-09*
1817 220ohms	£0-09*	1824 47kohms	£0-09*
1818 470ohms	£0-09*	1825 100kohms	£0-09*
1819 1kohms	£0-09*	1826 220kohms	£0-09*
1820 2kohms	£0-09*	1827 470kohms	£0-09*
1821 4k7ohms	£0-09*	1828 1Megohms	£0-09*
1822 10kohms	£0-09*	1829 2M2ohms	£0-09*
		1830 4M7ohms	£0-09*

## OPTOELECTRONICS

### NEW INCREASED RANGE - ALL 1ST QUALITY LED's (diffused)

O/no.	Type	Size	Colour	Price
1501	ARL209(TL209)	3mm (1.25)	RED	£0-10
1502	MIL3232(TL211)	3mm (1.25)	GREEN	£0-15
1503	MIL331 (OPL212A)	3mm (1.25)	YELLOW	£0-15
1504	ARL4850(FLY117)	5mm (2)	RED	£0-10
1505	MIL5251(TL222)	5mm (2)	GREEN	£0-15
1506	MIL5351(MV5353)	5mm (2)	YELLOW	£0-15
1509	FLY111	5mm (2)	CLEAR (fill. Red)	£0-11

### SUPER 'Hi-Brite' Type

1521	MIL32	3mm (1.25)	RED	£0-10
1522	MIL52	5mm (2)	RED	£0-10
1514	ORP12	Light dependent resistor		£0-55
1520	OCP71	Photo transistor		£0-35

### LED CLIPS

1508/125	pack of 5	125 clips		£0-15
1508/2	pack of 5	2 clips		£0-18
ALL $\pm 8\%$ V.A.T.				

### DISPLAYS

DL703	7 segment D.P. left (.30" height)	Common Anode		
RED	Single Digit	O/No. 1523		£0-70
DL707	7 segment D.P. left (.0.3" height)	Common Anode		
RED	Single Digit	O/No. 1510		£0-95
DL527	7 segment D.P. left (.50" height)	Common Anode		
RED	Two-Digit Reflector	O/No. 1524		£1-70
DL727	7 segment D.P. right (.510" height)	Common Anode		
RED	Two-Digit Light Pipe	O/No. 1521		£2-20
DL747	7 segment D.P. left (.630" height)	Common Anode		
RED	Single-Digit Light Pipe	O/No. 1511		£1-70
ALL $\pm 8\%$ V.A.T.				

### OPTO-ISOLATORS

Isolation Breakdown - Voltage 1500 - continuous fwd current 100mA

CIL74	Single-Channel 6 pin DIP standard type - optically coupled pair with infra-red LED Emitter and NPN Silicon Photo Transistor.	O/No. 1497	£0-50
CILD74	Multi-Channel 8 pin DIP Two Isolated Channels.	O/No. 1498	£1-00
CILQ74	Multi-Channel 16 pin DIP Four Isolated Channels.	O/No. 1499	£2-20
ALL $\pm 8\%$ V.A.T.			

### 2nd GRADE LED's

A pack of 10 standard sizes and colours which fail to perform to their very rigid specification, but which are ideal for amateurs who do not require the full spec. O/No. 1507 **£1-50**

## THYRISTORS

600ma	TO 18 Case	TO 48 Case	
Volts No.	Price	Price	
10 THY600/10	£0-15	50 THY7A/50	£0-48
20 THY600/20	£0-16	100 THY7A/100	£0-51
30 THY600/30	£0-20	200 THY7A/200	£0-57
50 THY600/50	£0-22	400 THY7A/400	£0-62
100 THY600/100	£0-25	600 THY7A/600	£0-78
200 THY600/200	£0-38	800 THY7A/800	£0-92
400 THY600/400	£0-44		
<b>10 Amp</b>			
Volts No.			
50 THY1A/50	£0-28	200 THY10A/200	£0-62
100 THY1A/100	£0-28	400 THY10A/400	£0-71
200 THY1A/200	£0-32	600 THY10A/600	£0-99
400 THY1A/400	£0-38	800 THY10A/800	£1-22
600 THY1A/600	£0-45		
800 THY1A/800	£0-58		
<b>16 Amp</b>			
Volts No.			
50 THY16A/50	£0-58	200 THY16A/200	£0-62
100 THY16A/100	£0-58	400 THY16A/400	£0-77
200 THY16A/200	£0-62	600 THY16A/600	£0-90
400 THY16A/400	£0-77	800 THY16A/800	£1-39
<b>30 Amp</b>			
Volts No.			
50 THY30A/50	£1-18	100 THY30A/100	£1-43
100 THY30A/100	£1-43	200 THY30A/200	£1-63
400 THY30A/400	£1-79	600 THY30A/600	£2-50
<b>No.</b>			
Price</			



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## CB?

**T**HE airing given to the Citizens Band controversy in our April issue certainly did provoke some heart-felt comments from our readers, one or two of them frankly libellous! It does seem surprising that some members of the amateur radio fraternity should express quite so forcefully the view that no-one, but no-one, who has not passed the RAE should have any right whatever to any form of personal radio communication. There must be many people who, like one of our correspondents, are interested in radio but just seem unable to pass the RAE despite repeated attempts. And there are many, many thousands who could make good use of a personal, short-range communication facility.

The choice of frequency band is obviously important. It should preferably be in a presently unused portion of the spectrum, and well away from any bands for which off-the-shelf, high-powered transmitters or amplifiers are available. These requirements both put any portion of the 2 metre band out of court. The use of v.h.f. or u.h.f. is obviously preferable, in order to limit the range achievable, but this brings us back to the question of equipment cost.

Informed sources are quoting £150 as the likely cost of a UK-produced hand-portable set. Just how many would be sold, when there are reputed to be factories in the Far East with output capacities of 25 000–50 000 CB sets per month, and FOB prices for 5 W output, 40-channel car transceivers as low as £25? Without some sort of import quota system for at least a limited period, our communications industry would suffer in the same way that our hi-fi industry already has, and our balance of trade situation be made even worse.



**Keith Woodruff — Assistant Art Editor**

After leaving grammar school, Keith began his working life as a junior in the art department of a print company. He next joined Metro-Goldwyn-Mayer Film Studios as a Set Decorator, where he stayed until the studios closed down. Keith then had an unsettled spell drifting from job to job until he joined IPC in 1973.

Having lived in Hoddesdon, Hertfordshire and commuted to London, he finds that the move to

Poole has drastically cut his travelling time to work. This gives him more time with his wife and daughter, who find the move to Dorset one of the best things to have happened to them.

Keith and his family are members of Poole Camera Club, with Keith and his daughter actively engaged in competitions. His other interest is gardening, growing vegetables, soft fruit and cacti in a greenhouse.

## Catalogues

Belzer, one of Europe's leading hand tool manufacturers, have been producing high-quality tools in their West German works for almost 100 years. A selection of some 200 precision electronic tools is now available from Toolrange Ltd.

Belzer are certainly not cheap but meet the highest standards of quality and finish. The range includes, special pliers with spring-loaded handles, cutters, screwdrivers, tweezers, adjustable tools and complete tool kits.

To receive a free 32 page catalogue and price list, apply to: *Toolrange Ltd., Upton Road, Reading RG3 4JA. Tel: (0734) 29446 or 22245.*

Watford Electronics' latest catalogue contains 92 pages, packed with the most useful information for the electronics constructor. Watford also supply kits for many PW projects, including the *Purbeck Oscilloscope* (for details see Watford's advertisement).

The catalogue costs 50p plus 25p p&p, available from: *Watford Electronics, 33/35 Cardiff Road, Watford, Herts WD1 8ED. Tel: (0923) 40588/9.*

Marshall's latest catalogue has been expanded from 40 to 48 pages and includes many new items, such as, oscilloscopes, KIM and PET microcomputers, extended capacitor and switch ranges, more tools and a new digital multimeter.

A new feature of the catalogue is the limited line section covering obsolete items. The catalogue is available at 50p post paid or 40p to callers at their branches. *A. Marshall (London) Ltd., Kingsgate House, Kingsgate Place, London NW6 4TA. Tel: 01-624 0805.*

Astra, the electronic component mail order company, inform us their latest catalogue is now available. Among the many items featured are crystals, i.c.s, resistors, capacitors and electronics books. The free catalogue is available if you send a sae to; *Astra-Pak, 92 Godstone Road, Whyteleafe, Surrey CR3 0EB.*

## Teach-in

The University of Salford is again running a one-week course in July 1979 on Electronic Applications for Teachers. The aim of the course is to provide teachers who have some basic knowledge of semiconductor electronics with the opportunity to study the subject in greater depth. The

material covered will be adequate for the option of the JMB 'A' level physics syllabus, or other syllabi of comparable standard. The course will be devoted primarily to the study of operational amplifier and integrated logic circuit applications, approximately half the time being spent on experimental work.

The course organiser is Dr E. A. Flinn, of the University's Department of Electrical Engineering. For further details contact: *The Administrative Assistant (Short Courses), Room 110, Registrar's Department, University of Salford, Salford M5 4WT. Tel: 061-736 5843, extension 449.*

## Mobile Rallies

Otley Radio and Electronics Society (G8JTD, G3XNO) are holding "The Northern Mobile Rally 1979," at The Victoria Park Hall, Keighley on Sunday 20 May, between 11.30am and 5.30pm. There will be talk-in stations on S22 and SU8 also trade stands, films for the children, refreshments, bar and many other attractions. Further details from: *Jack E. Annakin G8DFZ, 25 Ashfield Place, Otley, West Yorkshire LS21 3JN.*

Maidstone YMCA Amateur Radio Society (G3TRF, G3YSC) Mobile Rally is to be held at the Y Sports centre, Melrose Close, Maidstone, Kent, on Sunday 27 May, 1979, commencing at 11.00am. In addition to talk-in stations using the callsign GB2YSC on 1925kHz s.s.b., 144.270MHz s.s.b., and S22 f.m., there will be bring-and-buy stalls (10% to club funds), covered trade accommodation, on-site parking, snack bar and special attractions for all the family. Further details from: *John Parker, 42 Mote Road, Maidstone, Kent. Tel: (0622) 50350.*

## Getting started

A new careers publication has been issued by the Institution of Electrical and Electronic Technicians Engineers (IEETE) entitled: "*Engineering a Career in the electrical and electronics industry*".

The booklet avoids excessive detail, concentrating rather on giving a general picture of the profession of electrical and electronic engineering, and the qualifications required to become a Technician Engineer, a Technician or a Chartered Engineer. The publication should be useful not

only to young people considering their career, but also to those engaged in offering careers advice and guidance.

Copies are available on request from: *The Secretary, IEETE, 2 Savoy Hill, London WC2R 0BS.*

The Department of Industry has also produced a full-colour brochure entitled: "*Microelectronics—the new technology*", which should help the non-specialist to understand the basic principles of the new "silicon-chip technology". Copies of the brochure are available from: *The Electronics Applications Division, Dean Bradley House, 52 Horseferry Road, London SW1.*

## Look you here

Barry College of Further Education Radio Society are holding their annual Welsh Amateur Radio, TV, Electronics and Computer Exhibition at the Barry Memorial Hall, Hoton Road, Barry, S. Glamorgan, on Sunday, 20 May, 1979, commencing at 11.00am. There will be all the usual attractions including a licensed bar. Further information from: *Reg Rowles GW4FOM, 4 Cowbridge Road West, Ely, Cardiff CF5 5BR. Tel: (0222) 565656.*

## Here we are again!

Once more it's time for the RSGB Amateur Radio Exhibition, at Alexandra Palace. The two-day exhibition will be open between 10.00am and 7.30pm on Friday, 11 May, and 10.00am and 6.00pm on Saturday, 12 May, 1979.

The RSGB will occupy their largest-ever stand at the exhibition with staff and members there to answer your questions and run a talk-in station GB2AP on S22 and SU8, also listening-watch on 144.28MHz s.s.b.

Among the many features of the exhibition are stands from other amateur organisations, including RAYNET, trade exhibitors, films for the newcomer, a full range of catering amenities and a larger supply of real ale than last year at the licensed bar.

Admission will be 60p (RSGB members 50p), children under 12yrs free. Facilities for the disabled are available, plus free parking for up to 2,000 cars.

Technical staff from *Practical Wireless* will be attending the exhibition on stand N10, and look forward to meeting as many as possible of our readers.

# PASSIVE

## 10:1 DIVIDER

### I. HICKMAN

# PROBE

FOR THE PW PURBECK

Most readers will know that when using a multimeter to measure the voltages at various points in a circuit, account must be taken of the usually small, but none-the-less finite, current drawn by the meter. This additional circuit loading can actually change the voltage at the point of measurement by a significant amount if the source resistance is high.

Fig. 1a shows the case where the emitter and base voltages of a small signal amplifier stage are measured separately. The figures in square boxes are the voltages as measured by a  $1k\Omega$  per volt meter on the 10V range, whilst the figures without boxes are the actual voltages when the meter is not connected. The emitter voltage changes by a negligible amount, as the transistor acts as an emitter follower, i.e. a low source resistance. However, the source resistance of the base circuit is  $16.6k\Omega$  ( $22k\Omega$  and  $68k\Omega$  in parallel), which is not negligibly low compared to the  $10k\Omega$  resistance of a  $1k\Omega$  per volt meter on the 10V range.

The erroneous conclusion one might draw if no allowance were made for the meter loading effect is that the transistor is cut off! The figures in round boxes are the voltages as measured on the 10V range of  $120k\Omega$  per volt meter and, as can be seen, the error due to meter loading is small. For this reason, multimeters specifically meant for electronic work (as distinct from general electrical work) have a sensitivity of at least  $10k\Omega$  per volt, commonly  $20k\Omega$  per volt and not infrequently  $30k\Omega$  per volt or even higher.

### Waveforms

Exactly the same problem of the measuring instrument loading the circuit and actually changing the very voltage that one is trying to measure, can arise when using an oscilloscope.

It should be obvious that with an input resistance of  $1M\Omega$ , the oscilloscope loads the circuit under test less than a  $20k\Omega$  per volt multimeter (for voltage ranges up to 50 V full scale deflection).

However, the oscilloscope is specifically used for examining voltage waveforms, i.e. voltages which are changing. Therefore, we also have to consider the input capacitance of the oscilloscope and this amounts to a few tens of picofarads (pF).

Whilst this would generally cause no problems at audio frequencies, the *PW Purbeck* might be typically used to examine, say, a 1MHz square-wave. An ideal square-wave contains harmonics extending up to an infinitely high

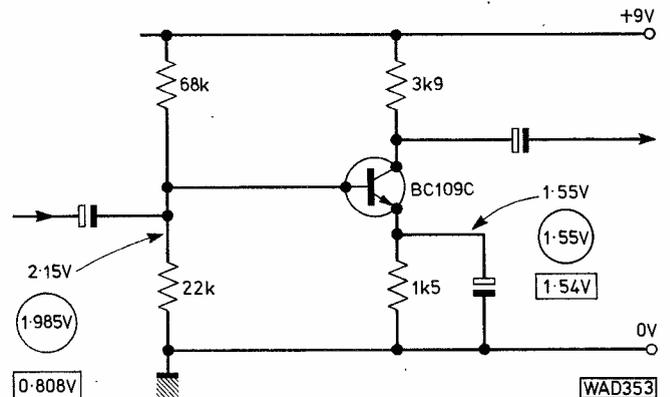
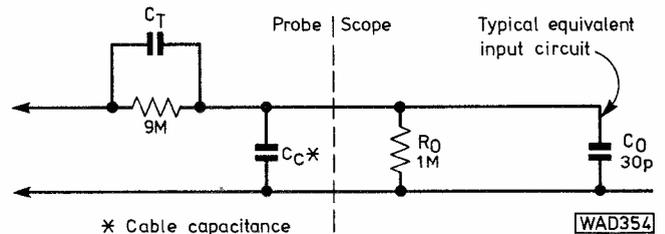


Fig. 1: (a) above, shows the effect of  $20k\Omega/V$  and  $1k\Omega/V$  meters on voltages measured. (b) below, is the circuit of a 10:1 probe to reduce circuit loading

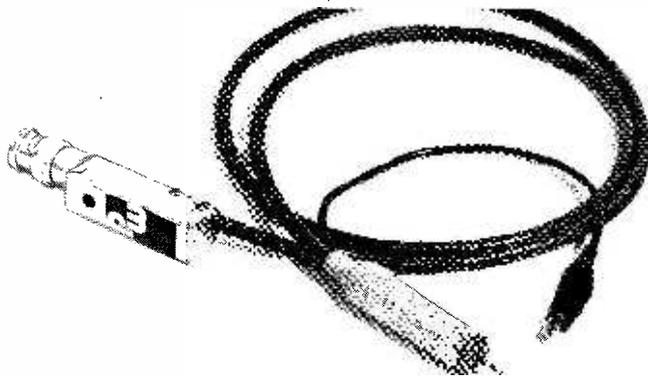
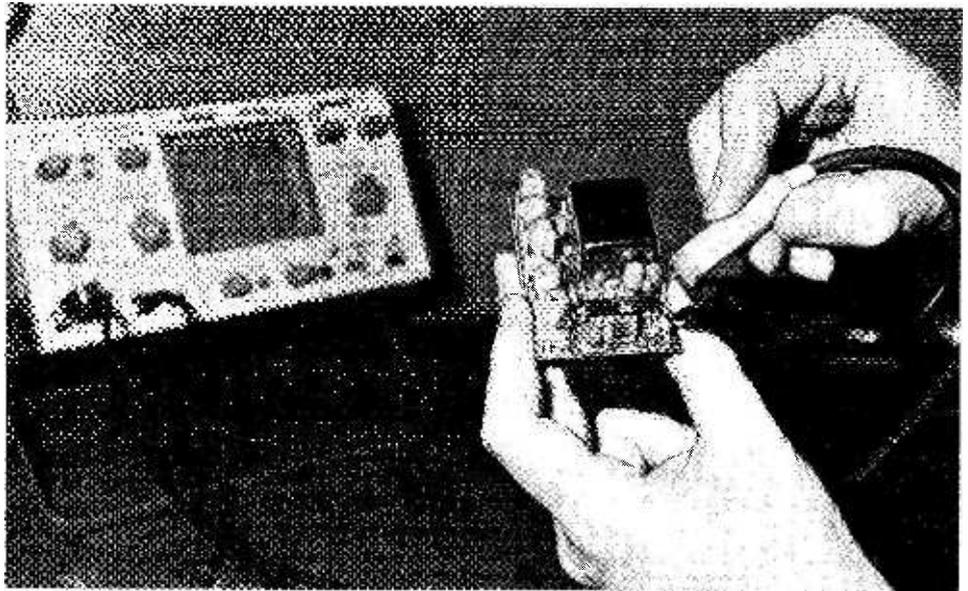


frequency and even a "practical" 1MHz square-wave will involve frequencies greater than 10MHz. Now 30pF (and the input capacitance of the *PW Purbeck* oscilloscope is of this order) has a reactance of only  $500\Omega$  at 10MHz and could thus considerably affect the waveform unless the source impedance were under  $50\Omega$ ! In fact, matters are a good deal worse than this, as we have not allowed for the capacitance to ground of a lead from the test point to the oscilloscope—trying to connect the circuit under test directly to the input connector of the oscilloscope with negligible lead lengths is always tedious and often impossible. Experience dictates that for general-purpose use, a lead of two to three feet is needed, screened to avoid hum pick up when working on high impedance circuits. Even choosing a low capacitance screened lead such as  $75\Omega$  coaxial cable, we have about 20pF per foot, so that  $2\frac{1}{2}$  feet of cable plus the input capacitance of the oscilloscope leaves us with a total of around 100pF. The purpose of a 10:1 divider probe is to reduce the effective input capacitance of the scope plus connecting lead to nearer  $10pF$ .

# ★ components

R1 30MΩ 1% (Vavard)  
 C1 12pF ceramic 500V  
 CA 2-220F trimmer (Mullard)  
 1 metre 75Ω "Uniradio 70"  
 coaxial cable  
 100.4B1C plug with hexagonal  
 screw type cable clamp  
 Tinsplate, Araldite, etc. as  
 required

**The 10:1 passive divider probe is a useful addition to the PW Purbeck oscilloscope. On the right it is seen being used with a Scopex 4D10 scope while the picture below shows the completed probe**



## Theory of Operation

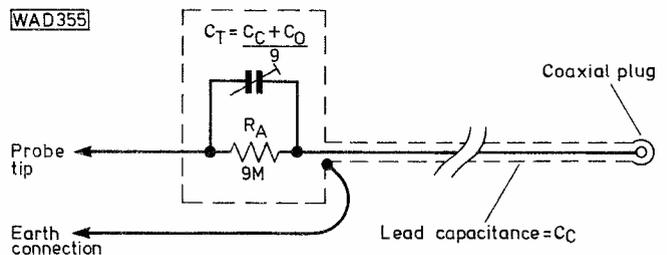
Fig. 2a shows the circuit diagram of the traditional type of oscilloscope probe. The capacitance of the screened lead plus the input capacitance of the oscilloscope form one section of a capacitive potential divider. The trimmer  $C_T$  forms the other and it can be set so that the attenuation of this capacitive divider is 10:1 in volts, which is the same attenuation as provided by  $R_A$  ( $9M\Omega$ ) and the  $1M\Omega$  input resistance of the oscilloscope. When this condition is fulfilled, the attenuation is independent of frequency (Fig. 3a). Assuming  $C_E$  the cable plus 'scope input capacitance ( $C_E = C_c + C_o$ ) totals  $100pF$ ,  $C_T$  should at any frequency have a reactance nine times that of  $C_E$ . i.e. will equal  $\frac{1}{9}$  of  $C_E$ . If  $C_T$  is too small, high frequencies (e.g. the edges of a square-wave) will be attenuated by more than 10:1, whereas the attenuation of the steady level will still be 10:1 resulting in the waveform of Fig. 3b. Conversely if  $C_T$  is too large, the result is as in Fig. 3c. All of the above has assumed that  $C_E$  is constant and this will only be so if the input capacitance of the 'scope is the same on all ranges. This is the purpose of capacitors C3-6 in Fig. 2, p. 29 of the June 1978 issue of *PW* as they allow the input capacitance of positions 2-5 of S3B (Input Range) on the *PW* Purbeck to be set to the same value as on position 1.

The rounding or pip on the edges of a square-wave will be difficult to see on a very low frequency signal, as with the slow time-base speed needed, the square-wave will appear to settle very rapidly to the positive and negative levels. Conversely, at very high frequencies, the displayed square-wave amplitude will be affected by the capacitive divider only. The time constant  $CR$  of the oscilloscope

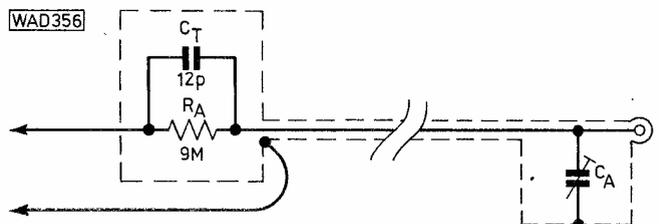
input is  $30pF \times 1M\Omega$  or 30 microseconds. Therefore, waveforms as in Fig. 3 will be seen with a square-wave input of around 1kHz.

At very high frequencies, where the length of the probe cable is an appreciable fraction of a wavelength, reflections will occur, as the cable is not terminated in its characteristic impedance of  $75\Omega$ . For this reason, commercial oscilloscope probes often incorporate a resistor of a few tens of ohms in series with the inner of the cable at one or both ends, or use a special cable with an inner made of resistance wire. Such probes are suitable for oscilloscopes with a bandwidth of 100MHz or more, but in the case of the *PW* Purbeck, a resistor is already incorporated in the input circuit of the oscilloscope, so that further resistors in the probe are unnecessary.

Fig. 2a shows  $C_T$  as a variable capacitor. However, this is mounted at the business end of the probe, where it is not very convenient to accommodate a trimmer. Therefore, a fixed capacitor is used for  $C_T$ , permitting a neat, compact design for the probe head. Adjustment is carried out by means of a trimmer mounted in a small box at the oscilloscope end of the probe. Inevitably, this means that  $C_E$  (and hence the capacitive loading of a circuit under test) is higher than with the scheme of Fig. 2a, but only slightly, and is well worth the extra convenience. With the



**Fig. 2: (a) above shows the traditional 10:1 divider probe and (b) below the design used for the PW Purbeck scope probe**



chosen design of Fig. 2b in use, CA is adjusted so that  $C_T = \frac{1}{9}(C_C + C_A + C_O)$ , by the simple procedure of setting it to reproduce a test square-wave as in Fig. 3a rather than b or c.

## Construction

This calls for the employment of a little ingenuity in the use of materials such as Araldite, tinfoil (from the proverbial cocoa tin or similar), insulating tape, etc. and of tools such as tin-snips, snipe nosed pliers and the like. If you are adept at this sort of thing, construction is really straightforward and sketches of the necessary bits and pieces are given in Fig. 4.

The housing of CA is fabricated in two parts, the body being soldered to the rear of a BNC plug and the cover fitted later when construction and testing are complete. The BNC plug used by the author had a cable clamping sleeve with hexagonal flats and the body of the CA housing was shaped and soldered to this.

The method of fixing the 75Ω coaxial cable is crude but effective, the Araldite being essential to support the cable firmly. Araldite is also used, again as a strain-relief, at the cable entry into the probe head. The body of this is also made from tinfoil and can usefully be as small as RA and CT will allow, bearing in mind that these should be firmly mounted and reliably insulated. The author used a long 8BA brass bolt as the probe tip. After assembly, the shank was filed smooth, the tip sharpened and then flatted and nicked as shown in Fig. 4. This enables it to be hooked on to wires, transistor or diode leads, etc. when checking through a circuit and is a very useful feature as it leaves the hands free.

The reliability of the earth wire is most important. Many commercial probes, even of the best known makes, give continual trouble due to the earth lead going open circuit. Ordinary stranded wire will not stand up to the continual flexing, so the author used black plastic covered extra-flexible wire as sold for multimeter leads and this has proved very successful. The free end is terminated in a miniature croc-clip, preferably the sort with an insulating plastic boot. It must be stressed that the 75Ω coaxial cable must have a stranded inner conductor, e.g. "Uniradio 70". Cable with a solid inner is too stiff to be convenient in use and with the flexing to which it will be subjected, the inner will certainly go open-circuit eventually.

Note that as the probe attenuates the waveform to the oscilloscope by a factor of 10, nine-tenths of the voltage applied to the probe will appear across RA and CT. The latter should therefore have a voltage rating adequate to cope with the highest voltage the probe may experience, say 500V working or better still, 1000V.

## Setting Up The Probe

This requires a square-wave generator with an output which can be set to around 100mV peak-to-peak at a frequency of 1kHz or thereabouts. If it has accurately known output levels it can also be used for checking the oscilloscope's "Y" gain settings and the Oscilloscope Calibrator published in the January 1977 issue of *PW* is quite suitable. Alternatively, the design shown in Fig. 5 can be used. This calibrator is powered from the front panel accessory socket of the *PW* Purbeck oscilloscope itself.

Whichever source is used, connect the probe to the oscilloscope with the "Y" gain at  $10\text{mV} \times 0.5$  and a sweep speed of  $500\mu\text{s}$  per division. Apply a square-wave source and adjust "Trig Level" for a locked picture. The

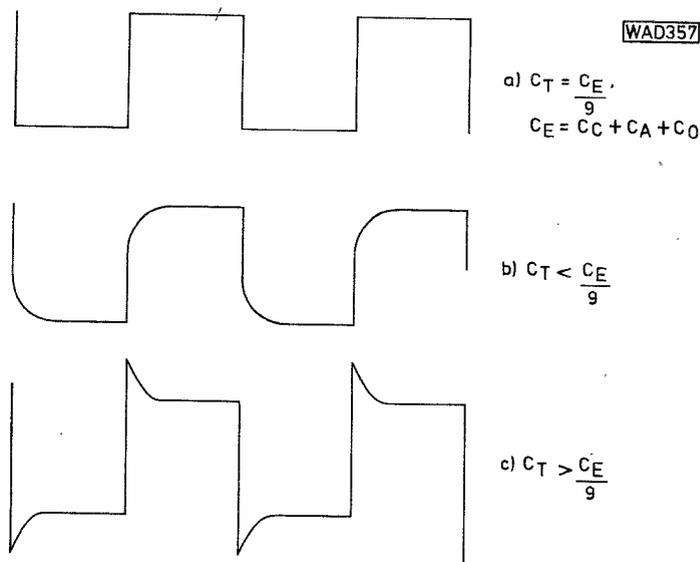


Fig. 3: The effects of misadjustment of  $C_T$

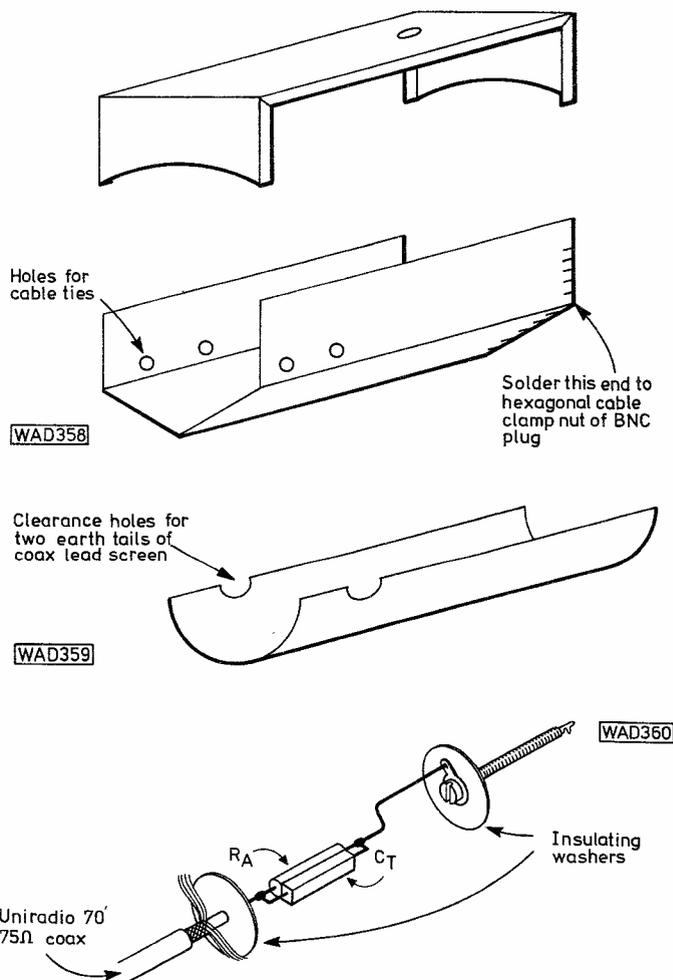


Fig. 4: The component parts of the probe housings. (Top) the housing for CA (Centre) the half shell for the probe head, two of these are needed. (Bottom) the details of the probe head wiring

Notes. CA mounted in housing at BNC plug end. RA and CT are insulated and fitted between shells which are then soldered along their seams. The screen tails are soldered to the outside of the shells. Araldite is added at both ends, the insulating washers preventing ingress. The coaxial cable is secured to the CA housing by soldering the screen tails, wire ties through the four holes provided and also by Araldite. The inner connects to CA at probe head and BNC plug inner at the other end





# student radio

C. ARUNDEL

Interesting experiments in community broadcasting are currently being conducted in three English new towns: Telford, Basildon and at Newton Aycliffe in County Durham. Further closed-circuit local broadcasting has been introduced to suburban housing developments in Greater London.

Stations operating in the medium frequency band and based at seventeen universities and colleges in the United Kingdom have broadcast successfully for several years. Indeed the oldest of these, University Radio York, recently celebrated the tenth anniversary of its first broadcast, so this would seem an appropriate time to take a look at this form of radio.

## Origins

It is often surprising how widely the effects of a simple new idea are felt, and the growth of campus radio certainly seems to fall into this pattern. It has its origins in the plan of a single student, who saw the potential value of this kind of facility as a forum for information and ideas within a university community. So it was that in 1967 the administration of York University was approached in order that the response to a scheme to operate a radio station might be gauged. It is worth pointing out at this juncture that a closed-circuit TV system had operated successfully since the University's inception several years earlier. There was therefore a generally favourable response to the idea, and representations were consequently made to the Post Office asking that the project should be allowed to proceed.

Lecturers currently at York remember the problems encountered in persuading the authorities of the feasibility of the project to create the first licensed radio station in England independent of the BBC. The fact that experimental local radio organised by that body was also planned at the time, may have been influential in their decision to provide a licence. University Radio York was eventually allocated the medium wave channel 998kHz 301 metres, on the understanding that the signal should be audible only at the University site. The experience gained at York was to prove useful at the University of Kent, where plans for a similar project were in preparation.

## Transmitting Installation

In order to restrict the signal to the campus as required, a system of aeriels known as induction loops are in use at URY and the stations which have followed. Indeed, this is the only feature of the transmission systems of campus radio to differ from local radio generally.

The signal from the transmitter is transported to each part of the campus via runs of coaxial cable terminated in a r.f. transformer. The secondary winding of this transformer is connected in parallel with a single loop aerial, composed of approximately 25 metres of insulated wire wound in a coil upon a frame and connected to a variable capacitor, so forming a parallel tuned circuit, subsequently brought to resonance at the operating frequency. (Medium wave DXers will recognise this as a further application of the popular DX reception aerial).



The on-air studio at University Radio York, showing Sony mixer and cassette decks, Thorens TD125 transcription turntables and Revox B77 tape deck

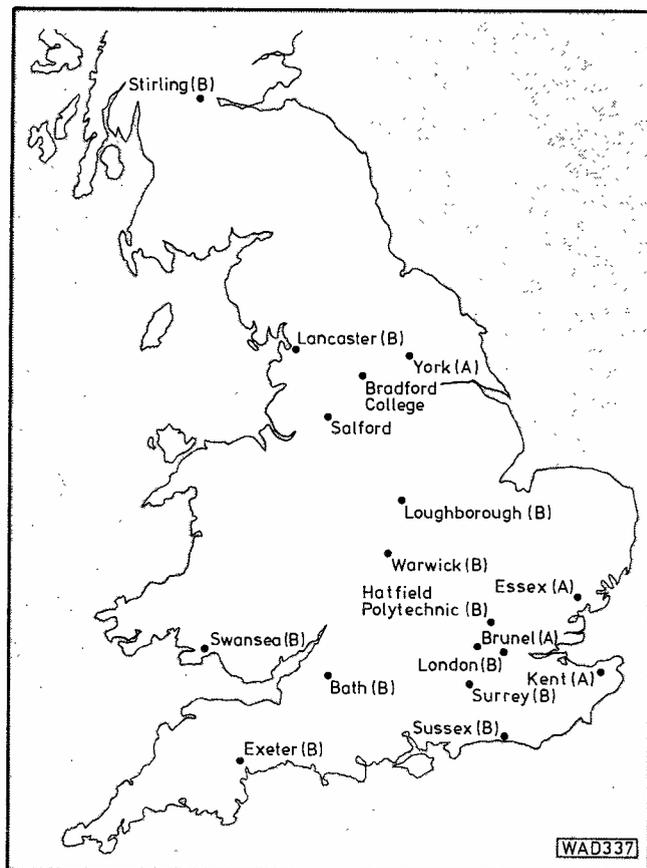
Each loop provides a high field strength of transmitted signal at short range, but signal strength is very low at distances of only a few tens of metres from the aerial, minimising the risk of off-campus radiation. The loops are then installed on the roofs of groups of buildings to be supplied with programmes.

## Developments

At URY, 30 April 1969 marked the end of a period of experimentation with the first official broadcast, a programme recorded for the occasion by BBC presenter John Peel.

The development of URY has proved to be characteristic of many of the campus stations, the initial capital outlay being donated by the University or college student union, and annual grants being provided thereafter to meet running costs, though some stations have found supplementary sources of income. University Radio Bath, for example, have shown some enterprise in running their own disco which appears four nights or so every week at venues in the town. The stations are not permitted to carry advertising.

As more stations came on-air it became clear that a co-ordinating organisation was required to negotiate with the licensing body and performing rights organisations, and to act as an information exchange between stations. Consequently the National Association of Student Broadcasters was formed, and each year its annual conference is hosted by one of the member stations.



**Campus stations in operation at June 1978. Stations given the suffix (A) use 999kHz, 300 metres. Those given the suffix (B) use 963kHz, 312 metres. These are the post-November 1978 channels**

## Programmes

The programme formats adopted contain music, news, "what's on" information and features; and generally, record companies are very generous in supplying a good selection of their latest material. Singles and album charts are run in conjunction with local record shops and playlists are used at many universities to ensure the music heard has a wide appeal.

Typically, a fast-moving breakfast show is broadcast daily, plus a teatime magazine programme of local news and interviews, request shows and a variety of other material until the early hours. Minority interest features are also to be heard; thus the output of UKC Radio at Kent University includes arts reviews, plays, short stories, classical music and current affairs during the 80 or so hours of their broadcasting week. Apart from programmes presented during the course of a normal week, there is often news of particular local interest, and it is on these occasions that the benefits of campus radio become clear.

Stress is placed upon putting people on the air as soon as they feel confident in the use of studio equipment. The duration of courses being as they are, roughly one-third of the personnel depart each year and the gap which they leave must be filled as soon as possible. The policy is also consistent with the concept of ease of access and a belief that the most effective way to produce competent presenters is to give them plenty of practice.

Surveys carried out by the stations have shown a demand for regular news summaries and there has therefore been a tendency to relay the hourly bulletins of Independent Radio News, by arrangement, from the v.h.f. transmissions of commercial radio. Others have formed links with the BBC; Radio Bradford college produces a weekly programme of interest to students in West Yorkshire, which is broadcast by BBC Radio Leeds, and a link has also developed between the Kent University station and BBC local radio.

## The Future

As for the future, it seems likely that campus radio will be brought within the auspices of the IBA. What the effects of this interaction will be remain to be seen, however several stations have pointed out that if the IBA was to assume responsibility for maintenance of transmitters, as is done at present with local commercial radio, it would be possible to devote more time to the basic process of programme production.

Whatever the future holds, the fact that University radio stations not only survive on relatively small budgets but that their number increase annually suggests that small community radio stations could succeed in a wide range of other environments. It is to be hoped that the next ten years of student radio prove as interesting as the last.

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WHEN REPLYING  
TO ADVERTISEMENTS**

# LOGICAL NOUGHTS & CROSSES

J.D. MITCHELL PART 1

## Mounting the l.e.d.s

The display l.e.d.s are mounted on PCB 3 and pushed up through holes drilled in the case lid. The board is held to the lid by the 6BA bolts used as input switching studs.

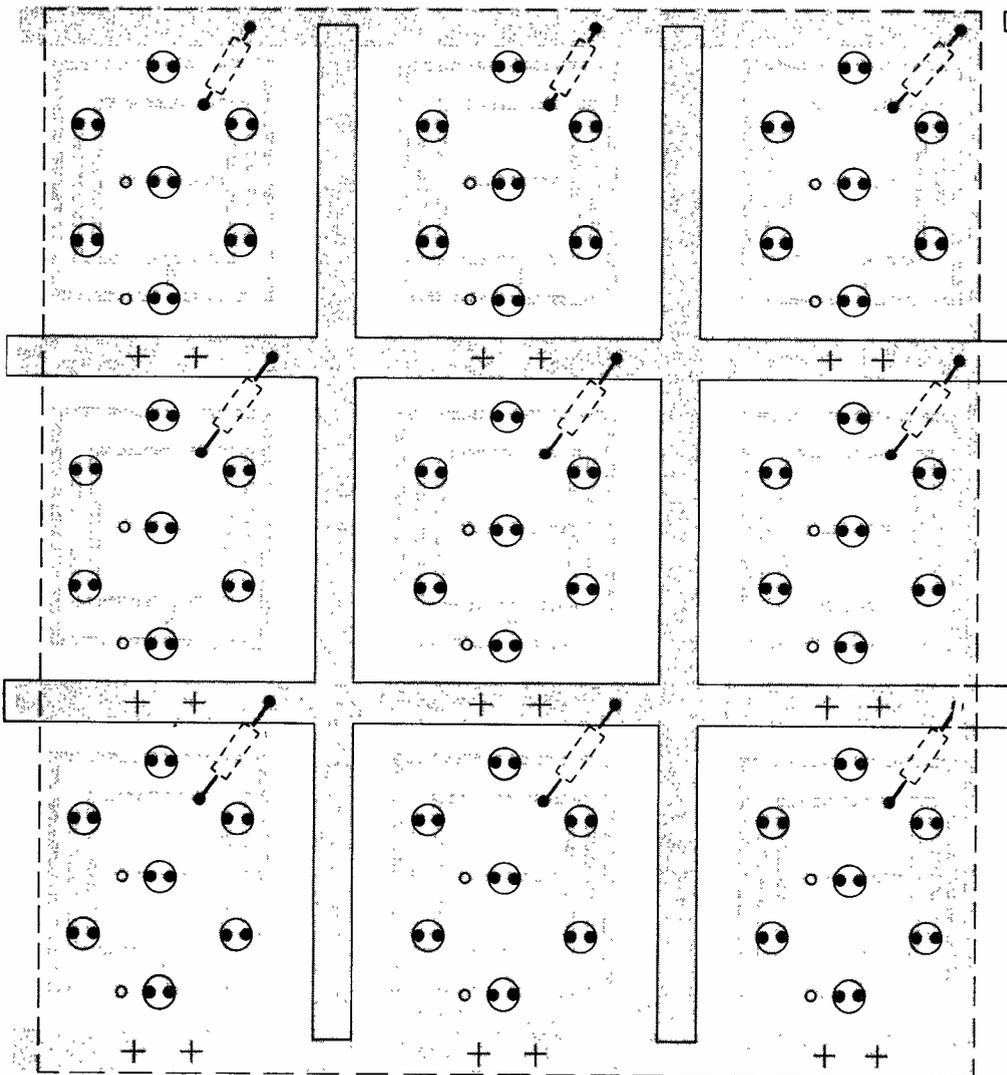
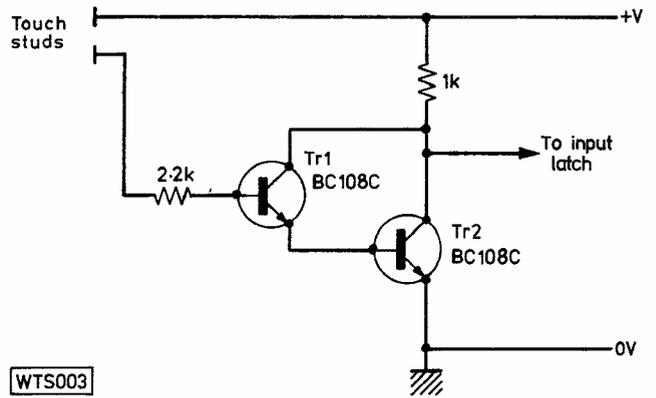


Fig. 5: Component placement layout for PCB3



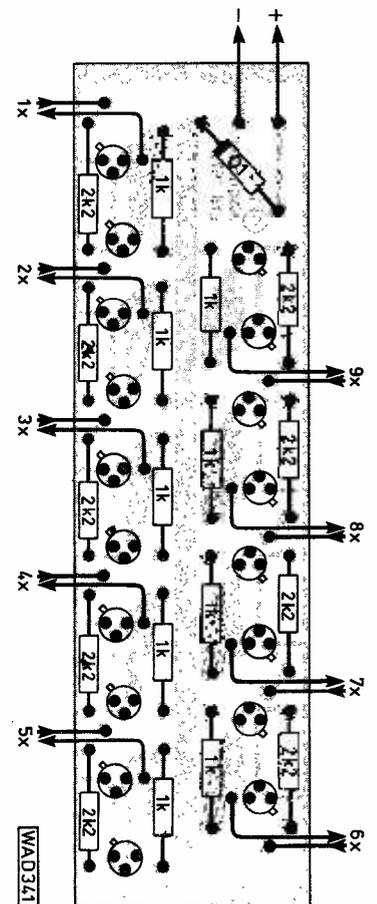
WTS003

Fig. 6: The touch-switch input circuit, note this circuit is repeated nine times on the p.c.b.

The touch-switching input components are mounted on PCB 4, which is held on edge at the switch end of the case behind the corner pillars.

The power supply used in the prototype comprises of a battery-holder containing four HP11 or type C cells held two by two, and a silicon diode. The diode reduces the positive rail from 6V to protect the input latches from damage. Alternatively, any supply giving 5V at 500mA d.c. may be built in if a larger case is used.

WAD342



WAD341

Fig. 7: Component placement layout for PCB4

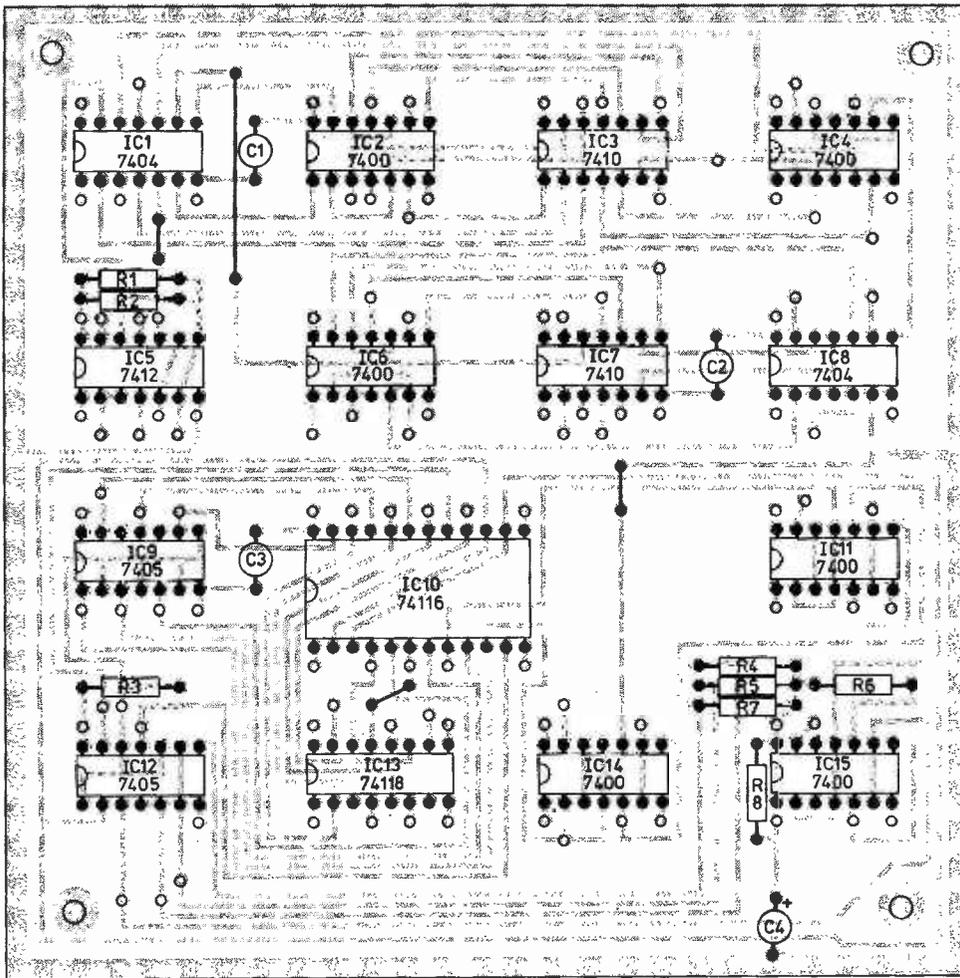


Fig. 8: Component placement layout for PCB1

WAD344

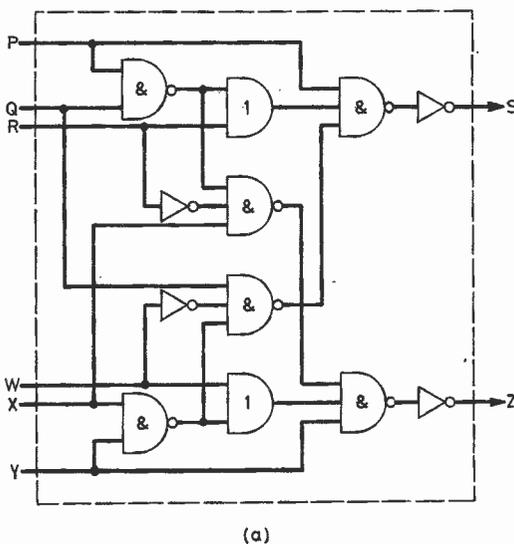
## Making the display

Display Board 3 is best constructed by inserting the l.e.d.s and initially soldering one leg only. The dropping resistors are mounted on the copper side either on pins pushed down through the board and cropped on the l.e.d. side, or by blob-soldering. Their leads should be sleeved. All connections from Board 1 are similarly made on the underside. The touch-switch screws may then be inserted

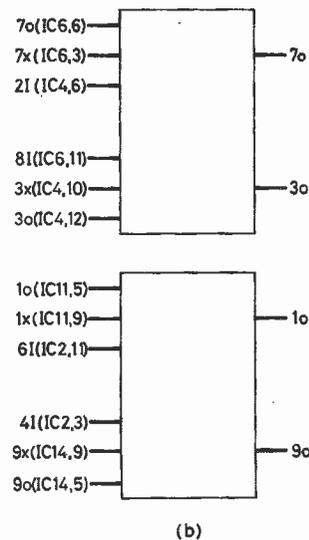
in the lid and held temporarily with strips of Sellotape. Invert the lid and drop a washer over each screw as spacers. Board 3 may then be fitted, and bolted in place.

Board 4 is mounted with the component side facing into the case. The leads from Boards 1 and 3 may be soldered in with the board close to the end of the case, and then lifted back as the board is placed in the case.

It is very helpful in construction if leads between boards are colour-coded.



(a)



(b)

(c)

Truth table							
P	Q	R	W	X	Y	S	Z
1	1	1	1	1	1	1	1
1	1	1	1	1	0	1	0
1	1	1	1	0	1	1	1
1	1	1	0	1	1	1	0
1	1	1	0	1	0	0	0
1	1	1	0	0	1	0	1
1	1	1	0	0	0	1	0
1	1	0	1	1	1	0	0
1	1	0	1	1	0	0	0
1	1	0	1	0	1	0	1
1	1	0	1	0	0	1	1
1	1	0	0	1	1	1	0
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1	0	0	1	0	1	1	0
1	0	0	1	0	0	1	1
1	0	0	0	1	1	1	0
1	0	0	0	1	0	1	0
1	0	0	0	0	1	1	0
0	1	1	1	1	1	0	0
0	1	1	1	1	0	0	0
0	1	1	1	0	1	0	1
0	1	1	1	0	0	0	0
0	1	1	0	1	1	0	0
0	1	1	0	1	0	0	0
0	1	1	0	0	1	0	0
0	1	1	0	0	0	1	0
0	1	0	1	1	1	0	0
0	1	0	1	1	0	0	0
0	1	0	1	0	1	0	0
0	1	0	1	0	0	1	0
0	1	0	0	1	1	0	0
0	1	0	0	1	0	0	0
0	1	0	0	0	1	0	0
0	1	0	0	0	0	1	0

Fig. 9: Variations on "illogical moves"

WRM112

## Illogical moves

The program of the basic circuit is designed to make no reply to certain "illogical" moves, those associated with the five 3-input NAND gates which enable the display inhibit. This was considered to be the logical response whereby 126 games may be won by the player.

A variation to the above is possible using additional output gating as shown in Fig. 9. A reply is routed to one of the two Nought displays when such a move is made (see Truth Table). The number of games which may be won by the player is reduced to 16. Two circuits as in Fig. 9(a) are required, inputs taken from display gating on PCB 1 and outputs to the l.e.d. display as shown in Fig. 9(b).

Additional components required for the above are one SN7432 (Quad 2 i/p OR), three SN7410 (Triple 3 i/p NAND), two SN7404 (Hex. inverter) and one SN7400 (Quad 2 i/p NAND). These may be mounted on an additional board above PCB 1, but a deeper case will be needed. The track between IC5-6 and 5-8 on Board 1 should be cut. R1 is replaced by a 9.1kΩ, IC5-6 is linked to IC 1-1 and R10 is replaced by a 1.5kΩ.

## Construction

The case is moulded in ABS plastic, and a number of p.c.b. fixings and other extrusions have to be removed from inside the case. This is simply done using a coarse-toothed hacksaw blade, around which a piece of tape is wrapped as a grip. In order to fit the battery-holder flush to the grooved end of the base, approx. 2.5mm must be carefully removed from the inner edges of the two nearby corner pillars, through which the screw fixing is made. This may also be done with the saw blade. The batteries are fitted here to allow clearance for the switches mounted in the lid at the lower end. The diode is soldered directly to the positive terminal of the battery-holder in the prototype, but could be mounted on Board 4.

Holes in the lid for l.e.d.s and switch studs may be positioned by gumming a tracing of Fig. 5 on top. Holes for the l.e.d.s should be drilled using a 5.10mm drill; those for the studs require a 2.95mm drill. The squares on the lid may be marked out using a sharp knife and a straight edge. "Brasso" or a similar metal polish will clean up the lid after soaking off most of the paper. The lines around

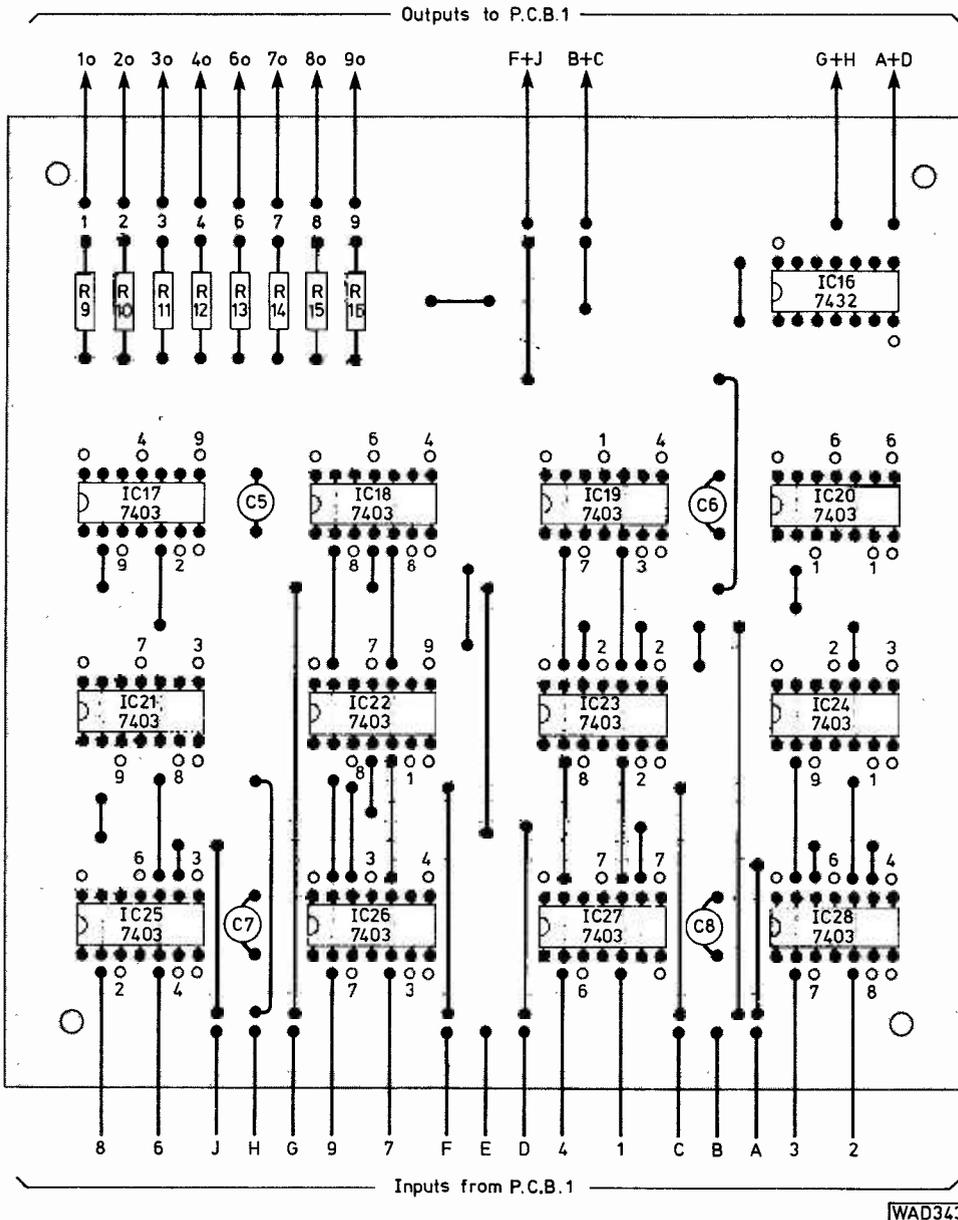


Fig. 10: Component placement layout for PCB2

WAD343

the squares may then be used as guides for thin plastic strips fixed using acetone as an adhesive (hold the strips in place and lightly brush the liquid along the edges with a fine brush. The weld will be firm in about 30 seconds).

## Minimising costs

In order to keep cost to a minimum, only single-sided p.c.b.s are used and i.c.s are soldered directly into the boards. PCB 1 should be constructed as shown, using Veropins at all points where connection is made to more than one other pin or to another board. After testing the completed board, remove R5 before connecting to PCB 2.

PCB 2 should be constructed as shown, using Veropins on all NAND gate outputs and where connections are made to Board 1. After checking, it may be mounted beneath Board 1 using 4BA nuts and bolts with 12mm spacers. Input leads from Board 1 may then be connected, and Board 2's outputs checked before connecting back to Board 1. Operation of the complete logic circuit may then be tested, using a probe as input and a logic probe. (A probe circuit is given in Fig. 11.)

The bolts holding the two boards together should be heads down. A blob of epoxy will then fix them to the floor of the case, in the space left by the battery-holder, which is fixed similarly.

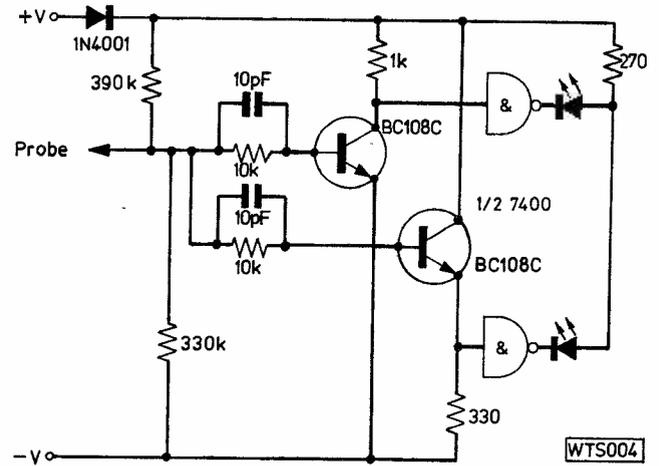
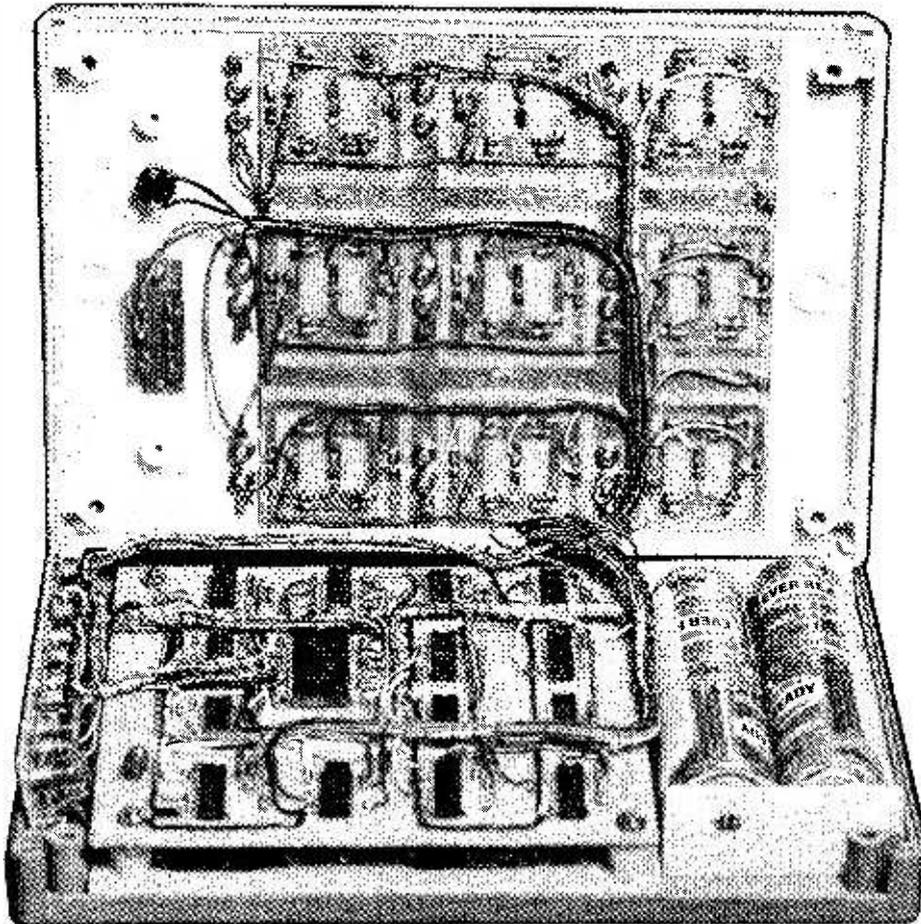


Fig. 11: The logic probe circuit diagram

### An internal view of the Author's prototype



## Embellishment

There are of course many extras which may be added to the basic circuit, such as a win indication, delayed replies, an external larger display, etc. Deeper cases are available in the same style for those who may need the extra space. ●

Full-size paper prints of the p.c.b. layouts are available at an inclusive price of 40p. Apply to *Practical Wireless, Westover House, West Quay Road, Poole, Dorset BH15 1JG*. Cheques and P.O.s should be payable to: *IPC Magazines Ltd.*

## Mainline takeover

Arrow Electronics Ltd. of Leader House, Coptford Road, Brentwood, Essex, have acquired the entire stock of Mainline Electronics Ltd. previously of Windsor and Slough, Berks.

Mainline Electronics audio equipment will be available from Arrow and it is contemplated that production of the Mainline amplifiers will be continued, as it is proposed to merge these products with Arrow's existing "Leader" range of kits.

## Can I Help You!

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

Alan Martin

## RAE Reprint

A reprint of the complete series—So You Want to Pass the RAE?—including details of the new examination format being introduced this year, is now available.

Order your copy by completing and returning the coupon on page 70.

## Hi-Fi f.m.

A new piece of equipment which greatly improves the quality of frequency modulation (f.m.) transmission has been developed in Australia.

For use with a typical £100 000 transmitter the new equipment—about the size of two cigarette packets—costs around £10.

It is the result of four years' research by Dr Keith J. Kikkert, senior lecturer in the Electrical and Electronic Engineering Department at the James Cook University of North Queensland, Townsville. Dr Kikkert, 34, was born in Amsterdam and went to Australia in 1962.

Tests of his new equipment have produced f.m. reception with a distortion factor 20 times less than the best



## New Portable Radiophone

Marconi Mobile Radio, a Division of Marconi Communication Systems Ltd, is now an approved supplier of equipment to the Post Office Radiophone Service and the new 'go-anywhere' telephone, the SV1320A, opens up completely new uses for the service.

With the extension of the East Pennine Radiophone Area coming into operation in the near future the SV1320A is a telephone that could be extremely attractive to new subscribers. The versatile equipment is designed to fit into the corner of a car boot with the control unit and handset easy to hand for the driver or

passenger. Take the equipment out of the vehicle, a simple operation taking less than a minute, and a completely portable telephone is available to take to your weekend cottage, on the boat, fishing, into the garden or wherever you need to be contacted.

With a battery or charger unit the equipment can be used as a temporary telephone at major construction sites and office accommodation before land lines are installed. The equipment works from 12 volts or by attached battery pack, which with normal operating will last a day without recharging. *Marconi Mobile Radio, M.C.S.L., Marconi House, Chelmsford CM1 1PL. Tel: (0245) 53221.*

equipment now used by large f.m. radio and t.v. stations.

Dr Kikkert said the reduction in distortion might even be much better than indicated, because there was no equipment available capable of measuring it above the "20 times" mark.

Conventional f.m. transmitters—those used in radio, television sound and microwave communication relays—generate at a high frequency. Dr Kikkert's success has been achieved by generating f.m. at a low frequency of 1MHz, which is then amplified and transmitted at 101MHz. Existing f.m. transmitters have a direct output. *Australian Information Service, Australia House, Strand, London WC2B 4LA.*

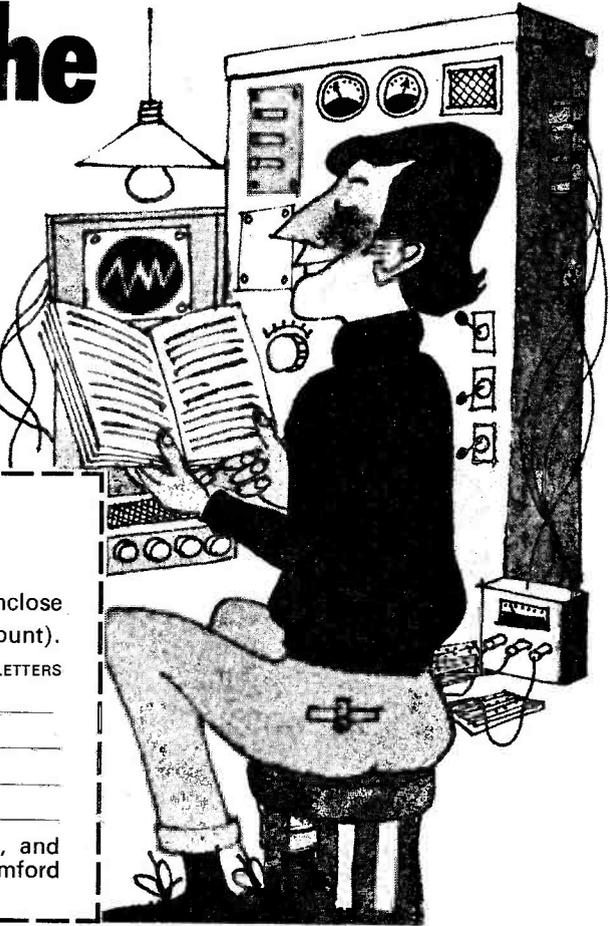


**Dr Kikkert with the piece of equipment he developed**

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7400.13*	19*	7449	.87*	74136	—	.39*	74191 1.21*	.75*	4000 .15*	4063 .81*	DIL (Texas)	Static RAM's	1+	17-63 64+	78M Series	CA3080	.75	7401.13*	19*	7450	.16*	74138	—	.55*	74192 1.21*	1.85*	4001 .16*	4054 1.29*	8 pin .10*	2102A (350ns)	1.05*	95*	.88*	+(POS) 500mA	CA3130E	.90	7402.15*	19*	7451	.16*	74139	—	.55*	74193 1.21*	1.85*	4002 .16*	4056 1.46*	14 pin .12*	2102A-2 (650ns)	1.29*	1.15*	1.08*	5v. 6v. 8v. 12v. 15v.	CA3140E	.37	7403.15*	19*	7453	.16*	74141	.76*	—	74194 1.21*	—	4009 .92*	4059 5.18*	16 pin .13*	2111A-1 (500ns)	2.46*	2.19*	2.05*	20v & 24v.	LM301AN	.30	7404.16*	21*	7454	.—	74145	.75*	1.05*	74195 1.01*	1.05*	4008 .92*	4060 1.24*	18 pin .18*	2112A-2 (250ns)	2.14*	1.90*	1.78*	All 60p* each	LM324N	.73	7405.16*	21*	7455	.—	74147	1.59*	—	74196 1.18*	1.05*	4007 .18*	4066 4.8*	20 pin .20*	2102 (350ns)	1.07*	.96*	.86*	79M Series	LM348N	.99	7406.26*	—	7460	.16*	74148	1.32*	—	74197 1.18*	1.05*	4009 .54*	4068 2.1*	22 pin .22*	MM5257 (TMS4044)	8.10*	7.19*	6.75*	-(NEG) 500mA	LM380N	.97	7407.26*	—	7470	.27*	74150	1.02*	—	74198 1.81*	—	4010 .54*	4069 2.1*	24 pin .26*	2114 (450ns)	8.10*	7.19*	6.75*	5v. 6v. 8v. 12v. 15v.	LM380N	1.73	7408.17*	19*	7472	2.3*	74151	.67*	.88*	74199 1.81*	—	4011 .18*	4070 2.1*	28 pin .30*	6810	3.50*	2.97*	2.52*	20v & 24v.	LM382N	1.33	7409.17*	19*	7473	.29*	74153	.67*	.48*	74201	—	4012 .18*	4071 2.1*	40 pin .44*	8080	5.95*	—	—	All 85p* each	LM3892N	.65	7410.15*	19*	7474	.28*	74154	1.21*	1.25*	74240	—	4013 .49*	4072 2.1*	—	8080	8.95*	—	—	78 Series	LM3803N	.70*	7411.25*	19*	7475	.29*	74155	.67*	.78*	74241	—	4014 .92*	4073 2.1*	—	9800	42.50*	—	—	+(POS) 1A	LM3803N	1.02	7412.18*	19*	7476	.30*	74156	.67*	.78*	74242	—	4015 .92*	4081 2.1*	—	E-Prom's UV	8126P	1.65*	—	18v & 24v.	SN78003N	2.32	7413.25*	40*	7478	.—	74157	.67*	—	74243	—	4016 .43*	4082 2.1*	—	1702A0	5.57*	—	—	5v. 6v. 12v. 15v.	SN76013N	1.55	7414.71*	79*	7482	.73*	74158	—	.58*	74247	—	4017 .81*	4085 .92*	—	27080	8.78*	—	—	All 85p* each	SN76023N	1.55	7415.25*	—	7485	1.18*	74160 1.21*	.39*	74248	—	—	4018 .92*	4086 .92*	—	TriState Buffers	8139P	1.49*	—	—	TB6810AS	.90	7417.34*	—	7488	2.50*	74162 1.21*	.65*	74249	—	—	4019 .56*	4088 9.81*	—	811395	.75*	—	—	79 Series	TC4540	1.75	7420.16*	19*	7489	2.60*	74163 1.21*	.65*	74251	—	—	4020 .92*	4099 1.8*	—	811396	.75*	—	—	-(NEG) 1A	ZM414	.30	7421.25*	19*	7490	.34*	74164 1.02*	.115*	74257	—	—	4021 .92*	4502 9.2*	—	811397	.75*	—	—	5v. 6v. 12v. 15v.	ZM424E	1.35	7422.25*	19*	7491	.73*	74165	.78*	74258	—	—	4022 .92*	4508 2.46*	—	74365	.75*	—	—	18v & 24v.	ZM425E	3.78*	7423.25*	19*	7492	.46*	74166 1.02*	.88*	74260	—	—	4023 .18*	4510 1.0*	—	74366	.75*	—	—	All £1.00* each	ZM459CT	3.54	7425.25*	—	7493	.34*	74168	—	1.85*	74266	—	4024 .65*	4511 .95*	—	74367	.75*	—	—	LM200	ZM1034E	2.03*	7426.25*	19*	7495	.54*	74169	—	1.85*	74273	—	4025 .18*	4515 2.70*	—	74368	.75*	—	—	LM304H	ZM1040E	8.43*	7427.39*	19*	7496	.67*	74170 1.85*	1.65*	74279	—	—	4026 1.84*	4516 1.0*	—	74369	.75*	—	—	LM323K	ZM116E	6.75*	7428.36*	19*	74107	.27*	74173 1.41*	.88*	74283	—	—	4027 .51*	4518 1.0*	—	74370	.75*	—	—	LM325N	—	—	7429.16*	19*	74109	.44*	74174 1.01*	1.05*	74290	—	—	4028 .70*	4518 9.5*	—	74371	.75*	—	—	LM326N	—	—	7430.16*	19*	74123	.60*	74175 1.01*	1.05*	74293	—	—	4029 1.08*	4521 2.54*	—	74372	.75*	—	—	LM326N	—	—	7432.25*	25*	74112	—	74176 1.01*	1.05*	74295	—	—	4030 .56*	4521 2.86*	—	74373	.75*	—	—	LM345K	—	—	7433.25*	19*	74113	—	74177 1.01*	1.05*	74295	—	—	4031 .56*	4522 1.89*	—	74374	.75*	—	—	LM345K	—	—	7437.25*	25*	74114	—	74178 1.01*	1.05*	74298	—	—	4032 .18*	4525 1.80*	—	74375	.75*	—	—	LM345K	—	—	7438.25*	25*	74121	.27*	74180 1.01*	—	74365	—	—	4033 1.06*	4528 .92*	—	74376	.75*	—	—	LM345K	—	—	7440.17*	19*	74122	.50*	74181 2.21*	2.99*	74366	—	—	4034 1.88*	4534 7.12*	—	74377	.75*	—	—	LM345K	—	—	7441.70*	19*	74123	.60*	74182 .81*	—	74367	—	—	4035 1.06*	4534 7.12*	—	74378	.75*	—	—	LM345K	—	—	7442.50*	55*	74124	—	74183 1.81*	—	74368	—	—	4036 1.06*	4543 1.62*	—	74379	.75*	—	—	LM345K	—	—	7445.60*	—	74125	.51*	74185 1.62*	—	74369	—	—	4037 .51*	4543 4.53*	—	74380	.75*	—	—	LM345K	—	—	7446.60*	—	74126	.51*	74186 2.97*	—	74369	—	—	4038 1.06*	4545 1.51*	—	74381	.75*	—	—	LM345K	—	—	7447.60*	.87*	74132	.72*	74189 3.17*	2.25*	74369	—	—	4039 .43*	4583 1.02*	—	74382	.75*	—	—	LM345K	—	—	7448.60*	.87*	74133	—	74190 1.21*	.75*	74369	—	—	4040 .92*	4585 1.07*	—	74383	.75*	—	—	LM345K	—	—

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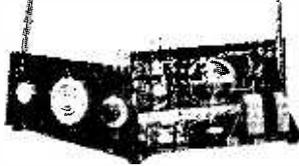
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Build this converter kit and receive the aircraft band by placing it by the side of a radio tuned to medium wave or the VHF band and operating as shown in the instructions supplied free with all parts. Uses a retractable chrome-plated telescopic aerial, gain control, V.H.F. tuning capacitor, transistor, etc. Size 5½" x 1½" x 3½". All parts including case and plans.

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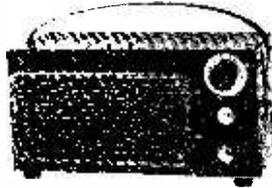


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8 transistors and 3 diodes. Push pull output. 3 in. loudspeaker, gain control, 7 section chrome-plated telescopic aerial, V.H.F. tuning capacitor, resistors, capacitors, transistors, etc. Will receive T.V. sound, public service band, aircraft, V.H.F.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

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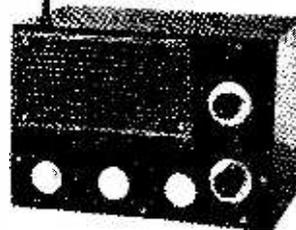
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## NEW ROAMER TEN MODEL R.K.3.



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Complete kit of parts including carrying strap. Building Instructions and operating Manuals.

**£14.79 + P & P £1.10**

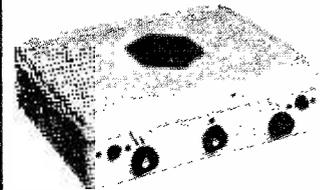
## E.V.6 PLUS ONE



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Total Building Costs:  
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## EDU-KIT MAJOR



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- Signal Injector ● Transistor Tester NPN-PNP ● 7 Transistor Loudspeaker Radio MW/LW ● 5 Transistor Short Wave Radio.

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Total building costs:

**£9.99 + P & P and Ins. £1.10**

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# direct use of COMMUNICATIONS SATELLITES

We have already seen great developments in satellite communications, but far more impressive systems are likely to become available during the next ten years. Initially the larger manufacturing companies will have their own earth stations which will provide them with continuous communications facilities, but hand-held personal communications sets for direct transmission to huge spacecraft are being planned for about 1990.

In European homes the greatest impact of satellite communications occurs when a television signal is relayed from another continent. All such very long distance television links are made using satellites in geosynchronous orbit some 36 000km above the equator; such satellites orbit the earth once every 24 hours and hence remain above the same point of the earth at all times. However, television relays account for only about 2 per cent of the total use of communications satellites, the greatest demand being for ordinary telephone conversations by businessmen, together with high-speed data transmissions.

At the present time, communications satellites are used mainly for intercontinental communications by means of the INTELSAT spacecraft, although maritime and military satellite communications are also of vital importance. Very rapid developments are taking place; the European Space Agency recently launched the OTS2 vehicle which will be a forerunner of the first European satellite to carry telephone and television signals on a commercial basis across Europe.

Satellites are presently handling rather more intercontinental telephone traffic than sub-oceanic cables. The American Federal Communications Commission is apparently delaying the production and laying of a new TAT-7 transatlantic telephone cable whose 4000 telephone circuits would provide a more equally balanced capacity between cables and satellites. Cables are more expensive than satellites, but have a much longer life than the typical seven years design life of a satellite.

The INTELSAT spacecraft provide first class communications facilities over the largest distances, but involve the use of extremely expensive earth stations with parabolic reflectors of some 30 metres diameter; all points of these huge reflectors should be positioned with an accuracy of about 1 millimetre and retain this accuracy even in a high wind. Such stations became available in the mid-1960s at a cost in the order of £5 million. Some smaller, more economical earth stations with 10 metre diameter aerial reflectors are used in low density traffic areas for international communications where maximum bandwidth is not required.

The era of satellite broadcasting of television and radio programmes is now commencing. Aerials with reflector diameters of some 5 metres can be used in earth stations costing some £30 000, for receiving television signals from a geosynchronous satellite and relaying them to a whole community of users. Smaller aerials (perhaps 1 metre in diameter) can be used with more economical receivers costing no more than a few hundred pounds, to provide

television signals to individual homes in out-of-the-way places. Higher power satellite transmitters combined with very high gain satellite aerials make such economical earth stations possible for reception only, without facilities for transmitting to the satellite.

Eventually very large aerial structures will be assembled in space and, when used with far more powerful satellite transmitters, are expected to make possible the use of small hand-held transmitters for direct communications with the satellite by about 1990. The earth station reflectors may be about 100mm diameter and the total cost of the hand-held equipment about £10 on present day values. One of the advantages will be that you will eventually be able to telephone almost any person via a satellite by merely dialling his number; it will not be necessary to know whether he is working at his office, on a visit to another company, at his home, at his club or even taking a bath—although some protection of his privacy may be necessary.

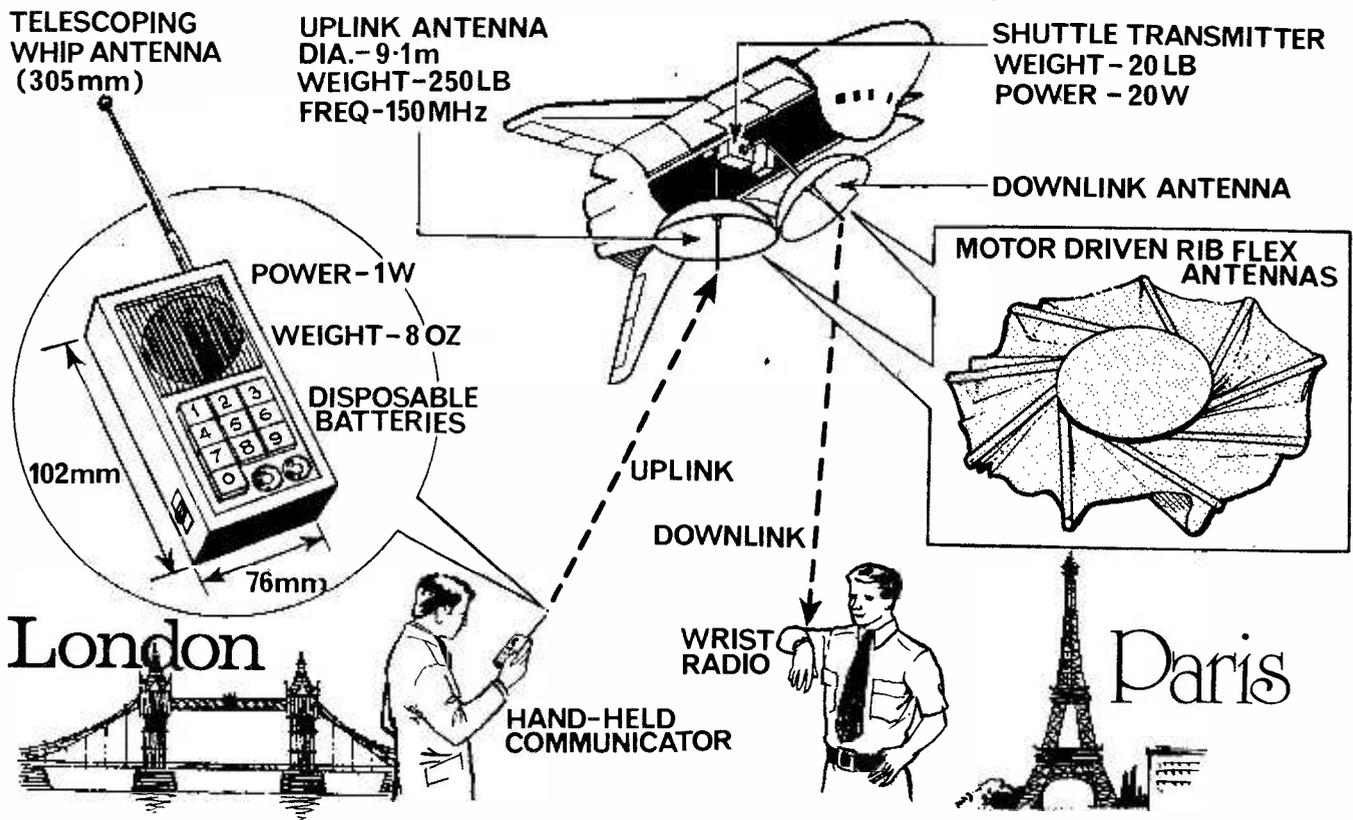
One can even imagine a wrist radio communications system in the next century. Enormous satellite aerials with very high power transmitters will be required for such a system. However, it is claimed that the cost of such systems will be surprisingly low owing to the enormous amount of telephone traffic they would handle. It seems likely that the cost of a call over a distance of 3000km will be similar to that of a call to a person a few doors away in the same street. Competing with such telephone systems will be electronic letter facsimile transmission systems, which will (hopefully!) ensure the fast delivery of letters across intercontinental distances even if messages cannot be immediately delivered.

## SBS

In the more immediate future, a series of satellites will be launched in 1981 by a consortium known as SBS (Satellite Business Systems), which will provide US businessmen with direct access to the satellites for communications purposes through small company-owned unattended earth stations using 5 or 7 metre diameter aerial reflectors. One can imagine such dish reflectors being as commonplace as our present-day television aerials.

The Hughes Aircraft Company of California has been awarded a \$63 million contract by SBS for the construction of three domestic satellites for the direct transmission of voice, facsimile (printed matter), video, high-speed computer data and tele-conferencing pictures for US business and government agencies.

The SBS system will be the first US domestic commercial communications satellite system to use the higher frequency "K" Band (12 and 14GHz; that is, 12 000 and 14 000MHz). This high frequency system will enable earth stations to be located in urban areas without causing interference to terrestrial systems or to other spacecraft, whilst small and relatively inexpensive earth stations can be used at such frequencies.



**Fig. 1: A concept of how we may be able to communicate in the future by a personal satellite link**

The SBS satellite system will cover all of the 48 contiguous states of the USA. The beam transmitted from the spacecraft will be electronically shaped so that the strongest signals are sent to the more densely populated east-central and west coast regions of the US, where SBS will install 5 metre diameter aerial reflectors on users' premises. In the remainder of the US the signals will be somewhat weaker, so 7 metre diameter aeriels will probably be employed.

Perhaps the most interesting feature of the SBS satellites is the use of a telescoping solar panel system. During the launch phase, the cylindrical solar panels are closed over one another to keep the satellite as compact as possible, but the panels will be deployed in space to provide the relatively high power level of about 914W. The spacecraft will be spin stabilised, so each part of the solar panel array comes into full sunlight in turn. It is intended that the SBS satellites will be launched by the Space Shuttle, since this type of launch will be much less costly than rocket launching. A SBS satellite will be able to sit upright in the cargo bay of the Shuttle vehicle with its aerial folded; this saves Shuttle charges, since the charge is more or less proportional to the payload bay length employed in the launch.

The travelling wave tubes in the SBS satellite transmitter will be able to provide an output power of 20W; this is higher than the more usual 5 or 6W in satellite transmitters. Ten channels, each 43MHz wide, will be available. Time Division Multiple Access (TDMA) will be used to provide the maximum signal-carrying capacity.

The specially shaped beam for providing maximum signal strength in the most heavily populated areas will be created by a 1.83 metre reflector with two reflecting surfaces. The front horizontal grid reflector is essentially

transparent to vertically polarised r.f. signals bounced off the rear reflector. Superimposition of the reflectors in a single aperture allows both of them to share structural support and have the maximum possible diameter. The two reflectors are offset from each other with a corresponding offset of their focal planes so that two separate feed arrays for transmit and receive can be employed without any mutual interference. It is expected that a minimum signal strength of 43.7dBW will be provided over the primary eastern coverage zone of the USA.

The SBS spacecraft are 2.16 metres in diameter by 6.6 metres in height when the solar panels are fully deployed. Each will weigh some 1057kg at launch, but after the apogee engine has been fired to place the craft in its correct geosynchronous orbit, the weight will be 555kg. Design life is seven years.

## Conclusions

Satellite communications are going to have an even larger impact on our lives in the future and will greatly facilitate business communications. It is interesting to note that it has been reported that the US has been using a "Pyramider" satellite communications link to enable their foreign agents to transmit short bursts of secret coded information via the satellite to their National Security Agency. Apparently Soviet agents in Mexico have purchased details of the system and former employees of a US satellite manufacturer have been charged with security offences. Presumably the US National Security Agency is rapidly searching for a replacement for their previous link. It is understood that the National Security Agency is interested in spread-spectrum links of very wide bandwidths (even up to 5GHz), since signals of such extremely wide bandwidths are very difficult to detect when transmitted at fairly low power, even with the most sophisticated receivers.

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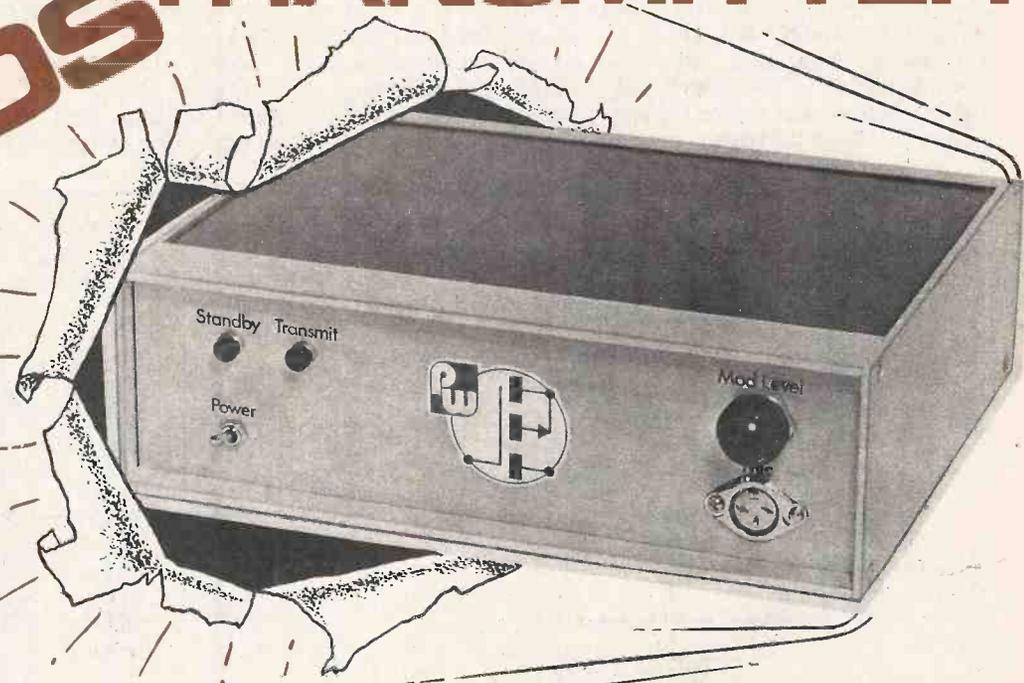
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# JUMBO

## Wall Clock

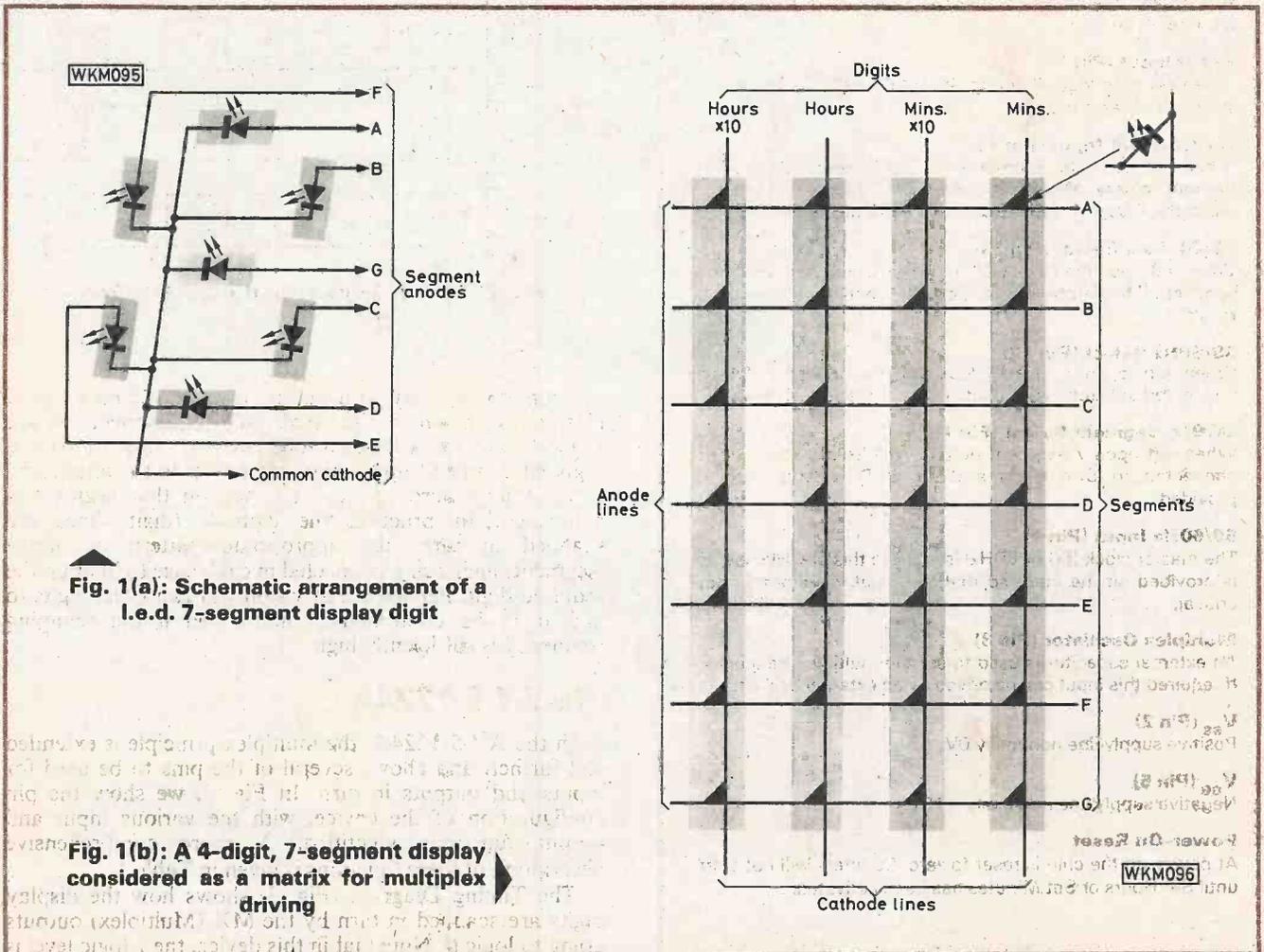
There have been many published designs for digital clocks, but these have almost all been for a digit height of less than 25mm. By using an array of discrete l.e.d.s, this clock has digits 64mm (2½in) high, and is ideal for use in shops, offices, kitchens, etc.

The circuit is based on the General Instrument Microelectronics clock chip AY-5-1224A, which utilises *p*-channel m.o.s. technology. Although not one of the most recent clock chips, it nevertheless incorporates a wide range of features, not all of which are used in this particular application. By the use of multiplexing techniques, a 16-pin dual-in-line package can be used. A non-multiplexed device offering similar facilities would require a 40-pin package.

### Multiplexing

The time division multiplexing technique, whereby several separate signals are passed in turn via one connection, is now widely used, particularly in digital displays and in calculator or typewriter keyboards. For the benefit of readers not familiar with the principle, a brief explanation may not be out of place. This will be based on the 7-segment, common-cathode l.e.d. displays used in this clock.

In Fig. 1(a), we show the schematic arrangement of one 7-segment display digit, with segments conventionally identified. Each digit requires eight external connections, so four digits connected in the normal way would require



**Table 1—Pin Functions**

Pins 1 and 11 to 16 are multifunction. During multiplex times 1 to 4 they function as data outputs, either 7-segment code or BCD according to the display mode selected. During multiplex time 5 (Strobe) they function as inputs.

**Segment Outputs A-G (Pins 1 and 11 to 16)**

In 7-segment mode the digits are multiplexed out on to these pins. Normally the outputs are at logic 0 (positive to display).

**BCD Outputs 2<sup>0</sup>—2<sup>3</sup> (Pins 1, 16, 15, 14)**

In BCD mode the digits are multiplexed on to these pins in BCD code. Normally the outputs are at logic 0 (positive), i.e. code 0=0000.

**Multiplex Outputs 1-4 (Pins 10, 9, 8, 7)**

These pins are successively switched to logic 0 to select appropriate digit display. A fifth multiplex time (Strobe) is used to enable the control inputs. The multiplex rate is 1/20th the multiplex clock frequency.

**Strobe Output (Pin 6)**

This pin is used to enable the control input lines; it goes to logic 0 to enable.

**Set Hours Input (Pin 1)**

When taken to logic 0 during Strobe time this input causes the hours counter to advance at the rate of 1 hour per second.

**Set Min Input (Pin 16)**

When taken to logic 0 during Strobe time this input causes the minutes counter to advance at the rate of 1 minute per second and the hours counter to advance at the rate of 1 hour per minute.

**Reset Input (Pin 15)**

When taken to logic 0 during Strobe time this input causes the clock to reset to zero.

**Complement Input (Pin 14)**

When left open the segments and BCD outputs will have normal polarity. When connected to Strobe output via a diode the 7-segment and BCD output will be inverted.

**12/24 Hour Select (Pin 13)**

When left open the clock will run in the 12 hour mode, when connected to Strobe via a diode 24 hour operation will result.

**50/60Hz Select (Pin 12)**

When left open a 50Hz clock will be accepted. When connected to Strobe via a diode 60Hz operation will result.

**BCD/7-Segment Select (Pin 11)**

When left open 7-segment outputs will be provided, when connected to Strobe via a diode BCD outputs will be provided.

**50/60Hz Input (Pin 4)**

The master clock (50 or 60Hz) is input to this pin. Hysteresis is provided on the input so that the input waveform is not critical.

**Multiplex Oscillator (Pin 3)**

An external capacitor is used to set the multiplex frequency. If required this input can be driven by an external oscillator.

**V<sub>ss</sub> (Pin 2)**

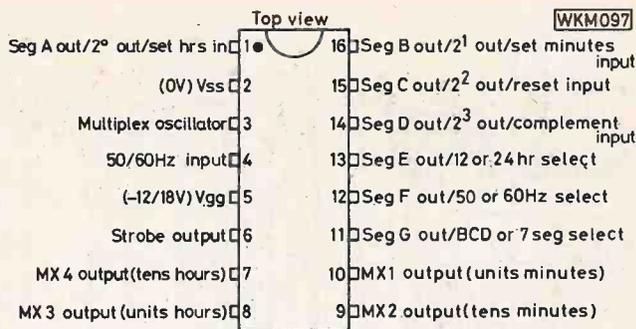
Positive supply line nominally 0V.

**V<sub>gg</sub> (Pin 5)**

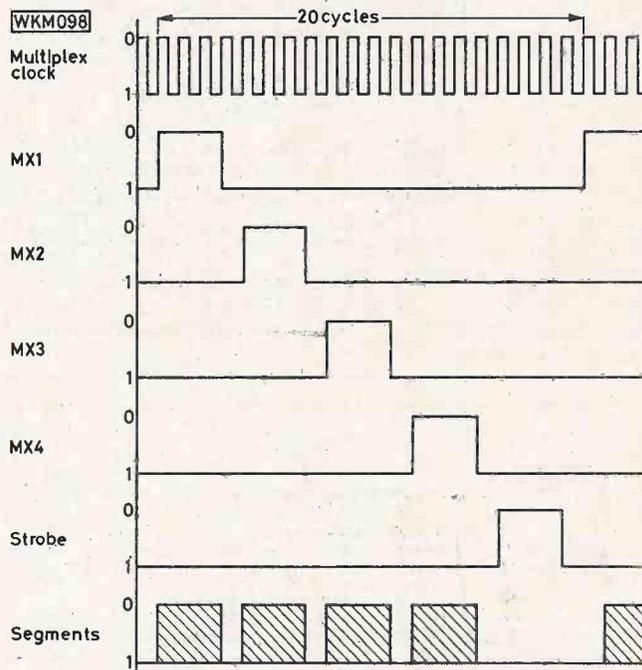
Negative supply line nominally -15V.

**Power-On Reset**

At power-on the chip is reset to zero. Counters will not start until Set Hours or Set Minutes has been activated.



**Fig. 2: Pin configuration of the GIM AY-5-1224A clock chip**



**Fig. 3: Timing diagram for the AY-5-1224A**

32 connections. By connecting the 28 segments in a matrix, as shown in Fig. 1(b), only 11 connections are needed—almost a three-to-one saving. Any individual segment can be lit up by applying power to the anode and cathode lines across whose intersection that segment is connected. In practice, the cathode (digit) lines are scanned in turn, the appropriate pattern of anode (segment) lines being connected in each case to light up the required digit. Persistence of vision will cause the digits to appear to be continuously illuminated if the scanning frequency is sufficiently high.

**The AY-5-1224A**

In the AY-5-1224A, the multiplex principle is extended still further, and allows several of the pins to be used for inputs and outputs in turn. In Fig. 2, we show the pin configuration of the device, with the various input and output functions identified. A more comprehensive description of these functions is given in Table 1.

The Timing Diagram (Fig. 3) shows how the display digits are scanned in turn by the MX (Multiplex) outputs going to logic 0. Note that in this device, the 1 logic level is

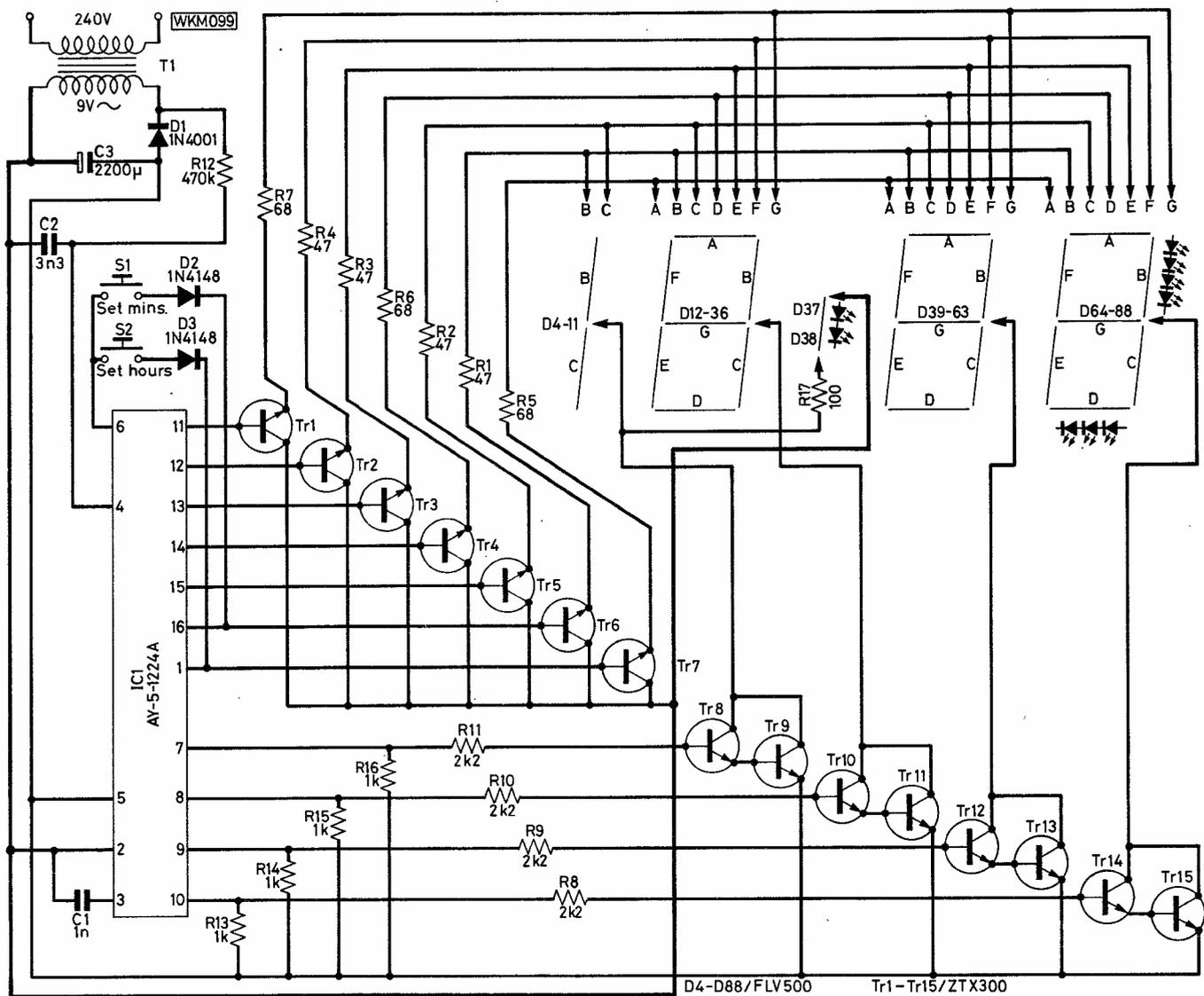
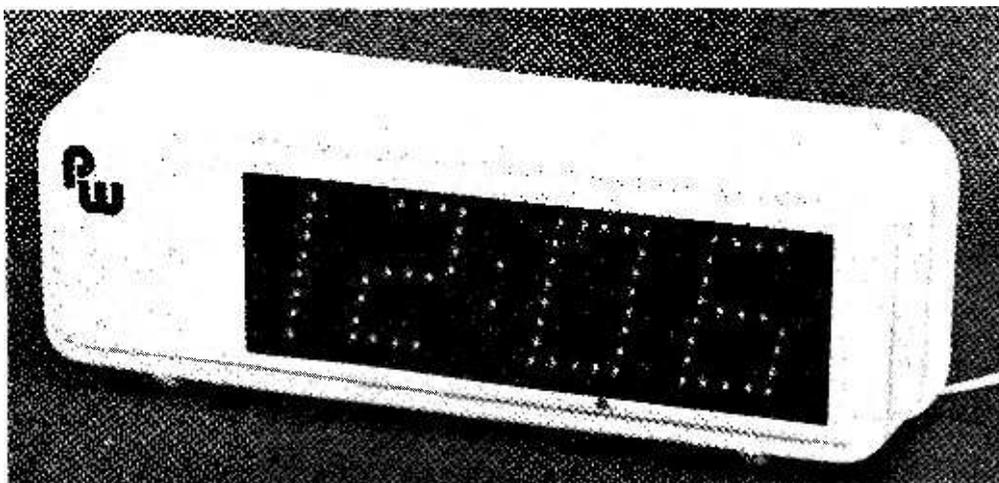


Fig. 4: Complete circuit diagram of the Jumbo Wall Clock



a negative voltage, approaching the  $V_{CC}$  supply rail. The input/output pins become inputs during the period that the Strobe output goes to logic 0.

## Circuit Description

The complete circuit diagram of the clock is shown in Fig. 4. Transformer T1 has a nominal 9 volt secondary, and the rectified and smoothed d.c. output across C3 will be around 13 volts. A sample of the 50Hz a.c. supply is taken from T1 secondary via R12, and after shaping by C2, is fed to pin 4 on IC1 as the Master Clock. The frequency of the on-chip Multiplex Clock is set by C1, and will be about 6.7kHz.

The 7-segment outputs are applied to transistors Tr1-7, which drive the l.e.d. arrays via limiting resistors R1-7. Each horizontal segment uses three series-connected l.e.d.s, and each vertical segment uses four. The values selected for the limiting resistors compensate for the resulting difference in voltage drop across each segment, and give an even overall brightness to the display.

The four Multiplex outputs are applied to Darlington pairs Tr8/9, 10/11, 12/13 and 14/15, and control the "Tens of hours", "Hours", "Tens of minutes" and "Minutes" digits respectively. Only two vertical segments are required for the "Tens of hours" digit, since this can only be a blank or a "1". This form of display is known in instrumentation circles as a  $3\frac{1}{2}$ -digit display, meaning that there are three full digits, each capable of displaying "0" to "9", and one half digit, capable of displaying only a blank or a "1".

The colon separating the hours and minutes digits comprises two l.e.d.s, and is scanned at the same time as the "Tens of hours" digit. The cathode end of the colon pair is fed via limiting resistor R17 directly from the 0V line.

## Construction

All the components, apart from the mains transformer and the time-setting switches, S1 and 2, are mounted on a single p.c.b., greatly simplifying construction. In the display window area, all the wire links and resistor R18 are mounted on the foil side (underside) of the board, to preserve a clean frontal appearance. The power supply reservoir capacitor C3 is also mounted on the foil side, because there is insufficient room for it between the p.c.b. and the case front.

Being an m.o.s. device, IC1 should be left in its static protection pack until it is actually to be fitted to the board.

The first step in construction is to fit the wire links. Take the length of 20 s.w.g. tinned copper wire, secure one end in a vice, hold the other end with pliers and stretch slightly. This will remove all kinks, etc., and make the wire easier to cut and bend. Cut 21 lengths, each 45mm long, and bend both ends, allowing 26mm between bends. Because these links are fitted on the foil side of the board, they must be spaced off to avoid short-circuits to other tracks. It is easier to achieve this spacing if the bends are made curved rather than sharp, as shown in the photograph. A bend of some 2-3mm radius is about right. Place the links in the foil side of the board as shown in Fig. 6, solder both ends and trim the protruding wire ends flush with the plain (top) side of the p.c.b. The plain side of the board should then be sprayed with a light coat of matt black paint, to provide maximum display contrast in high ambient light levels.

## ★ components

### Resistors

$\frac{1}{2}W$ 5%		
47 $\Omega$	4	R1-4
68 $\Omega$	3	R5-7
100 $\Omega$	1	R17
1k $\Omega$	4	R13-16
2.2k $\Omega$	4	R8-11
470k $\Omega$	1	R12

### Capacitors

#### Polystyrene 160V

1nF	1	C1
3.3nF	1	C2

#### Electrolytic Axial leads

2200 $\mu$ F 40V

### Semiconductors

#### Integrated circuit

AY-5-1224A	1	IC1
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#### Transistors

ZTX300	15	Tr1-15
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#### Diodes

1N4001	1	D1
1N4148	2	D2, 3
FLV110	85	D4-88 (0.2in red l.e.d.s)

### Miscellaneous

T1 9V 0.75A secondary.

S1, S2 Min. push-button, s.p. push-to-make.

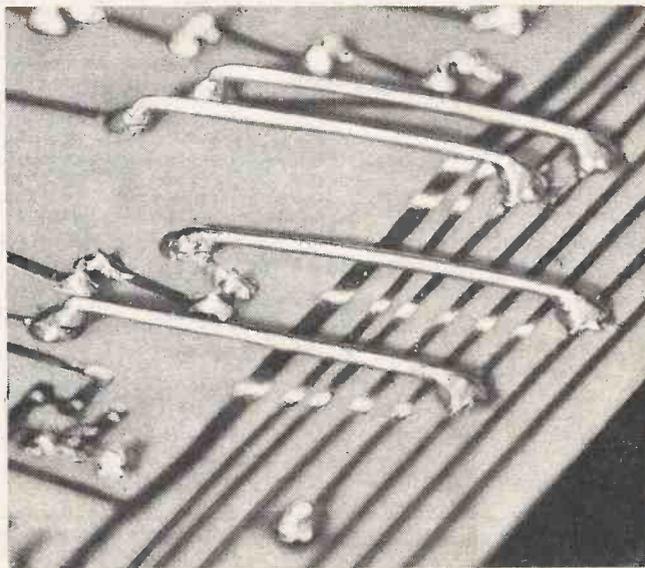
Printed circuit board Ref. WR051\*

Case, Perspex window and p.c.b. mounting pillars.\*

16-pin d.i.l. socket for IC1.

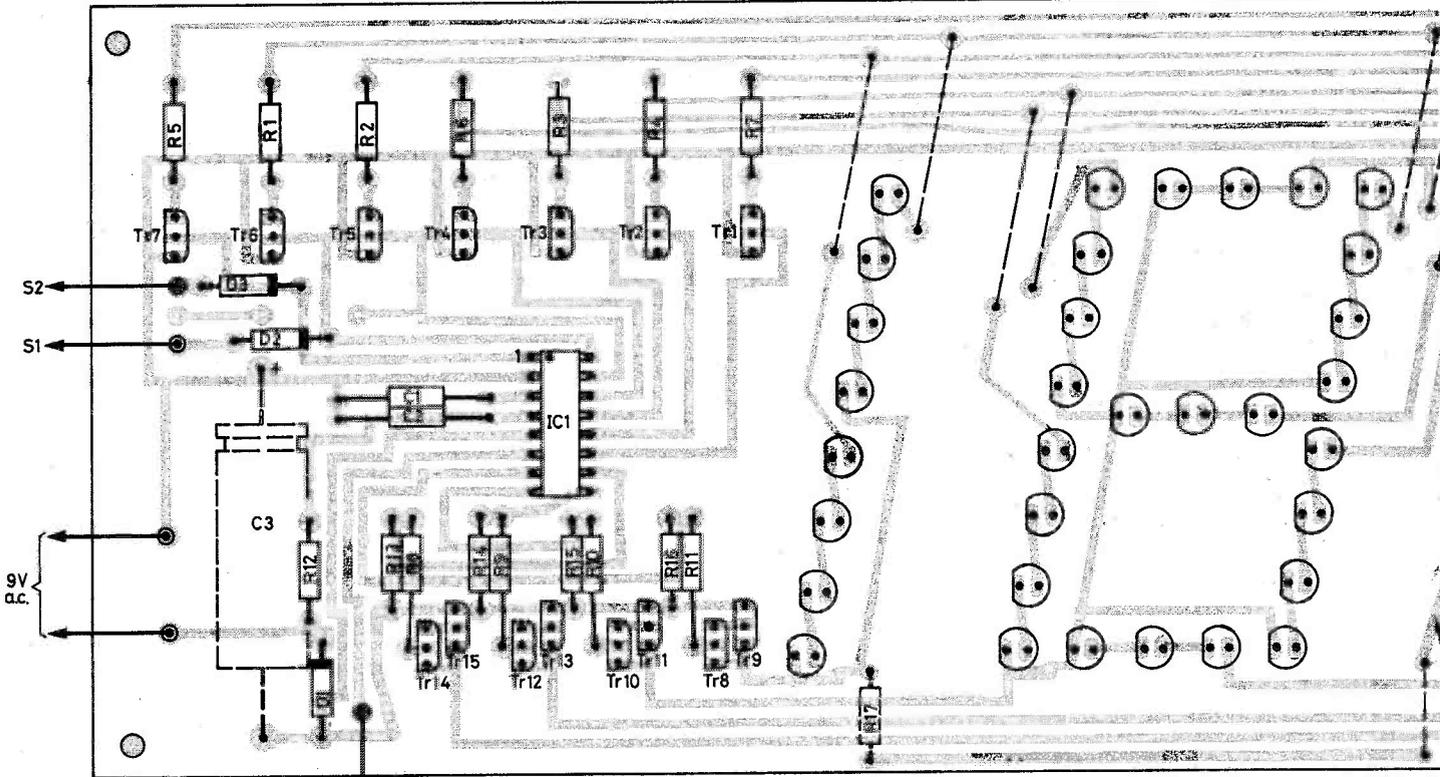
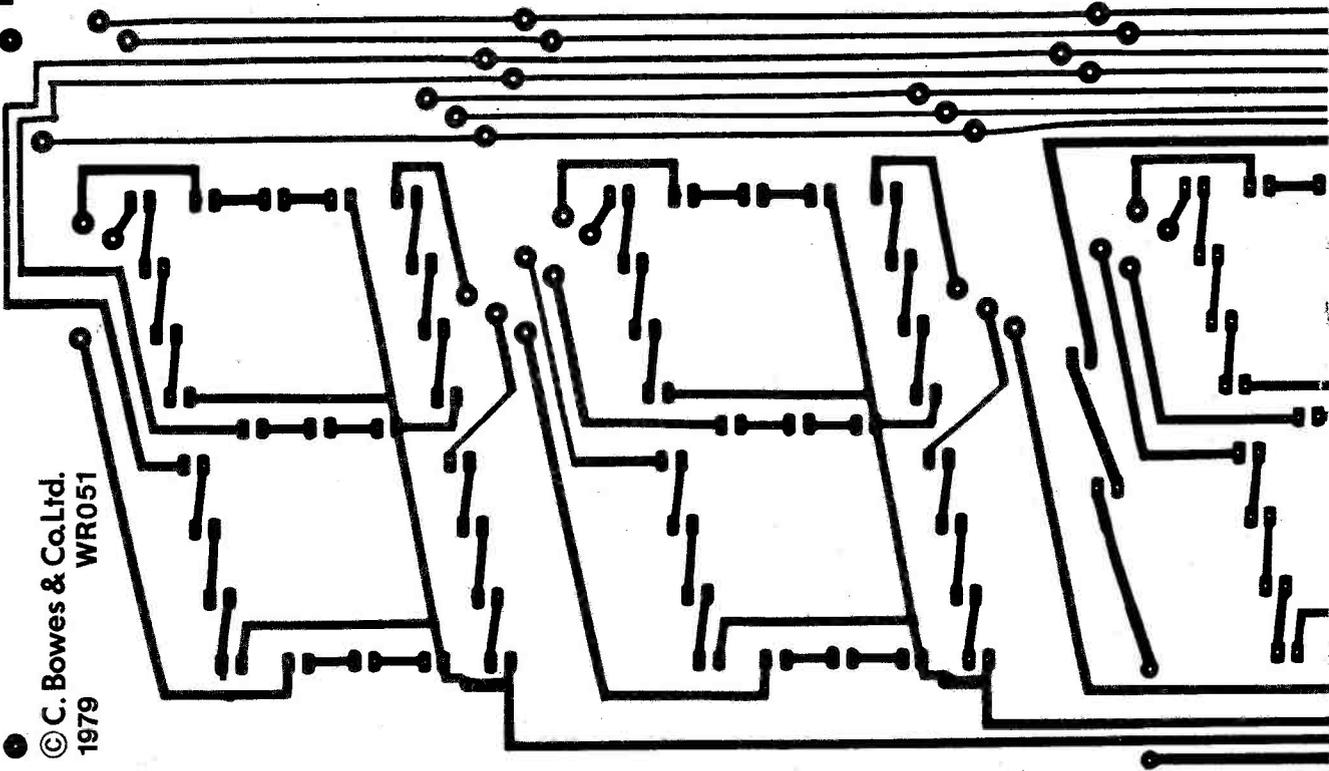
1 metre 20 s.w.g. tinned copper wire.

\*Available from C. Bowes & Co. Ltd. (see Advertisers' Index).

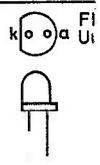
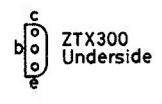


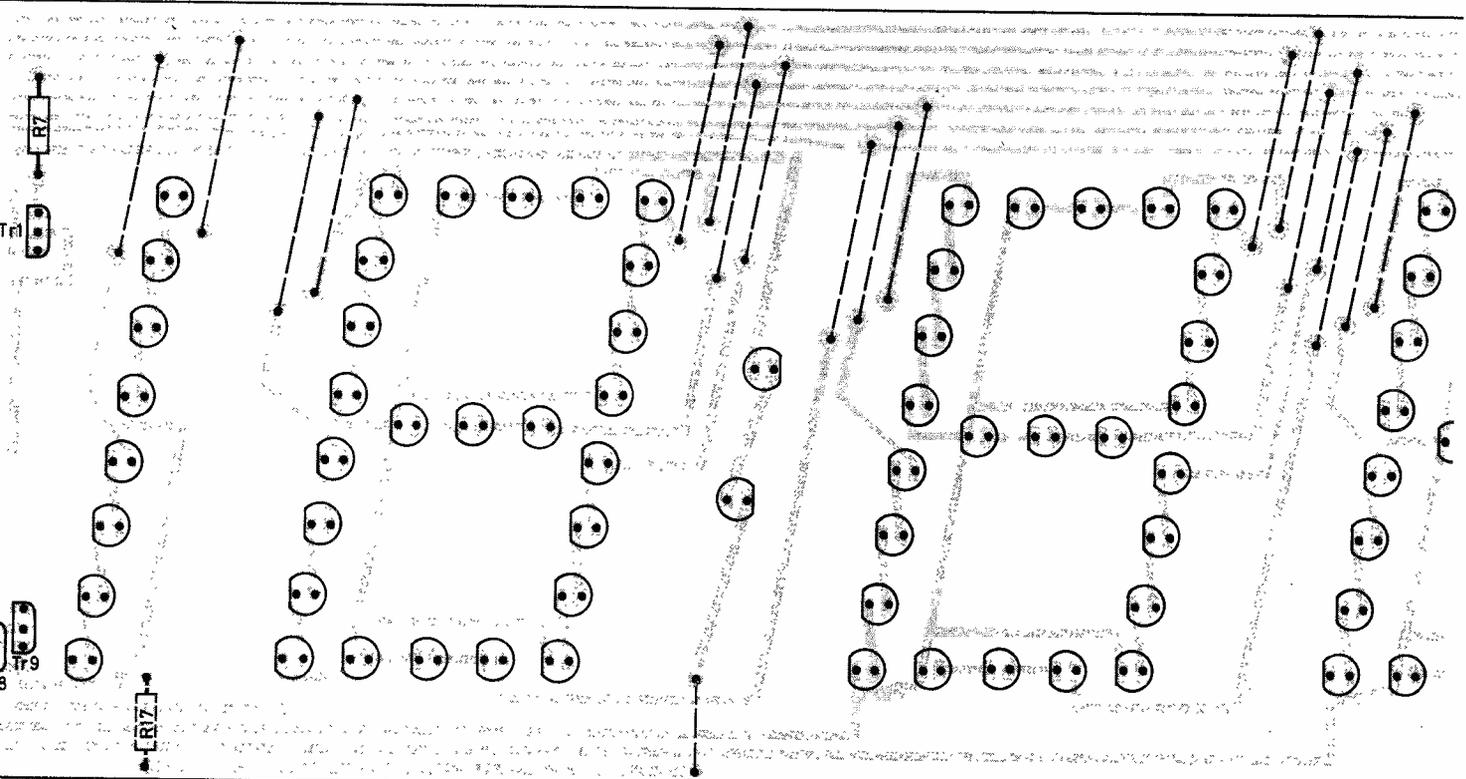
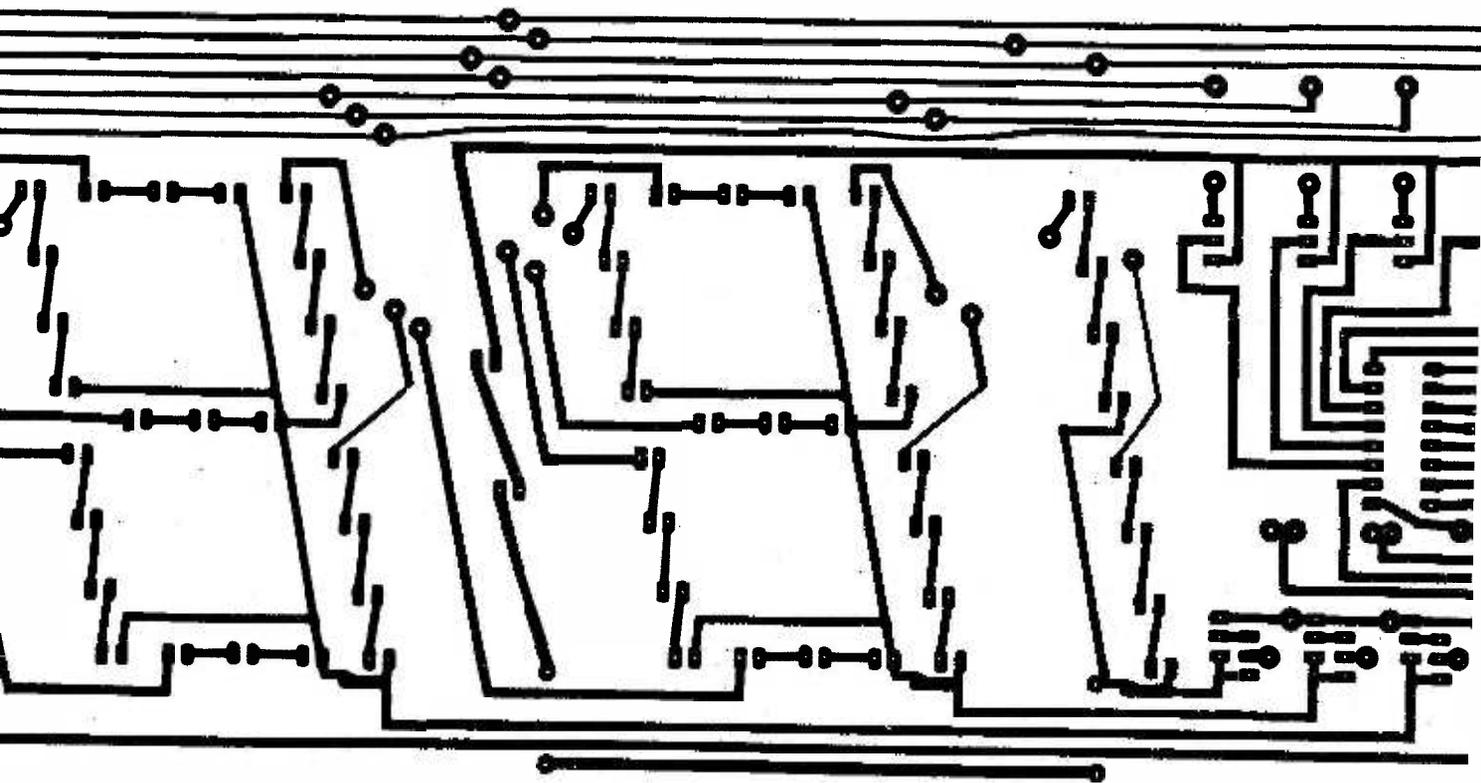
This photograph shows the way in which the 20 s.w.g. wire links are made to stand clear of the board by the radiused bends to the legs at each end

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WR051  
1979



All links & components R18/C3 (shown dotted) are mounted on track side of PCB.





(shown dotted)  
CB.

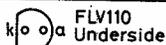
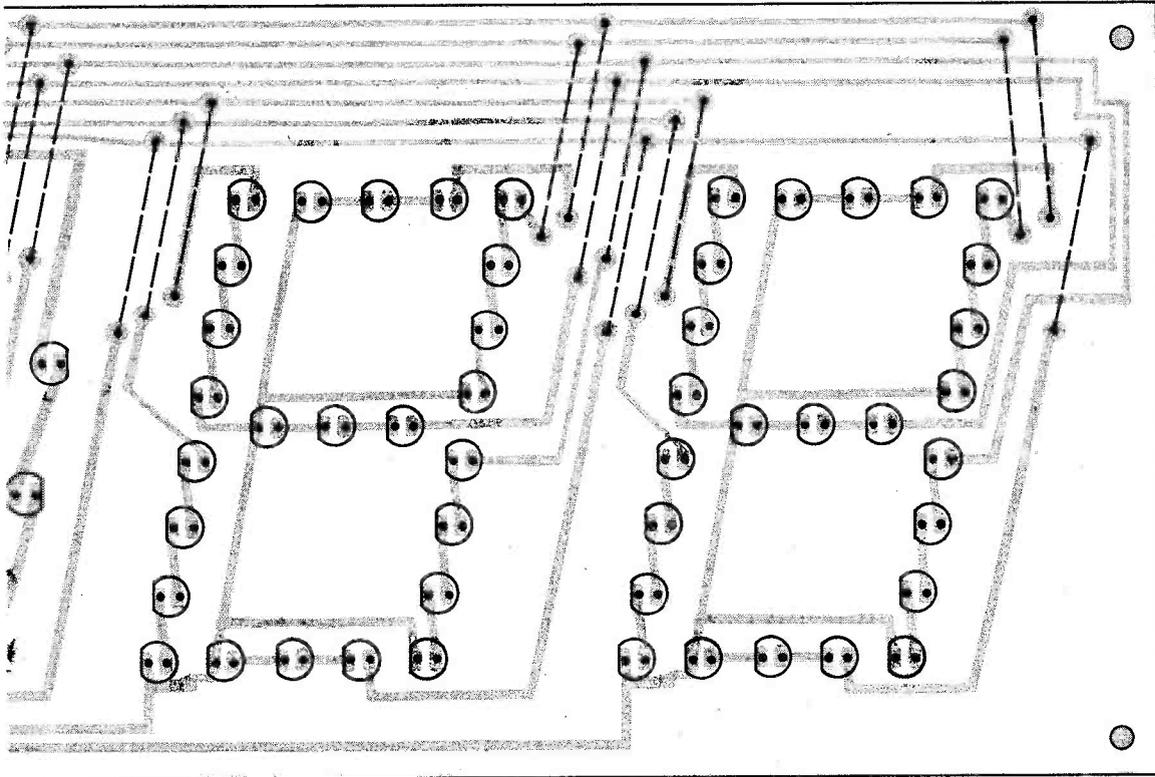
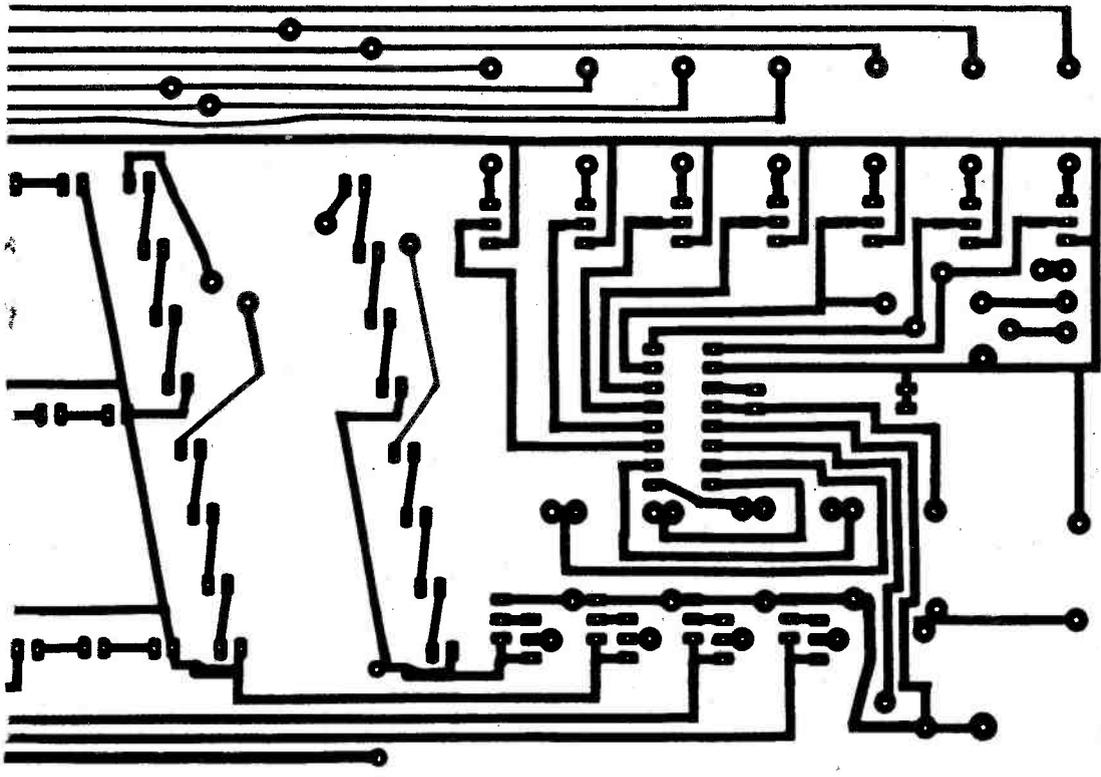




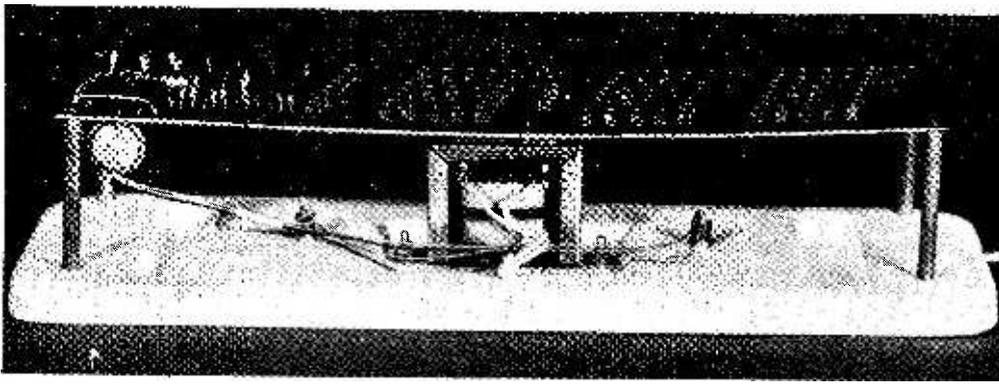
Fig. 5: The p.c.b. track pattern, shown full size



V110  
underside

WKM094

Fig. 6: Component layout and off-board connections



**An internal view of the clock, showing the two time-setting switches and the mains transformer mounted on the rear panel**

Insert all resistors, diodes, transistors and capacitors (except C3), and the i.c. socket, taking care to check that the semiconductors are fitted the right way round. Solder all the leads and trim the ends close to the p.c.b.

Next insert the l.e.d.s, noting that these are polarised, and should be fitted with the longest lead (the opposite side to the flat on the l.e.d. body) on the side facing away from the transistor, **except** for the two l.e.d.s forming the colon, which face the opposite way.

The l.e.d.s are easily damaged by excessive heat during soldering, and it is best to solder just one leg of each l.e.d. first, and then allow them to cool. Check that all l.e.d.s are in line and flat against the p.c.b., and then solder the second leg and trim off the excess wire ends.

Fit and solder five 300mm lengths of thin, pvc-covered wire to the p.c.b. in the positions shown in Fig. 6. Insert IC1 in its socket (**check correct orientation**). Fit C3 on the foil side of the board, noting that the negative end faces the edge of the board. After pushing the capacitor flush against the underside of the p.c.b., bend the wires over flat against the top side of the board before cutting, so as to create a mechanical fixing. Solder the leads on the foil side.

The four p.c.b. mounting pillars are made from 6mm diameter rod, and drilled 2.4mm to about 12mm deep at each end to take self-tapping screws. If the l.e.d.s and case mentioned in the components list have been used, the pillars will need to be 57mm long. If other types are used, the length will have to be adjusted to suit.

The transformer and switches are mounted on the back of the case, as shown in the photograph, and wired as shown in Figs. 4 and 6. Note that S2 (Set Hours) is on the left-hand side, behind the hours digits. The mains lead should be terminated in a fused clock connector or plug, fitted with a 1 amp fuse.

## Testing

When connected to a mains supply, the display should show three zeros and light the colon. On pressing a button at the rear of the case the appropriate digits should change, enabling the time to be set correctly.

Experience has shown that any l.e.d.s damaged internally through soldering are likely to fail during the first 24 hours of operation. It is therefore advisable to run the clock for two days out of the case.

When satisfied with the operation of the clock, the remainder of the case may be assembled. The red Perspex window should be glued into the case front with Evostik

(use sparingly to avoid spoiling the finished appearance), and the case fixed together either by means of self-tapping screws or Evostik.

## Fault Finding

If a single segment of the display fails to light when power is first applied, it is probable that one l.e.d. has been damaged when soldering. To locate the faulty l.e.d., select a number by means of the rear buttons, when it is known that the particular segment should be illuminated, and carefully short out each individual l.e.d. in that segment. The l.e.d. which, when shorted, lights the remainder, is the faulty one. Switch off the power and replace the faulty l.e.d.

If the same segment on each digit is off, check the resistor feeding the line, and the soldering of the associated transistor connections. If one digit is out completely, make the same checks on the resistors and transistor pairs at the bottom of the board.

## Noise

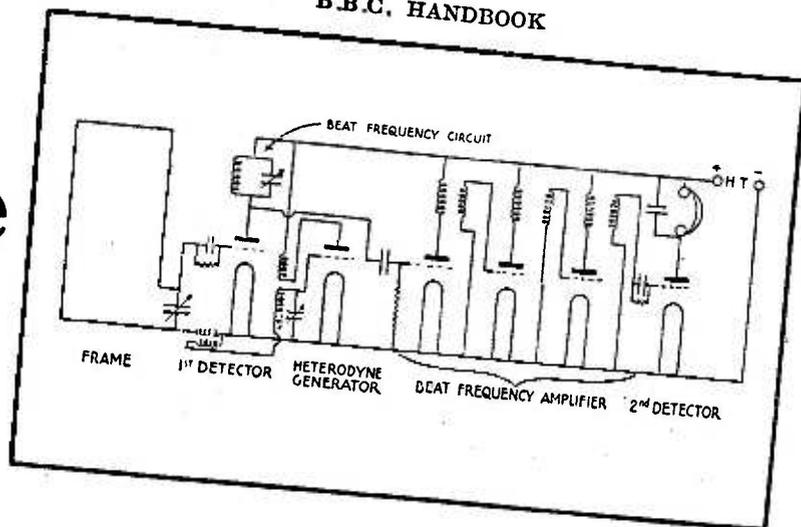
In common with all other multiplexed displays, it will be found that severe interference is caused to radio reception in the immediate vicinity of the clock. This interference is radiated from the display wiring, and it is not really practicable to suppress it. It will be found, however, that the noise disappears when the radio receiver is moved more than about a metre from the clock, and it should not normally prove a problem. ●

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# A Glance into the Past

Chas. E. MILLER

B.B.C. HANDBOOK



I recently acquired a copy of the BBC Handbook for 1928. It's a slim, but quite weighty volume of 384 pages, handsomely bound in dark red. Surprisingly, it contains a large number of advertisements, and at this distance in time these are arguably of at least as much interest as the text! For instance, on pages 2 and 3 we find a double-spread for Mr C. S. Dunham, late radio engineer to the Marconi Scientific Inst. Co., and a member of the BBC since its conception. (A somewhat doubtful word to employ in connection with that august organisation, I would have thought!), who has now set up in business as a manufacturer of high-class receivers. The two-valve loudspeaker set has a performance equal to many three-valve sets, at half the price and half the maintenance costs. Tuning is by a single dial with a small knob to vary reception power to individual requirements. Coils are entirely dispensed with. The larger C.S.D. 51D three-valver has a handsome cabinet fitted with a lock and key! It is a beautiful piece of furniture worthy of the most exclusive (but not presumably the most affluent) home, and is secured by a down payment of 35s 6d, and 25s monthly. Should you doubt any of the claims made, sworn statements are available for only 2d postage.

Passing on, Messrs Igranic Electric Co. Ltd. modestly announce their Neutrosomic Seven Radio Receiver, with the words: Igranic Radio Devices put life into a circuit — life in the zest and virility they give to results — life in the extraordinary length of time they continue to give such complete satisfaction. But what's this on page 17? An appeal To The Women Of Britain, no less, by a firm which has an enormous range of sizes, shapes, and designs. Of lampshades, I hasten to add. Hailwood & Ackroyd Ltd. (Morley, Nr. Leeds), enjoin the ladies to make their homes a Heaven on Earth for their menfolk by the use of their glassware. Zest, virility, and Mutual Pleasure! They certainly don't write advertisements like that any more. It makes one yearn for those far-off days when people thought a double-entendre was French for a pair of earphones.

## Origins

Ah well, on to the text. In an article entitled "BBC — the old Regime" we learn that the original British Broadcasting Company was set up in a remarkably short space of time — talks started in May, 1922, and the Company was registered on 15 December of that year. However, stations in London, Birmingham, and Manchester were commissioned on 15 November, and Newcastle had programmes from the following Christmas Eve. Thus, by the end of the year the BBC was able to claim that 40 per cent of the population were in "crystal range" of a transmitter. By the Autumn of 1925 this figure had increased to nearly 80 per cent.

In June, 1927, there were 2 299 822 licences in force for reception, which wasn't bad growth from virtually a standing start less than five years previously. Curiously enough the BBC now wished to dismantle the local stations in favour of "regional" broadcasting, not without some opposition from listeners, particularly in Birmingham, where the old 5IT transmitter in Summer Lane had already been closed down and replaced, in part, by the new high power experimental station 5GB at Daventry. High power in this instance meant 30kW; not a lot by today's standards, but vastly greater than the other stations then operating. 2LO, for example, was the next in line with 3kW, while most of the others had no more than 200 watts (0.2kW). In the light of this it is really surprising that so many people could expect to get good results on the insensitive receivers then in common use, albeit with very largely no choice of programmes.

With a glance forward to the independent radio network set up in the 70s, we find that it more closely mirrors the old British Broadcasting Company's chain of stations than does the latter day BBC's own local radio. La plus ça change, etc . . . Returning to the lack of choice in the 20s, however, it is refreshing to find that the handbook contains a list of all the major European radio stations as well as the domestic ones, for what was quaintly termed "reachers

out", or long-distance listeners. There is even a reference to broadcasting in the United States — "... many of (the stations) giving regular transmissions of fair to excellent quality..." There were, incidentally, 50 stations in Chicago alone, so choice would not seem to have been any problem!

## Programmes

Browsing along, in an article entitled "Topical Addresses", we discover that the Instant TV Pundit of today is merely a descendant of an older breed: "... the 9.20 space on Monday evening is still vacant on the morning of the same day, and somebody on the staff of the BBC is wondering whether it would not be possible to shift the centenary of Dante or King Charles the Martyr on the strength of some historical quibble, and make it, rather abruptly, that very Monday as ever is, and by the same token telephone to Professor Asterisk Space, the celebrated Italian authority, and get him to broadcast at 9.20." It appears that one talk broadcast from London was criticised in listeners' letters because it was (a) biased towards Communism, (b) Fascist propaganda, (c) anti-clerical, (d) sectarian propaganda, (e) frivolous, (f) over-intellectual. We are not told who made the broadcast in question, or what was its burden, but one hopes that the luckless author could shrug off the reaction with the time-honoured "Ah well, you can't please 'em all!"

A large section of the book is devoted to explaining how the programmes were produced, and fascinating reading it is. However, perhaps we should now confine ourselves to the technical matter, which is truly comprehensive, starting with an historical survey of "Wireless", and going on to detailed discussion of the BBC transmitters, with circuits of amplifiers and oscillators, and of other radio stations, such as that used for transatlantic telephones. This latter worked on about 5000 metres (60kHz) using single-side-band! At least there shouldn't have been too much difficulty in keeping the local b.f.o. on tune at that frequency.

## Equipment

Moving on to receivers, there are details of many types of set, from the simplest crystal to a superhet, with two stages of "h.f. magnification". The listener is warned against wearing headphones whilst making adjustments to mains-powered high tension supplies, because of the danger of electric shock. It was remarked that "modern headphones are much improved acoustically, but whether sufficient attention has been given to the response/frequency curve in every case is open to question. No doubt the necessity for a low price is responsible..." Neither could the moving-iron type of loudspeaker boast of really good reproduction, but in America the moving-

# THE PERSONAL AND EXPERIENCE OF

It was realised by Mr. C. S. Dunham (who until some time ago was Radio Engineer to Marconi Scientific Inst. Co. and had been a member of the B.B.C. since its conception) that radio appliances should not be machine-made articles designed on conventional

# RECOMMENDATION A RADIO ENGINEER

lines. So he applied his knowledge and experience to the production of a range of radio sets and components that would be entirely different in their design and performance. These, by skilful methods of production, are sold at prices which represent wonderful value.



This Dunham two-valve loud-speaker set is a handsome oak cabinet model. In performance equal to many three-valve sets (at half the price and half the maintenance cost) the design of this receiver represents a combination of simplicity with efficiency that has met with universal approval. Valves fitted internally on anti-microphonic battery. Tuning is by a single dial with a small knob to vary reception power to suit individual requirements. Coils are entirely dispensed with. Range on loud-speaker 25-50 miles on ordinary station. 100-120 miles from Daventry. Phone range includes reception from many other stations at excellent strength. Just plug in and out to start set working. This action automatically lights up valves and puts all switches on. Complete with two Cosser dull-emitter valves, slide accumulator, extra large H.T. battery (100 volts), loud-speaker, in fact an installation complete. Marconi royalty paid, for £7/19/6, or 12/6 deposit secures and 12/6 monthly.

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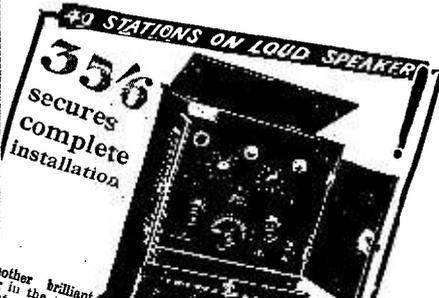
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## Personal Installation

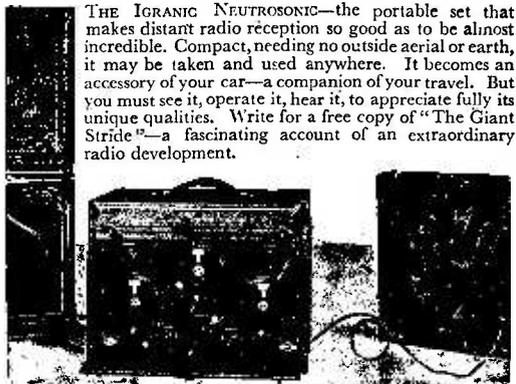
Another brilliant star in the firmament of Dunham achievements is the C.S.D. 51 D. A three-valve set of exceptional attributes, this set has lock and key. Valves are protected by "windows," from accidental damage. The cabinet itself is a beautifully decorated piece of furniture worthy of the most exclusive home and is secured for 36/6 deposit and 25/- monthly, complete with valves, all batteries, and long-speaker. As the set has almost entirely done away with the expensive litter of interchangeable cabinet loud-speaker, 21 guineas. Marconi royalty paid. For those who wish to construct a wireless set de Luxe, we issue full instructions that include five pictorial diagrams, Every constructional detail is clearly explained and with the assistance of the diagrams amateurs will find pleasurable and profitable occupation in building this first class set.

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Works: BEDFORD

coil speaker had already become widely used. Interspersed into the pages of this particular section are the numerous advertisements of the loudspeaker manufacturers. The Celestion C.12 could be had in oak for £7 5s, or in mahogany for an extra 5 shillings; but "this is but one of the 1927-28 Celestions, which range in price from £5 10s to £25.(!) They all definitely improve with age." Perhaps they matured, like wine. No doubt if anyone discovers one which had been laid down in a cellar back in 1928, it will by now out-perform anything the hi-fi merchants can offer!

And so to aeriels. Once again the advice given to listeners is applicable to all sorts of receivers and reception conditions. In general they were urged to use the maximum length of wire allowed by the receiving licence — 100ft, and no doubt they needed to if they wished to hear a 200 watt transmitter at any distance with a crystal set. The earth, too, was important, the recommended method of ensuring good results was to bury a 3 feet square plate in damp ground, with the lead-in wire soldered to several points along its top edge, with a "... small wooden cover over the joint, so that it may be inspected from time to time." This section ends, incongruously, with a picture of four aristocrats playing a hand of Bridge, which was being broadcast! There is no sign of a commentator, so perhaps the listener heard only the player's voices, plus the occasional soft thud of a well-shod foot impinging on a partner's shin!

From then on, most of the text is devoted to the do-it-yourself enthusiasts of the day, with articles by outside contributors on subjects such as "Hints for the Novice", and "The Home Constructor Scores", followed by 12 Don'ts for Listeners (e.g. DON'T forget that it is impossible practically to get true reproduction when receiving in the "silent point". How about that?), a glossary of technical terms. In this latter are some terms which are surprisingly familiar, such as, KiloHertz, Push-pull Amplification, and Cathode Ray Oscillograph.

In a limited space it is clearly impossible to do full justice to a book which is rich in interest, so here are just three more samples.

The Ormond 5-valve Portable advertised on page 306 is "... ideal for indoor and outdoor use ... and will render perfect reproduction under average conditions from a main BBC station within about 30 to 40 miles, and about 400 miles of Daventry." Price, ready for immediate use, £24 10s — but then comes the sting in the tail. Marconi Royalty, extra, was no less than £3 2s 6d, or just over 12½%. No doubt this caused as much displeasure as does VAT today! On the very last page is an ad. for the British Radio Corporation, of Weybridge. It can't be the same one owned by Thorn, can it? Anyway, their speciality of the day was a High Frequency Combination Transformer, 200-2000 metres, which sounds as though it was intended to convert ordinary t.r.f. sets into superhets, although only hinted at by the reference to a high value of intermediate frequency. A somewhat strange reticence compared with

## TO THE WOMEN OF BRITAIN

The Radio has undoubtedly helped you to keep your husband and boys away from the club and kept them at home where they thus experience the benefits of your gentle charm and influence, but you must now go *one step further* and make your home comfy and cheerful by having Hailglass Shades and Globes on your lights. Hailglass is made only by Hailwood & Ackroyd, Ltd., Morley, near Leeds. It is made in beautiful opals and is decorated or tinted with lovely colours and designs. Each piece is marked "Hailglass." Don't let your supplier foist upon you foreign glass which is made under sweated conditions. Your supplier gets a reasonable profit on our glass. We are putting up a hard fight in the face of unfair foreign competition and against certain atrocious British dealers who want *excessive profits*. Please help us to keep the Trade and British Money in Britain. Your men-folk, as they listen to the Radio in a home made bright and comfy by our charmingly coloured glassware, will indeed feel that they are in a real "Heaven on Earth," and you women of England will mutually join in this pleasure. We have an enormous range of sizes, shapes and designs.

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32 Shaftesbury Avenue, LONDON, W. 1  
21 Waterloo Street, GLASGOW

continued on page 59

# Ideas DEPARTMENT

Some original circuit ideas provided by our readers. These designs have not been proved by us, and we cannot therefore guarantee their effectiveness. They should at least provide a basis for experimentation.

Why not send us your idea? If it is published, you will receive payment according to its merits. Articles submitted should follow the usual style of PW in circuit diagrams and the use of abbreviations. Diagrams should be clearly drawn on separate sheets, not included in the text.

Each idea should be accompanied by a declaration that it is the original work of the person submitting it, and that it has not been accepted for publication elsewhere.

## REMOTE AERIAL PRE-AMP SUPPLY

There have been several published designs for remote (mast-head) aerial pre-amplifiers, but these have generally been battery powered, or fed via a separate supply cable. It is very convenient, and not difficult, to supply power via the signal coaxial cable, using the circuitry shown here to draw power from the associated tuner.

In Fig. 1, C1 isolates the d.c. supply from the pre-amp output, and L1 prevents the r.f. output from being shunted away via the pre-amp power supply circuits. Resistor R<sub>x</sub> is

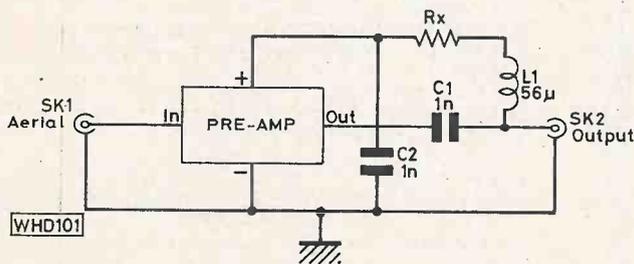


Fig. 1

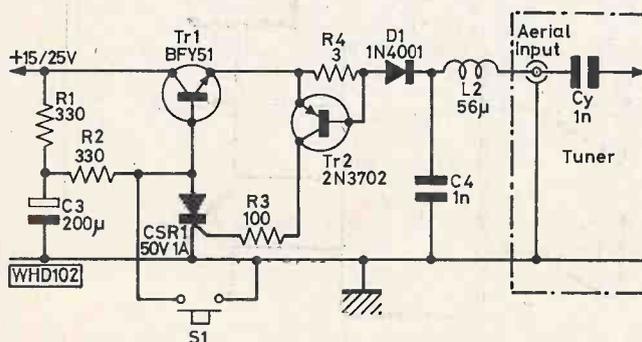


Fig. 2

chosen to reduce the supply voltage to the required value at the rated current consumption of the pre-amplifier, and also provides supply decoupling in conjunction with C2.

To prevent damage to the tuner's power supply, in the event of a short-circuit on the aerial download, some sort of overload protection is necessary. The circuit of Fig. 2 is fed from the power supply reservoir capacitor, which will often have around +15/25V on it. The series pass transistor Tr1 acts as the control element of the overload protection circuit, and also provides electronic smoothing by the action of R1, C3, R2. When an excessive current is drawn, the voltage drop across R4 will rise above about 0.6V, turning on Tr2, whose collector current triggers CSR1. When CSR1 conducts, it removes the base drive from Tr1 and so shuts off the d.c. supply to the tuner aerial socket via D1 and L2. The supply is restored by pressing S1, the "Reset" button. Diode D1 protects Tr1 from high reverse emitter-base voltages which can occur at switch-off if there is a large-value capacitor in the aerial pre-amplifier. Decoupling is provided by L2 and C4. Capacitor C<sub>y</sub> must be added to the tuner input circuit if the latter is not a d.c. open circuit.

The output voltage of the protection circuit will be about 1.5V less than the tuner supply voltage, due to the voltage dropped across Tr1, R4 and D1. With the value shown for R4, shutdown will occur at a load current of about 200mA. If some other value is required (dictated by the maximum safe additional current which can be drawn from the tuner power supply), the value of R4 can be calculated from the formula:

$$R4 = 0.6/I_c$$

where R4 is in ohms and I<sub>c</sub> is in amps.

The inductors L1 and L2 should be mounted as close as possible to the coaxial sockets, and may be made by winding about five turns of enamelled copper wire onto a ferrite bead. Other than this, the circuit layout is in no way critical.

P. J. H. Fox  
Oxford

# THE 'TRENT' 150W BROADBAND H.F. LINEAR AMPLIFIER PART ONE

This article describes the theoretical and practical considerations necessary to construct a push-pull 150 watt, solid state linear r.f. power amplifier. The unit, which provides a 15dB gain, is primarily intended for use with s.s.b. transmitters, and employs broadband technology, covering the range 2–28MHz. Operation is from a 13.8V d.c. source and the full output is achieved for only 3 watts excitation. Intermodulation products, measured at 28MHz for 150 watts p.e.p. are better than –30dB.

The amplifier, which is fairly simple to construct, uses two TRW power transistors type PT9784/A and a BD135. A schematic diagram is given in Fig. 1. Readily-available European components were a prerequisite design consideration.

## Design Criteria

In a push-pull configuration the transistor input or output impedances are in series, making the required transformation ratio one-quarter of that required for parallel operation. This method has been chosen to improve even-harmonic suppression and to simplify the matching problems due to very low input and output transistor impedances.

The circuit calculation was made in the following order:

1. Choice of the input and output transformer ratio.
2. Choice of transformer type.
3. Estimation of the transformer volumes.
4. Calculation of the transformer compensation.
5. Calculation of the input network between the input transformer and the transistors to match the two input impedances to  $3\Omega$  and to stabilise the gain/frequency characteristic.

A detailed analysis of the theoretical parameters will be given later for those wishing to study the technology. However, this should not deter the amateur from constructing the module, which requires only a little care and common sense in order to make it work.

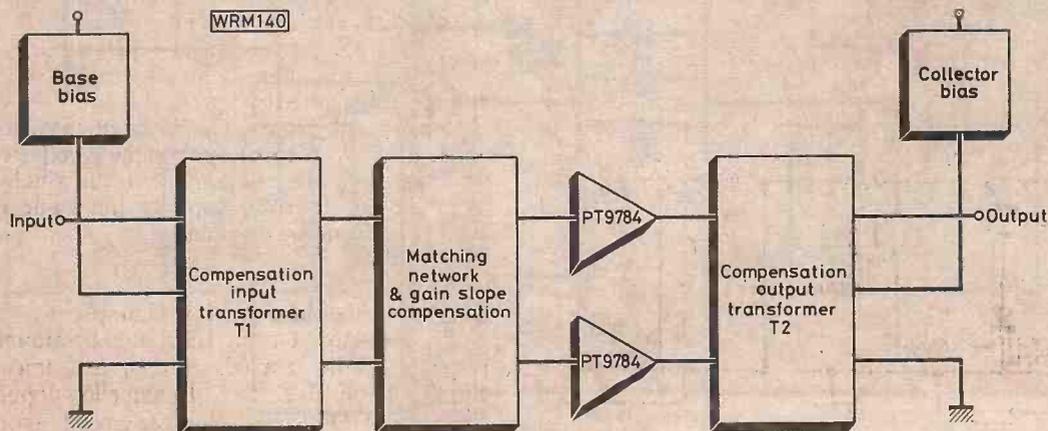
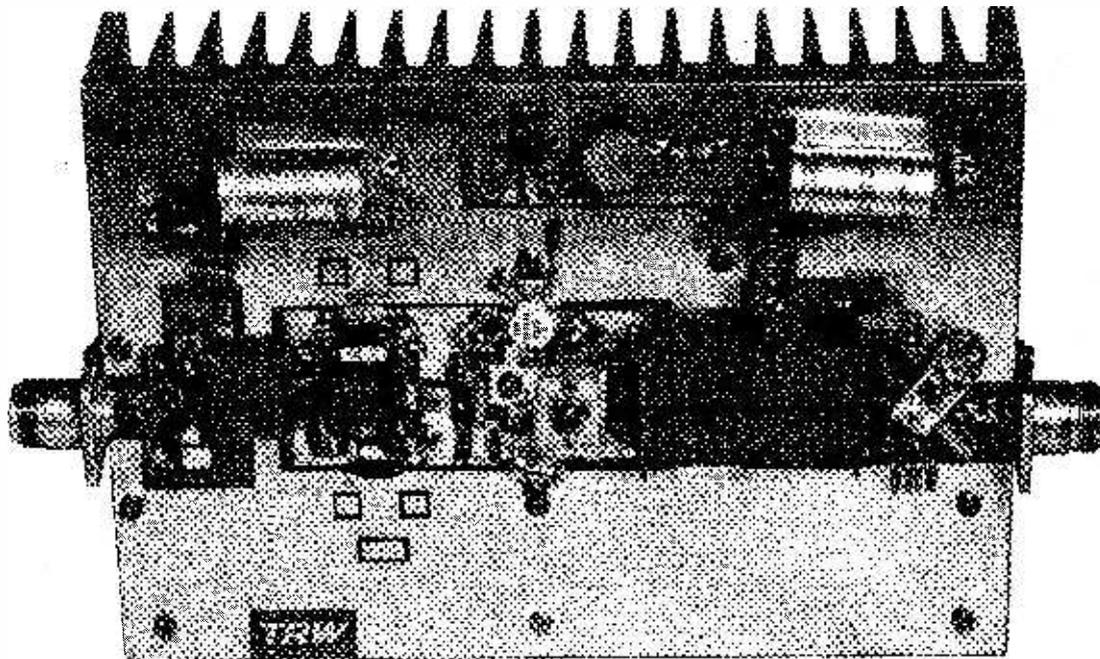


Fig. 1: Block diagram of the amplifier



The complete circuit is shown in Fig. 2 and the p.c.b. and component locations in Figs. 6 and 7. On-the-top assembly is employed throughout and the heatsink should be drilled and countersunk to permit the power transistors to seat properly on the p.c.b. The mica chip capacitor and the transformers should be the first devices to be fixed to the board. *Note that one of the transformer end-pieces forms the centre-tap in each case.*

When the transformers for the prototype were built, some difficulty was experienced in locating brass tubing of the prescribed dimensions. It is possible that copper would suffice, but the original development module called for brass, so a supply was ultimately found, and appears in the components list. Several other devices could possibly be substituted, but those listed are those currently working in the prototype.

## Output Circuit

The equivalent r.f. output circuit is given in Fig. 3. Resistor AA, capacitor AA and inductor BB form the equivalent circuit to  $2 \times Z_{OUT}$  in series. Capacitor CC, capacitor EE and inductor FF are the transformer h.f. compensation. The transformer itself is a black box, described by its S-parameters.

Optimisation of the compensation elements was carried out with the aid of a computer and the maximum output v.s.w.r. is lower than 1.6:1.

## Input Circuit

The equivalent r.f. input circuit is shown in Fig. 4. Here IMP JJ represents the two transistor input impedances in

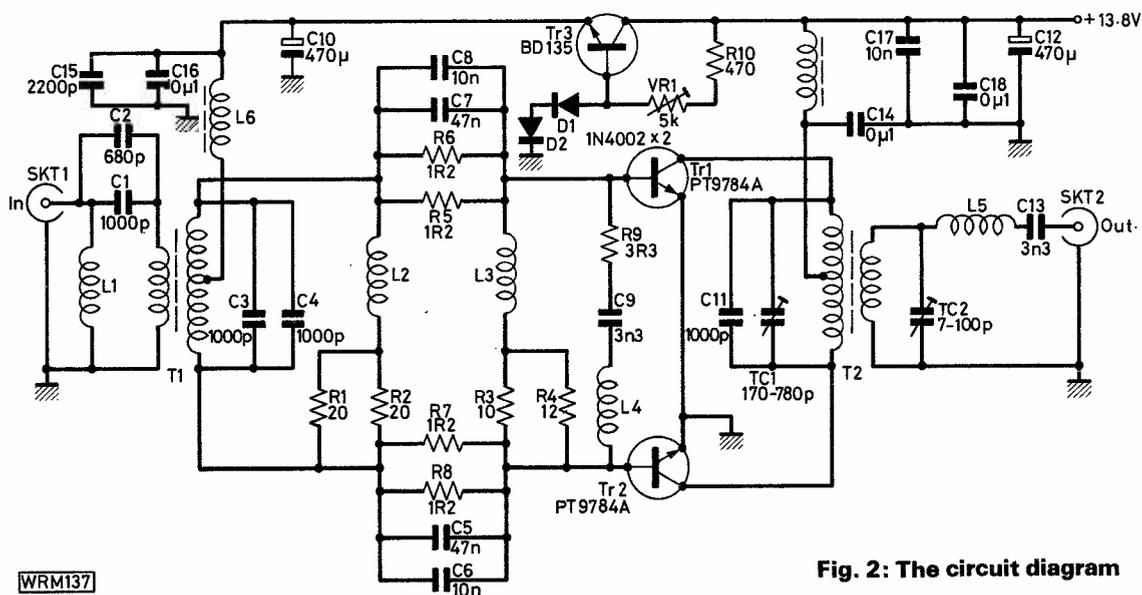


Fig. 2: The circuit diagram

Elements		Calc. value	Empirical value
CC	Cap (pF)	1474	1000+100/700 *
EE	Cap(pF)	136	20/100 *
FF	Ind. (nH)	256	90
	Cap (pF)	2993	4700

\* Variable capacitor

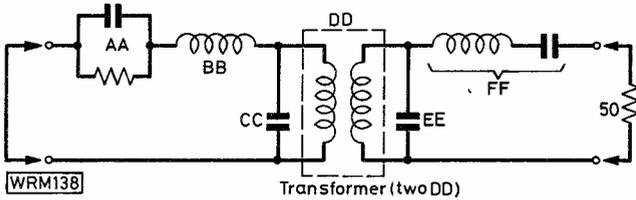


Fig. 3: Equivalent output circuit

Elements		Calc. value	Empirical value
AA	Ind. (nH)	5732	4000
BB	Cap (pF)	1294	1680
DD	Cap (pF)	1146	2000
EE	Res (Ω)	13.4	10
	Ind. (nH)	189	200
FF	Res. (Ω)	1.3	1.2
	Cap. (pF)	33350	57000
GG	Res (Ω)	7.2	5.5
	Ind (nH)	93.3	95
HH	Res (Ω)	6.8	4.3
	Ind (nH)	31.5	45
	Cap (pF)	3040	3300

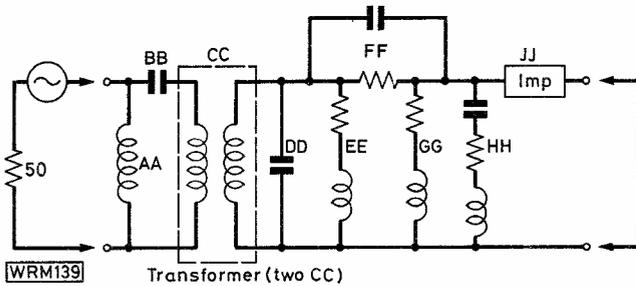


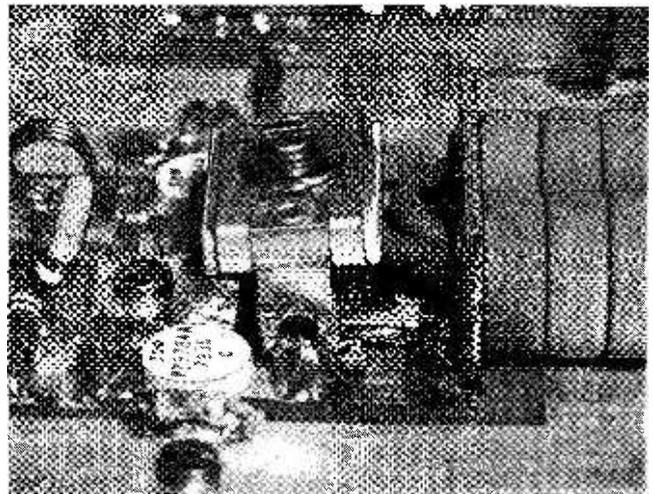
Fig. 4: Equivalent input circuit

series. Inductor AA and capacitor BB are for low-frequency transformer compensation and capacitor DD forms the high-frequency compensation.

Circuits EE, FF, GG and HH have two functions, namely to form a selective attenuator with 3Ω input impedance to stabilise the gain/frequency characteristic and to match the two transistor input impedances (which are in series) to 3Ω with the minimum of loss at the highest frequency. Again a computer program was employed to arrive at the final figures and the maximum v.s.w.r. is lower than 1.6:1.

## Bias Circuit

Naturally, the two power transistors heat during operation, although this effect is reduced if the duty cycle



The mica chip capacitor can be seen between the trimmer and the end of the transformer. Note also the fins of the power transistor

is low—as in the case of c.w. or s.s.b. Never-the-less, a thermally-compensated bias current must be arranged. In this instance an emitter-follower circuit is used producing a low output resistance, in which the base voltage is fixed by a thermally-variable component—diode D2. This is fixed to the heatsink in a manner which ensures good heat transfer to take place. The method used in this project was to shape the adjacent fin on one of the power transistors into a bracket with which to secure the diode. A detailed illustration is given in Fig. 5. The diode D1 is needed to compensate the VBE of the transistor.

A more sophisticated circuit could have been evolved but this is quite adequate for the purpose. Potentiometer VR1 is used to adjust the current through the diodes by changing the voltage across them.

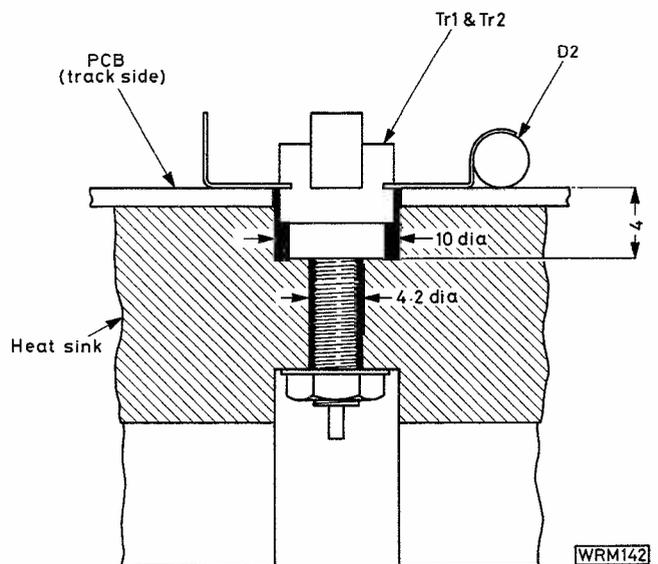


Fig. 5: Fixing diode D2 and mounting the power transistors

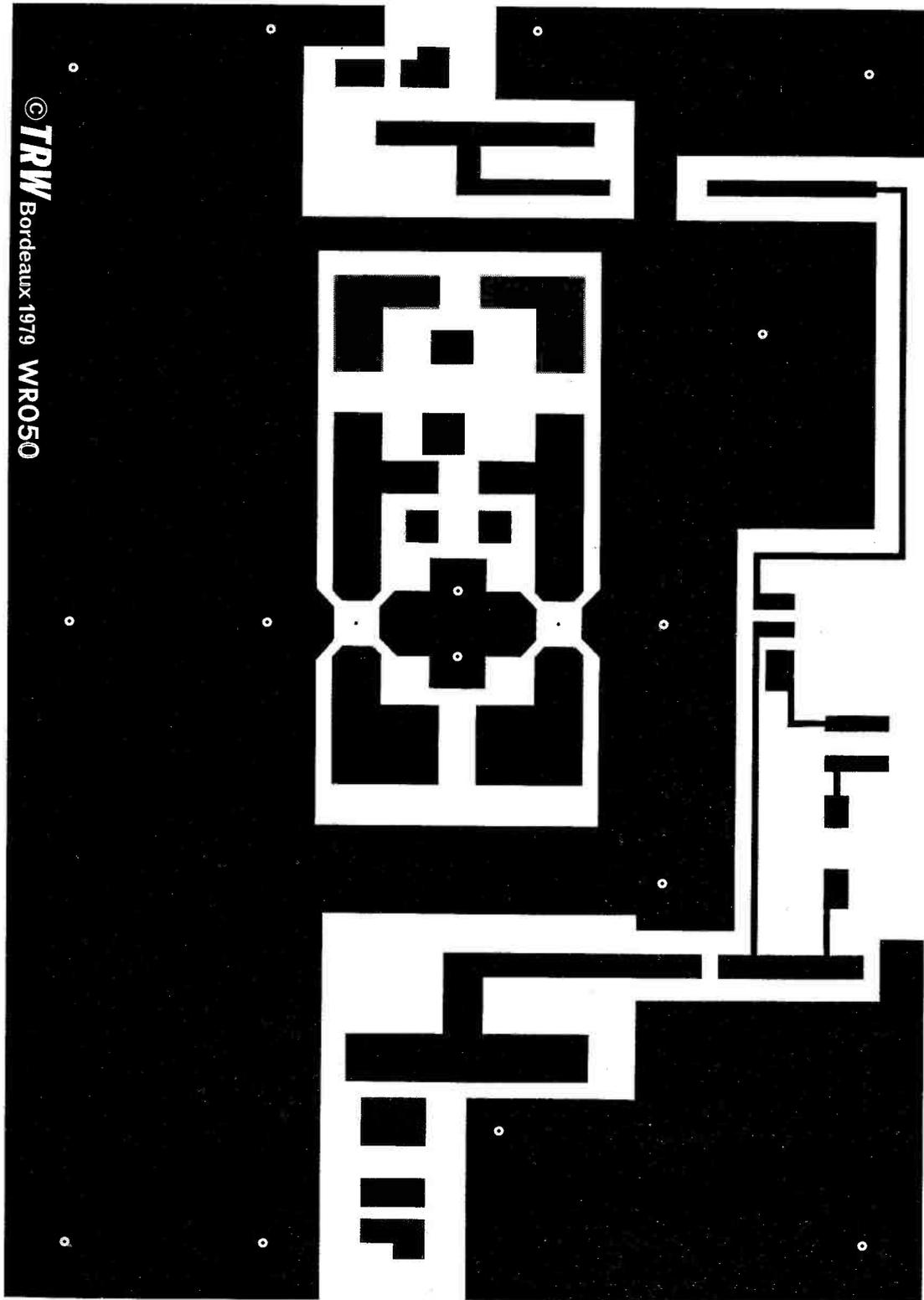


Fig. 6: Printed circuit board pattern

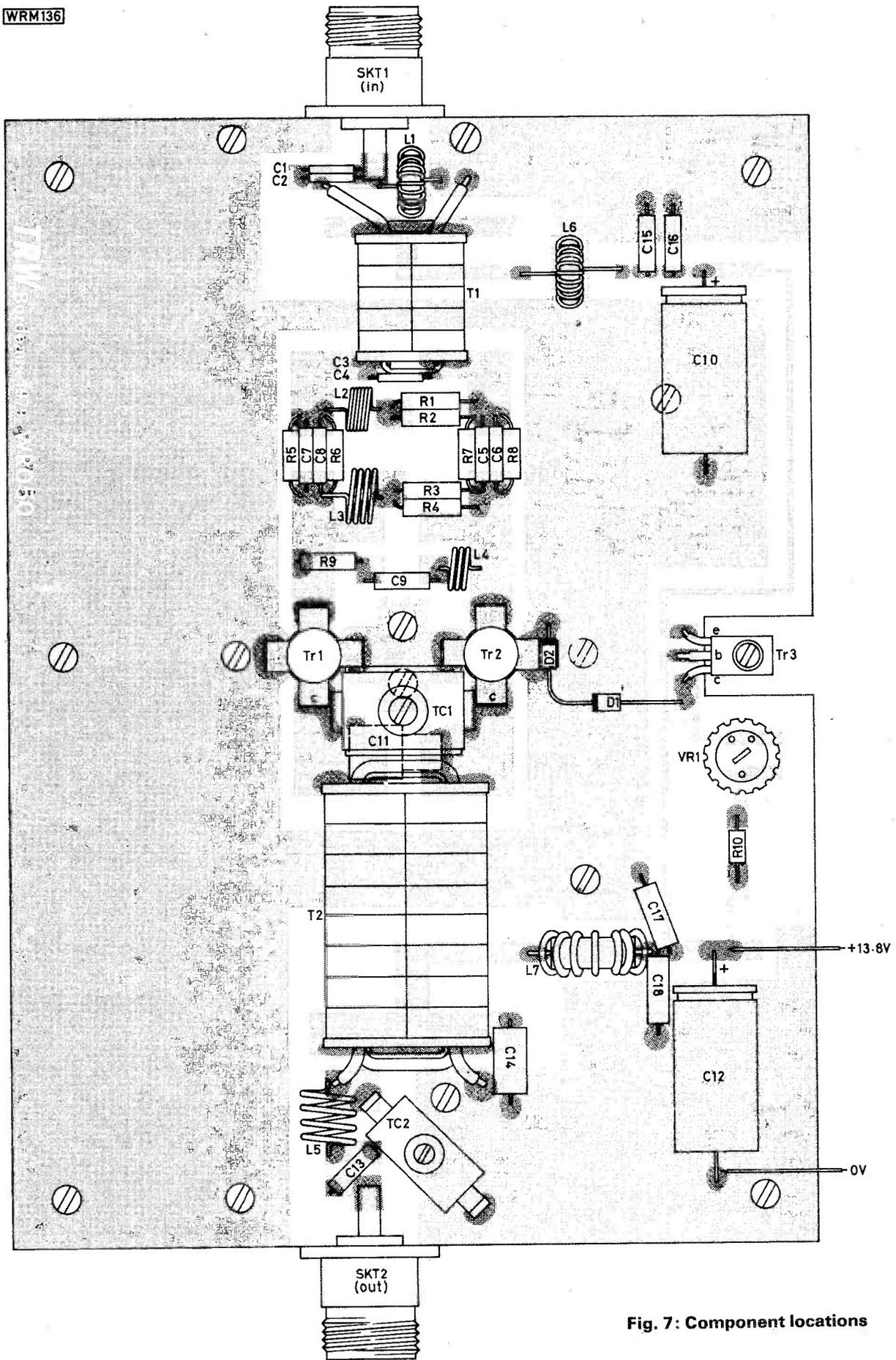
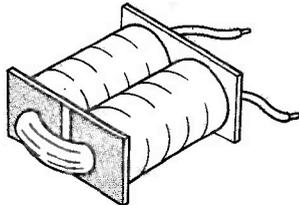
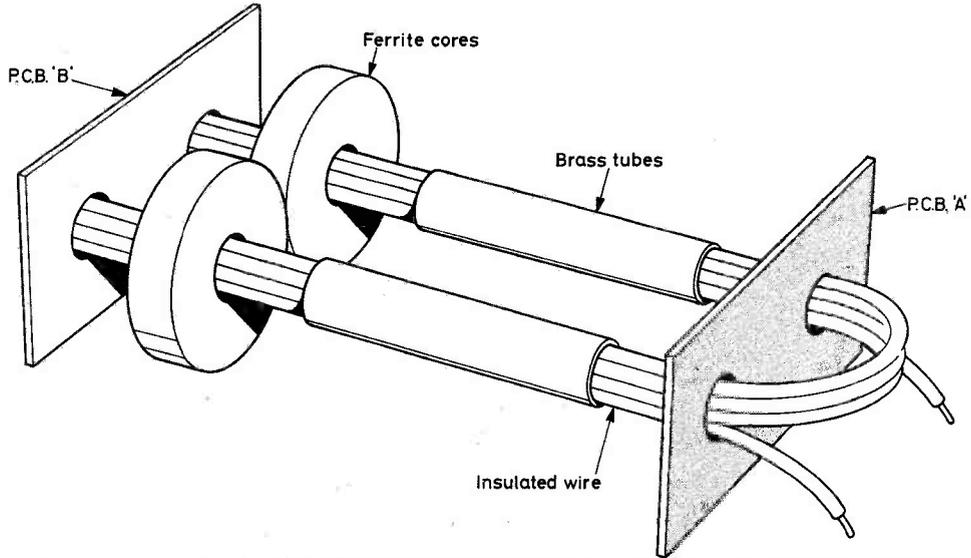
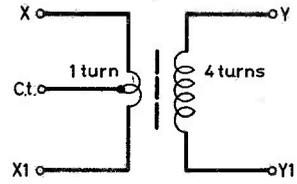
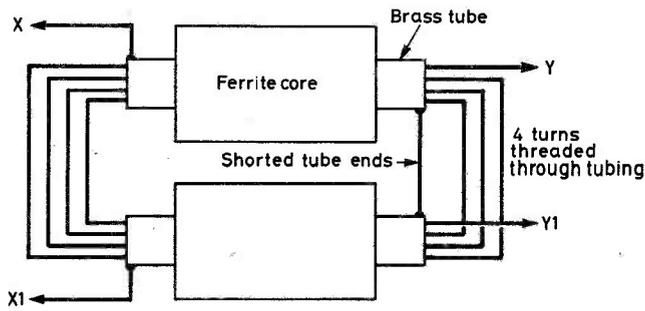
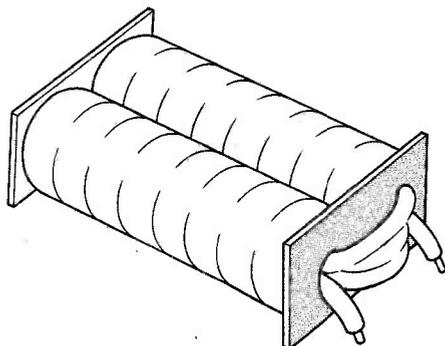
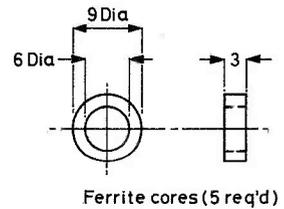
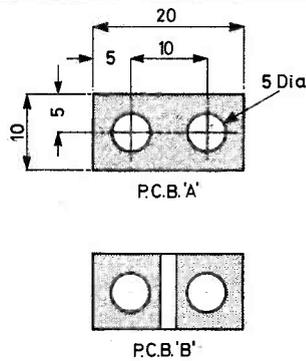


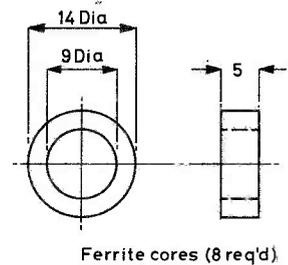
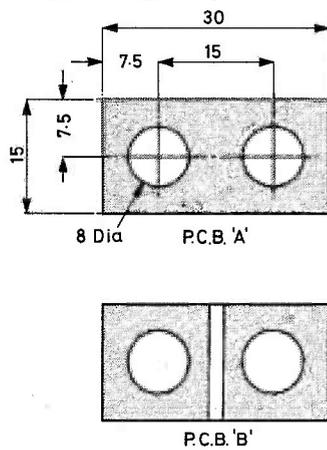
Fig. 7: Component locations



T1 (input transformer)



T2 (output transformer)



WRM134

## ★ components

### Resistors

$\frac{1}{2}$ W 10% metal oxide

1.2 $\Omega$	4	R5, 6, 7, 8
470 $\Omega$	1	R10

$\frac{1}{2}$ W 5% carbon composition

3.3 $\Omega$	1	R9
10 $\Omega$	1	R3
12 $\Omega$	1	R4
20 $\Omega$	2	R1, 2

### Potentiometers

Horizontal mounting, cermet, enclosed pre-set

5k $\Omega$	1	VR1
-------------	---	-----

### Capacitors

Miniature dipped-case polyester

2.2nF	1	C15
3.3nF	2	C9, 13
10nF	2	C6, 8
47nF	2	C5, 7

Miniature ceramic disc

680pF	1	C2
1nF	3	C1, 3, 4
10nF	1	C17

Monolithic ceramic

0.1 $\mu$ F	3	C14, 16, 18
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Mica chip

1nF*	1	C11
------	---	-----

Tubular electrolytic. Axial leads

470 $\mu$ F 25V	2	C10, 12
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### Trimmers

Arco compression type

7-100pF*	1	TC2 (Arco 423)
170-780pF*	1	TC1 (Arco 469)

### Semiconductors

Transistors

PT9784/A*	2	Tr1, 2
BD135	1	Tr3

Diodes

1N4002	2	D1, 2
--------	---	-------

### Coils

- L1 15 turns 0.5mm enamelled copper wire on \*RTC 4322-020-97170 toroid
- L2 6 turns 8mm inside diameter of 0.8mm enamelled copper wire
- L3 6 turns 8mm inside diameter of 1mm enamelled copper wire
- L4 4 turns 8mm inside diameter of 0.6-0.8mm enamelled copper wire 6mm long
- L5 4 turns 10mm inside diameter of 0.8-1.4mm enamelled copper wire 9mm long
- L6 25 turns 0.5mm enamelled copper wire on \*RTC 4322-020-97170 toroid
- L7 10 turns 1.5mm enamelled copper wire on \*RTC 4322-020-97180 toroid

### Transformers

T1—Primary

\* 2 x 5 ferrite cores 9 x 6 x 3mm  $\mu_r = 120$ , material 4C6 RTC reference 4322-020-97170 on 2 brass tubes 5mm o.d., 22mm long, with 10 x 20mm piece of copper-clad board at each end—see text.

T1—Secondary

4 turns of 0.5mm<sup>2</sup> insulated wire, wound through the 2 brass tubes.

T2—Primary

\* 2 x 8 ferrite cores 14 x 9 x 5mm  $\mu_r = 120$ , material 4C6, RTC reference 4322-020-97180 on 2 brass tubes 8mm o.d., 49mm long with a 15 x 30mm piece of copper-clad board at each end—see text.

T2—Secondary

4 turns of 1.8mm<sup>2</sup> insulated wire, wound through the 2 brass tubes.

### Miscellaneous

Printed circuit board (C. Bowes & Co.)  
Heatsink\*. Coaxial sockets (2)

### Component Sources

The specialised components marked with an asterisk are available from R. B. Knight, 28 Lynwood Drive, Wimborne, Dorset. Tel: (0202) 888426. These include the RTC ferrites used for the transformers and coils L1, L6 and L7. In addition, suitable brass tubing for T1 and T2 can also be obtained from this source.

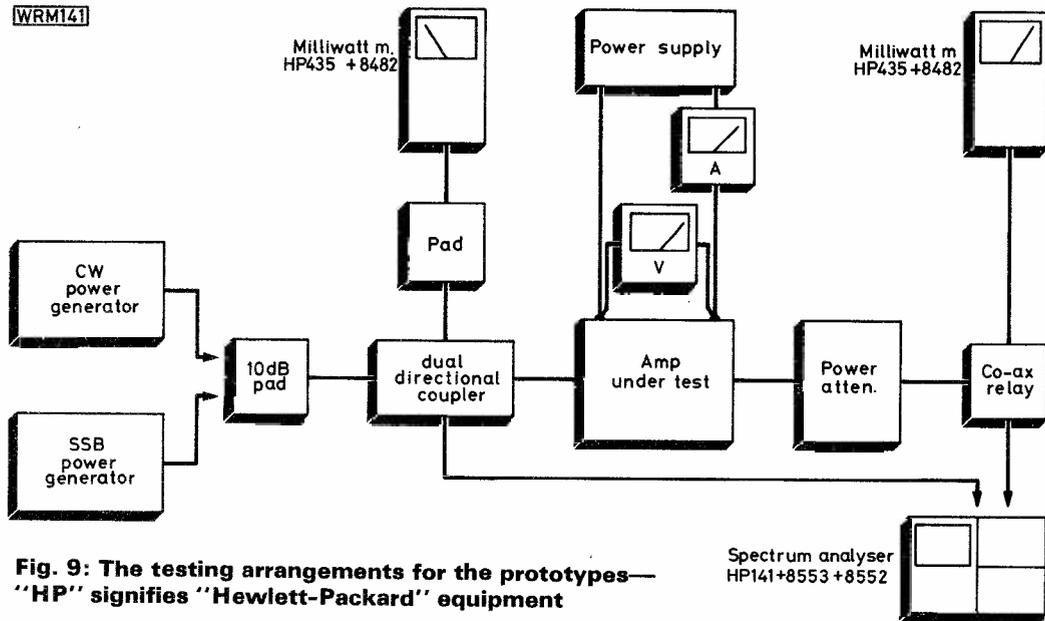
## Making the Transformers (Fig. 8)

By careful reference to the drawings one should be able to reproduce the transformers with a high degree of accuracy. Note the end pieces (which are made from small rectangles of single-sided copper-clad board) very carefully. One has a narrow strip of copper removed to form two distinct and separate islands. The other joins the two brass tubes and when fixed to the main p.c.b. forms the centre-tap connection.

Only the dimensions, wire gauges and—most important—the toroids specified must be used. The transformer assemblies should be fitted to the p.c.b. before the windings of insulated wire are inserted into the tubes, otherwise heat generated during the soldering process may destroy the sleeving.

The heatsink used to accommodate the prototype can be seen to be quite substantial—around 0.5°C/W. However, the power amplifier could well be reduced in size and mounted within existing equipment, say on a metal

WRM141



**Fig. 9: The testing arrangements for the prototypes—**  
**"HP" signifies "Hewlett-Packard" equipment**

back-plate. In this case, additional heatsinking could be provided on the outside.

If the method of mounting the power transistors used in the prototype is used, it will be necessary to put a small, flat-bottomed countersink in the heatsink to settle the devices properly (Fig. 5). Great care should be taken to ensure maximum heat transfer by making the stud holes only just large enough for the thread to pass through. Do not chamfer, but de-burr with Emery cloth. Apply a smear of thermal grease and tighten—firmly, but not so as to stretch the studding. (About 10lb. inches torque, for the perfectionist.)

Finally, note that in some areas continuity of the earth plane sections of the p.c.b. is effected by the fixings to the heatsink. If other arrangements of the amplifier are envisaged, it may be necessary to take this into account.

### Setting up the Amplifier

The technology employed in this project means that a minimum of adjustment is required to achieve acceptable performance. If you are fortunate enough to have access to a spectrum analyser, all the better. A description of the original test arrangements is given in Fig. 9.

In its quiescent state, the module will only draw a few hundred milliamps—typically 200. This is set by the

potentiometer VR1. It is a good idea to initially apply a very low level of r.f., which is increased gradually whilst carefully observing the current consumption. Judicious peaking of the trimmers should be all that is necessary to produce the required output.

## KINDLY NOTE!

### PW "Soundlite", March 1979

On Fig. 5, electrolytic capacitor labelled C18 adjacent to D12 should be C13. On Fig. 6 the labels on the Bass and Treble switches should be transposed.

### Car Test Probe, May 1979

The three l.e.d.s (D2, 3, 4) are shown connected the wrong way round in the circuit diagram. They are correctly shown in the component drawing.

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AA30 0.27	ASV27 0.40	BC167 0.12*	BCZ11 1.50	BF196 0.10*	BZY88 0.13	QA79 0.30	OC83 0.65	ZS278 0.57*	2N698 0.30	2N3440 0.60
AA32 0.42	ASZ15 1.25	BC170 0.11*	BD121 1.20	BF197 0.12*	Series	OA81 0.30	OC84 0.65	ZTX107 0.11*	2N705 1.20	2N3441 0.80
AA33 0.18	ASZ16 1.25	BC171 0.10*	BD123 1.20	BF200 0.27	CRS/105 0.45	OA85 0.30	OC122 1.50	ZTX109 0.10*	2N706 0.15	2N3442 1.10
AA37 0.27	ASZ20 1.50*	BC173 0.12*	BD124 1.30	BF224 0.20*	CRS/140 0.60	OA90 0.08	OC123 1.75	ZTX109 0.12*	2N708 0.20	2N3525 0.80
AC107 0.60	ASZ21 2.00	BC177 0.15	BD131 0.35	BF244 0.28*	CRS/340 0.75	OA91 0.08	OC139 2.25	ZTX300 0.12*	2N930 0.20	2N3614 1.50
AC125 0.20	AU110 1.70*	BC178 0.14	BD132 0.38*	BF257 0.24	CRS/360 0.90	OA95 0.08	OC140 2.75	ZTX301 0.13*	2N1131 0.26	2N3702 0.11*
AC126 0.20	AU113 1.70*	BC179 0.16	BD136 0.34*	BF258 0.26	GEX66 1.50	OA200 0.09	OC141 3.25	ZTX303 0.15*	2N1132 0.26	2N3703 0.13*
AC127 0.20	AU117 1.70*	BC182 0.11*	BD138 0.40*	BF259 0.32	GEX54 1.75	OA202 0.09	OC170 1.00	ZTX303 0.17*	2N1202 0.35	2N3704 0.13*
AC128 0.20	BA145 0.13*	BC183 0.10*	BD139 0.43*	BF338 0.31*	GJ5M 0.75	OA201 1.00	OC200 1.50	ZTX311 0.12*	2N1304 0.45	2N3706 0.13*
AC141 0.25	BA148 0.13*	BC184 0.11*	BD140 0.44*	BF521 3.96	GM0378A 1.75	OA206 1.00	OC201 1.75	ZTX314 0.20*	2N1305 0.45	2N3707 0.13*
AC141K 0.35	BA154 0.09	BC212 0.13*	BD144 2.00	BF528 2.23	MJ340 0.80	OC16 2.90	OC202 1.75	ZTX500 0.13*	2N1306 0.50	2N3708 0.10*
AC142 0.75	BA155 0.10	BC213 0.10*	BD181 1.18	BF531 1.10*	MJE370 1.10	OC20 2.50	OC203 1.75	ZTX501 0.14*	2N1307 0.50	2N3709 0.13*
AC142K 0.30	BA156 0.09	BC214 0.15*	BD237 0.40	BF532 0.26	MJE371 0.61	OC22 2.50	OC205 2.50	ZTX503 0.17*	2N1308 0.55	2N3710 1.00*
AC176 0.20	BAW62 0.05	BC237 0.09*	BD238 0.55	BFW11 0.65	MJE520 0.32	OC23 2.75	OC206 2.50	ZTX504 0.20*	2N1309 0.55	2N3711 0.10*
AC187 0.20	BAX13 0.06	BC238 0.12*	BDX10 0.91	BFX84 0.22	MJE521 0.55	OC24 3.00	OC207 1.75	ZTX511 0.20*	2N1671 1.50	2N3771 1.75
AC188 0.20	BAX16 0.09	BC301 0.25	BDX32 2.00	BFX85 0.23	MJE2955 1.25	OC25 0.90	OC208 2.50	ZTX511 0.20*	2N1893 0.25	2N3772 2.00
AC19 0.80	BC107 0.12	BC303 0.24	BDY00 1.25	BFX87 0.21	MJE3055 0.75	OC26 0.90	OC209 2.25*	IN915 0.07	2N2148 1.65	2N3773 3.00
AC197 0.75	BC108 0.12	BC307 0.10*	BF100 0.50	BFY80 0.26	MPF102 0.30*	OC28 2.00	R2010B 1.75*	IN4002 0.06	2N2218 0.25	2N3823 0.55*
AC20 0.70	BC109 0.13*	BC322 0.20*	BF115 0.25	BFY80 0.26	MPF103 0.30*	OC29 2.00	IC44 0.30	IN4003 0.07	2N2220 0.18	2N3866 0.72
AC21 0.75	BC114 0.12*	BC327 0.18*	BF152 0.18	BFY51 0.26	MPF104 0.30*	OC35 1.50	IC226D 1.20	IN4004 0.07	2N2221 0.18	2N3904 0.13*
AC39 1.50	BC115 0.14*	BC337 0.18*	BF153 0.20	BFY52 0.26	MPF104 0.30*	OC36 1.50	IL209 0.20	IN4005 0.08	2N2222 0.18	2N3905 0.13*
AD149 0.70	BC116 0.15*	BC338 0.17*	BF154 0.17	BFY64 0.26	MPF105 0.30*	OC41 0.80	IP29A 0.41*	IN4006 0.08	2N2223 2.17	2N3906 0.13*
AD161 0.45	BC117 0.17*	BCY30 1.00	BF159 0.23	BFY90 1.25	MPSA06 2.4*	OC42 0.75	IP30A 0.44*	IN4007 0.09	2N2368 0.27	2N4058 0.14*
AD162 0.45	BC118 0.10*	BCY31 1.00	BF160 0.16	BSX19 0.21	MPSU10 0.36*	OC43 2.25	IP31A 0.45	IN4009 0.06	2N2369A 0.21	2N4060 0.12*
AF105 0.45	BC125 0.09	BCY32 1.00	BF167 0.20	BSX20 0.21	MPSU06 0.46*	OC44 0.60	IP32A 0.48	IN4148 0.06	2N2484 0.20	2N4061 0.12*
AF114 0.75	BC126 0.10*	BCY33 0.90	BF173 0.20	BSY61 1.20*	MPS560 0.49*	OC45 0.65	IP33A 0.48	IN4149 0.06	2N2485 0.20	2N4062 0.12*
AF115 0.75	BC135 0.14*	BCY34 0.90	BF177 0.24	BT106 0.55	NE555 0.45	OC71 0.55	IP34A 1.73	IN5401 0.13	2N2904 0.25	2N4062 0.13*
AF116 0.75	BC136 0.15*	BCY39 3.00	BF178 0.24	BTY79/400R	NK740 1.70	OC72 0.55	IP41A 0.63	IS44 0.04	2N2905 0.25	2N4124 0.15*
AF117 0.75	BC137 0.15*	BCY40 1.00	BF179 0.25	BU205 3.19	NKT403 2.00	OC73 0.70	IP42A 0.70	IS920 0.07	2N2906 0.21	2N4126 0.15*
AF139 1.40	BC147 0.09*	BCY42 0.25	BF180 0.30	BU206 2.25*	NKT404 1.73	OC74 0.65	IP2955 1.67	IS921 0.07	2N2907 0.21	2N4286 0.20*
AF186 1.20	BC148 0.08*	BCY43 0.25	BF182 0.30	BU208 2.00*	OA5 0.50	OC75 0.65	IP3055 0.56	IS922 0.07	2N2924 0.21*	2N4286 0.20*
AF239 0.45	BC149 0.09*	BCY58 0.25	BF183 0.30	BU209 2.00*	OA6 0.50	OC76 0.65	IS143 1.00	IS923 0.07	2N3032 1.00	2N4389 0.24*
AF239 0.45	BC157 0.09*	BCY59 0.25	BF184 0.25	BU210 2.00*	OA7 0.50	OC77 1.20	IS143 1.00	IS924 0.07	2N3032 1.00	2N4389 0.24*
AF212 2.75	BC158 0.08*	BCY70 0.17	BF184 0.25	BU211 2.00*	OA10 0.60	OC78 0.65	IS170 1.21	IS925 0.07	2N4044 1.00	2N5457 0.35*
			BF185 0.25	BU212 2.00*	OA17 0.14	OC81 1.20	IS178 0.54*	IS926 0.07	2N4045 1.00	2N5458 0.35*
									2N4046 1.00	2N5459 0.35*

#### VALVES

AZ31 1.10*	ECC821 0.47*	MU14 1.60*	PL81A1 1.20	UR41 1.25*	5Z3 1.50*	6BH61 1.20*	6K6GT 1.30*	7H7 2.00*	85A2 1.75
CBL31 1.50	ECC831 0.55*	N78 9.00*	PL82 0.60*	UR41C 1.10*	5Z4G 1.52*	6BJ6 1.20*	6K7 1.50*	7R7 1.50*	90AG 7.96
CL33 2.00*	ECC841 0.60*	OA21 0.55*	PL83 0.55*	URF89 0.60*	5Z4GT 1.50*	6BK4 4.21*	6K8 1.75*	757 2.25*	90AV 7.96
CY31 1.00*	ECC851 0.55*	OB21 0.60*	PL84 0.75*	URC84 1.10*	6-30L2 1.80*	6BL6 85.00	6K6D 2.50*	7Y4 1.80*	90C1 1.80
DAF911 0.40*	ECC881 0.75*	OC31 0.75	PL504/500†	UC85† 0.55*	6AB7 0.75*	6BL7GT 3.86*	6L6G 6.16*	7Z4 1.85*	90CG 13.68
DAF96 1.00*	ECC911 0.55*	EL34 (Mullard)	PL508† 1.80	UCF80 1.15*	6AC7 0.75*	6BN6 0.80*	6L6GA 1.50*	12AT8 1.20*	90CV 13.30
DF911 0.40*	ECC189 1.66*	EL41 1.25*	PL509† 3.00	UCH42 1.20*	6AF4† 0.70*	6BD7A 1.50*	6L6GT 0.85*	12AT7† 0.50*	92AG 7.96
DF86 1.00*	ECC190 0.60*	EL42 1.75*	PL519† 3.20	UCH81† 0.65*	6AG7 0.75*	6BR7 4.00*	6L6GC 1.95*	12AU6 0.65*	92AV 7.96
DK92 1.25*	ECC321 0.70*	EL43 1.00*	PL801 1.10*	UCL82† 0.75*	6AH6† 0.95*	6BR8† 1.20*	6L7 2.00*	12AU7† 0.47*	150B2 2.15
DK96 1.10*	ECC381 0.70*	EL44 1.25*	PL802 3.48*	ULC83 1.44*	6AK5† 0.50*	6BS7 4.00*	6N2P 1.05*	12AV6 0.85*	150C2 1.60
DL92 0.75*	ECC42 1.15*	EL45 0.85*	PL803 3.48*	UF41 1.00*	6AK6 0.95*	6BW6 3.75*	6N3P 1.05*	12AV7 3.48*	150C4 2.30
DL94 1.20*	ECC43 1.15*	EL46 0.85*	PL804 3.48*	UF80† 0.50*	6AL5† 0.40*	6BW7 1.50*	6N3P 1.05*	12AX7 0.55*	211 6.00
DL96 1.10*	ECC44 1.15*	EL47 0.85*	PL805 3.48*	UF85† 0.50*	6AM4 2.30*	6B7GT 9.95*	6P25 3.50*	12AY7† 0.85*	723AB† 8.00
				UL1 1.80*	6AM5 3.85*	6BZ 1.75*	6D2 2.20*	12BA4† 1.00*	807† 1.20
				UL41 0.85*	6AM6† 0.70*	6C4† 0.55*	6R7 1.00*	12BA6 0.65*	811A† 3.80
				UL84† 0.85*	6AN5 5.32*	6C6BA† 0.55*	6SA7 1.45*	12BE6 1.60*	812A 3.35
				UM80 1.00*	6ANB† 0.70*	6C6GA† 0.90*	6SC7 1.50*	12BH7† 0.65*	813† 10.00
				UY41† 0.75*		6C6G† 1.72*	6SF7 1.80*	12BY7† 0.80*	814† 6.00
				UY85† 0.85*		6C6H† 1.50*	6S7 1.50*	12C1 7.00	866A 8.85
				6AQ5† 0.85*		6C6I† 1.50*	6S7 1.50*	12CA7 1.20*	872A 13.75
				6AR5 0.70*		6C6J† 1.50*	6S7 1.50*	12CA7 1.20*	872A 13.75
				6AS† 0.55*		6C6K† 1.50*	6S7 1.50*	12CA7 1.20*	872A 13.75
				6AS7† 1.50*		6C6L† 0.75*	6S7 1.50*	12CA7 1.20*	872A 13.75
				6AT6† 0.75*		6C6M† 1.50*	6S7 1.50*	12CA7 1.20*	872A 13.75
				6AUS† 4.26*		6C6N† 1.50*	6S7 1.50*	12CA7 1.20*	872A 13.75
				6AU6† 0.55*		6C6O† 1.50*	6S7 1.50*	12CA7 1.20*	872A 13.75
				6AV† 4.18*		6C6P† 1.50*	6S7 1.50*	12CA7 1.20*	872A 13.75
				6AV6† 0.75*		6C6Q† 1.50*	6S7 1.50*	12CA7 1.20*	872A 13.75
				6AW8† 1.00*		6C6R† 1.50*	6S7 1.50*	12CA7 1.20*	872A 13.75
				6AX5† 3.10*		6C6S† 1.50*	6S7 1.50*	12CA7 1.20*	872A 13.75
				6B† 0.75*		6C6T† 1.50*	6S7 1.50*	12CA7 1.20*	872A 13.75
				6B† 0.75*		6C6U† 1.50*	6S7 1.50*	12CA7 1.20*	872A 13.75
				6B† 0.75*		6C6V† 1.50*	6S7 1.50*	12CA7 1.20*	872A 13.75
				6B† 0.75*		6C6W† 1.50*	6S7 1.50*	12CA7 1.20*	872A 13.75
				6B† 0.75*		6C6X† 1.50*	6S7 1.50*	12CA7 1.20*	872A 13.75
				6B† 0.75*		6C6Y† 1.50*	6S7 1.50*	12CA7 1.20*	872A 13.75
				6B† 0.75*		6C6Z† 1.50*	6S7 1.50*	12CA7 1.20*	872A 13.75
				6B† 0.75*		6C6A† 1.50*	6S7 1.50*	12CA7 1.20*	872A 13.75
				6B† 0.75*		6C6B† 1.50*	6S7 1.50*	12CA7 1.20*	872A 13.75
				6B† 0.75*		6C6C† 1.50*	6S7 1.50*	12CA7 1.20*	872A 13.75
				6B† 0.75*		6C6D† 1.50*	6S7 1.50*	12CA7 1.20*	872A 13.75
				6B† 0.75*		6C6E† 1.50*	6S7 1.50*	12CA7 1.20*	872A 13.75
				6B† 0.75*		6C6F† 1.50*	6S7 1.50*	12CA7 1.20*	872A 13.75
				6B† 0.75*		6C6G† 1.50*	6S7 1.50*	12CA7 1.20*	872A 13.75
				6B† 0.75*		6C6H† 1.50*	6S7 1.50*	12CA7 1.20*	872A 13.75
				6B† 0.75*		6C6I† 1.50*	6S7 1.50*	12CA7 1.20*	872A 13.75
				6B† 0.75*		6C6J† 1.50*	6S7 1.50*	12CA7 1.20*	872A 13.75
				6B† 0.75*		6C6K† 1.50*	6S7 1.50*	12CA7 1.20*	872A 13.75

# P.W. JUMBO CLOCK

*Kits of parts by the designers of the clock.*

## Kit A.

Comprising of printed circuit board. **Price £8.96.** V.A.T. and postage included.

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June 79.	Jumbo Clock		Price £8.66 & 30 pence p & p.

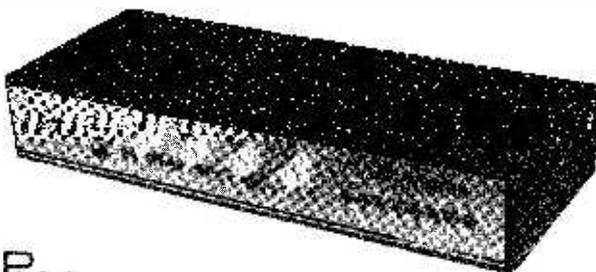
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## Hey, Good Looking!



P.W.  
**'WINTON'**

Beautiful innit?, but a swish exterior can often be an eye catching cover for some very ordinary "guts", so what's so different about the WINTON?

Well, for a start we have discarded Bi-Polar output devices in favour of the far superior performance of the Hitachi Power MOS-FETS, which until now have only been available in some of the most expensive Hi-Fi Amplifiers around, (and we consider £700 to be expensive with a capital E!). Secondly, our extremely low distortion figures are obtained at FULL RATED OUTPUT with both channels driven, across the entire audio spectrum.

Further, at these power levels 2nd and 3rd order inter-modulation components are typically less than 0.005% (See the March issue of P.W. for the full spec' and a few shots from the Spectrum Analyser.) Whilst we freely admit that ownership of a Winton will not prevent your hair from falling out, nor warts from growing on your nose, you will feel a nice sense of achievement when the job is complete, and you will own an Amplifier that will make your mates positively green with envy, until that is they see the light and obtain one of their own.

The WINTON Kit is available in the following form:-

Pack (A) Capacitors & Fixed Value Resistors	Price Inc. V.A.T. & carriage.
Pack (B) Switches, Potentiometers, Pre-Sets & Knobs	<b>£21.45</b>
Pack (C) Printed Circuit Board, and Terminal Pins	<b>£13.26</b>
Pack (D) Hardware Pack, consisting of Chassis, Heat Sinks, Cabinet, Screws, Wire, Fuseholders etc., and a Brushed Aluminium Fascia Front Panel.	<b>£8.10</b>
Pack (E) Semiconductors (including HITACHI MOS Power Fets)	<b>£32.99</b>
Pack (F) Toroidal Mains Transformer	<b>£30.53</b>
Complete Kit of all parts necessary to build the WINTON	<b>£17.22</b>
	<b>£120.00</b>

ORDER WITH COMPLETE CONFIDENCE (Cash with order please) FROM:-

**T. & T. ELECTRONICS. GREEN HAYES, SURLINGHAM LANE, ROCKLAND ST. MARY, NORWICH, NORFOLK. NR14 7HH.**  
PLEASE ALLOW 28 DAYS FOR DELIVERY.

# THE PW 'WINTON' Stereo Amplifier

## Part 4

### E.A.RULE

The manner in which the peripheral components of a hi-fi system are connected to the main amplifier is very important, especially if low noise and hum are required. One extra earth connection can lead to horrible hum problems through earth loops.

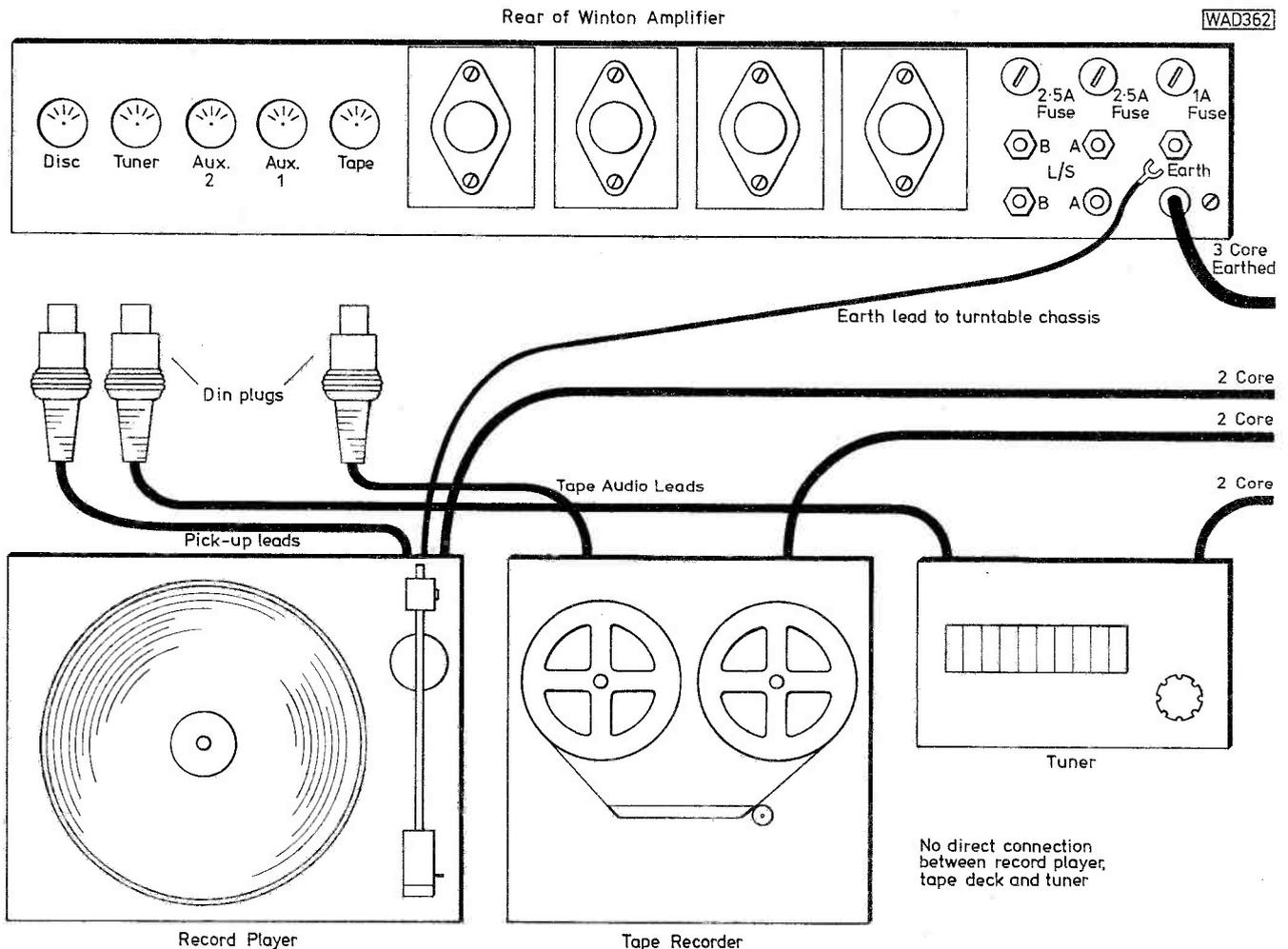
The drawing (Fig. 19) shows how the connections should be made between the PW Winton amplifier and the tape, record deck and tuner unit.

Three minor errors occurred in the metalwork drawings in the April issue. Fig. 13 which shows the mounting

details of the power transistors has the chassis upside down and inside out. The right-angle fold should be at the bottom and folded away from the heat sink.

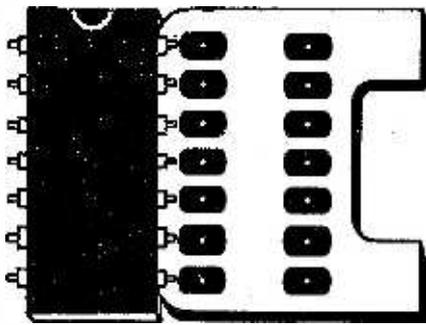
Fig. 14 the main chassis drawing has the mains transformer fixing holes shown at 75mm from the back edge of the chassis. The entire group of holes for this component should be centred at 75mm from the front edge.

Fig. 15 has the chassis front shown upside down, with the bottom fold at the top.



**Very Important**  
No direct connection between record player chassis and pick-up

**Interconnections between PW Winton amplifier and peripheral equipment**



# OF THE MONTH 76

Brian DANCE M.Sc

## FAIRCHILD μA78HG REGULATOR

Most of the currently available voltage regulators will provide only a small output current of the order of 100mA to 1A. Greater current demands require the use of a low current regulator with a series-pass transistor in a more complex circuit or a number of low current regulators.

Most regulator devices have a fixed output voltage. Although variation is possible by suitable circuit techniques, it is not generally convenient to purchase just one type of fixed voltage device and expect to be able to use it to provide a specific voltage range.

The new Fairchild μA78HG 5A regulator with variable output voltage can provide the answer to the problem of obtaining high output currents from simple circuitry over the wide operating output range of 5V to 20V.

### The μA78HG

The μA78HG is encapsulated in an hermetically sealed metal package like that of TO-3 transistors, but has the four connections shown in Fig. 1 instead of the normal three leads of a TO-3 device. The case must be bolted to a suitable heat sink where the internal power dissipation is appreciable. The letter "H" in the type number of this device signifies that it is a "hybrid" component which unlike monolithic integrated circuits contains several silicon chips joined together internally.

The μA78HG can be used in the simple circuit of Fig. 2. The internal circuitry of the device maintains the "control" pin at +5V relative to the "common" pin. It is recommended that the value of the current in R2 should be 1mA, so R2 should normally have a value of 5 kilohm.

The value used for R1 determines the output voltage. This output voltage,  $V_o$ , is given by the equation:

$$V_o = 5 \times (1 + R1/R2)$$

Thus if R1 has a value of 5kΩ, the output voltage will be 10V, whilst R1 should be 15kΩ for a 20V regulated output.

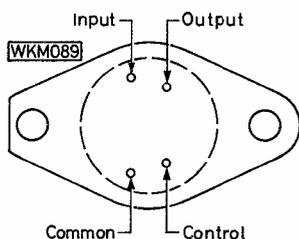


Fig. 1: The μA78HG package and connections

For a variable output voltage, R1 should be replaced with a suitable potentiometer.

### Drop-out Voltage

It must be emphasised that this type of regulator cannot supply a greater output voltage than the applied input voltage; indeed, the output will always be somewhat less than the input. As the input voltage is decreased, a point is reached at which the regulator circuit "drops out" and ceases to function. The drop-out voltage is the difference between the input and output voltages when the regulator ceases to function.

The drop-out voltage of the μA78HG is typically 2.6 volts at 3 amps output, and 3 volts at 5 amps output. Thus one should always ensure that the input voltage to the circuit is at least 3.5 volts above the maximum output voltage required. However, the input voltage must never be allowed to exceed 25 volts, even for an instant, or the regulator device may be damaged.

The μA78HG contains an internal circuit to prevent damage when the output voltage is accidentally shorted to ground. This internal circuit limits the output current to approximately 7 amps under such conditions. In addition, the device incorporates "safe operating area" protection which ensures that the power transistors in the device are kept within the safe operating area of their current/voltage characteristic. Any tendency to go outside this safe operating area will result in the device being shut down with little output current until the condition is cleared.

### Thermal Considerations

The μA78HG also has internal circuitry which prevents damage to the device by overheating, such as when an inadequate heatsink is fitted. Never-the-less, it is advisable to operate the device so that it does not become too hot, since high temperature operation tends to reduce the life by a factor of about two for each 10°C rise.

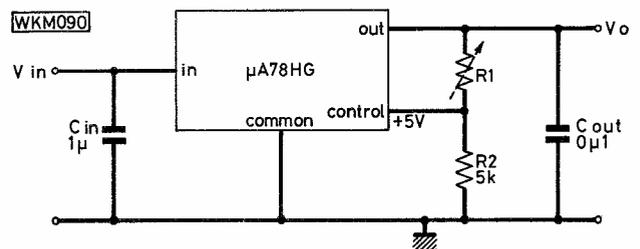


Fig. 2: A simple circuit using the μA78HG

The maximum permissible dissipation in the  $\mu A78HG$  is 50W, but this applies only when the case temperature is  $25^{\circ}C$ . At higher case temperatures the internal dissipation must be de-rated according to the graph shown in Fig. 3.

The size of the heatsink required depends on the internal thermal dissipation which in turn depends on the input voltage, output voltage and output current. The quiescent current is only 10mA, so the dissipation it produces is fairly small. The internal dissipation in watts will therefore be approximately equal to the output current multiplied by the difference between the input and output voltages.

To obtain an output voltage which can be varied over a wide range, a fairly high input voltage is necessary and the internal dissipation will be large if the output current is large. This requires a large heatsink. However, to maintain a fixed output voltage, the input voltage can be set at about 3.5 volts above this output voltage and the heat dissipated in the regulator device will then be much reduced.

The maximum value of the thermal resistance of the heatsink required may be estimated in the following way. The difference between the case temperature of the  $\mu A78HG$  (from Fig. 3) and the maximum room temperature is divided by the internal dissipation in watts. About  $0.2^{\circ}C/W$  is then deducted from the result to allow a safety factor.

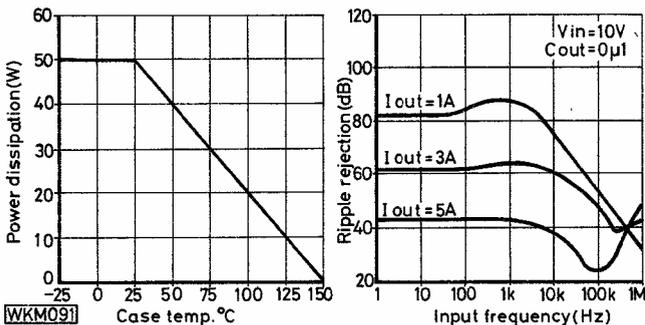


Fig. 3 (left): Maximum internal power dissipation in the  $\mu A78HG$ . Fig. 4 (right): Ripple rejection provided by the  $\mu A78HG$

The  $\mu A78HG$  contains a beryllium oxide substrate for efficient heat transfer. This material is extremely toxic, so it is very important to note that one must never cut open the case of this device. If one were to saw through the beryllium oxide, the toxic particles could enter the lungs.

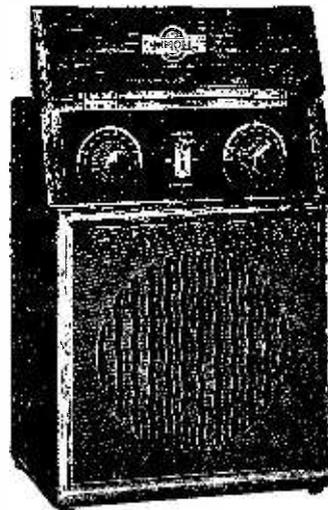
### Performance

The line and load regulation are respectively the variation of the output voltage with the input voltage and with the output current; their values do not exceed 1% of the output voltage of the  $\mu A78HG$ .

The rejection of unwanted noise and ripple on the input power supply is quite high, as shown in Fig. 4 at various frequencies. The output noise voltage is typically  $50\mu V$  r.m.s. The output capacitor shown in Fig. 2 improves the transient response, whilst the input capacitor should be used if the regulator is located more than a short distance from the power supply reservoir capacitor. Solid tantalum capacitors are recommended for use in Fig. 2.

The  $\mu A78HG$  is available from Arrow Electronics Limited, Coptfold Road, Brentwood CM14 4BN.

## The ORMOND 5 VALVE PORTABLE SET



This set is ideal for indoor and outdoor use. It is contained in a Handsome Mahogany Cabinet, is extremely simple to control, and will render perfect reproduction under average conditions from a main B.B.C. Station within about 30 to 40 miles, and about 400 miles of Daventry.

A simple switch gives choice of short and long wavebands. Entirely self-contained and is fitted with a Celestion Loud Speaker. Complete with all Accessories and ready for immediate use.

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FACTORIES: WHISKIN ST. & HARDWICK ST., CLERKENWELL, E.C.1  
Continental Agents: Messrs. Pettigrew & Merriman Ltd., "Phonos House," 2 and 4, Bucknall Street, New Oxford Street, London, W.C.1

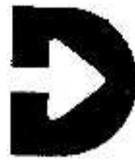
the hyperbole used by other firms, but perhaps explained by their not wishing to frighten-off timid constructors!

### Censorship

Lastly, now that permissiveness reigns, let us see what Sir John Reith wrote in 1928 about censorship: "The peculiar nature of Broadcasting . . . inevitably transfers the choice . . . from the listener himself to the broadcaster. The theatre manager, the editor, the preacher, deal each with his own public rather than with the public, and the . . . subject and opinions likely to be expressed is established by their assembling and buying. To impose limits upon the freedom of such publicists, therefore, is sheer censorship, to be justified or not as such. But the broadcaster's censorship, if it be fair to call it so, has a different basis. He has not to consider the willing but the unwilling audience, the people who if the matter were, say, performed in a hall would not be there. And he has further to consider that even for the same people, matter entirely proper in a hall or a newspaper may be in bad taste or even frankly objectionable in a family group. This is not Philistinism but common-sense." I don't think one needs to be too much of a Mary Whitehouse to concur with this statement, or even to wish that certain television producers would take note of it!

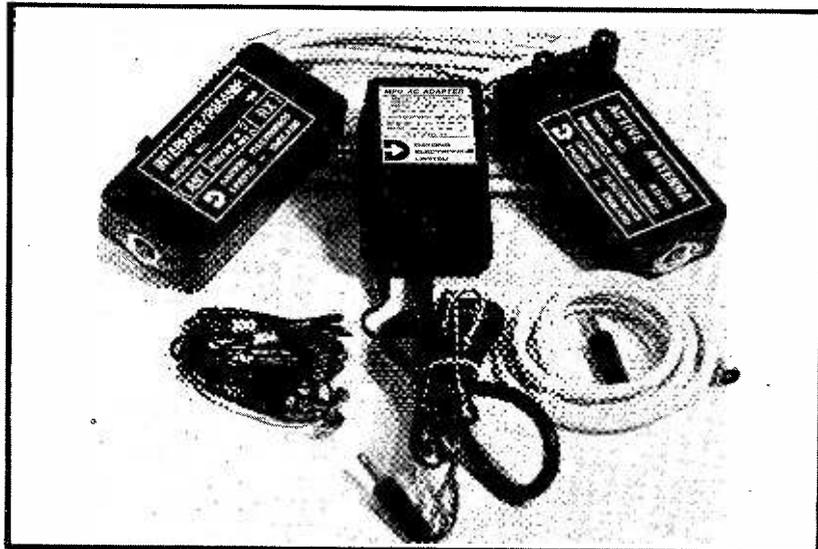
Our grateful thanks to the BBC for permission to reproduce the illustrations in this article

**SPECIAL  
PRODUCT  
REPORT**



**DATONG  
ELECTRONICS  
LIMITED**

# ACTIVE ANTENNA MODEL AD170



For those enthusiasts who enjoy the l.f. and h.f. bands an efficient antenna is a fundamental necessity and whilst many may dream about three-element beams on 120ft. towers, few will be fortunate enough to be able to obtain one. Some, such as those living in flats, may well be denied any outside wires at all and this group in particular should reap the greatest benefit from an active antenna.

The Datong AD170 Active Antenna is a matched set of modules which, when assembled, exhibits some of the characteristics of a full size half-wave dipole. The kit consists of a short wire dipole, each leg being connected to a high-impedance differential input amplifier whose output is arranged to match a low impedance feeder which carries the signals to the receiver. Some signal amplification is also achieved within this module.

A second "interface" unit mixes d.c. power with the r.f. output signal, which is fed via coaxial cable to the antenna module. Its power input is filtered to avoid interference pick-up and is also protected against a polarity reversal.

The Datong units are designed for indoor use and may be installed almost anywhere, an ideal position being the loft or similar high siting. Try to avoid places likely to be influenced by electrical noises, such as may be experienced from fluorescent lights. Remember also that water tanks, overflow pipes and so on will also affect the performance of any antenna.

The two wires from the head amplifier are stretched out and the ends attached to convenient fixing points (rafters, etc.) by non-conductive material—string, for example. For this purpose, two loops are provided. Optimum orientation of the dipole will depend on many factors, such as distance from the transmitter, mode of propagation, transmitter polarisation, time of day and operation frequency, so some experimentation is necessary. Vertical or near-vertical mounting is recommended for frequencies above 10MHz. This will give omnidirectional reception of ground waves (e.g. from l.f. stations) and of low-angle sky waves from DX

## ★ specification

**Frequency range:** 60kHz–70MHz

**Output impedance:** 50Ω

**Differential voltage gain of amplifier:** Unity

**Recommended dipole length:** 3m overall

**Third order intermodulation products:** typically –90dB relative to two output signals of 100mV e.m.f. (Equivalent to 100mV p.d. at the differential inputs)

**Second order intermodulation products:** typically –80dB relative to two output signals of 50mV e.m.f. (Equivalent to 50mV p.d. at the differential inputs)

**Current consumption:** 80mA

**Supply voltage:** 12V d.c. nominal

The Datong AD170 is supplied as a package containing the active aerial, the interface unit, 2 x 1.5m antenna wires, 1 x 4m jumper cable and a 3.5mm jack plug. The mains power unit shown in the photograph is an optional extra.

Price: Antenna £33.19 incl. VAT

Power Supply £6.19 incl. VAT

Both units (inclusive price) £37.13 incl. VAT

**Datong Electronics Ltd, Spence Mills, Mill Lane, Bramley, Leeds LS13 3HE Tel: 0532-552461**

stations. Reception of high-angle sky waves from medium distance stations will be relatively poor, however.

Horizontal mounting gives almost omni-directional reception of high-angle sky waves and directional reception of low-angle sky waves. In the latter case, maximum response will be obtained when the line of the dipole wires is perpendicular to the line between antenna and transmitter. Null responses occur in directions along the line of the wires and can be used to reduce local interference.

continued on page 62

# PRODUCTION LINES

alan martin

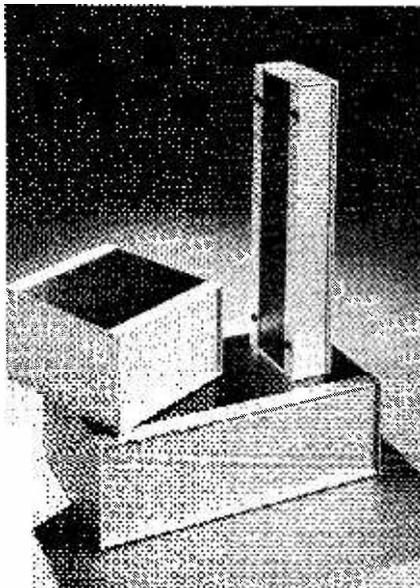
## Classic case

West Hyde Developments have recently introduced a new, versatile series of 45 different cases called the "Contil Classic II."

The main design feature of the cases is the extruded rail, which for the new Classic II has been extensively modified, giving much greater flexibility in use: The slot for the front and back panels is now stepped to give a choice of three different panel thicknesses and to allow for an added translucent panel. The screw groove has been altered to prevent thread stripping and more slots are provided for mounting a chassis or p.c.b. horizontally or vertically.

The case sizes have been carefully chosen to accept single or double Eurocards, which will fit horizontally across the "T" slots or slide vertically behind the front or back panels.

The Contil Classic II is available in three widths, five heights and three depths and held in stock as component parts. For further information contact: *West Hyde Developments Ltd., Unit 9, Park Street Industrial Estate, Aylesbury, Bucks HP20 1ET. Tel: (0296) 20441/5*



## Simple wrapper

OK's new WSU-30M is about the size of a small screwdriver, but performs the complete wire-wrapping function. At one end it has a bit for making wire-wrapped terminal connections, in the middle a "no-nick" wire stripper and, at the other end, an unwrapping bit.

Designed for use with AWG30 (0.25mm) wire and 0.025in (0.63mm) square terminal posts, the all-metal tool produces a modified wrap which has a small amount of insulated wire

## If you please

Would readers kindly mention "Production Lines", when applying to manufacturers or suppliers featured on this page.

## Safety buzzer

Those who have ever had a freezer full of food ruined because the power to the unit has been accidentally switched off, or a fuse has blown, will be well aware of the value of the Buzz Plug recently introduced by Videotime Products.

Wired like an ordinary plug and looking not much larger, the Buzz Plug may be fitted as a direct replacement for a standard plug.

The slightly thicker top contains the circuit which continuously monitors the mains supply. Should the power fail the plug produces a loud instantaneous warning which will persist until some action is taken.

The plug is powered by a single inexpensive battery which will give up to 48 hours warning. Typical applications include use with freezers, fridges, incubators and equipment which must run constantly or would require recalibration. The RRP is £5.95, and is available from: *Videotime Products, 56 Queens Road, Basingstoke, Hants. Tel: (0256) 56417.*

around the terminal, in addition to the bare wire, to improve vibration resistance. The connection, which takes only seconds to make, is considerably stronger than solder, has excellent conductivity characteristics but can be quickly "undone" if necessary.

The WSU-30M is available at a VAT and carriage inclusive price of £5.64 from: *OK Machine & Tool (UK) Ltd., 48a The Avenue, Southampton, Hants SO1 2SY. Tel: (0703) 38966/7.*

# PRODUCTION LINES

alan martin

## A better 555

Rapid Recall Ltd. are now distributing to retailers the ICM7555 and 7556 timers, which provide a significantly improved performance over the standard SE/NE555/6 and 355 timers and are direct replacements for these devices in most applications.

The devices are manufactured by Intersil using a low-power CMOS process and will provide time delays from a few microseconds to several hours.

Operating from any d.c. power source within the range of 2V to 18V, and consuming only 80µA (typical), the ICM7555 or the ICM7556 (160µA) can be used without the special decoupling arrangements which are mandatory with standard 555 devices.

This is because the 7555/6 creates switching spikes on the power rail of only 2 or 3mA compared with 200 to 300mA with standard devices. Also, because the CMOS comparators on the chip possess a very high impedance, control voltage decoupling capacitors are unnecessary. Therefore, in many applications the two or three capacitors needed with the 555/6 are not needed with the 7555/6.

For details of availability and price contact: *Watford Electronics, 33/35 Cardiff Road, Watford, Herts. Tel: (0923) 40588/9.*

## Display bezel

Newly-available from Vero Electronics, is a moulded "display bezel AB064" in

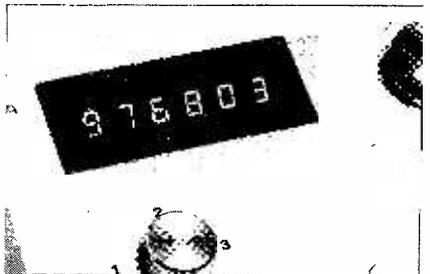
two sizes to attractively frame and highlight a display and at the same time cover unsightly tool marks around a panel cut-out.

Designed to fit into a single rectangular cut-out, the bezel is positioned in the cut-out by four removable location pegs, and firmly secured by two moulded-in screwed studs which also secure the display mounting board on spacers provided.

A choice of lenses are offered—neutral, red and clear, polarised or unpolarised and a full range of compatible mounting boards for both i.e.d. and l.c.d. displays is available.

Prices range from £1.50, for a 4-digit bezel with clear lens, to £2.65 for a 6-digit bezel with coloured lens.

Further details from: *Vero Electronics Ltd., Industrial Estate, Chandler's Ford, Eastleigh, Hants SO5 3ZR. Tel: (04215) 69911.*



## DATONG ACTIVE ANTENNA

continued from page 60

The AD170 has a frequency range of 60kHz to 70MHz. On "medium" and "long" waves there are many strong stations which call for a very good intermodulation performance from a unit such as this. At -80dB on second-order products and -90dB on third-order products the Datong antenna fulfils this requirement admirably.

The interface unit previously referred to contains a switchable amplifier of 12dB gain which will help compensate for the poorer h.f. performance of some older receivers, but is not essential if the unit is to be used with more modern equipment. It is, however, very convenient to have a couple of S-points extra gain available when required to winkle out that elusive DX station.

On test, the AD170 gave very impressive results. It should be fully-understood, however, that the level of signal at the receiver will only compare with that from a full-size dipole at frequencies of about 16MHz, appearing to be about one S-point better at 30MHz.

Below 16MHz the "gain" relative to a full-size resonant half-wave dipole falls at approximately 6dB per octave and at 2MHz will be three S-points down on a 75 metre passive dipole. However, this may not be as dramatic as may first appear, because at 2MHz the level of signal received on a full-sized dipole is considerable, as is the noise level. The active antenna worked quite satisfactorily at these frequencies and its all-important signal-to-noise ratio was at worst equal to and in many cases better than the full-size dipole against which comparisons were made.

Peter Preston

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**by Eric Dowdeswell G4AR**

An oft-repeated complaint by readers of this column concerns interference on the amateur bands, generally between amateur stations, but frequently from other services. It is often assumed that the amateur bands are exclusive allocations, but a look at the allotments will show that sharing with other services is not uncommon. The 80m band is a typical example.

Such QRM can be the making or breaking of a newcomer to the amateur bands, especially if the equipment in use is relatively simple or unsuitable, which is frequently the case. I would say from my correspondence that about 50 per cent of budding amateurs buy equipment on the strength of ads in the popular press, instead of seeking advice from those having some experience of amateur radio.

All too often, sums of well over £100 are spent on receivers claimed to be able to "get the world", on a telescopic aerial! "Listen to the amateurs" they say, about a receiver that does not have a b.f.o., when the vast majority of amateurs today use single-sideband on our h.f. bands, necessitating the use of a b.f.o. "Eavesdrop on the aircraft bands, the police, the taxis etc.," is quite common, all of which is illegal in this country, but it sounds good in advertising.

So my advice must be to contact another person before buying a receiver for use either on the amateur bands or

for general s.w. listening. Avoid also the sets that claim to cover the long-wave band through to the v.h.f. or even u.h.f. bands! There are few, if any, sets that can do this efficiently over such a wide range of frequencies. Get a good communications set for the h.f. bands and use its facilities in conjunction with a converter for the v.h.f. and u.h.f. bands. There must be another amateur not too far away, or a radio club of some kind, where you can seek advice on buying a set. An intelligent look at the advertising in magazines devoted to amateur radio is as good a start as any.

A good secondhand receiver is not to be despised, can be quite cheap, and can always be sold or swapped for another set if it is not up to expectations. Old valved sets, especially those with i.f. filters intended for use on s.s.b., can frequently out-perform many solid-state receivers under the conditions of interference that prevail on some amateur bands. They are virtually free of the bugbear of most transistorised sets, cross-modulation, where signals which are on adjacent channels, or even far apart in terms of frequency, inter-modulate giving the effect of interference on the desired signal. It is frequently almost impossible to convince a listener that the interfering station is not on an adjacent channel! Turning down the r.f. gain can usually prove the point.

## What's on the Bands

From Marple, near Stockport, **John and Steven Goodier** used their FRG-7 and 30ft wire to log J6LFU, a new prefix for St. Lucia, previously VP2L, plus suffix. On 20m s.s.b. FW0TT on Wallis Is. was a good find as well as JX9WT, much nearer home on Jan Mayen but still quite rare. S8AAT is another unusual prefix, this time for the Transkei while D68AD in the Comoro Is. is not heard all that often.

School work doesn't prevent **Ian Marquis** BRS41426 in Leigh-on-Sea, Essex, from digging out some goodies with his FRG-7, such as EA8CR and VO1HP on 160m c.w., FP8, HR3, TI5, 6W8 and 9K2 on 80m s.s.b. in spite of the rising sunspot number, or is it? **David Palmer** writes for the first time from Stowmarket, Suffolk, with a goodly selection of DX heard on his Trio JR310 with indoor dipoles for 10, 15 and 20m, and a 100ft wire for the l.f. bands, plus an a.t.u. I have suggested that David tries the wire on the h.f. bands, too, if he hasn't already done so. He found 10m quite good with prefixes like C5, DU1, HH2, H44, J28 and 6W8. David's two precepts for good DX are, getting on at the right time, and skill in operating the receiver. *D'accord!*

Finally, some more grist for the June DX mill, says **Bill Rendell** in Truro, Cornwall. He's been trying his h.f. dipoles as centre-fed "T"s on 80m using an a.t.u., as well

Reports on the various bands are welcome and should be sent direct, by the 15th of the month, to:

**AMATEUR BANDS** Eric Dowdeswell G4AR, Silver Firs, Leatherhead Road, Ashted, Surrey KT21 2TW. Logs by bands, each in alphabetical order.

**MEDIUM and SW BANDS** Charles Molloy G8BUS, 132 Segars Lane, Southport PR8 3JG. Reports for both bands **must** be kept separate.

**VHF BANDS** Ron Ham BRS15744, Faraday, Greyfriars, Storrington, Sussex RH20 4HE.

as on the design frequencies of 20 and 15m. Bill's still hankering after a new set to replace his beloved Heathkit AR3, but so far an AR88 in the pipeline has been vetoed by the XYL! The QTH of AA6AA turned out to be Los Angeles much to Bill's disappointment as did KG4W in Virginia. However, he did manage three ZLs on the same band, 80m, while on 20m VK2AGT on Lord Howe Is. was some compensation. VP8SO seems to be a new one on from Signy Is. with QSLs via G3KTJ, S79MC is still a mystery to Bill, and me, so if anyone can enlighten us please do so. Could it be old timer VS5MC?

## The Month's Mail

**Andrew Smith** in Glasgow admits to being just a beginner but is lucky to be off the mark with an FRG-7 and Joystick aerial and a.t.u. He thought of contacting someone else in his area who might also just be starting, but my advice in such a case is to find the local radio society or group and get among the experienced amateurs and listeners who will be only too willing to assist. G4HWB hides the identity of **Mike Stollov** of Blackley, near Manchester, who complains that although modern technology has given him colour TV and non-stick frying pans it hasn't indicated how he can pay for all the modern amateur radio gear!

However, he has an FRG-7, and being keen on c.w. he ought not to have much trouble getting hold of one of the older c.w. rigs such as the LG300 for next to nothing. Another recruit from the BC bands is **Martin Gill** (Kirkby Lonsdale, Cumbria) who has been active on 10, 15 and 20m with a Barlow-Wadley XCR30 and logged 67 countries in four months. **David Wyatt** a 14-year-old from Oswestry, Salop, is starting to copy c.w. on his BC348 and queries a few prefixes. I can only advise, as I do most months, buying Geoff Watt's prefix list for the grand sum of 45p from 62 Belmore Road, Norwich. His weekly news sheet is also good value for those keen on keeping up with the latest DX news.

A note of warning for owners of Realistic DX160 receivers comes from **D. Dempster** of Birmingham, who points out that the set's on-off switch only cuts the internal low-voltage supply and not the mains supply in the conventional manner. The set is therefore always live, which could be dangerous if one is poking around inside believing the mains is switched off. **W. Semmens**, writing from Penzance, Cornwall, says that he is handicapped but very keen to take up amateur radio, if he had a receiver, so if anyone in his area can help with a secondhand set at a reasonable price please let me know.

The above note on the DX160 should be of interest to **P. C. Hawkes** who uses his with a 100ft wire. A beginner of only a few months, P.C.H. has been disappointed at not finding a radio amateur's map of the world at his local bookshops. Only source for these are the RSGB and *Short Wave Magazine*, and to be of any use such maps must be on a great-circle projection which gives true direction, so important when used with rotary beams. Incidentally P.C.H. sold part of a stamp collection to take up our hobby, but I can assure him he will never be disappointed with his choice.

After five years of studying electronics **Phil Charlesworth**, now BRS41107, in Southport, went to a mobile rally with G8EFQ and fell for amateur radio. He passed the RAE last December and is going all out on his code before getting his G4+3. He even threatens to send in some c.w. logs! **Alan Billington** is very lucky indeed, as his Dad is teaching him the code and he sits the RAE in May, Alan, that is! He is only 16 and has a Lafayette HA350 plus 80ft aerial and homebrew a.t.u. Alan is BRS40845

and wonders if there are any other SWLs in Morecambe, Lancs.

**John Cassidy** of Shanklin, IOW, is 13 and recently bought a five-valve set from AH Supplies of Sheffield, and wonders if any reader has a circuit diagram. He'd also like to get hold of a pair of 4kΩ headphones (so would I!) at a reasonable price. John lives at 15 Sibden Road if anyone can help. Some comments on the National DR2800 mentioned in the April column, from **John Gomer** (Colchester). He had one but swapped it for a Hammarlund SP600JX which sounds like a good swap to me. He heard subsequently that the 2800 was traded for a VW Beetle! John is dedicating a couple of nights a week for RAE study so good luck OM.

## News from the Clubs

Editor of *SWM*, G3KFE, will be talking to the **West Kent ARS** on making homebrew equipment on Friday May 25 at the Adult Education Centre, Monson Road, Tunbridge Wells where meetings are held fortnightly. Alternate Tuesdays for informal meetings, Morse practice and chat at the Drill Hall, Victoria Road. **Bury RS** (G3BRS) will benefit from a chat on modifying Pye gear by G8EUM on May 8 at Mosses Centre, Cecil St., Bury, and every Tuesday evening. Contact: G4GSY at 7 Rothbury Close, Ainsworth Road, Bury, or ring 061-761 5083.

**Stevenage & District ARS** normally meet first and third Thursdays but contact Trevor G8KMV, 11 The Dell, Stevenage for details of the 2m DF Hunt on May 10, or ring 0438 54689. An anonymous secretary has sent details of the **Loughor Amateur Radio & Electronics Club** operating near Swansea. Only formed late last year the club is looking for more members so ring said Sec on 0792 893392.

A little detective work on the **Crawley ARC** (W. Sussex) Newsletter reveals that it meets on the last Wednesday of the month with informal gatherings at a member's QTH on the second Wednesday. Formal meetings at Trinity United Reformed Church Hall, Ifield Drive, Ifield but write to "Dot and Vernon" G3MER and G3MSK respectively for details of club activity, at 16 Newmarket Road, Crawley, W. Sussex.

Don't forget, letters and logs by 15th of the month and don't miss the RSGB's Exhibition at Alexandra Palace on May 11 and 12.

## Log Extracts

**M. Gill:—20m** HS1WR VU2JNA VP2LFZ TU2HS  
15m ZP5LN HC7DR 10m FM7WY ZP5CDE YS9RE

**R. Bell:—20m** HC9CB HP7OP VP2MFO YA3DM  
YB61B 15m TR8AC 10m CX8CN JR2LDM

**W. Rendell:—80m** CO2JA CT2SH (QSL W3HMK)  
HR0QL KG4W PJ2FR VP2SK XE1OW YV5ANS  
ZL2BT/ZL4AP 20m C5AAL CT2YB HS1ABD  
TU2AE VK2AGT (Lord Howe Is.) VK7AE VP2MF  
VP8SO 15m CT2CP C6ANU D4CBS HK3AXT  
J3AAE S79MC TG5WQ

**D. Palmer:—15m** C5ABK J28AY VQ9MR YB0WR  
10m C5AAP HH2PW HR0QL H44JD J28AG TA1MB  
VS6EZ YB0TZ YS9RVE 6W8DY 7Z2AP

**J. & S. Goodier:—20m** FW0TT JX9WT J6LFU  
KA1MI S8AAT 5U7AG 15m D68AD VP2AC  
9Y4TRV 10m C5AAP ZE2JK

**I. Marquis:—80m** CT2SH VE3BWK/4U 20m  
VP8SO ZD7PL 4S7DJ 5U7AG 15m FC9VN FG7AX  
HR0QL VP2LFZ 6W8DY

All above loggings were on s.s.b.



## MEDIUM WAVE DX

by Charles Molloy G8BUS

While tuning round the medium waves recently, I was intrigued by the number of 1kHz heterodynes that could be heard. A quick check brought a surprising total of 33, some quite strong, which indicates in each case there was a station still working on the old pre-Geneva frequency, 1kHz below the correct channel. If two stations are operating 1kHz apart then they will interfere with each other, and the difference in frequency between them will appear as a 1kHz audio tone at the loudspeaker.

A note over Sweden Calling DXers shed some light on the problem when it was stated that a number of countries have not (yet?) adopted the Geneva plan. Algeria, Iraq, Jordan, Lebanon, Libya and Tunisia it was claimed had not changed over at all, while several others in the same area have altered only a few of their transmitters. Algeria is still on 251kHz on the long-waves, while 520kHz now appears to be an out-of-band frequency at the l.f. end of the medium waves, inhabited by low-power Austrian and German stations.

## Heterodynes and DXing

Although a heterodyne is usually associated with a frequency difference between two signals that is at least great enough to generate an audible note, it is possible to have a sub-audio heterodyne. These are called "beats". A beat is generated when two stations, nominally on the same frequency, are separated by only a few hertz, which is usually the case when two signals are not synchronised. This is of particular interest to the DXer, as the beat will show up on the "S" meter. Even a weak station swamped by a much stronger one on the same channel will produce a beat strong enough to be indicated on the "S" meter and thus reveal its presence to the DXer. If you come across such a beat then stay on the frequency for a few minutes. DX on the medium waves is usually subjected to slow cyclic fading, so the strong station may fade and the weak one may increase in strength and even become dominant for a short while. I have often picked up interesting DX just by sitting on a channel that has a strong signal with a beat.

## West African DX

Sunset along the West African coast occurs at much the same hour as in the UK, which makes this part of the world attractive to anyone who would like to DX during a summer's evening. Since the DX is coming from the south and any interference will most likely be from other directions, a loop will be useful in getting rid of unwanted co-channel interference.

Radio Las Palmas in the Canary Islands is now conspicuous, in Spanish, on 1008kHz after Lopik in Holland signs-off. The Radio Nacional España outlet in Tenerife can be heard with the call "Centro Emisor del Atlantico" on 621kHz, but there will be QRM from Batra

in Egypt which a loop should be able to deal with. Brussels, which is on the same frequency, signs-off at 2245. Radio Dakar in Senegal shares 765kHz with Sottens in Switzerland and it is often heard in the UK with African music and French announcements. Conakry in Guinea is a regular on 1404kHz with the call "La voix de la Revolution," and it is difficult to miss it after 2300 when the France Cultur network on the same channel goes off for the night. Bissau, located in Guinea-Bissau, is now on 1071kHz and the time to look for this one is after 2100 when the France Inter network closes down.

## World Radio and TV Handbook

The 1979 edition of this handbook is now available and it contains the latest changes on the medium and long waves. As well as listing the stations authorised under the Geneva Plan, it also indicates those that are not yet on the air, or are operating with less than maximum power. This is the only up-to-date list of medium- and long-wave stations that is available at the time of writing. The *WRTVH* contains all sorts of information that is useful to the DXer including station addresses, schedules, and details of interval signals from broadcasters in every country in the world, and it covers the long, medium, short, v.h.f. and TV bands. The 1979 edition costs £8.50. It is published by Billboard, distributed in the UK by Argus Books, 14 St James Rd, Watford, Herts and it can be ordered through bookshops.

## WARC 1979

These initials stand for the World Administrative Radio Conference, which is due to be held in Geneva in September this year. This conference is concerned with the allocation of frequencies to different users, and when I wrote about its possible effects on s.w. broadcasting last month, it did not occur to me that the conference would concern itself with the medium waves. There is, however, a proposal to the conference from the US Government, that the medium waves should be extended to 1860kHz in Region 2, which covers North, Central and South America.

Radio amateurs will be far from happy at the prospect of having broadcasting in the lower 60kHz of the 160m band, and one can only hope that this part of the proposal is not implemented. The US intention is to use the extended part of the band to provide another 14 channels which would be occupied by 700 low-power local stations. Each would become what is known as a graveyard channel, like 1230, 1240, 1340, 1480 and 1490kHz are at the moment. These frequencies are the resting place for hundreds of stations with powers of 500 watts or less, some of which operate during the daytime only.

It is hard to predict what DXing among these new channels would be like, but experience of existing graveyarders indicates that some interesting and unpredictable results can be expected.

## Readers' Letters

"Perhaps the internal ferrite rod interferes," writes **D. R. A. Lowe** from Lichfield, who has been trying to use a m.w. loop with a Philips 543A receiver. He found that the loop exhibited no directional properties. Yes, this is what is wrong. The receiver is picking up signals from the internal ferrite rod aerial at the same time that the loop is trying to null-out this signal. You should only connect a loop to a receiver that does not have an internal aerial, and preferably a receiver that is well screened in a metal

cabinet, so that the receiver wiring does not act as an aerial. It is easy to test the receiver. Unplug the loop and the receiver should now be dead.

A similar problem comes from **Roy Haynes** who has been trying a loop with his Realistic DX160 and cannot get directional reception. Unplug the loop and see if the receiver still picks up the station you are trying to null-out. If it does then the loop is OK and it is the receiver that is causing the problem. Some versions of the DX160 are fitted with a ferrite rod aerial for m.w. reception, and this will have to be disconnected before a loop can be used with it. The ferrite rod should be fitted at the back, externally to the metal cabinet.

**Chris Constantinides** would like to listen to any of the Greek medium-wave stations and wonders if he should swap his DX160 for a better receiver. A more selective receiver will not help Chris, as the interference you are experiencing comes from stations operating on the same frequency as the signals you are trying to pick up. Try a m.w. loop along with your DX160, making sure that the latter does not have an aerial of its own. Don't be optimistic about obtaining regular reception from Greece on the m.w.s as there is a lot of co-channel interference to overcome.

Athens is now on 729kHz and signs-off at 2300. The power is 150kW but there is high-power interference from Egypt, USSR and Finland, and also from stations in East Germany and Spain. Similarly with the main Yened outlet which is on 981kHz with 200kW, there is QRM from Algeria, Bulgaria, Cyprus and Sweden. The best time to listen to the Eastern Mediterranean is from 0400 onwards when, owing to the different time zones, stations in that area are signing-on while those further west are still off for the night.

## DX Heard

Using a DX160, 90ft long wire, a.t.u. and pre-amp **K. Lewis** (Pensilva, Cornwall) pulled in Radio Margarita, Venezuela on 1020kHz, WINS New York on 1010, Radio Coro Venezuela on 1210 and Radio Paradise, St Kitts 1265, all heard between 0145 and 0330 in mid-March. Listen at this time of the year for North America and the Caribbean during the hour before sunrise. Reception is often good and QRM is light.



## SHORT-WAVE BROADCASTS

by **Charles Molloy G8BUS**

A three-transistor receiver is in use at Fareham by **Simon Pegler**, who finds he gets improved reception if he unplugs the aerial from the receiver and runs the aerial lead close to a piece of wire which is plugged into the aerial socket. Similar results would be obtained by fitting a low-value fixed capacitor in series with the aerial. **Peter Simms** has a similar problem with his 9-valve, semi-vintage domestic receiver, which he uses with a 40ft inverted "L" aerial.

This set-up works well on some bands but not on others: "It picks up very little and selectivity becomes poor. This does not happen if I use short lengths of wire . . ."

It is possible to electrically shorten an aerial by inserting a capacitor between the aerial and the receiver. A variable capacitor with a maximum value of about 50pF will do the trick on the main short-wave bands. This dodge is as old as radio itself and it was once the subject of a patent held, I believe, by Scott Taggart who designed the famous ST series of receivers. A long aerial picks up a lot of signal which is useful when you are listening to a weak station, but it can cause receiver overloading with strong signals, as well as damping the receiver input tuned circuits as in the two cases quoted above. A capacitor in series with the aerial will be found beneficial with many sets.

## Tropical Bands

Some very good DX has been reported on the Tropical Bands recently. **Bob Bell** (Blyth) used an FRG-7, a.t.u. and a vertical aerial to pull in Radio Nepal at Katmandu on 3425kHz in the 90m band at 0030, Radio Bolivar Venezuela 4770kHz (60m) at 0100, Radio Tallin in English on 4860 at 0105, Radio Naçional Luanda 4820 at 0120, Dacca in Bangladesh 4790 at 2050, Radio RSA 4875 at 2350 with sign-off, Gansu in China on 4865 at 2155 in Chinese with jamming, an unidentified station in Arabic on 4845 at 2215, Alma Ata on 5035 at 2205 in Chinese, and Ashkhabad on 4895 at 2350.

From Pensilva in Cornwall, **K. Lewis** reports hearing Radio Guatapuri in Colombia on 4817kHz at 0535 and Radio Garoua in Cameroon on 5010 at 1840 in English, the receiver being a DX160. **Peter Ramsey** (Ayrshire) used an AR88 and a loft aerial to pull in Radio Singapore on 5010 at 0315, Tegucigalpa Honduras on 4820 at 0330 and Lagos, Nigeria on 4990 at 0440. **David Wyatt** (BC348) heard Radio Reloj in Costa Rica on 4832 at 0755, Nouakchott in Mauretania on 4845 at 2305, Cotonou Benin on 4870 at 0550, Radio Rumbos (Villa de Cora) in Venezuela on 4970 at 0625, Radio Colosal (Neiva) Colombia on 4945 plus two he could not identify—Radio Superas on 4879 (R: Super at Medellin Colombia is on 4870) and Radio Cosanti on 4950 (anyone any ideas?).

DXers who have not tried the Tropical Bands should study the above carefully as it is representative of what can be heard. Listen after dark during the summer for African stations and throughout the night for Latin Americans.

## "Long Live Short-Wave"

This is the title of an album (12 inch LP) issued by the well-known songwriter and record producer Mitch Murray. Mitch, who is a keen DXer himself, is the narrator who in the space of an hour, guides the listener through just about every aspect of DXing. One advantage of this type of presentation is that the audience can actually hear what it is all about, whether it is a signal from a satellite, WWVH in Hawaii, or QRM such as facsimile or Teletype. Station announcements and interval signals from a number of stations, some everyday and some exotic, are presented and I must admit there were a couple that were new to me. A few words from Henry Hatch of the BBC World Radio Club are included.

The album, which is advertised on page 159 of the 1979 *World Radio and TV Handbook* is accompanied by an explanatory booklet. It is available from Trans-Island Productions, PO Box 24, Douglas, Isle of Man, either as a record or cassette for £3.50, post paid. It should provide a

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M9



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novel introduction to the hobby for the newcomer as well as being of interest to many old hands like myself.

## Frequency Standard and Time Signal Stations

Fourteen-year-old David Wyatt (Oswestry) got hold of a BC348 surplus receiver which was made in 1942, and is the type that was used in the wartime Flying Fortress. When used with a 90ft long wire, it pulled in IBF in Turin, Italy on 5MHz at 0700 with identification in Italian and English plus IBF in Morse, VNG Lyndhurst, Australia on 12MHz at 0915 and WWV Fort Collins USA on 10MHz at 0955. David finds these frequency standard stations useful to check the calibration of his receiver. This is, of course, one of the reasons why these stations are on the air. Others that are logged now and again (I nearly said from time to time) are Podebrady, Czechoslovakia 3170kHz, BPV Shanghai and JJY Tokyo on 10MHz, CHU in Ottawa on 14 670kHz, RWM Moscow and WWVH Hawaii on 15MHz.

## Readers' Letters

Fourteen-year-old Alistair Dupres (Cardiff) has made a good start with DXing by logging Radio Japan on 15 195kHz at 2200, using his Vega Selena MB 210/2 with telescopic aerial; their address is 2-2-1 Jinnan, Shibuya-Ku, Tokyo. Alistair asks: "what is a QSL card?" A QSL card is a colourful picture postcard, or a card with an artistic design, that a station will send to a listener in return for a reception report. See the front cover of the August 1978 issue of *PW* and my article on QSLs in the same issue. The card will usually have the station callsign or slogan printed on it together with the verification details that will confirm that the DXer actually heard the station.

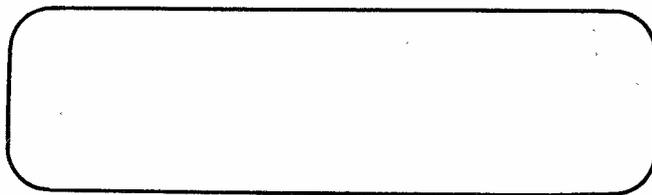
A Hitachi Radio Cassette Type TRK5320E with telescopic aerial is in use by P. W. Oliver of Paisley, who wonders if he would get improved reception by joining an additional aerial to the telescopic one. I would not recommend it as you may get overloading. A series capacitor will help, but I like the method suggested by Mitch Murray in *Long Live Short-Wave*, which is to wrap a piece of insulated wire round the whip aerial without making direct contact with it. Then join your aerial to one end of this piece of wire, the degree of coupling being adjusted by altering the number of turns.

"What is a mechanical filter?" asks Michael Welsh, who is thinking of investing in a Collins R390A which possesses "mechanical intermediate frequency filters for selectivity." It is an electromechanical device which replaces an i.f. transformer. It will give results equal to, if not better than a crystal filter, and its main advantage is the steep sides of the reponse curve. A mechanical filter should not be confused with a ceramic filter which gives results similar to an i.f. transformer. Since the ceramic filter does not require adjustment it has advantages from the manufacturer's viewpoint and they are now widely used for domestic receivers.

Ian McLean has a Pye Cambridge R35 and he wonders if anyone could put an age to it. Replies direct to Ian at 46 Golf Drive, Port Glasgow, Scotland. Used with a PR40 preselector and 50ft long wire this receiver pulled in Radio Australia on 17 785kHz at 0306 and Radio Pakistan in English on 17 890 at 0245, both in the 16m band. Derek Vivian would like to contact any reader who has fitted an "S" meter to the CR100 and his address is 9 Dymock House, 19 Malden Rd, Wallington, Surrey.

Radio Tinian crops up again with a suggestion from Dr S. K. Kellet Smith (Guernsey) that this station might be

located on an island called Tinian in the Marianas Group in the SW Pacific (Micronesia). This would really be DX! Unfortunately, broadcasting in this area (according to the *WRTVH*) is on the medium waves and v.h.f., neither of them being likely to be heard in the UK. Dr Kellet Smith, who is now retired, has a Sanyo RP990 with telescopic aerial which pulled in Australia on 11 855kHz after midnight for him. Receiver trouble is being experienced by 15-year-old Julien Smith who has a Philips 341A which has blown a valve and also a new replacement. Julien lives at 48 Seafeld Close, Seaford, Sussex, and help from anyone in his area would be appreciated as he is currently "off the air". Neil Devlin writes from Dundee to say that his Ferguson 5-valve domestic receiver and 60ft long wire pulled in Vietnam on 12 035 at 2115, Iran on 9022 at 1705 (out-of-band) and Radio Yugoslavia on 9620 at 2202 and Radio Australia on 6005 at 1705.



**by Ron Ham BRS15744**

I always enjoy attending the RSGB's annual VHF Convention and this year's event, held on March 10, at the Winning Post Hotel, Whitton, was no exception mainly because it is a wonderful opportunity to meet many of our readers and to feel the pulse of the current v.h.f. affairs.

## Sudden Ionospheric Disturbance

Soon after I arrived at Whitton, Mark Deutsch G3VJG, told me about the Sudden Ionospheric Disturbance which occurred between 1035 and 1142 on March 9. Shortly afterwards I met Charlie Newton G2FKZ, with the same news and Cmdr Henry Hatfield, Sevenoaks, who was not a bit surprised because, at that time, he recorded solar radio noise at both 136 and 1296MHz. Another old friend, Harry Gratton G6GN, up for the day from Bristol, knew something had happened because 10m conditions were extra good at midday. At 1215 he worked VK2QL on c.w. and as late as 1400 he heard a VK in QSO with a GW on the key.

## Aurora

The Convention was a mine of information and during the afternoon lecture session, Charlie Newton explained, with illustrations, how the equipment aboard SkyLab improved our knowledge of the sun's coronal holes, great solar filaments that unwind like a knotted rope, and the occurrence of auroral events. "Information is vital," said Charlie, "I often have a thousand observers on the air throughout Europe during an event," and he told Angus McKenzie G3OSS, London, who recently achieved a tone-A contact with a GM on 70cm, that auroral contacts on the u.h.f.s and microwaves should be attempted. Many of the pundits were expecting an aurora after the previous day's s.i.d., and soon after I arrived home from Whitton, Alan Baker G4GNX, Newhaven, phoned around 2300, saying that signals on 20m had gone auroral. By midnight, John Cooper G8NGO, Cowfold, had received a GM and Roy Bannister G4GPX, Lancing, almost completed a

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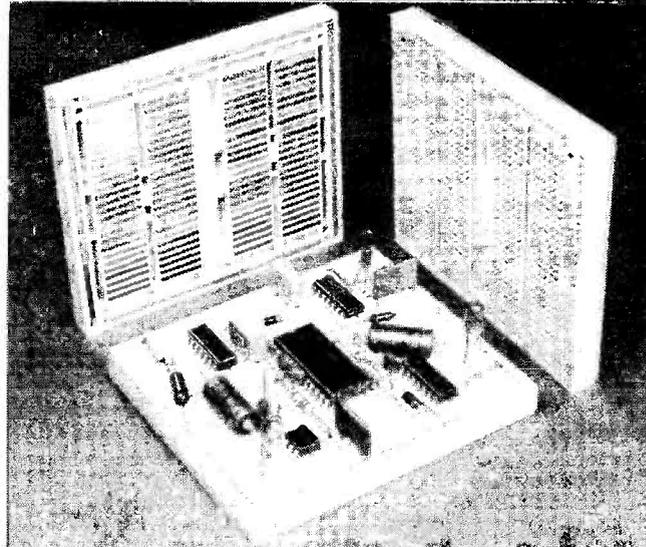
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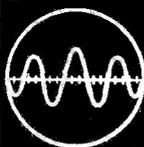
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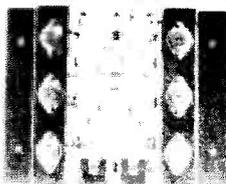


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tone-A QSO with a GM on 2m. SM4IVE told **John Branegan** GM8OXQ, Saline, Fife, that an aurora manifested east of northern Sweden around 1925 on February 24, and John saw the effect of a weak aurora on Band I television on the 26th. Between 1900 and 2200 on the 21st, John received auroral signals from the 2m beacons in Germany DL0PR, Cornwall GB3CTC, Northern Ireland GB3GI and from three amateur stations in Scotland.

## Solar

There is little doubt that the February aurorae were caused by the solar activity which was recorded by **Robin Knight**, South East Essex Astronomical Society on 60MHz, Henry Hatfield on 136MHz, **John Smith**, Rudgwick, Sussex, on 142MHz, and myself on 146MHz, between the 19th and 23rd. Also on the 23rd, Henry, using his spectrohelioscope, saw a sunspot group nearing the western limb. Alan Baker visited Henry on the 25th and saw a prominence, several sunspots and a cloud of gas through Henry's machine. At 1052 on March 1, Henry located a bright area and a prominence just inside the east limb which may well have caused the solar radio noise recorded earlier by himself and John Branegan.

## Satellites

I chatted to **Ron Broadbent** G3AAJ, Secretary/editor of AMSAT-UK at the Convention, and he sent me a copy of their journal, *OSCAR News*, in which I am delighted to read that Britain's first Amateur Radio Spacecraft is in the pipeline and will be built at the University of Surrey. Ron is going to update us on all future developments. (Full details were given in "News" in our last issue. Ed.)

On March 4, John Branegan received a QSL card from W3JPT, Washington, DC, confirming his best OSCAR-8J DX to date. John raises an interesting point in his letter, "The intense high pressure to the east side of the UK on February 25 and 26 had a marked effect on satellite results, creating a barrier which slowly moved south-south-east. It was not possible to put a 2m signal into a satellite through this barrier when the satellite's elevation was below 25°." (My barograph recorded 30.75in at that time.)

Several stations have given John propagation data by coming back to his OSCAR-Mode J CQs, in particular the 11 QSOs with each of VE2LI Montreal, WA3ZHW Pennsylvania and WB2OXJ New Jersey.

## The 10 Metre Band

**Harold Brodribb**, St Leonards-On-Sea, writes: "Now that 10m is so brilliant and the Russian stations so numerous, we have a new field to hunt in." Harold has far too many American and Russian stations for a detailed report, which shows that his AR88 and loft-mounted, inverted "V" dipole are going well. Harry Gratton has been concentrating on 10m and in just two weeks has worked 60 JAs on the key. Between February 20 and March 18, I heard signals almost daily from the International Beacon Project stations in Bahrain A9XC, Cyprus 5B4CY, Germany DL0IGI, and periodically at midday, Bermuda VP9BA.

## DX TV

Both **Ian Rennison**, Horsham, and myself noticed frequent short bursts of signals on Channel R1, 49.75MHz during the early mornings. Around 0956 on

February 26, I received an unidentifiable picture, with vertical bars, on R1 and at 0900 on March 6 there were bursts of test card. **Ian Roberts**, Glenstantia, Rep. South Africa, says that conditions for DXTV were good on March 3 and writes: "The spectrum was literally jammed at the low-frequency end and the only pictures I could make out in detail were on R2 at 1609 GMT and later in the evening from 2053 to 2200, local time, Channel E2, Kenya." At 2300 Ian could still hear video signals above the receiver noise on Channels E2, R1 and IA. At the suggestion of young **Stuart Hardy**, Loudham, Notts, I wrote to Granada Television, Manchester, to find out more about the Granada caption that several of us saw during a Band I sporadic-E disturbance last year. In reply, one of our readers, **Arthur Brennan** G2AUC, of their engineering department said: "I can confirm that it was a Granada Television International caption which you saw. We do export to all European Countries and during sporadic-E we do have reports of our own station at Winter Hill, Lancashire, being received in Holland, Sweden and Norway". Arthur also expressed his interest in the "Five Metre Story" (*PW* March 78), because he and GW2CPU listened to the Snowdon tests, in 1932, with a super-regen receiver situated 800ft a.s.l. some 10 miles inland from Aberystwyth.

From Western Australia, **Anthony Mann** writes: "I spent February 10 and 11 modifying a valved TV set for 405 lines, just in time to lock B1 video, 45.0MHz, on the 12th, and B1 was in again on the 14th, 16th, 17th, 20th and 21st. Without doubt February 21 was the best B1 opening so far. Next day was completely different, absolutely dead, as is often the case with enhanced F2 conditions the day before." Anthony also heard B1 sound, 41.5MHz, briefly on March 8, 9 and 10 and signals from China on R1, on February 14 and March 2.

## Tropospheric

Anthony Mann tells me that on December 29, 1978, a two-way QSO on 1296MHz established a new world record between VK6KZ, 160km west of Albany, across the Great Australian Bight to VK5MC, 70km west of Mt Gambier. Our congratulations to the participants.

Although the atmospheric pressure rose from 29.1in at midday on February 13 to a record of 30.75in on the 25th, the v.h.f.s did not open as much as we hoped. However, some DX was about and on the 19th, **David Wakefield** G8RVK, Worthing, worked ON1YW and ON4VN; on the 20th, G3CHN, south Devon and at 1815 on the 26th, GU3KFT. David has a Mizuho SB-2M portable rig and a 10 watt linear on loan from **Mitch Tribe** G8PMT, and has worked G, GJ, GU, GW, F and ON and had QSOs in 13 different QRA locator squares including ZM, YJ and YK. On the 21st, a newly licensed husband and wife team, **John** G8RZP and **Jackie** G8RZO, **Brakespeare**, Slough, worked into Belgium and Holland on 2m s.s.b. During the evening of the 25th, Alan Baker worked F1ANH and ON5UN on s.s.b., ON6CP on c.w. and F1FJT through the Brighton repeater GB3SR, R3. At the Convention, Random Electronics displayed a massive, eye catching, 21ft long, 2m Yagi, French made by Tonna, which, along with their 70cm beams were selling well. Harry Gratton uses one of these beams and is delighted with its performance. During one of the Convention lectures, **Ray Flavell** G3LTP, talked about the mechanics of tropospheric openings and explained how to use the data published in the RSGB's VHF Manual. He also emphasised the importance of getting the "upper air data"

when obtaining daily met. information which is available from many sources.

## 144/432MHz Contest

Although conditions were generally poor for the RSGB's 144/432MHz and SWL Contest held on March 3 and 4, Alan Baker worked four French stations, one ON, one GW and a GJ on 2m s.s.b., and **David Wakefield**, a first timer, made 30 QSOs including 2 Fs and 1 GW. The multi-operators of the Hastings Electronics and Radio Club, G6HH/P, made 496 QSOs during the event with a best DX of 620km into France.

## St Dunstan's Weekend

Among the guests at the AGM of the St Dunstan's Amateur Radio Society held at Ian Fraser House, Ovingdean, Nr Brighton, on February 24, were Alan Baker, President of the Brighton and District Radio Society, **Barry Cook** G4BWJ, Royal Naval Amateur Radio Society, **Eric Letts**, Chairman of the Mid-Sussex Amateur Radio Society and **John O'Houlihan** G4BLJ and **Len Wooller** G9GEZ, of the Post Office Radio Division. After the official business a talk was given by **Louis Varney** G5RV, and during the weekend the St Dunstaners contacted several Ws on 10m and many locals on 2m through the Brighton repeater.

## Raynet

On March 1, several of our readers took part in an East Sussex Raynet exercise designed to assist the Red Cross ambulance service if the need arose. The group covered a wide area from Worthing along the south coast to Eastbourne and inland to Crowborough, with **Dermot Cronin** G3GRO, on the Royal Sovereign Light as a relay station. Many Sussex Raynet members were again on exercise on March 11 when they operated throughout Sussex in conjunction with the County Emergency Planning Officer, using 80m and 2m, s.s.b. and f.m.

## Amateur Co-operation

On February 25, F1FJT of Radio Club de Normandie wanted to contact **Geoff Ellis** G3LFZ of the Southdown Amateur Radio Society, so Alan Baker, who worked the Frenchman, called Geoff on the land line and they were soon in QSO. During the evening of March 9, Alan heard G5BYU/M on 2m s.s.b. in Haywards Heath and G3IIR, in London, calling each other in order to arrange a meeting at the VHF Convention the following day. By breaking in, Alan linked the two stations together.

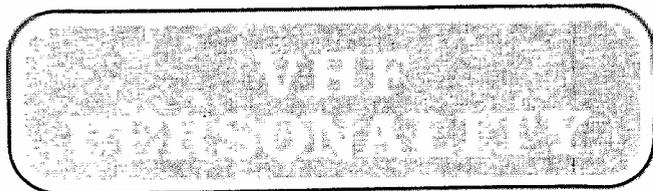
## Sporadic-E

I was fortunate to be chairman for the Convention lectures given by Charlie Newton, Ray Flavell and **Professor Martin Harrison** G3USF, who began by playing tape recordings of music from Budapest, and an Italian commercial heard around 70MHz during a sporadic-E disturbance last summer. Martin explained some of the theories about sporadic-E, and emphasised that it was an erratic phenomenon occurring annually between May and August and most likely to affect the 2m band in the late afternoon.

## The VHF Convention

During the morning I met my two opposite numbers, **Graham Knight** and **Norman Fitch**, the v.h.f. columnists for *Radio Communication* and *Short Wave Magazine*, who, like myself were surveying the trade stands which were laden with components especially for the home constructor. Among the trade exhibitors, who were all most helpful, were Messrs Burns, Cambrian, C and C, Display, Garex, Heller, J.M.G., Modular and S.G.S. Electronics, J Birkett, Catronics, Crayford, Hamvel,

Packer, South Midlands Communications, SOTA, S.W. Webb, Wood and Douglas, Amateur Radio Technical Service and Amateur Radio Exchange. At the end of the day Westlake Electronics told me that they had their usual run on coaxial cables, and John Fisher Electronics sold a lot of finishing materials, such as knobs, pilot lampholders and bits for making p.c. boards. The RSGB's bookstall and Bring and Buy sale were well supported and **Mike Dormer** G3DAH, and his lady assistants at the reception desk, were kept very busy as approximately 800 visitors arrived for the convention.



## THE RENNISON BROTHERS

by **RON HAM**

A variety of receivers belonging to radio enthusiasts, David and Ian Rennison, are installed in their respective bedrooms at their parents' home in Horsham, Sussex.

David, an 18-year-old trainee electrician, caught the bug for radio from his elder brother Ian and Ian's friend, Chris Otley G4CYA, some six years ago when the Rennisons lived in Sheffield. Ian, a 28-year-old bank employee, recalls that he began around the age of 14, when Chris and he listened to the medium waves on an old valved set which, after taking some 30 minutes to warm up, gave about 30 minutes good service before developing a loud squeal.

Ian's first communications receiver was a Codar 70A which he used to take around to Chris's home, in a shopping bag, because, with a bigger garden, Chris had a larger aerial and more signals were heard. David, a member of the Horsham Amateur Radio Club, is more inclined toward amateur radio than Ian whose main interests are medium wave DX, Band II broadcast listening and v.h.f. television DXing.

Both David and Ian use Trio 9R59 communications receivers with Codar preselectors. David uses an NR56 v.h.f. receiver for the 2m repeaters and a dual-gate MOSFET converter for general coverage of the 2m band, while Ian uses a Aiwa 5080A, with its wide bandspread for the f.m. stations in Band II, and a JVC 3040 UKC receiver for the European TV Channels, E2-4 and 5-12.

Both brothers have sound recording facilities and use sundry home-constructed items, such as aerial tuning units and crystal calibrators, and, in the large loft of the Rennison home, David has a Slim Jim, a 5/8 ground-plane and a home-brew 2m beam, while Ian has a dipole for Band I and a Yagi for Band III.

David is also keen on motor car engineering, while, over the years, Ian has built a large collection of pop records. As a regular reader of *Practical Wireless*, Ian makes frequent contributions to the columns of Charles Molloy and myself.

Although living under the same roof, their mutual interest in radio is separated by the different wavebands which suit the needs of Ian, the BCL and David, the SWL.



David Rennison operating his Trio receiver



Ian Rennison with his DX TV gear

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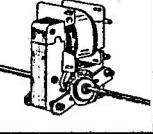
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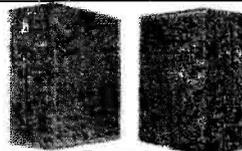
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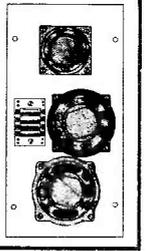
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212	1A, 1A	0-6-0-6	3-08	0-84
13	100	9-0-9	2-31	0-41
235	330	0-8-0-9	2-15	0-41
207	500, 500	0-8-9, 0-8-9	2-89	0-77
208	1A, 1A	0-8-9, 0-8-9	3-81	0-84
236	200, 200	0-15-0-15	2-15	0-41
214	300, 300	0-20-0-20	3-02	0-84
217	700 (DC)	20-12-0-12-20	3-68	0-84
206	1A, 1A	0-15-20-0-15-20	5-00	1-04
203	500, 500	0-15-27-0-15-27	4-31	1-04
204	1A, 1A	0-15-27-0-15-27	6-52	1-04
239	50	12-0-12	2-78	0-41

COMPONENT PACKS				
Ref	mA	VAT	P & P	Inc.
65	1W Metal Oxide Resistors.			
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150	Mixed Value Capacitors.			
10	Reed Switches.			
50	Wire Wound Resistors.			
100	3000mf 30V Capacitors.			
25	Assorted presets.			
60	3 tag terminal strips.			
	Hardware, BA nuts, bolts.			
	200 Mixed Resistors.			
	10 mixed valve electrologic caps			
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	79p per pack.			
	43p P & P VAT incl.			

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200V	2A	£0.61		
200V	4A	£0.56		
400V	6A	£1.61		
500V PM7A6	12A*	£3.08		
	P & P 16p incl. VAT.			

TEST METERS				
Ref	Net	VAT	P & P	Inc.
AVO 8 MK5	88-10	95-15		
AVO 71	36-00	38-88		
AVO 73	48-70	52-60		
AVO MM5	32-95	35-89		
Wee Megger	74-85	80-19		
EM272	57-80	62-42		
DA116 digital	108-90	117-61		

15V RANGE				
Ref	VAT	P & P	Inc.	Ref
O.C.T. 15V.				
171	500 mA	2-26	0-49	
172	1A	3-20	0-84	
173	2A	3-88	0-84	
174	3A	4-05	0-93	
175	4A	6-19	1-04	

Special Offer				
Ref	VAT	P & P	Inc.	Ref
BE3	100V Line to 40 7/10W	£2.21		
BE4	0-120V x 2 (120V or 240V) Screen Sec. 9-0-9V 1 amp	£2.59		
BE5	15W matching trans. sec 150V suit EL84	£1.62		
BE6	Pri 0-220V Sec 4500V 10mA	£4.86		
BE7	0-110-120-220V Pn 240V sec 20V 1 amp	£1.62		
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Ref 30	240-240 iso-lator 200VA	£4.54		
Ref 59	0-240V 25-0-25V 4A	£6.32		
BE9	Miniature Pri. 0-240V SCR Sec 12-0-12V 50mA	£9.7p		

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1R5	0-56	6AX5GT	1-46	6CY7	1-13	12AT7	0-56	ECF201	1-01	EM87	1-13	PCL82	0-80	PY88	0-79	UCC85	0-68
1X2B	1-35	6BA6	0-61	6D06B	1-63	12AU6	0-73	ECF801	1-07	EY81	0-82	PCL84	0-84	PY83	0-84	UCF80	0-84
5AT8	0-90	6BE6	0-54	6DT6	0-80	12AU7	0-53	ECF802	1-07	EY87	0-56	PCL86	0-96	PY500A	1-69	UCH42	1-13
5T4	0-84	6BF5	0-96	6DT8	0-90	12AV6	0-96	ECY42	1-24	EY88	0-82	PCL805	0-90	TT21	10-69	UCH81	0-73
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5X4G	0-90	6BJ6	1-35	6EW6	0-90	12BA6	0-73	ECL81	0-84	GY501	1-01	PL82	0-62	UAC80	0-65	UF41	1-13
5X8	1-01	6BJ7	0-73	6GH8A	0-90	12BF6	0-75	ECL82	0-88	GZ30	0-68	PL83	0-56	UAF41	0-90	UF80	0-56
5Y3GT	0-73	6BK4B	1-58	6GK5	0-79	12BH7A	0-84	ECL83	1-30	GZ32	0-73	PL84	0-84	UBC41	0-79	UF85	0-56
5Z4GT	0-73	6BN4A	1-01	6GK6	1-01	12BL6	0-79	ECL84	0-79	GZ33	4-28	PL504	1-35	UBC81	0-65	UL84	0-96
6AB7	0-68	6BN6	0-90	6J4	1-35	12B06	1-01	ECL85	0-73	OA2	0-70	PL508	1-58	UBF80	0-68	UM80	0-88
6AC7	0-90	6B07A	0-79	6J5GT	0-90	12BY7A	0-90	ECL86	0-96	OA3	0-81	PL802	3-15	UBF89	0-68	UM81	0-84
6AD8	0-68	6BR8A	1-35	6J6	0-62	12CU6	1-01	EF80	0-45	OB2	0-76	PY81	0-79	UBL21	1-01	UM84	0-51
6AF4A	0-90	6BS7	2-59	6J7	0-90	19A05	0-84	EF85	0-54	OB3	0-81						
6AG5	0-73	6BU8	0-96	6K5GT	0-84	19B66G	0-56	EF86	0-68	OC2	1-51						
6AG7	0-96	6BW7	1-13	6K6GT	0-96	35A3	0-79	EF92	1-13	OC3	0-92						
6AH6	1-07	6BZ6	0-73	6L6GT	1-24	35B3	0-73	EF97	0-79	OD3	0-81						
6AJ5	0-73	6C7	0-79	6N7GT	0-96	35C5	0-96	EF98	1-01	PAB80	0-51						
6AK5	0-62	6C4	0-62	6D7	1-01	50C5	1-13	EF183	0-79	PC86	1-01						
6AK6	0-84	6CSGT	0-68	6SA7	0-90	50E55	0-96	EF184	0-79	PC88	1-01						
6AK7	0-96	6C6	0-56	6SG7	0-90	DAF96	0-68	EF1200	1-01	PC96	0-56						
6AL5	0-45	6C8G	0-68	6SK7	0-40	DF96	0-68	EH90	0-68	PC97	1-07						
6AM6	0-79	6C8B	0-62	6SL7GT	0-79	DK92	1-13	EL33	2-81	PC900	1-13						
6AM8	0-79	6C67	0-79	6SN7GT	0-79	DL96	0-68	EL36	1-69	PC884	0-56						
6AN5	2-81	6CS8A	0-84	6S07	0-90	ECC84	0-68	EL81	0-68	PC85	0-68						
6AN6	0-96	6CM7	0-90	6SR7	0-90	ECC85	0-54	EL82	0-68	PC888	0-73						
6AO5	0-96	6CN7	1-35	6V8GT	0-90	ECC86	1-41	EL83	0-68	PC899	0-84						
6AS6	1-13	6C08	0-84	6X4	0-79	ECC88	0-84	EL84	0-73	PC189	1-13						
6AS7G	1-35	6CS7	0-96	6X5GT	0-68	ECC89	0-90	EL86	0-84	PCF80	0-96						
6AT6	0-84	6C16	1-13	6X8	0-90	ECC189	0-90	EL95	1-07	PCF82	0-51						
6AU6	0-56	6C18	1-13	12A6	0-68	ECF80	0-68	EL504	0-79	PCF84	0-73						
6AV6	0-84	6CW4	3-75	12AL5	0-73	ECF82	0-62	EM80	0-73	PCF86	0-84						
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