

FREE GADGETS, GAMES & KITS SUPPLEMENT INSIDE

Hobby Electronics

JULY '81

ISSN 0142-6192

60p

For A Down-To-Earth Approach To Electronics

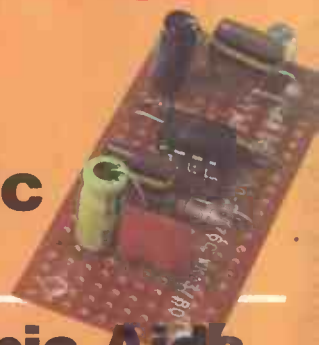
Burglar Alarm

Protect your home *cheaply* with our ultrasonic system



Guitar Treble Booster

- adds punch to your music
- easily built



**Electronic Aids
For The Disabled**
Special Feature

High-quality Furniture Kits for your Hi-fi
• modular design • low cost - *See inside for details*

LINEAR ICS	LINEAR ICS	LINEAR ICS	LINEAR ICS	4000 series	4000 series	TTL	'N'	'LPSN'	TTL	'N'	'LPSN'	TTL	'N'	'LPSN'	TTL	'N'	'LPSN'	MICROMARKET	LEDS	LEDS		
TBA120S	1.00	SL1610P	1.60	HA11223	2.15	4000	0.18	4068	0.25	TTL	'N'	'LSN'	TTL	'N'	'LSN'	TTL	'N'	'LSN'	8224	3.50	STD DOMED TYPES	
L200	1.95	SL1811P	1.60	HA11225	1.45	4001	0.18	4069	0.25	7400	0.13	0.20	7454	0.20	0.30	74128	0.74	74194	1.05	6.25	5mm RED	12p
U237B	1.28	SL1612P	1.60	HA12002	1.45	4002	0.24	4070	0.30	7401	0.13	0.20	7455	0.30	0.30	74132	0.73	74196	1.34	1.20	3mm RED	15p
U247B	1.28	SL1613P	1.85	HA12017	0.80	4007	0.30	4071	0.24	7402	0.14	0.20	7456	0.20	1.24	74136	0.40	74197	1.10	0.78	3mm RED	15p
U257B	1.28	SL1620P	2.17	HA12402	1.95	4008	0.80	4072	0.24	7403	0.14	0.20	7463	0.20	0.20	74138	0.40	74198	1.60	0.72	2.5x5 RED	17p
U267B	1.28	SL1621P	2.17	HA12411	1.20	4008AE	0.80	4073	0.24	7404	0.14	0.24	7470	0.40	0.20	74141	0.75	74199	1.60	0.93	5mm GRN	15p
LM301H	0.67	SL1623P	2.44	SLA12412	1.55	4009	0.58	4075	0.25	7405	0.18	0.26	7472	0.30	0.20	74142	2.65	74247	0.99	0.89	3mm GRN	16p
LM301N	0.30	SL1624C	3.28	LF13741	0.33	4010	0.58	4076	0.90	7407	0.38	0.38	7473	0.35	0.45	74143	3.12	74257	1.08	0.89	3mm GRN	16p
LM308TC	0.65	SL1625P	2.17	SN76660N	0.80	4011AE	0.24	4077	0.35	7408	0.36	0.36	7474	0.35	0.35	74144	3.12	74257	1.08	0.89	3mm GRN	16p
LM324	0.64	SL1626P	2.44	FREQ. DISPLAY		4011B	0.24	4078	0.30	7408	0.19	0.24	7475	0.56	0.56	74145	3.12	74257	1.08	0.89	3mm GRN	16p
LM339N	0.66	SL1630P	1.62	AND SYNTH.		4012	0.55	4082	0.28	7409	0.21	0.24	7476	0.41	0.45	74147	1.75	74283	1.20	1.20	5mm YL	16p
LM348N	1.86	SL1613P	1.85	DEVICES		4015	0.95	4175	1.15	7411	0.26	0.32	7477	0.50	0.50	74148	1.09	74293	1.32	0.97	3mm YL	20p
LF351N	0.49	SL1641P	1.69			4015	0.95	4175	1.15	7411	0.26	0.32	7478	0.50	0.50	74149	1.09	74293	1.32	0.97	3mm YL	20p
LF353N	0.76	TDA2002	1.25	SAA1056	3.75	4016	0.52	4503	1.15	7412	0.27	0.27	7480	0.52	0.52	74150	0.99	74365	0.66	0.66	5mm ORA	20p
LM374N	3.75	ULN2242A	3.05	SAA1058	3.35	4017	0.80	4506	0.68	7413	0.32	0.32	7481	1.20	1.20	74151	0.55	74366	0.90	0.90	5mm ORA	20p
LM380N-14	1.00	SN76660N	0.80	SAA1059	3.35	4019	0.60	4510	0.99	7414	0.51	0.51	7482	0.75	0.75	74153	0.70	74367	0.64	0.64	5mm ORA	20p
LM380N-8	1.00	CA3080E	0.70	LF13741	0.33	4019	0.60	4510	0.99	7414	0.51	0.51	7483	1.04	0.99	74154	1.30	74368	0.92	0.92	5mm ORA	20p
LM381N	1.81	CA3089E	1.84	LN1232	19.00	4021	0.82	4512	0.98	7415	0.30	0.40	7486	0.50	0.40	74155	0.75	74374	1.80	1.80	5mm ORA	20p
ZN419CE	1.98	CA3090AQ	3.35	LN1242	19.00	4022	0.96	4514	2.55	7417	0.30	0.30	7489	0.50	0.78	74159	2.10	74377	1.99	1.99	5mm ORA	20p
NE544N	1.80	CA3123E	1.40	MSL2318	3.84	4023	0.25	4518	1.03	7420	0.19	0.24	7491	0.85	1.25	74158	0.80	74379	1.99	1.99	5mm ORA	20p
NE555N	0.30	CA3130E	0.80	MSM5523	11.30	4024	0.76	4520	1.09	7421	0.38	0.24	7492	0.50	0.78	74159	2.10	74379	1.99	1.99	5mm ORA	20p
NE560N	0.50	CA3130T	0.90	MSM5524	11.30	4025	0.25	4521	2.36	7423	0.27	0.27	7493	0.57	0.99	74160	0.99	74380	0.99	0.99	5mm ORA	20p
NE562N	3.50	CA3140E	0.46	MSM5525	7.85	4026	1.80	4522	1.49	7425	0.27	0.27	7494	0.85	1.15	74162	0.30	74381	0.99	0.99	5mm ORA	20p
NE562N	4.05	CA3189E	2.20	MSM5526	7.85	4028	0.79	4529	1.61	7427	0.32	0.35	7495	0.70	1.15	74163	0.99	74382	0.99	0.99	5mm ORA	20p
NE564N	4.29	CA3240	1.27	MSM5527	9.75	4029	1.04	4539	1.28	7428	0.35	0.35	7496	0.58	1.20	74163	0.99	74383	0.99	0.99	5mm ORA	20p
NE565N	1.00	MC3357P	2.85	MSM55271	9.75	4030	0.59	4549	3.50	7430	0.17	0.26	7497	1.85	0.45	74164	1.20	74384	1.20	1.45	5mm ORA	20p
NE566N	1.60	LM3900N	0.60	MSL2312	3.94	4035	1.20	4554	1.73	7432	0.32	0.28	7497	1.85	0.45	74165	1.20	74385	1.20	1.45	5mm ORA	20p
NE570N	3.85	LM3909N	0.68	SP8629	3.85	4040	0.98	4560	2.18	7437	0.40	0.40	7498	0.50	0.45	74166	1.20	74386	1.20	1.45	5mm ORA	20p
SL624	3.28	LM3914N	2.80	SP8647	6.00	4042	0.85	4566	1.59	7438	0.33	0.35	7499	0.50	0.45	74167	1.20	74387	1.20	1.45	5mm ORA	20p
TBA651	1.81	LM3915N	2.80	95H90PC	7.80	4043	0.85	4568	2.18	7440	0.20	0.28	7500	0.50	0.45	74168	1.20	74388	1.20	1.45	5mm ORA	20p
uA709HC	0.64	KB4400	0.80	HD10551	2.45	4043AE	0.93	4569	3.03	7441	0.74	0.74	7501	0.50	0.45	74169	2.30	74389	1.20	1.45	5mm ORA	20p
uA709PC	0.46	KB4406	0.60	HD44015	4.45	4044	0.94	4572	3.00	7442	0.70	0.99	7502	0.50	0.45	74170	2.30	74390	1.20	1.45	5mm ORA	20p
uA710HC	0.65	KB4412	1.95	HD12009	6.00	4046	1.30	4585	1.00	7443	1.15	1.15	7503	0.50	0.45	74171	2.30	74391	1.20	1.45	5mm ORA	20p
uA710PC	0.59	KB4413	1.95	HD44752	8.00	4047	0.99	4586	1.00	7444	1.12	1.12	7504	0.50	0.45	74172	2.30	74392	1.20	1.45	5mm ORA	20p
uA741CH	0.66	KB4417	1.80	MC145151	12.45	4049	0.52	4587	1.00	7445	1.05	1.05	7505	0.50	0.45	74173	2.30	74393	1.20	1.45	5mm ORA	20p
uA741CN	0.27	KB4420B	1.09	MC145156	8.75	4050	0.55	4588	1.00	7446	1.32	1.32	7506	0.50	0.45	74174	2.30	74394	1.20	1.45	5mm ORA	20p
uA747CN	0.70	TDA4420	2.65	MISC		4051	0.78	4589	1.00	7447	0.89	0.89	7507	0.50	0.45	74175	2.30	74395	1.20	1.45	5mm ORA	20p
uA748CN	0.36	KB4423	2.30	ICM7106CP	9.55	4052	0.79	4590	1.00	7448	0.56	0.99	7508	0.50	0.45	74176	2.30	74396	1.20	1.45	5mm ORA	20p
uA753	2.44	KB4424	1.65	ICM7107CP	9.55	4060	1.54	4591	1.00	7449	0.99	0.99	7509	0.50	0.45	74177	2.30	74397	1.20	1.45	5mm ORA	20p
uA758	2.35	KB4431	1.95	ICM7168BP	19.50	4063	1.18	4592	1.00	7450	0.20	0.25	7510	0.50	0.45	74178	2.30	74398	1.20	1.45	5mm ORA	20p
TBA820M	0.78	KB4432	1.95	ICM7555	0.94	4066	0.57	4593	1.00	7451	0.20	0.25	7511	0.50	0.45	74179	2.30	74399	1.20	1.45	5mm ORA	20p
TC9A04E	1.80	KB4433	1.52			4066	0.57			7452	0.20	0.25	7512	0.50	0.45	74180	2.30	74400	1.20	1.45	5mm ORA	20p
TDA1028	2.11	KB4436	2.53			4066	0.57			7453	0.20	0.25	7513	0.50	0.45	74181	2.30	74401	1.20	1.45	5mm ORA	20p
TDA1029	2.11	KB4437	1.75			4066	0.57			7454	0.20	0.25	7514	0.50	0.45	74182	2.30	74402	1.20	1.45	5mm ORA	20p
TDA1054	1.45	KB4438	2.22			4066	0.57			7455	0.20	0.25	7515	0.50	0.45	74183	2.30	74403	1.20	1.45	5mm ORA	20p
TDA1062	1.95	KB4441	1.35			4066	0.57			7456	0.20	0.25	7516	0.50	0.45	74184	2.30	74404	1.20	1.45	5mm ORA	20p
TDA1072	2.69	KB4445	1.29			4066	0.57			7457	0.20	0.25	7517	0.50	0.45	74185	2.30	74405	1.20	1.45	5mm ORA	20p
TDA1074A	1.94	KB4446	2.75			4066	0.57			7458	0.20	0.25	7518	0.50	0.45	74186	2.30	74406	1.20	1.45	5mm ORA	20p
TDA1083	5.05	KB4448	1.65			4066	0.57			7459	0.20	0.25	7519	0.50	0.45	74187	2.30	74407	1.20	1.45	5mm ORA	20p
TDA1090	3.05	NE5040A	2.26			4066	0.57			7460	0.20	0.25	7520	0.50	0.45	74188	2.30	74408	1.20	1.45	5mm ORA	20p
HA1137	1.20	NE5532N	1.85			4066	0.57			7461	0.20	0.25	7521	0.50	0.45	74189	2.30	74409	1.20	1.45	5mm ORA	20p
HA1196	2.00	SD6000	3.75																			

Hobby Electronics

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Vol 3 No 9

Editor: Hugh Davies Group Art Editor: Paul Wilson-Patterson BA
Advertisement Manager: Stephen Rowe

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SIMPLY AHEAD
and staying there

The range grows bigger... better...

New Profile Amplifiers - Two New Series

MOSFET

CHOOSE AN I.L.P. MOSFET POWER AMP when it is advantageous to have a faster slew rate, lower distortion at higher frequencies, enhanced thermal stability, the ability to work with complex loads without difficulty and complete absence of cross-over distortion. I.L.P.'s exclusive encapsulation technique within fully adequate heatsinks has been taken a stage further with specially developed computer-verified 'New Profile' extrusions. These ensure optimum operating efficiency from our new MOSFETS, and are easier to mount. Connections via five pins on the underside. I.L.P. MOSFETS ARE IDENTICAL IN PERFORMANCE TO THE COSTLIEST AMPLIFIERS IN THIS EXCITING NEW CATEGORY BUT ARE ONLY A FRACTION OF PRICES CHARGED ELSEWHERE.

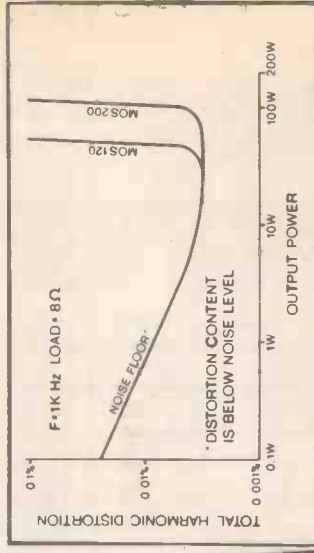
Model	Output Power RMS	Distortion Typical at 1KHz	Slew Rate	Rise Time	Signal/Noise Ratio DIN AUDIO	Price & VAT
MOS120	60W into 4-8Ω	0.005%	20V/μs	3μs	100dB	£25.88 + £3.88
MOS200	120W into 4-8Ω	0.005%	20V/μs	3μs	100dB	£33.46 + £5.02

BIPOLAR

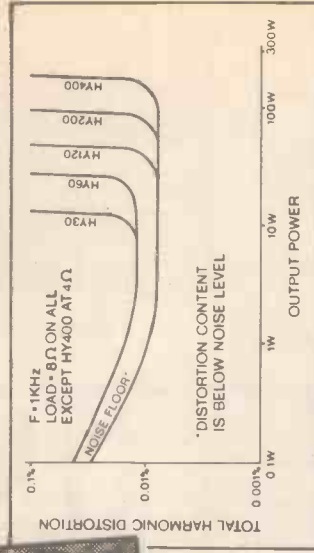
(Standard Q-P Transistors)

CHOOSE AN I.L.P. BIPOLAR POWER AMP where power and price are first consideration while maintaining optimum performance with hi-fi quality and wide choice of models. From domestic hi-fi to disco and P.A., for instrument amplification, there is an I.L.P. Bipolar to fill the bill, and as with our new Mosfets, we have encapsulated Bipolars within our New Profile extrusions with their computer-verified thermal efficiency and improved mounting shoulders. Connections are simple, via five pins on the underside and with our newest pre-amps and power supply units, it becomes easier than ever to have a system layout housed the way you want it.

Model	Output Power RMS	Distortion Typical at 1KHz	Slew Rate	Rise Time	Signal/Noise Ratio DIN AUDIO	Price & VAT
HY30	15W into 4-8Ω	0.015%	15V/μs	5μs	100dB	£7.29 + £1.09
HY60	30W into 4-8Ω	0.015%	15V/μs	5μs	100dB	£8.33 + £2.62
HY120	60W into 4-8Ω	0.01%	15V/μs	5μs	100dB	£17.48 + £2.62
HY200	120W into 4-8Ω	0.01%	15V/μs	5μs	100dB	£21.21 + £3.18
HY400	240W into 4Ω	0.01%	15V/μs	5μs	100dB	£31.83 + £4.77

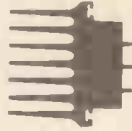


Load impedance both models 4Ω-∞ Input sensitivity both models 500mV. Frequency response both models 15Hz-100KHz -3dB



Load impedance all models 4Ω-∞ Input impedance all models 100KΩ. Input sensitivity all models 500mV. Frequency response all models 15Hz-50KHz -3dB

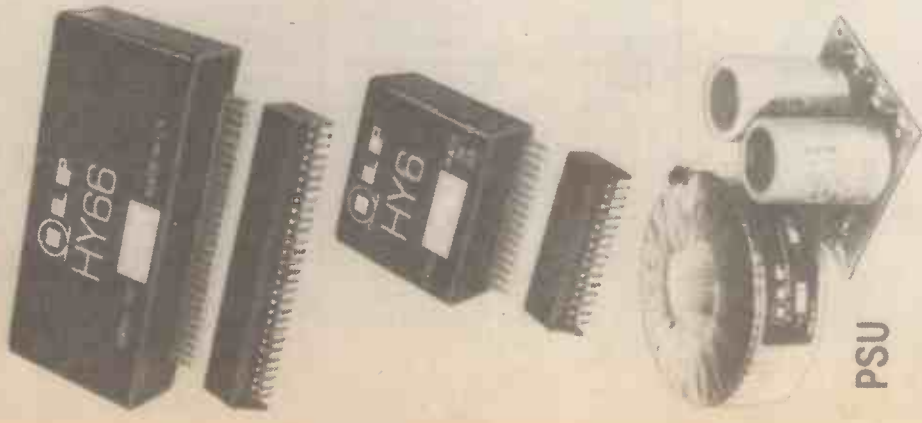
THE NEW PROFILE EXTRUSIONS
The introduction of standard heatsink extrusion for all I.L.P. power amplifiers achieves many advantages. Research shows they provide optimum thermal dissipation and stability. Slotted shoulders allow easy mounting; standardisation enables us to keep our prices competitive. Surfaces are matt black, anodised for higher thermal conductivity. Extrusions vary in size according to module number.



HY120



HY60



NO QUIBBLE 5 YEAR GUARANTEE
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BRITISH DESIGN AND MANUFACTURE
FREEPOST SERVICE



NEW PRE-AMPS

HY6 (mono) and HY66 (stereo) are new to I.L.P.'s range of advanced audio modules. Their improved characteristics and styling ensure their being compatible with all I.L.P. power-amps both MOSFET and BIPOLAR, giving you chance to get the best possible reproduction from your equipment. HY6 and HY66 pre-amps are protected against short circuit and wrong polarity. Full assembly instructions are provided. Mounting boards are available as below.

Sizes - HY6 - 45 x 20 x 40 mm. HY66 - 90 x 20 x 40 mm. Active Tone Control circuits provide ± 12 dB cut and boost. Inputs Sensitivity - Mag. PU - 3mV; Mic - selectable 1-12mV; All others 100mV. Tape O/P - 100mV. Main O/P - 500mV. Frequency response - D.C. to 100KHz - 3dB.

- HY6 mono £8.44 + 97p VAT Connectors included
- HY66 stereo £12.19 + £1.83 VAT Connectors included
- B6 Mounting Board for one HY6 78p + 12p VAT
- B66 Mounting Board for one HY66 99p + 15p VAT

NEW POWER SUPPLY UNITS

Of the eleven power supply units which comprise our current range, nine have toroidal transformers made in our own factory. Thus these I.L.P. power supply units are space-saving, more efficient and their better overall design helps enormously when assembly building. All models in the range are compatible with all I.L.P. amps and pre-amps with types to match whatever I.L.P. power amps you choose.

- PSU30 ± 15 V at 100mA to drive up to 12 x HY6 or 6 x HY66 £4.50 + 0.68p VAT
- PSU36 for use with 1 or 2 HY30's £8.10 + £1.22 VAT
- PSU50 for use with 1 or 2 HY30's £10.94 + £1.64 VAT
- PSU60 for use with 1 HY120 £13.04 + £1.96 VAT
- PSU65 for use with 1 MOS120 £13.32 + £2.00 VAT
- PSU70 for use with 1 or 2 HY120's £15.92 + £2.39 VAT
- PSU75 for use with 1 or 2 MOS120 £16.20 + £2.43 VAT
- PSU90 for use with 1 HY200 £16.20 + £2.43 VAT
- PSU95 for use with 1 MOS200 £16.32 + £2.45 VAT
- PSU180 for use with 1 HY400 or 2 HY200 £21.34 + £3.20 VAT
- PSU185 for use with 1 or 2 MOS200 £21.46 + £3.22 VAT

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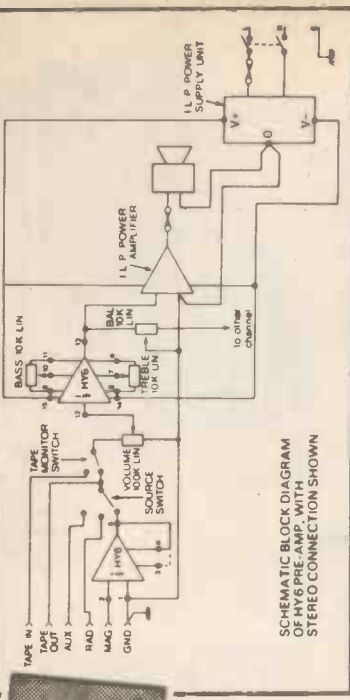
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★ Now turn to page six for our ad. on a bigger than ever range of transformers.

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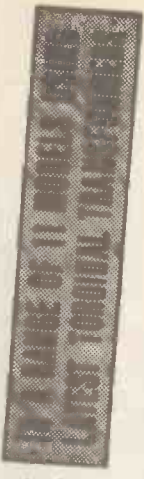
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Available also from MARSHALLS, WATFORD ELECTRONICS and certain other selected retailers



SCHEMATIC BLOCK DIAGRAM OF HY6 PRE-AMP WITH STEREO CONNECTION SHOWN

- DISTORTION TYPICALLY 0.005%
- S/N RATIO - 90dB (Mag. P.U. - 68 dB)
- 38 dB overload margin on Mag. P.U.
- LATEST DESIGN HIGH QUALITY CONNECTORS
- ONLY POTS, SWITCHES AND PLUGS/SOCKETS NEED ADDING
- NEEDS ONLY UNREGULATED POWER SUPPLY ± 15 to ± 60 V



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MONITOR



Pele Kicks Off TV Football Game

Thursday 30th April saw the public launch of Atari's new football games cartridge for the Atari Video Computer — Pele's Championship Soccer. The game, for one or two players, is personally endorsed by the brilliant Brazilian footballer, Pele, who flew into London the day before the launch.

Pele spent a hectic five days in the capital, signing autographs

and at the mercy of press, radio and television journalists.

As yet we haven't managed to get our hands (or should we say feet?) on a games cartridge for more than just a few minutes, but we hope to review it in next month's Gadgets, Games & Kits supplement. Suggested retail price of the cartridge is £29.95 including VAT.

Also released by Atari were two other games cartridges — Video Pinball and Othello. Suggested retail price of these games is £23.95 including VAT.

Budget Toroids

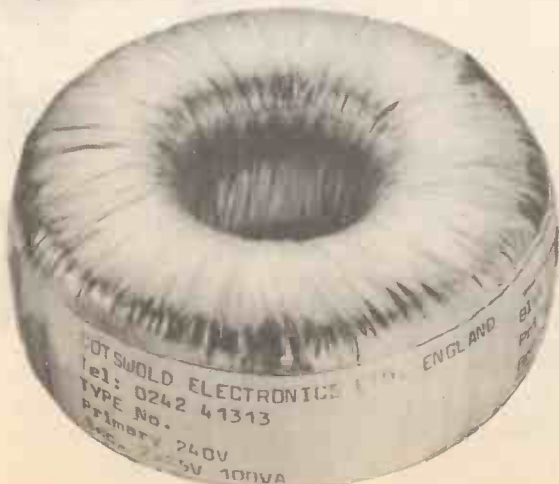
Cotswold Electronics is offering a 'budget range' of toroidal transformers for use by professional and do-it-yourself enthusiasts in 30, 60, 100, 160, 230, 330 and 530 VA sizes at prices ranging from £4.55 to £15.80.

All types are normally supplied with 240, 110 or 220 V primary windings, but special windings can be supplied on request.

Toroids have some significant advantages over traditional

stacked-laminate types. They are, for instance, about 50% lighter and have 50% lower volume because they are more efficient. Unlike laminated types toroids have no air gap, and thus have less reluctance (magnetic resistance) and less magnetic radiation. The low height profile of toroids makes them suitable for use in slim-line equipment.

More details are available from Cotswold Electronics Ltd, Unit T1, Kingsville Road, Kingsditch Trading Estate, Cheltenham GL51 9NX (tel 0242 41313).



Digital Multimeter — Introductory Offer

Danesbury Marketing is offering a pocket-sized digital multimeter at a special introductory price of £49.95 for orders of one to four, or £47.45 for orders of five to nine. These prices include VAT and carriage in the UK.

The meter, model DMM 600D, has a liquid crystal display (LCD) with 3½ characters 13 mm high. It has 21 ranges, covering DC voltage and current, AC voltage and current, resistance and a diode check facility. Accuracy on the DC

voltage and resistance ranges is claimed to be 0.5%.

A brief specification is as follows:

DC voltage 1 mV to 1000 V

DC current 1 µA to 1 A

AC voltage 1 mV to 500 V

AC current 1 µA to 1 A

Resistance 1R to 20 M

Overall size of the meter is 105 mm by 85 mm by 32 mm, and it comes complete with a moulded carrying case 109 mm by 110 mm by 37 mm, test leads and a handbook.

Danesbury Marketing Ltd, 22 Parkway, Welwyn Garden City, Herts AL8 6HG (tel 07073 29112).

New Source Of Electronic Components

RKS Electronics, which came into operation in the last couple of months, aims to cut the cost of electronic components by means of low overheads.

Kelvin Whittaker, who runs RKS Electronics, claims that every order will be sent by return of post, first class, and orders should be received within three days of dispatch.

Whittaker told HE that he had been planning this venture for two years. Because of where he is situated in Dorset, he has sought, and is still waiting for, assistance from COSIRA (Council for Small Industries in Rural Areas).

At present he offers only a mail order service but he hopes to add a counter service later. Similar expansion is planned for his catalogue, which at present spans only a small selection of popular components for the hobbyist.

Apart from electronic components, Whittaker offers an express PCB drilling service (0.9p/hole for 18p/board postage, additional boards 4p postage).

Send a stamped-addressed envelope for the catalogue and further details to K Whittaker, RKS Electronics, 13 Queens Terrace, Sherborne, Dorset DT9 4ED (tel 093581 2488).

G8EOP Petition

We received details of a petition, organised by Melvyn Jackson (GBEOP) in the wake of the recent proposals for a UK citizens' band.

The petition sets out 'slight modifications to the radio ham licence', as follows:

- The use of CW by class B radio hams receiving and sending as part of the self-training in communication by CW on VHF bands

- Limited use of station under supervision (eg, jamboree on air, radio conventions, radio clubs, SWLs, XYLs, YLs, etc)

- The 27 and 930 MHz CB bands to be used by radio hams on existing licence at no extra fee and not with type-approved rigs

- The 10 and 4 m ham bands to extend to class B radio hams (eg, the 10 m band not taken over by CB to be used by licensed radio hams).

The petition, signed by Melvyn Jackson, G8EAH, G8PSE, G8WWE, G3LHQ, G4LED and '460 others' also invites any club requiring a copy of the signature sheet to send a stamped addressed envelope to M Jackson, 17 Bywell Road, Dewsbury, West Yorkshire ZN2 2C (tel 0924 463850).



Hi-fi ICE From Blaupunkt

Latest addition to Blaupunkt's ICE (In-car entertainment) range is a three-way hi-fi sound component system.

Four slim-line speakers are used for each channel of this system to allow greater flexibility in fitting to individual makes of car and for the best sound radiation (particularly from the tweeter).

The system consists of the following:

- two woofers, each 100 mm by 100 mm, installation depth 45 mm and linear frequency response 40 to 600 Hz
- one mid-range speaker, 85 mm by 85 mm, installation depth 33 mm and linear frequency response 600 Hz to 4 kHz
- one tweeter, 42 mm radius, installation depth 23 mm and linear frequency response 4 to 20 kHz
- a three-way divider.

The system conforms with the DIN hi-fi standard 45,500 and has 60 W/channel music power handling capability.

Price of the system (eight speakers and two divider units) is £90.85 including VAT.

For those preferring a four-

channel installation in their car, Blaupunkt has recently introduced an equaliser on a flexible stalk. This gadget has slide controls and two illuminated VU meters. It costs £79.35 including VAT.

The four channel booster amplifier (4 x 20 W), model 7 607 367 111, which goes with the equaliser will set you back another £79.35 including VAT.

HE was given a demonstration of all the above items fitted in a Ford Cortina. One of Blaupunkt's Bamberg QTS CR receivers was fitted in the dash and the sound, coming from the front door panels and from the rear parcel shelf, was very impressive. The equaliser stalk sprouted close to the steering column.

If you're interested in the whole system described above, start saving (the Bamberg QTS CR costs £517.50 including VAT). Alternatively, you could opt, for example, just for the speakers.

Details from Robert Bosch Ltd, PO Box 166, Rhodes Way, Watford, Herts WD2 4LB (tel 92 44233).

owners of Sinclair ZX80 microcomputers (and possibly ZX81 owners in the future).

We looked at a copy of the club newsletter, also titled ZX Guaranteed and printed quarterly. It contained six programs for the ZX80 which, according to G A Bobker, who runs the club, are guaranteed to work.

Membership stood at 27 when we received the information but the classified advertisement placed in the June '81 issue of HE could well have increased this.

Membership costs £5 a year. Contact G A Bobker, 29 Chadderton Drive, Unsworth, Bury, Lancs.

Easi-Grip Lightweight Handtools

A set of miniature handtools, designed for use in electronics and fine modelling, have been introduced by Tele-Production Tools.

The set comprises miniature carbon steel side cutters, fine-nosed stainless steel tweezers and a serrated stainless steel scissor-shear for light cutting work.

Each tool is fitted with what are described as 'ergonomically-styled self-opening handles', intended for fingertip operation. The handles are held in the open position by means of a plastic strip linking the ends of the handles. Average weight of each tool is only 40 g.

Cost of each tool is £3.75 or £10 for the set of three (these prices include post, packing and VAT).

Also available is the K-40 plastic lockable tweezer-plier, moulded in glass-filled propylene

and incorporating self-locking handles. This locking facility enables the serrated jaws to grip and hold objects up to 7 mm wide.

The K-40 costs £1.44 including post and VAT.

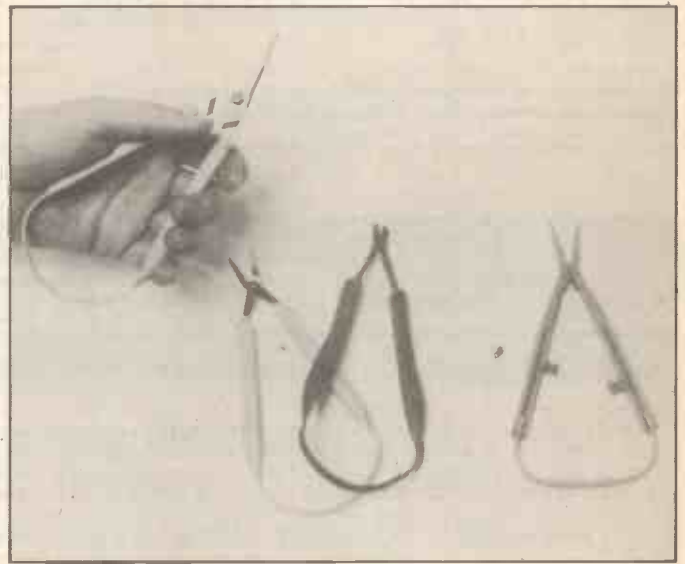
We tested all the above tools and found them to be good value for money.

The side cutters had a novel feature: if you tried to cut a wire which was beyond the capability of the cutters then the flexible handles simply bowed under the applied pressure.

The tweezer-pliers proved to be fine for holding small components and for tightening small nuts, while the shears were sharp enough to nibble through a piece of Veroboard without cracking it.

We found the K-40 lockable tweezer-plier particularly useful because, as claimed by the supplier, it will even grip and hold a human hair.

All these products are available from Tele-Production Tools Limited, Stron House, Electric Avenue, Westcliff-on-Sea, Essex SS0 9NW (tel 0702 352719).



Electronic Aids For The Handicapped Child

On Thursday 25th June 1981 an intensive day course, covering a broad range of technical aids, equipment and techniques developed for physically and mentally handicapped children, will be run at St Josephs' College, Lawrence Street, Mill Hill, London N7.

The course, starting around 10 am, will include a small exhibition of aids, including a special display of microcomputers. Although of particular interest to specialists and professional people, anybody who would like some insight into these developments will be welcome. Relatives of handicapped

children are especially welcome.

This course will cover some of the subjects discussed in Electronic Aids For The Disabled, this month's special feature on page 15.

Nearest underground station is Burnt Oak (Northern Line), then take a 251 bus to the college. By road, the college is 500 m north of Mill Hill roundabout (Watford Way). An access map will be sent to all who register.

The fee is £7 to professionals or £6 to relatives of handicapped people and non-professionals. Fees must be paid in advance to Castle Priory College, Thames Street, Wallingford, Oxfordshire OX10 0HE (tel 0491 37551). Cheques should be made payable to Castle Priory College.

Although tea and coffee are provided, those attending must bring their own packed lunch.

Response To Club Call

In response to our Put Your Club On The Map invitation in Monitor in the May '81 issue of HE, we are starting to receive details of a variety of clubs. Details of one are given below.

This could be an opportunity to increase your membership: send us details of your club and of any coming events likely to be of interest to HE readers.

ZX Guaranteed

Recently we received details of a new club called ZX Guaranteed, which could be of interest to

Hobby Electronics

ELECTRONIC CAR IGNITION

With the HE Electronic Ignition project next month you'll be able to get better performance and greater fuel economy from your car than with its conventional ignition system. The HE Electronic Ignition is a transistor-assisted, capacitive discharge system which virtually eliminates points-wear and allows more healthy and dependable sparks to be generated at the plugs.

This project doesn't cost the earth and is simple-to-build. With the current high fuel prices the chances are that it will pay for itself very quickly. Can you afford not to build it?

POWER SUPPLY

Of all the pieces of equipment that you're ever likely to need in your hobby a power supply unit is, arguably, the most important. If you are going to build your own, it needs to be rugged, cheap, reliable and easy-to-build. Next month we give details of a power supply which is all these things and more.

Output voltage is fully adjustable from about 1 V up to 15 VDC and it is capable of supplying currents of over an amp. A complete kit of parts will be available for this superb project.

Items mentioned here are those planned, but unforeseen circumstances may affect the actual contents

RPM METER

Anywhere or anytime you need a reading of the revolutionary speed of a motor, shaft, oscillation etc, consider our revs-per-minute-meter project featured next month. This ingenious device is battery-powered, making it an ideal hand-held meter which measures rotational speed within the range 300-30,000 RPM.

RADIO CONTROL

The first radio-controlled model aircraft were developed well before the Second World War. Today, radio-controlled modelling has become a hobby shared by thousands of enthusiasts throughout the world. Guest writer Peter Christy traces the history of radio control and outlines some of the technological advances in the equipment. He also gives some advice on how to get started in the hobby, the choice of equipment . . . and the likely cost.



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 <p>PUSHBUTTON CONSO TELEPHONE This is a superbly styled, one-piece, very compact push button telephone with last-number redial facility (on pressing one button it will redial the last number you dialled). A special MUTE Button enables you to talk at your end without the other party hearing you. The electronic buzzer can be switched on or off.</p> <p>£23.95 + £1.95 P&P</p>	 <p>DUAL TIME MUSICAL ALARM CHRONOGRAPH Continuously displays hours, mins., secs., day of the week, AM/PM indicator and alarm-on indicator - 1/10th sec. chronograph with lap time facility. Alarm plays "YELLOW ROSE OF TEXAS." Comes with a fully adjustable stainless steel matching bracelet. (Chrome colour).</p> <p>£12.95 LM101 +50p P&P</p>	 <p>SLIM PENDANT WATCH This watch is beautifully designed as a slim pendant and comes complete with a 26in. long neck chain. The functions include: hours, minutes, seconds, day, month and 4-year auto calendar. Comes in gold colour and is ideal for day and night wear.</p> <p>£8.95 + 50p P&P</p>	 <p>SOUND-A-ROUND STEREO PLAYER You can enjoy a very high-quality perfect stereo wherever you go or whatever you are doing. This very high quality stereo player comes complete with a carrying case, a set of super sensitive extremely lightweight headphones and a demonstration cassette. A very special feature is the "HOT LINE," this enables you to hear what is going on around you through a built-in microphone. It has a socket for additional headphones.</p> <p>£44.95 + £1.95 P&P Extra headphones £7.95 + 75p P&P</p>	 <p>COMPUPHONE LAMBDA 738 This is the most advanced computerised telephone on the market. It has a built-in calculator, clock with seven alarms, a stop watch/timer, 28 memories to store most frequently used telephone numbers, automatic dialling of pre-programmed number, automatic redial with repeat dialling at short intervals until the other party answers, a one-way speaker enables you to monitor the line. Push-button dialling, built-in telephone index and lots of other features. It is being sold in Exchange and Mart at £150.00, but we are offering it at a very special price.</p> <p>£99.95 + £2.90 P&P</p>																
 <p>FLIP CALLER PUSHBUTTON TELEPHONE This is a very compact beautifully designed, high technology digital telephone. It has last number redial facility at the touch of a button. The folding part directs the sound into a built-in microphone during use, and protects they keys when not in use.</p> <p>£23.95 + £1.95 P&P</p>	 <p>DUAL MELODY WORLD TIMER At a touch of a button it displays time anywhere in the world, with geographical position indicated by flashing that zone on the world map. It has two alarms, a home time alarm and a world time alarm, each play different melody for approx. 30 secs. It also has song demonstration facility.</p> <p>£24.95 + 75p P&P</p>	 <p>LADY'S SUGAR COATED WATCH Lady's 9-function LCD watch. Hours, minutes, seconds, month, date, backlight, auto date/time display mode, 4-year auto calendar. This watch has an optional auto date/time display mode. In this mode, time and date is alternatively displayed every 2 seconds. (Chrome or gold).</p> <p>£5.95 + 50p P&P</p>	 <p>COOKIE MONSTER ALARM CLOCK RADIO This is an ideal gift for young children, it has a top quality wind-up clock movement with sweep second hand. Wake to radio or buzzer alarm. Radio uses 4 penlite batteries and has rotary tuning and volume controls.</p> <p>£10.95 + £1.25 P&P</p>	 <p>ALCOM COLOURLESS TELEPHONE This telephone system gives you freedom from the desk, the base station connects to your telephone line, the remote hand set can be carried in, own case with shoulder strap or clips to your belt. You can receive calls or make calls from within a radius of 1/4-mile from base station. The hand set has push-button dialling with last number redial facility and has rechargeable batteries. The batteries are charged when plugged into base station. It is being sold elsewhere for £169.00, we are offering it at a very low price.</p> <p>£139.95 + £2.90 P&P</p>																
 <p>HANDHELD SPACE INVADERS A superb game, provides endless fun for children and adults alike. (WARNING - THIS GAME CAN SERIOUSLY EFFECT YOUR PAST-TIME). It gives you 90 seconds to hit enemy craft. The elapsed time and 4 digit score is constantly displayed. Score is decremented if you hit a friendly ship or if enemy missile penetrates your defence.</p> <p>£10.95 + 75p P&P</p>	 <p>DUAL TIME COUNT DOWN ALARM CHRONOGRAPH This superb watch has all the features one would ever need. It has selectable 12/24-hr. display count-down timer/alarm dual-time zone, chronograph with lap time facility, 24-hr. alarm with 5 min. snooze facility, back light fully adjustable stainless steel bracelet and we are offering it at our incredibly low price.</p> <p>£8.95 + 50p P&P</p>	 <p>6-DIGIT LADY'S SNOOZE ALARM This is a very good value for money, it has large easy to read 6-digit display and shows hours, minutes and seconds, pressing a button it shows date, month, and day of the week, the 24-hour alarm has 5 min. snooze facility. It has a fully-adjustable bracelet and a backlight. (Gold colour).</p> <p>£7.95 + 50p P&P</p>	 <p>CAR STEREO PLAYER WITH AM/FM-MPX RADIO This compact, quality product is designed to provide you with exceptional listening pleasure. The features include: AM/FM dial-in-door, local/distance attenuator switch for better stereo reception, AM/FM indicator, FM stereo indicator, Fast forward and eject button for cassette, balance, volume and tone controls, 7-watts per channel output.</p> <p>£20.95 + £1.90 P&P Suitable speakers £5 per pair + 95p P&P</p>	 <p>SMOKE DETECTOR FIRE ALARM Statistics show that it is not the fire that kills, it is the toxic fumes before the flames which are the killers. This early warning smoke detector can detect the fire at its early stages, and give those extra vital minutes to save life. At our offer price you could put one in each room. If you buy four, we will give you one free. Each unit comes complete with a battery. (Please note that all units are tested before despatch in case of malfunction, our liability is limited to the replacement of alarm unit).</p> <p>£8.95 + 75p P&P (P&P for than one unit is £1.50)</p>																
 <p>GALAXY GAME II This hand-held computerised game unit has three different games, and allows one or two players to play at two skill levels (slow and fast). A two-digit display shows the score. The three games are: 1. CROSS FIRE 2. PASS THROUGH 3. FOLLOW ME</p> <p>£10.95 + 75p P&P</p>	 <p>ELECTRONIC LIGHTERS Beautifully styled lighters for gentlemen and ladies. No need to change flint or put in new batteries. Battery-operated models also available if required (please specify). These lighters come in attractive presentation cases and are ideal gifts.</p> <p>£4.50 +50p P&P</p>	 <p>SUPER SLIM PEN WATCH Beautifully-styled super slim stainless steel ballpoint pen, (replaceable refill) combined with precision quartz timepiece, normal display is hours and minutes with flashing colon, date and month and second, can be displayed by pressing a button, 4-year auto calendar, it comes in a very neat presentation case. Our price</p> <p>£8.95 + 50p P&P</p>	 <p>COMBINATION LOCK BRIEF CASE This is a very good quality simulated leather executive brief case with combination lock (1 million combinations) having three independent digit combinations on each side. You set your own combination and you can change the combination whenever you desire. We are offering this superb product at a very special price.</p> <p>£18.95 + £2.90 P&P</p>	 <p>RAPID REACTOLITE SUNGLASSES These photochromatic sunglasses get darker as the sun gets brighter, and are crystal clear in the shade. These are available in strong metal frames in silver, gold or black colour. These come complete with a simulated leather carrying case. The suggested retail price is £12.95, but we are offering them at a very special price of</p> <p>£4.95 + 75p P&P *Sunstive Photochromatic sunglasses £2.95 + 75p P&P</p>																
 <p>STAR CODE 10 WALKIE TALKIES Made by GENERAL ELECTRIC COMPANY use 49MHz AM (Crystal controlled - single channel). The other features include: STAR CODE signal key for sending Morse code messages (range approx. 1/4-mile). Combination speaker/mic. (range approx. 1/8-mile). S.A.E. for details.</p> <p>£23.95 + £1.95 P&P</p>	 <p>FLUORESCENT PORTABLE LIGHT A very useful battery-operated high-power fluorescent light for use in the car or for camping. Uses 8 'D' size cells and it has a socket for 12V DC input for use in the car. Power consumption is 6 watts. New circuit makes batteries last longer.</p> <p>£4.95 +95p P&P</p>	 <p>FM WIRELESS MICROPHONE This high quality Electret microphone can be tuned to transmit in the range 85-95MHz FM. It can be received on any FM receiver, the range depends on the sensitivity of the receiver. Uses one penlight battery which fits inside the microphone. Ideal for parties, discos and clubs.</p> <p>£8.95 + 50p P&P</p>	 <p>THREE-IN-ONE FLUORESCENT This very compact unit is a torch, a portable fluorescent light and a hazard flashing amber light, all built into one neat case. It comes complete with a shoulder strap to allow both hands to be free. Ideal for campers, hikers and motorists. Runs on six 'C' size batteries.</p> <p>£8.95 95p P&P</p>	 <p>TALKING ALARM CLOCK/STOPWATCH This "Sharp" Talking Clock is a "state-of-the-art" product. On pressing the button it announces the time. At the preset alarm time a musical alarm is played and again the time is announced. It has 5 mins. snooze facility. Also has a useful timer and speaks time elapsed every 1 min., 5 mins. or 30 mins., whichever is selected in the stop watch mode it announces the elapsed time at preset intervals or on pressing of a button at any time it is an ideal gift, especially useful for blind people. Overall size is 11.4 x 6 x 2.2cms.</p> <p>£39.95 + £1.95 P&P</p>																
 <p>2-BAND HIGH QUALITY HEADPHONE RADIO You can buy this AM/FM Headphone radio for the price of just headphones. Runs off a single PP3 battery, has a volume control and a telescopic aerial for FM wave-band. The ideal gift for youngsters.</p> <p>£9.95 +95p P&P</p>	 <p>32 TUNES DOORCHIME/BURGLAR ALARM This doorchime is powered from 9V d.c. source, and has battery back-up facility. It has an automatic tune advance facility and single or dual play options at 3 selectable speeds. A built-in burglar alarm circuit allows construction of a NORMALLY CLOSED alarm system, two bell pushes can be connected, each playing different tunes.</p> <p>£8.95 + 95p P&P</p>	 <p>LIGHTWEIGHT HIGH QUALITY STEREO HEADPHONES This is a very high quality stereo headphone, to minimise the size and weight it uses Sanarium cobalt magnet and a sensitive polyester film vibrator unit enables very stable Hi-Fi stereo sound, with minimum distortion. The frequency range is 20-20,000Hz, impedance 32 ohms, sensitivity 98 db/mw, maximum input power 100mw, weight 40 gms (excluding cord).</p> <p>£7.95 + 25p P&P</p>	 <p>CAR ELECTRIC AERIAL Add a little luxury to your car by installing this motorised car aerial. Can be installed in any car or truck with 12V supply. It is an excellent value for money and is an ideal gift.</p> <p>£8.95 + £1.25 P&P</p>	 <p>QUARTZ TRAVEL ALARM CLOCK This is a very versatile alarm clock, you can use it in the car, in the kitchen or as a desk top clock. Large (1cm character size) display makes it easy to read from a distance. It has 4-year auto calendar, backlight, AM/PM Indicator and alarm on indicator.</p> <p>£7.95 + 75p P&P</p>																
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Ultrasound Burglar Alarm



Protect your valuables with an invisible net of doppler ultrasound

IF YOU WANT to protect the family heirlooms or just keep prying fingers off your back issues of 'Hobby' then this is the project for you. The HE Ultrasound Alarm runs off a single 9 V battery and uses only three chips and a handful of other components. It's quick to build and easy to set up, offering good sensitivity and a choice of operating modes.

Shifty Sounds

The alarm works on the doppler shift principle. Sounds complicated doesn't it? But it's really quite simple. The pitch of a moving sound source will seem to be higher then lower as the source moves toward then away from a stationary observer. This change in frequency is called the doppler shift. The effect is often heard in daily life as a jet screams overhead or a police car whizzes by. Of course, your average burglar isn't going to visit in a jet or a police car so how does doppler ultrasound catch a thief?

Since the burglar moves with silent stealth we have to make the noise ourselves and the circuit generates and transmits a beam of sound which fills the room. Of course, at 40 kHz you would need supersonic ears to hear it. So long as the sound waves bounce off

stationary objects the frequency remains unchanged and the alarm silent. However, when an intruder enters the sonic field the sound waves strike his moving limbs and the doppler effect produces reflected sounds shifted by a few tens of Hertz (cycles per second) from the original transmitted signal. We can detect those small changes in frequency by mixing the reflected sound and the original to produce a beat note. The beat note (the fancy name is 'heterodyne'), appears as a low-frequency envelope modulation of the ultrasonic carrier wave and we can detect it with a diode rectifier and low-pass filter in just the same way that an audio signal is detected in a radio receiver. The low-frequency signal can then be amplified and rectified and used to drive a relay, bell or tactical nuclear weapon.

Construction

Build-up the printed circuit board (PCB) as shown in Fig.2. Insert and solder in all low-profile components first (eg, resistors, diodes, IC sockets and preset resistors). Make sure the diodes are the right way round.

Use PCB pins where the 11 off-board connections are to be made.

Next, insert the remainder of the components to be soldered; capacitors and transistors — noting the correct polarity where appropriate.

Push-fit the ICs into their sockets, aligning the dot or notch on top of each IC with the notch shown in the overlay in Fig.2.

Now, mark and drill the case for the six, 4 mm sockets and switch SW1 (in the back panel) and the two ultrasonic transducers (in the front panel) and fit them in. The holes for the transducers should be $\frac{3}{8}$ " (9 mm). Glue the transducers to the inside of the panel behind the two holes. Their bodies should be electrically isolated so check that the layers of glue you use to hold the transducers to the panel also provide insulation.

Finally, wire-up your project as Fig.2 shows. Use screened cable to connect the receiving transducer (4OR) and make sure that the lead which is soldered to the body of the transducer connects to the earthed screen of the cable.

Tuning Up

Sensitivity can be controlled by adjustment of RV2 which alters the gain of the low-frequency amplifier. ▶

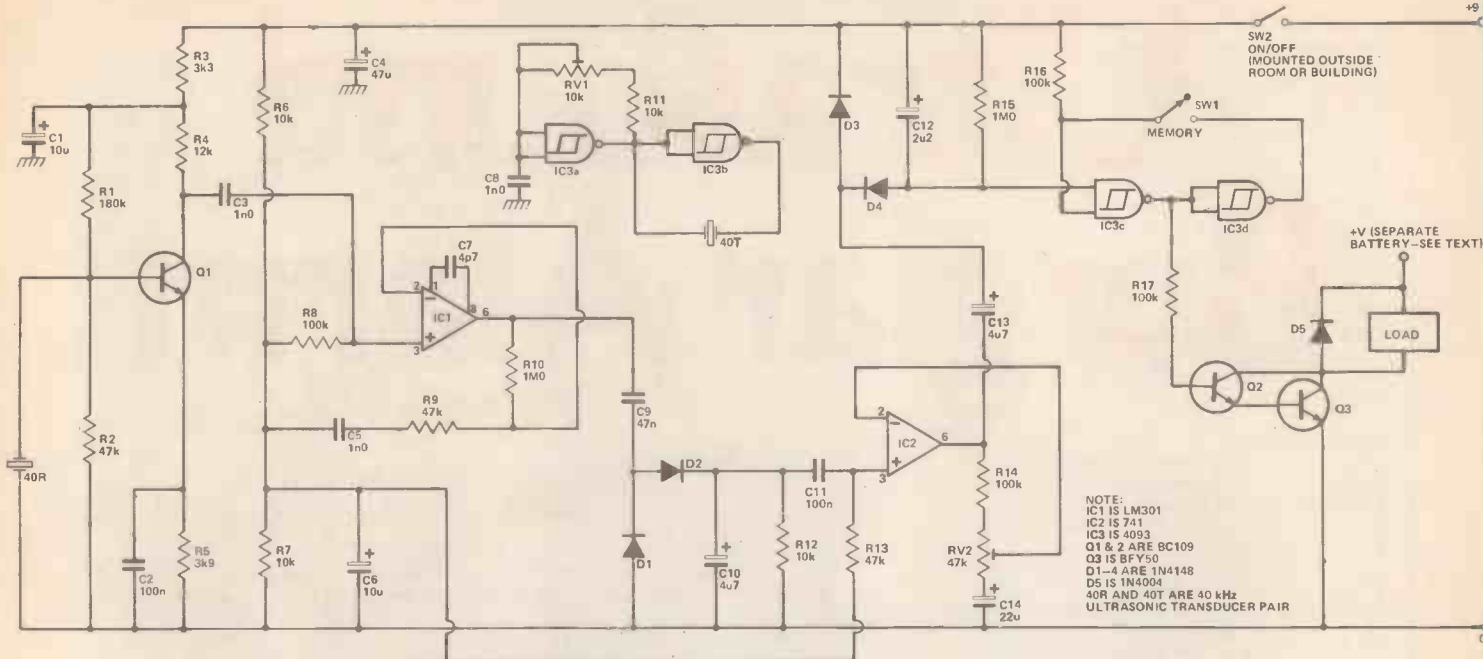


Figure 1. Circuit of the HE Ultrasound Burglar Alarm

However, the circuit is at its most sensitive when the detector is just not quite saturated. The transmitted and reflected signals mix in the receiving transducer and ultimately drive the relay. If the transmitted signal is too strong then IC1 will clip the signal, C10 will charge up to a maximum and the low-frequency envelope will be 'sliced off'. We overcome this problem not by controlling the amplitude of the transmitted signal but its frequency. As we tune the transmitter away from 40 kHz the efficiency of the transducers is reduced and IC1 and the detector will operate in a linear region. In practice this means adjusting RV1 by trial and error or connecting a voltmeter across C10 and adjusting RV1 for a reading of about 3.5 V. The optimum setting for RV1 will depend on the siting of the HE Ultrasound Alarm, in the area to be protected.

Ultrasound is quite directional but will readily bounce off walls and ceiling. Greatest range will be obtained in sparsely furnished rooms (put your valuables in the bathroom) as soft furnishings, curtains and carpets tend to absorb the ultrasound. Remember that the circuit will detect anything moving and that means people, curtains or even hot air from a radiator or air conditioner.

A switch is included to latch the output. This means that you can select either *unlatched*: alarm triggered during the period of detected movement or *latched*: continuous alarm from the moment of detection.

On/off switch SW2 can be any commonly available switch and it should be mounted outside the room which the alarm is protecting. That way you can switch off the alarm before you trigger it by walking into the room. If you do select a tactical nuclear weapon in favour of a bell, use cheap components . . . you'll only need them once.

Other uses for the HE Ultrasound Alarm:

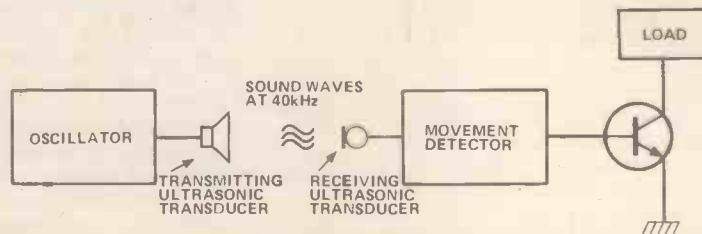
- Annunciator — it will keep an 'ear' open for you in unattended reception areas, shops, etc.
- Detector/counter — linked to a counting device (electro-mechanical or electronic) it will log moving objects such as people, vehicles, dogs, cats, flying saucers, etc.

An ideal audio alarm for use with the HE Ultrasound Alarm is the Super Siren, described in the April '81 issue of HE, pp 25-27. This will produce an ear-splitting noise of your choice when the ultrasound circuit is triggered.

How It Works

Ultrasound Burglar Alarm consists of two main parts:

- A multivibrator oscillator which produces a 40 kHz square wave transmitted by an ultrasonic transducer.
- A receiver which detects change in the received ultrasonic waves due to any movement of an object within the sound field. This movement detector triggers a transistor which activates the load. The load may be a relay or an alarm etc.



The ultrasonic signal is generated by an oscillator built around IC3a. Frequency is set by adjustment of RV1 and inverter IC3b provides an anti-phase drive to the ultrasonic transmitter.

The signal from the receiver transducer is amplified by Q1 and IC1. Resistor R1 shunts the transducer, giving it a less 'peaky' response. Integrated circuit IC1 is configured as a non-inverting amplifier with a gain of about 50. The output from this chip is rectified by D1 and D2 and smoothed by C10 and

R12. The combination of C11 and R13 acts as a high-pass filter, transmitting the signals caused by human movement but rejecting the very low frequency signals from moving air currents. Amplified by IC2 and smoothed by C12, the signals trigger IC3c and turn on Q2 and Q3 thus energising the load. When there is no signal C12 will discharge through R15 and the load will de-energise. However, the circuit can be latched by closing SW1.

Parts List

RESISTORS (All 1/4 W, 5%)

- R1 180k
- R2,9,13 47k
- R3 3k3
- R4 12k
- R5 3k9
- R6,7,11,12 10k
- R8,14,16, 100k
- R10,15 1M0

POTENTIOMETERS

- RV1 10k miniature horizontal preset
- RV2 47k miniature horizontal preset

CAPACITORS

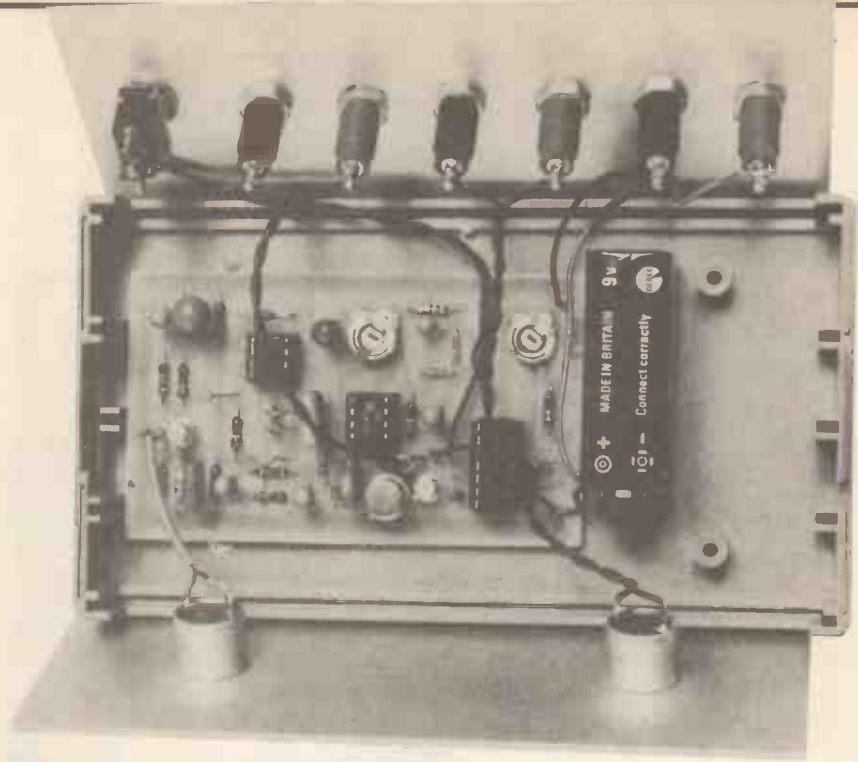
- C1,6 10u, 16 V tantalum
- C2 100n polyester
- C3,5 1n0 ceramic
- C4 47u, 16 V tantalum
- C7 4p7 ceramic
- C8 1n0 polyester
- C9 47n ceramic
- C10,13 4u7, 16 V tantalum
- C11 100n ceramic
- C12 2u2, 16 V tantalum
- C14 22u, 16 V tantalum

SEMICONDUCTORS

- IC1 LM301 operational amplifier
- IC2 741 operational amplifier
- IC3 4093 quad, 2-input NAND, Schmitt trigger
- Q1,2 BC109 NPN transistor
- Q3 BFY51 NPN transistor
- D1-4 1N4148 diode
- D5 1N4004, 1 A diode

MISCELLANEOUS

- SW1 single-pole, single-throw toggle
- SW2 on/off switch
- 40R,40T 40 kHz ultrasonic transducer pair
- Batteries, bell, nuclear warhead etc
- Case to suit



Buylines

All parts are easily obtainable — the ultrasonic transducers being the possible exception. Most of the mail order companies who advertise in HE should help.

The approximate cost of components, excluding the case and PCB will be £15.

Above. Internal layout of the project

THE EARTHED SCREEN OF THE CABLE MUST BE CONNECTED TO THE TRANSDUCER WHICH IS DIRECTLY CONNECTED TO ITS CASE

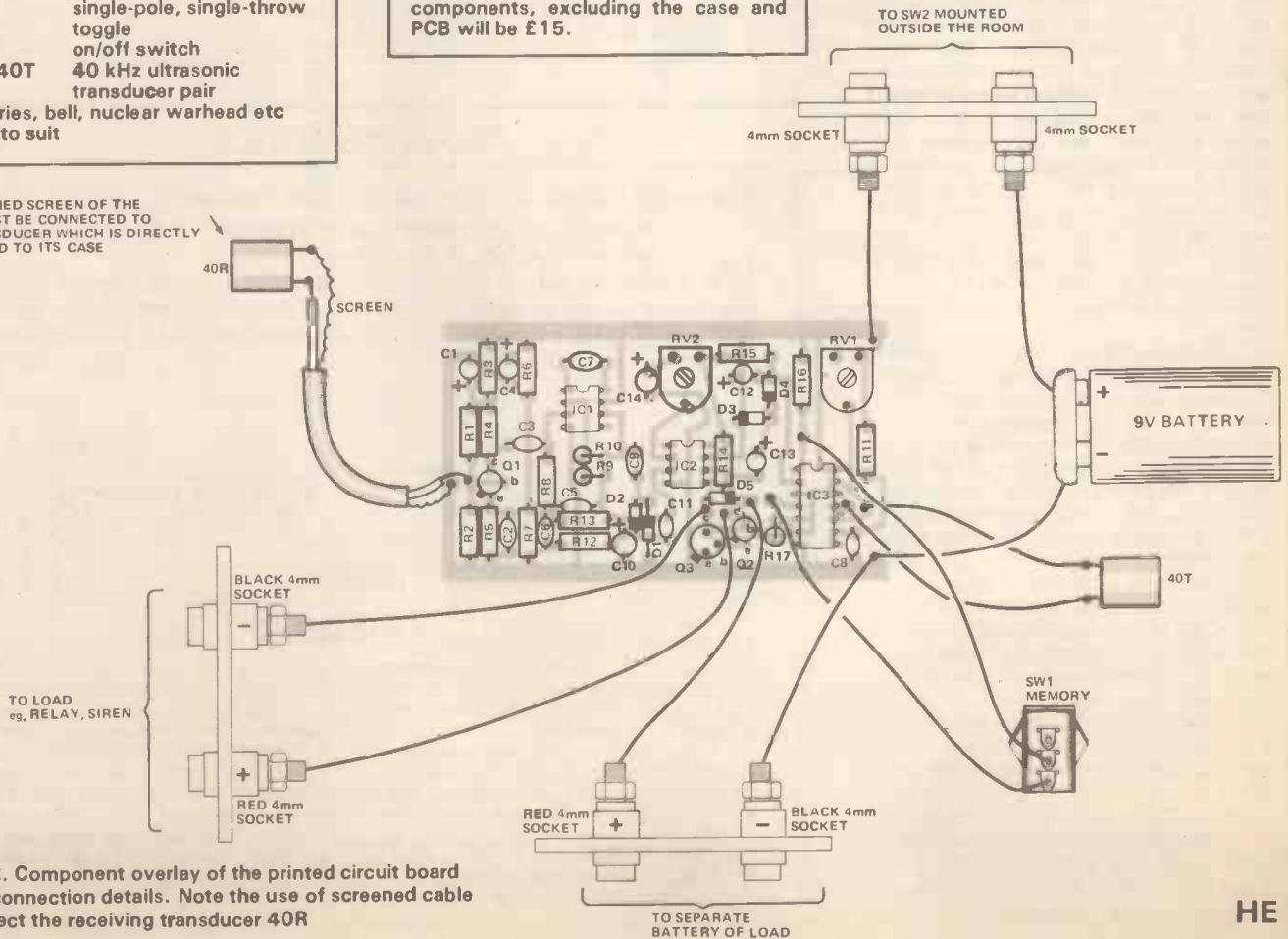


Figure 2. Component overlay of the printed circuit board and all connection details. Note the use of screened cable to connect the receiving transducer 40R

HE

TTLs by TEXAS			
7401	11p	74368	60p
7402	12p	74393	120p
7403	14p	74490	150p
7404	14p		4030
7405	30p	74LS SERIES	4031
7406	30p	74LS00	14p
7407	30p	74LS02	14p
7408	16p	74LS03	18p
7409	16p	74LS04	16p
7410	15p	74LS05	20p
7411	20p	74LS20	20p
7412	20p	74LS09	20p
7413	25p	74LS10	20p
7414	35p	74LS11	30p
7414C	90p	74LS13	30p
7416	27p	74LS14	50p
7417	27p	74LS20	20p
7420	17p	74LS21	30p
7421	30p	74LS27	30p
7422	22p	74LS30	20p
7423	25p	74LS32	27p
7425	30p	74LS37	30p
7426	30p	74LS38	30p
7427	25p	74LS42	60p
7428	30p	74LS47	60p
7430	17p	74LS51	24p
7432	30p	74LS55	30p
7433	30p	74LS73	30p
7437	30p	74LS74	27p
7438	30p	74LS75	36p
7440	17p	74LS76	36p
7441	70p	74LS83	70p
7442A	50p	74LS85	60p
7443	112p	74LS86	30p
7444	112p	74LS90	40p
7445	80p	74LS92	70p
7446A	93p	74LS93	50p
7447A	60p	74LS96	110p
7448	70p	74LS107	45p
7450	17p	74LS109	40p
7451	17p	74LS112	40p
7453	17p	74LS113	45p
7454	17p	74LS114	45p
7460	17p	74LS122	70p
7470	36p	74LS123	60p
7472	32p	74LS124	60p
7473	32p	74LS125	50p
7474	30p	74LS126	50p
7475	38p	74LS132	60p
7480	32p	74LS133	30p
7486	50p	74LS136	45p
7487	100p	74LS138	40p
7482	84p	74LS139	55p
7483A	60p	74LS145	120p
7484	100p	74LS147	160p
7485	110p	74LS148	140p
7489	210p	74LS151	60p
7490A	30p	74LS154	200p
7491	60p	74LS155	50p
7492A	60p	74LS156	50p
7493A	30p	74LS157	50p
7494	75p	74LS158	40p
7495A	60p	74LS160	90p
7496	50p	74LS161	75p
7497	180p	74LS162	90p
74100	100p	74LS163	60p
74107	34p	74LS164	70p
74109	40p	74LS165	100p
74116	100p	74LS166	120p
74118	100p	74LS170	120p
74119	100p	74LS173	110p
74120	110p	74LS174	80p
74121	34p	74LS175	70p
74122	60p	74LS181	200p
74123	60p	74LS190	75p
74125	60p	74LS191	75p
74126	60p	74LS192	75p
74128	60p	74LS193	75p
74132	60p	74LS195	75p
74136	60p	74LS196	75p
74141	75p	74LS197	90p
74142	200p	74LS221	90p
74145	90p	74LS240	120p
74147	120p	74LS241	120p
74148	100p	74LS242	90p
74150	120p	74LS243	90p
74151A	50p	74LS244	100p
74153	50p	74LS245	120p
74154	90p	74LS247	140p
74155	60p	74LS251	75p
74156	60p	74LS253	75p
74157	60p	74LS257	75p
74159	120p	74LS258	75p
74160	70p	74LS259	100p
74161	70p	74LS266	100p
74162	70p	74LS273	120p
74163	70p	74LS279	55p
74164	90p	74LS283	75p
74165	90p	74LS298	160p
74166	90p	74LS323	250p
74170	200p	74LS348	200p
74172	300p	74LS365	48p
74173	90p	74LS367	50p
74174	75p	74LS368	50p
74178	70p	74LS373	120p
74179	90p	74LS374	120p
74177	90p	74LS377	120p
74178	100p	74LS377	120p
74180	80p	74LS378	100p
74181	160p	74LS390	90p
74182	90p	74LS393	90p
74184A	200p	74LS399	200p
74185	120p	74LS445	140p
74186	500p	74LS670	225p
74188	325p		
74190	90p	4000 SERIES	25510
74191	90p	4000 15p	15174
74192	90p	4000 18p	15174
74193	90p	4002 20p	75107
74194	90p	4006 70p	75114
74195	95p	4007 20p	75150
74196	70p	4008 70p	75154
74197	90p	4010 40p	75182
74198	120p	4010 16p	75324
74199	120p	4011 16p	75361
74221	90p	4012 25p	75363
74251	100p	4013 35p	75365
74259	120p	4014 75p	75451/2
74278	200p	4015 75p	75491/2
74279	110p	4018 35p	8726
74283	140p	4017 50p	8728
74284	250p	4018 70p	8795
74285	250p	4019 45p	8797
74290	100p	4020 65p	81L595
74293	100p	4021 75p	81L596
74298	100p	4022 70p	81L597
74365	60p	4023 20p	81L598
74366	60p	4024 40p	9602

93 SERIES	74S SERIES	74S114 120p
9301	160p	74S04 60p
9302	175p	74S04 60p
9308	316p	74S05 75p
9310	275p	74S08 75p
9311	275p	74S10 75p
9312	160p	74S20 60p
9314	165p	74S30 60p
9316	225p	74S32 90p
9321	225p	74S37 90p
9322	150p	74S64 60p
9334	360p	74S74 90p
9368	250p	74S85 300p
9370	300p	74S86 120p
9374	300p	74S112 120p

LINEAR ICs	MC1310P
AY1-0212	600p
AY1-1313	668p
AY1-1320	32p
AY1-5050	140p
AY3-1270	840p
AY3-8910	750p
AY3-8912	650p
AYS-4007D	520p
CA2306	70p
CA3048	225p
CA3080E	72p
CA3086	48p
CA3089E	225p
CA3090AD	375p
CA3100	90p
CA3140E	50p
CA3160	50p
CA3162E	45p
CA3199E	30p
CA3220	30p
DAC14008-B	200p
HA1388	260p
ICL7106	850p
ICL8038	300p
LM3555	800p
LF1331	30p
LF351	48p
LF356P	95p
LM10C	425p
LM301A	27p
LM331	70p
LM319	225p
LM324	45p
LM339	75p
LM348	95p
LM3508	50p
LM377	175p
LM380	75p
LM381AN	180p
LM386	95p
LM393	100p
LM398	100p
LM398B	50p
LM710	50p
LM725	350p
LM733	100p
LM741	180p
LM747	70p
LM748	35p
LM7917	250p
LM3302	100p
LM3900	70p
LM3909	70p
LM3911	130p
LM3914	225p
LM3915	225p
LM3916	225p
LM13660	125p
MB3712	150p

VOLTAGE REGULATORS	Fixed Plastic TO-220
1A	7005 60p
5A	7805 55p
12V	7812 55p
15V	7815 55p
18V	7818 55p
24V	7824 55p
100mA	TO-92
5V	78L05 30p
12V	78L12 30p
15V	78L15 30p

OTHER REGULATORS	78HGKC
LM309K	135p
LM311	200p
LM323K	50p
LM723	37p

OPTO-ELECTRONICS	ORP60
ON7577	45p
ORP71	180p
ORP12	120p

OPTO-ISOLATORS	ILL11
ILD74	130p
MCT26	100p
MCS2400	190p

LEDS	ILL220 Red
ILL32	55p
TIL209 Red	13p
TIL211 Gr	20p
TIL212 Ye	25p
TIL216 Red	18p

DISPLAYS	3015F
FND357	110p
DL074	140p
DL07 Red	140p
FND507	120p
FND509	110p
MAN3640	175p
MAN4640	200p

TRANSISTORS	BFR40
AC126	25p
AC127/8	20p
AC176	25p
AC187	25p
AF116	50p
AD149	70p
AD161/2	45p
AU107	200p
BC107/8	11p
BC109	11p
BC117	20p
BC147/8	9p
BC149	10p
BC157/8	10p
BC159	11p
BC172	12p
BC177/8	17p
BC182/3	10p
BC184	11p
BC187	30p
BC212/3	10p
BC214	12p
BC237	15p
BC327	16p
BC337	16p
BC461	36p
BC477/8	30p
BC516/7	40p
BC547B	16p
BC549C	9p
BC557B	18p
BCV70	18p
BCV71/2	22p
BD132	50p
BD135/6	54p
BD140	60p
BD189	60p
BD232	95p
BD235	85p
BD241	70p
BD242	70p
BDY56	200p
BF200	32p
BF256B	35p
BF257/8	32p
BF259	35p
BF339	25p

MEMORIES	400p
2101-2L	120p
2107B	500p
2111-4	250p
2112-4	300p
2114-2L	300p
4014	200p
4116-4	300p
5101	500p
5145-4S	500p
6810	200p
74S201	300p

ROM/PROMS	700p
74S188	225p
74S287	350p
74S471	650p

CPUs	1600
8002CE	750p
2850A	160p
6800	370p
6802	650p
6809	160p
8080A	450p
8088A	650p
MS8080	1000p
TM59980A	620p
Z80	400p
Z80A	650p

EPROMS	1702A
2708	350p
2716 (+5V)	500p
2532	500p
2732	500p

SUPPORT DEVICES	800p
3242	450p
6522	600p
6532	825p
375p	375p
6821	180p
6845	160p
6850	180p
6852	370p
6875	600p
8154	950p
8205	800p
8205	120p
8212	200p
8216	200p
8224	250p
8228	250p
8251	400p
8253	400p
8255	400p
8257	400p
8259	800p

TIP30A	48p
TIP30C	60p
TIP31A	58p
TIP31C	62p
TIP32A	68p
TIP32C	82p
TIP33A	90p
TIP33C	114p
TIP34A	115p
TIP34C	160p
TIP35A	225p
TIP35C	290p
TIP36A	270p
TIP36C	340p
TIP41A	65p
TIP41C	78p
TIP42A	70p
TIP42C	82p
TIP54	160p
TIP120	120p
TIP122	130p
TIP142	130p
TIP147	130p
TIP2955	78p
TIP4055	70p
TIS43	48p
TIS93	30p
ZTX108	12p
ZTX100	13p
ZTX500	15p
ZTX502	18p

Electronic Aids For The Disabled

Hugh Davies interviews Roger Jefcoate, consultant assessor and lecturer on technical aids for disabled people



THROUGHOUT THE HISTORY of mankind, to be mentally or physically handicapped from birth, or disabled later in life, meant relegation from the life of normal healthy people. While advances in electronics have been proclaimed in areas such as communications, weaponry, medicine and space technology, simple electronic aids for handicapped and disabled people have been sadly neglected. One obvious reason has been the low return compared with other more profitable ventures.

But slowly, over the last two decades and thanks to the work of a handful of people like Roger Jefcoate, a neglected part of society has begun to receive recognition and help through the ingenious application of readily-available electronic devices.

In this interview with Roger, you will see how a little ingenuity and a low outlay can bring pleasure and fulfilment to a handicapped person's life.

Last 20 Years

I asked Roger Jefcoate what he considered were the main technological advances in the last 20 years. He saw the first as being Possum, which he helped to develop from 1962 and which is still commercially available. As the best known of electronic controls, it consists of a range of remote-controlled devices for disabled people, and is operated by various kinds of switches.

"Possum showed that disabled people, with appropriate electronics, can gain greater meaning from life."

Can you give any details of the electronics used in Possum?

"Yes, the original Possum was very simple, based upon standard electromechanical devices; that is, relays and Post Office type selectors — Uniselectors."

Possum enabled a single switch to operate a Uniselector which in turn enabled a light, a radio, a television, a heater or other appliances to be switched on.

He saw the next development as being Electraid, in 1969: "the first solid-state remote-controlled typewriter".

Possum had made use of typewriters for some years, but Electraid used solid-state electronics and was very versatile.

"The really clever bit about the Electraid is that for the first time the teacher or the therapist (or, indeed, if it is an adult, the disabled person) can program the machine by switching two knobs on the front, to provide a continuing physical and mental challenge."

Those with extreme handicaps can benefit from use of an Electraid. Roger gave the example of children with cerebral palsy (CP) who could try repeated actions with a single switch. It has been found that this repeated action gives improved residual ability — the child becomes less handicapped.

Roger Jefcoate demonstrating the Lightwriter, a communication aid developed by Toby Churchill of Cambridge. Toby lost the use of speech and the use of all his limbs apart from his left hand. His handicap struck while in the third year of an engineering course at Bath University and he used his skills to design this machine, which converts typed characters into a message moving across the display strip

"This was first discovered with a project I initiated called the Toy Aids projects where I realised by modifying toys and games in a very simple way — and this is right up the street of your Hobby Electronics readers — handicapped people were having more fun."

With the Electraid electronic typewriter, as few as one or two switches can be used to operate the machine. After the handicapped person has mastered these switches, the inputs can be increased to four, possibly coupled to a joystick. So with an increased number of switches, operation becomes faster. The machine, costing around £2,500, is especially useful for assessing the physical and mental ability of a child, and has been supplied to special schools and centres for the handicapped.

In 1981 came the application of the microcomputer to the needs of the handicapped. Roger sees this as being probably more significant than either of the other two developments, and he is heavily committed to the application of microcomputers.

"Apple have been very sensible here and they are the first microcomputer suppliers to set up an agency with national responsibility for disabled people."

The agency has been awarded to John Flack, principal of Electraid, after Apple saw the work he had been doing.

I visited Electraid at the Old Labour Exchange, Aylesbury, and I will give my own impressions of the work going on there in a later article.



Electraid Typewriter Control 5600, with visual indicator, Brother large-print typewriter and trolley. It incorporates the facility for one, two or up to eight switch inputs

Toy Aids

Roger was given the idea for starting Toy Aids by Peter Toft of the Inner London Education Authority's Engineering Centre for Special Schools at Woolich College. Peter had for a long time taken an interest in the possibilities for modifying toys for use by disabled people. It was he who had run the first workshop for parents, teachers and therapists to come and make these leisure aids.

"It was through discussions I had with Peter that I then asked the AIDIS (aids for disabled and elderly people) Trust if they might be prepared to support this. A former AIDIS trustee, Mr Colin Dann, decided that this was something worth pursuing."

The long-term result has been the setting up of a separate charity called the Toy Aids Projects, under the direction of Colin Dann. This makes available fully modified toys and leisure aids at reasonable cost to anyone working with handicapped people.

How The Electronics Hobbyist Can Help

Although Possum, Electraid or microcomputer aids are of great benefit to the handicapped, often simple home-made gadgets can also be of value, as Roger discovered when helping to set up the Toy Aids project.

"A two-year old, for example, isn't interested in Electraids and Possums — it wants to play with its doll. Kids can be so handicapped that they can't even reach out and hold a doll. This problem can be solved by buying an electric doll from Woolworths and bringing out its control to a pair of switches. It will give movement, colour, sound — and stimulation. A kid can become, by repeated use of the toy, less handicapped."

Roger runs courses throughout the year to bring professional and non-professional people up to date with technological developments and to enable those attending to share their ideas and experience. More details of these will be given later. During the talks, Roger says: "Isn't it exciting that we've got this wonderful technology? Now let's look for ways in which we can avoid it!"

He sees the need for those designing aids and equipment (and this includes hobbyists) to make life simpler and cheaper for disabled people.

Between 1973 and 1975 he realised that the technology was available but it cost a fortune. Ready-made commercial equipment did not suit every need because every disabled person's needs are different. Roger then considered how he could harness the talents of do-it-yourself enthusiasts — amateur or professional (but preferably amateur) — to make life more *enjoyable*, not just more meaningful, for the disabled. His solution was to start an organisation called ACTIVE: "because we're active people wanting to help disabled people themselves to be more active."

ACTIVE

The ACTIVE Association* was founded to promote do-it-yourself leisure, learning and communication aids. Roger Jefcoate sees it as his main vehicle for finding technicians to do odd jobs in particular areas. What is more significant is that, once enthusiasts become members of ACTIVE, they can set up their own links with a special school, centre for the handicapped and so on. As Roger said, "... if one of your Hobby Electronics readers reads this article and says, 'Well now, how can I help?', first thing they should do is to either join ACTIVE nationally, which will cost £4.50, or equally as good, initiate an ACTIVE group in their own patch if there isn't one."

"If there is one, join it, and then go charging along to the local special school, the local centre for disabled people, saying, 'My hobby is electronics. I am a member of ACTIVE. How can I help?'"

Roger sees this approach as being a very fruitful way of using people's skills. He gave an example of someone, armed with some knowledge of electronics, approaching a special school.

"They will say, 'Well, isn't there in ACTIVE's design index a 'wee detector' — a device which will tell when a child has urinated in the potty — part of toilet training?'"

"If you are a mentally handicapped child you do need positive reinforcement. It's very hard to train a mentally handicapped child to the potty. And it's not unusual to have people 15 years old still in nappies. Yet with appropriate technology — simple technology — this can all be avoided, because you can stick a little sensor inside the potty which can be linked to something that will give immense reward to that child. It might be a roller-coaster which performs. It might even be, obviously through very safe circuitry, something which switches on the telly."

Enthusiastic Amateurs

Roger is keener to pick up the amateurs rather than the professionals "... because it is the amateurs who seem to have more enthusiasm and certainly seem to be willing to give the time." He has found a fruitful area of talent among sixth-form schoolboys.

He turned to the example of a remote on/off control for a TV. Many people, particularly the elderly, are forced to spend a lot of time in bed. Roger sees the television as a "window on the world" — but not everybody can afford colour TVs with remote control built in. And there are virtually no sets available with remote on/off control.

"It's not a difficult job, using basically a few commercial components, to build a device that will give, very safely, remote on/off over a telly."

So it's left to the amateur to see the idea through to its conclusion?

"Oh yes, involvement must be the name of the game. What we would hope is that if they do a thing like this (on/off TV control), they shove the circuit, and preferably a picture or two of the end result, up to ACTIVE's headquarters so that we can put it, if it is felt suitable, desirable, in our design index. ACTIVE produces a design index of well-proven designs so that other people can copy a good initial job."

What about the safety of a design: does ACTIVE exercise any control?

"If somebody is doing a remote TV control (for example), my usual suggestion is to base it on an existing well-tried commercial device, such as the Home Automation single-channel infra-red device, where the bit at the mains end is already tied up and organised."

"The clever part, from the amateur's point of view, is to modify the infra-red unit so that the disabled person can work it."

Which is presumably at low voltage?

"On the whole, we in ACTIVE are not too enthusiastic about using mains voltage on anything. But you know you've got to let people use their own heads."

Windmill Teaching Aid

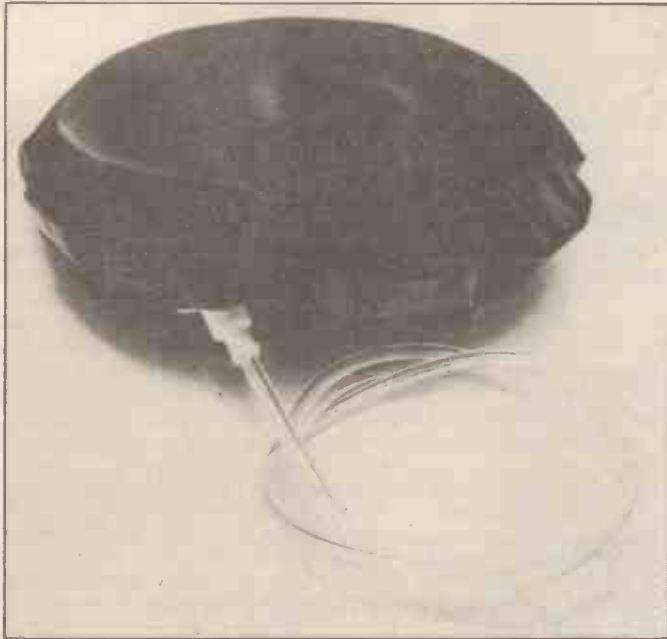
One example he gave of where mains might be used was of a motor driving a rotary pointer on a learning aid for children in a special school. Care was obviously needed to ensure that the switching circuit was either double-insulated or, preferably, operating from a low voltage (that is, 12 V or less).

Roger is still looking for a better design of this teaching aid — nicknamed a windmill. The model shown was developed for a school in Chipping Norton. He considered that HE readers could come up with better designs of their own. (Don't forget the HE Project Design Competition for the International Year of Disabled Persons, first announced in the April '81 issue. A fresh application form is provided on page 19.)

Roger said that mechanical rotary pointers (preferably single pointers) were more successful than circles of LEDs.

Electronic Aids For The Handicapped

Roger was asked to give specific examples of handicaps and how these had been made easier to bear by the use of some electronics ingenuity.



Head-operated pad from Electraid. This pad is made from a car spot lamp cover and produces changes in air pressure at the end of the tube when pressure is applied to the pad. These changes are converted in turn to on/off functions by a remote pressure-sensitive switch



Early 'windmill' teaching aid in use. The spastic child can operate switches to make the pointer come to rest at the word which corresponds to the picture being indicated. The machine is made from Meccano components and is battery-operated

"As I said earlier, it's always the ability which counts. In operating any remote-control device you've got to look for what the person can do. And if they've got good hand control, well you're home and dry. If they have good hand control then you've got to be very careful in mounting a switch or switches to operate some form of remote-control device.

"For the severely handicapped people there's often very small movement: for a person with advanced motor neurone disease it can be just a flicker in the foot.

"For the heavily handicapped spastic child, whose arms flail all over the place, you might have to end up with a single or dual switch in the head area, perhaps for side-to-side movement of the head."

He saw the ideal switch, because it's socially and psychologically acceptable, as being a standard switch operated by hand. But for a disabled person, a standard switch could be one that is 6" square, specially that made by an enthusiastic amateur.

Roger sees switches as being an interesting area of development because he considers nobody has yet designed a really good large flat surface area switch. He is looking for a good design for an electromechanical switch, possibly based on a microswitch, that can be logged on ACTIVE's design index. He is equally interested in a good design for a touch-operated switch (sensitive to a change in capacitance), with variable sensitivity. He put these designs forward as a challenge to you, our readers.

Commenting on touch switches he said: "Even now we have got a long way to go. Nobody has produced a good design. There is one commercially but it's very expensive."

Head control of a modified train set. Roger Jefcoate is seen sitting next to a spastic boy who can only move his hand, to which a magnet is attached. The magnet can be dropped into any one of 20 slots, each one controlling a signal, a point, a start or a stop. The picture was taken at one of ACTIVE's conferences



He is a 'microswitch man' primarily "... because it's an electromechanical thing, you can feel as the pressure increases against the switch and you can feel it as it snaps open."

Let's take a few examples of handicaps and what has been done for them.

"Take advanced multiple sclerosis, for a start. Here we have a person who is wheelchair bound, and who wants to do something remotely. Well then, looking for the ability: *they've got no ability*. They can't even turn their head from side to side. What can you do? Well, they can still drink. So you can get hold of an air-sensitive switch — you can either buy them commercially or go down to the washing machine service depot and scrounge a second-hand one — which could be operated by light sucking or light puffing down a tube."

He went on to give an example of a water level sensing switch from Hoover. Even those that are no longer reliable for the original function of switching a mains-operated pump or heating element are still satisfactory for low-voltage operation.

"At the other end of the range you've got a fairly badly-handicapped spastic child, arms flailing all over the place. Usually the spastic child hasn't got good puff and suck control because they can't close their mouth and seal their lips. Then we're going to have to look for an extra tough switch which on the one hand will trigger with a relatively modest pressure, say 1/2 lb, but at the same time will withstand a wack of 20 lb on the same switch. Tough specification, that."

One technique he suggested was to use two pieces of wood, hinged at one end, and with a very low profile. With a microswitch fixed between the hinged arms, the operating pressure can be adjusted simply by packing in a desired amount of plastic foam. Thus the more foam that is used, the tougher the switch is to operate. Such a design makes use of simple everyday materials.

Another example he gave of a handicap was muscular dystrophy in children, a progressive disability with progressive weakening of the muscles.

"There's no spasm there like there is with the spastic child. You need a light-duty, light-pressure switch — because it's never going to have to withstand a real bash — which can respond to whatever they can do. And I find that a muscular dystrophy child is particularly successful using joysticks."

Roger said that very easily home-made or commercial joystick assemblies can be used in this application.

"It's quite easy to build a sensitive joystick, with a spring underneath it to keep it in a central position against a couple of simple microswitches.

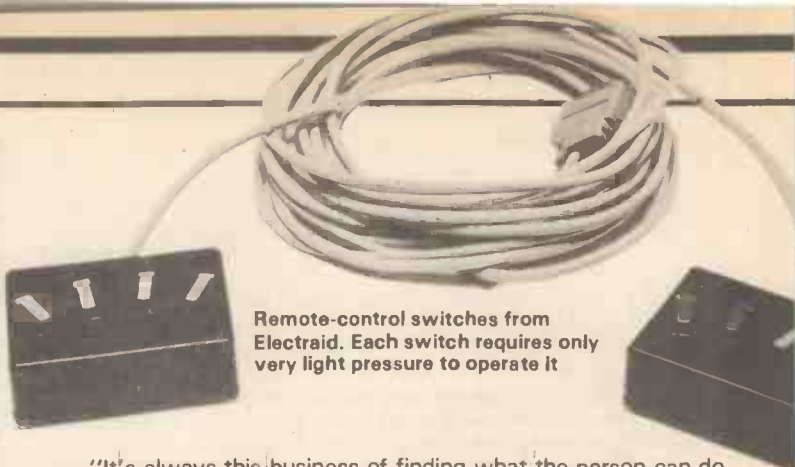
"The great advantage of joysticks is that you can get more than one result from the single lever action."

One example he gave for the use of a joystick was for it to enable the handicapped person to turn the pages of a book.



Eight-way toggle switch from Electraid

He next described a disability common to many of us. "Arthritis is a very distressing handicap amongst the older population — although even that can hit children. There is an unfortunate combination: it isn't just paralysis, it's pain to go with it as well as disfigurement. But again the same kind of fairly sensitive switches that would be used, for example, by a person with multiple sclerosis or a child with muscular dystrophy, would be relevant.



Remote-control switches from Electraid. Each switch requires only very light pressure to operate it

"It's always this business of finding what the person can do easily and satisfactorily: what they themselves feel is most appropriate."

What about the needs of adults?

"Adults have different needs. I find adults enjoy much more their window on the world — the telly. And of course we have this problem of safety with the mains and so on. And again it's the old story: what can they do most easily, balanced against what is socially and psychologically acceptable, because disabled people don't want to look like men and women from Mars, with wires festooned in every direction. How can we give them the remote control that they need without the wires, nice and discreetly?"

"I find, with your average handicapped adult, a modestly-sized switch will work out quite successfully. Even the quite heavily handicapped spastic adult can manage a switch that would, for example, be about the size of a C-60 cassette holder."

Proportional Control

All the switches described so far have been simple on/off devices, so I asked Roger whether any proportional movement controls were used by handicapped people.

"Certainly there are proportional joystick controls, for example on electric wheelchairs, where you do indeed want quite fine movement. But other than that there's not a lot of need for proportional control except on things like microcomputers, model aircraft, model boats and this kind of thing."

Would proportional control help a disabled person to paint a picture?

"If they can't manage to cover the whole painting area then a straight on/off control on a motorised easel is perfectly adequate."

One such easel was initiated by Roger and designed by REME (Royal Electrical and Mechanical Engineers).

Notting Dale Technology Centre

Designing aids for handicapped people can have some unlikely benefits, not least to the designers themselves. One such example of where this has happened is the Notting Dale Technology Centre at Hammersmith, set up by Christopher Webb. Here a group of unemployed youngsters from the Hammersmith area, most of whom have an interest in electronics, are being given a basic training, and are helping handicapped people through their work. It is in this concept of teaching a trade, linked to social awareness, that Roger comes in.

"I shove at them good projects which these lads can get stuck in with, they can tackle, they can see the disabled person who needs it, they can install it — and it's already working out quite successfully."

An example he gave was of a gadget called the Microprocessor-assisted Communicator, invented by Patrick Poon, a graduate student at Kings' College. It is a new communication device for disabled people.

"The beauty of Notting Dale is that they'll tackle things where they'll make them in ones and twos where commercially it would not be viable."

At least one of the lads has been offered employment as a result of his work at the centre.

Courses

It was mentioned earlier in this article that Roger Jefcoate runs courses throughout the year. These take two forms: in-depth residential courses on technology for the handicapped child, and single-day courses. The first are held at the Spastics' Society's Educational Centre, at a cost of £150, and are aimed at professional people throughout the world.

The second — and of interest to our readers — are held at various places throughout the UK at a cost of £7 to professional

people and £6 to non-professionals (the £1 reduction is a subsidy from one of the charities to which Roger is linked).

Readers are welcome to attend the next day course on Thursday, 25 June 1981 at St Joseph's College, Lawrence Street, Mill Hill, London NW7. The course opens with arrivals and coffee at 9.45 am. Fees must be paid in advance to the organisers: Castle

Priory College, Thames Street, Wallingford, Oxfordshire OX10 0HE (Telephone 0491 37551).

Further details of this course are given under Monitor on page 6. In a coming issue of HE, I hope to give details of my visit to Electraid in Aylesbury, and to outline some of the latest microcomputer aids for the handicapped.

Roger Jefcoate

In the early 60s, Roger Jefcoate was one of the original trio who developed Possum, the first fully adaptable electronic aid for the disabled, at the National Spinal Injuries Centre, Stoke Mandeville Hospital.

He saw a need in the early 70s for a freelance consultant on electronic aids to advise those concerned with rehabilitation about the most appropriate aid for a particular disability. So he set himself up in this rôle after leaving the Possum project in 1972. Without any commercial links whatsoever, he works with therapists, teachers, health visitors, district nurses and doctors, and liaises with societies such as the Spastics Society, the Multiple Sclerosis Society, the Muscular Dystrophy Group and many smaller ones both in the UK and abroad.

Roger founded the AIDIS Trust in 1975 to sponsor urgently needed electronic equipment and aids for disabled and elderly

people. He also founded ACTIVE, an association which promotes do-it-yourself leisure, learning and communication aids.

To keep people in touch with the latest developments in aids and to pool ideas, Roger runs residential and single-day courses throughout the UK. These are attended by people from many parts of the world.

He is concerned with all kinds of handicaps, and primarily with extreme cases. Having established the person's ability he will set about seeking a practical solution and the funds with which to achieve it.

Although Roger Jefcoate has no formal qualifications for this work, he received an honorary degree from the Open University in 1980 for his services to disabled people.

His interest in electronics stems from electronics as a hobby. One of his early achievements was to help develop the world's first electronically-controlled ventilator machine, which operates as an artificial lung.

COMPETITION Project Design for the International Year of Disabled Persons 1981



AS A REMINDER, we are repeating the entry form for our competition, first announced in the April '81 issue. Design an electronic aid for the disabled — even a very simple one — and you could win the first prize of £200 cash.

No restriction is placed on the area of electronics that you wish to use: transistors, integrated circuits, valves (if it is impossible for semiconductors to do the job!), electro-mechanical aids (electronically controlled), computer programs — the choice is yours.

The only restriction we place on entries is that of ORIGINALITY: the design must be original, or an original adaptation that has not been published or marketed.

No Design Is Too Small
Entries can be as simple or as complex as you like, but we envisage that the winning entries will be ingenious solutions to a problem or problems encountered by a disabled person rather than an enormous (and expensive) box of tricks.

We will, if necessary, segregate designs into 'classes

of complexity' or specific types. In judging, we may also take into consideration the ages of the entrants.

First Prize £200 cash
Second Prize Kikusui 538A oscilloscope
PLUS
Three runners-up prizes

Closing date for the competition was fixed as 31 July 1981 in the April '81 issue. So far the response has been low, so we have decided to extend this date to 1 September 1981.

No correspondence will be entered into after this closing date.

As a guide, set out your design along the lines of an HE project — we will publish the winning designs. Send your design to:

Project Design Competition
Hobby Electronics
Modmags Limited
145 Charing Cross Road
LONDON WC2H 0EE.

AND include the following:

- the completed entry form (see below)

- written details of your design, including drawings or black-and-white photographs
- a suitable sized stamped and addressed envelope (if you wish to have your material returned)

If your design is 'boxed' or breadboarded, *keep it intact* until at least two weeks after the closing date: if you haven't heard from us by then you can assume that your design is not among the winning entries (your daytime telephone number would be very helpful). **HE**

PROJECT DESIGN COMPETITION ENTRY FORM

I certify that my design, to the best of my knowledge, is original and has never been offered for publication or manufacture

Signature

Name
(CAPITALS)

Address
(CAPITALS)

Daytime tel.no

Project title

Parts List

Parts List Board 3

RESISTORS (All 1/4 W, 5%)

- R1, 5, 6, 10, 11, 15, 16, 20, 21, 25, 29, 30, 34, 35, 39, 40, 44, 45, 49, 53, 54, 58, 59, 63, 64, 68, 69, 73, 77, 78, 82, 83, 87, 88, 92, 93, 97, 101, 102, 106, 107, 111, 112, 116, 117
- 150k
- R2, 7, 12, 17, 22, 26, 31, 36, 41, 46, 50, 55, 60, 65, 70, 74, 79, 84, 89, 94, 98, 103, 108, 113, 118, 122, 127, 132, 137, 142
- 4k7
- R3, 8, 13, 18, 23, 27, 32, 37, 42, 47, 51, 56, 61, 66, 71, 75, 80, 85, 90, 95, 99, 104, 109, 114, 119, 123, 128, 133, 138, 143
- 22k
- R4, 9, 14, 19, 24, 28, 33, 38, 43, 48, 52, 57, 62, 67, 72, 76, 81, 86, 91, 96, 100, 105, 110, 115, 120, 124, 129, 134, 139, 144
- 100k
- R12f, 125, 126, 130, 131, 135, 136, 140, 141
- 120k

CAPACITORS

- C1, 2, 6, 7, 11, 12, 16, 17, 21, 22, 26, 27,
- 4u7, 16 V tantalum or electrolytic
- C3, 4, 8, 9, 13, 14, 18, 19, 23, 24, 28, 29,
- 3u3, 16 V tantalum or electrolytic
- C5, 10, 15, 20, 25, 30
- 2u2, 16 V tantalum or electrolytic

SEMICONDUCTORS

- IC1, 2, 3
- 4520 programmable counter
- Q1-30
- BC183 NPN transistor

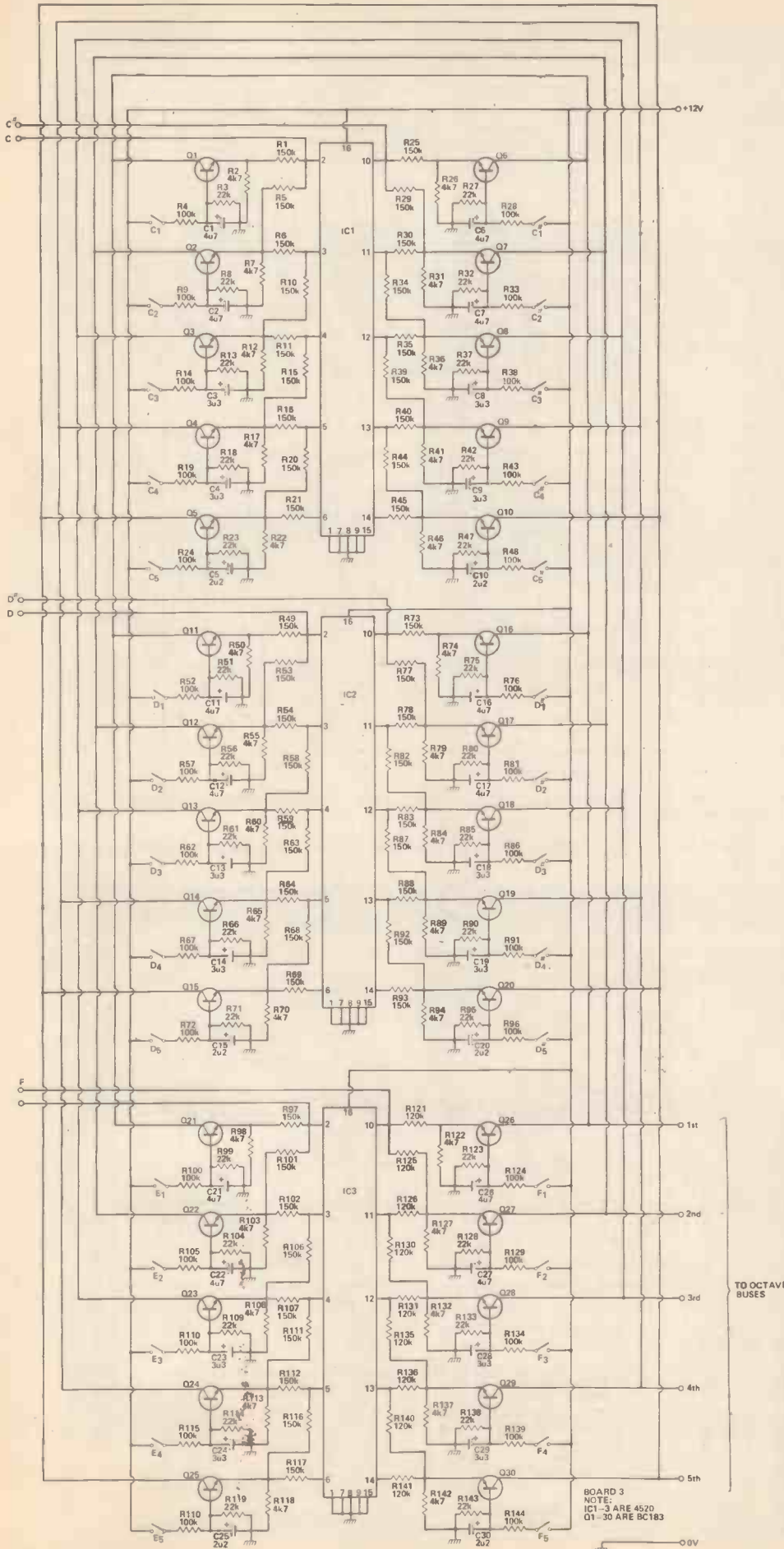
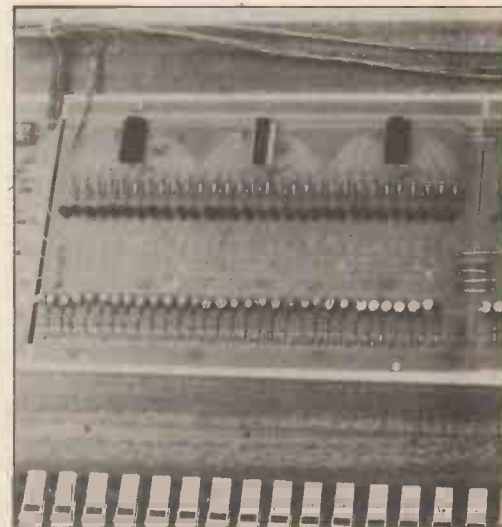


Figure 3. Circuit of Board 3



Above. Boards 3 and 4 in final position showing all single-strand wire links

Parts List

Parts List Board 4

RESISTORS (All 1/4 W, 5%)

- R1, 5, 6, 10, 11, 15, 16, 20, 21, 25, 29, 30, 34, 35, 39, 40, 44, 45, 49, 53, 54, 58, 59, 63, 64, 68, 69 120k
- R2, 7, 12, 17, 22, 26, 31, 36, 41, 46, 50, 55, 60, 65, 70, 74, 79, 84, 89, 94, 98, 103, 108, 113, 118, 122, 127, 132, 137, 142 4k7
- R3, 8, 13, 18, 23, 27, 32, 37, 42, 47, 51, 56, 61, 66, 71, 75, 80, 85, 90, 95, 99, 104, 109, 114, 119, 123, 128, 133, 138, 143 22k
- R4, 9, 14, 19, 24, 28, 33, 38, 43, 48, 52, 57, 62, 67, 72, 73, 76, 77, 78, 81, 82, 83, 86, 87, 88, 91, 92, 93, 96, 97, 100, 101, 102, 105, 106, 107, 110, 111, 112, 115, 116, 117, 120, 121, 124, 125, 126, 129, 130, 131, 134, 135, 136, 139, 140, 141, 144 100k

CAPACITORS

- C1, 2, 6, 7, 11, 12, 16, 17, 21, 22, 26, 27, 4u7, 16 V tantalum or electrolytic
- C3, 4, 8, 9, 13, 14, 18, 19, 23, 24, 28, 29, 3u3, 16 V tantalum or electrolytic
- C5, 10, 15, 20, 25, 30 2u2, 16 V tantalum or electrolytic

SEMICONDUCTORS

- IC1, 2, 3 4520 programmable counter
- Q1-30 BC183 NPN transistor

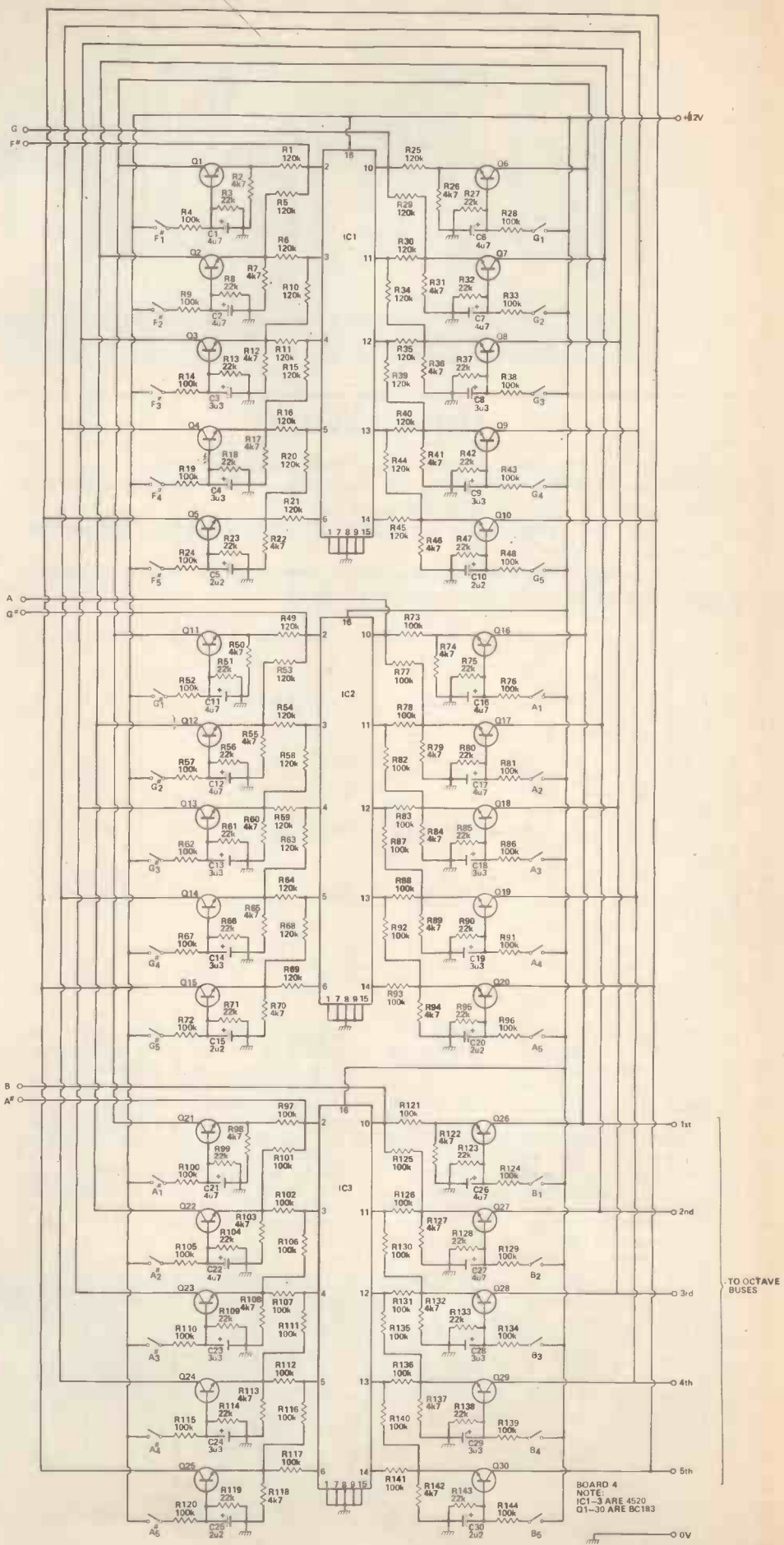
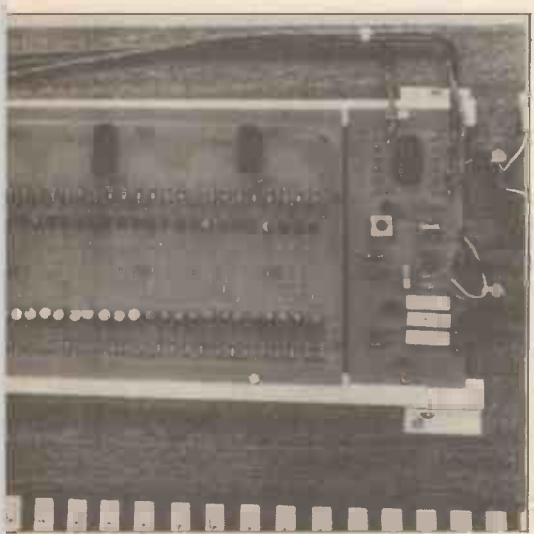
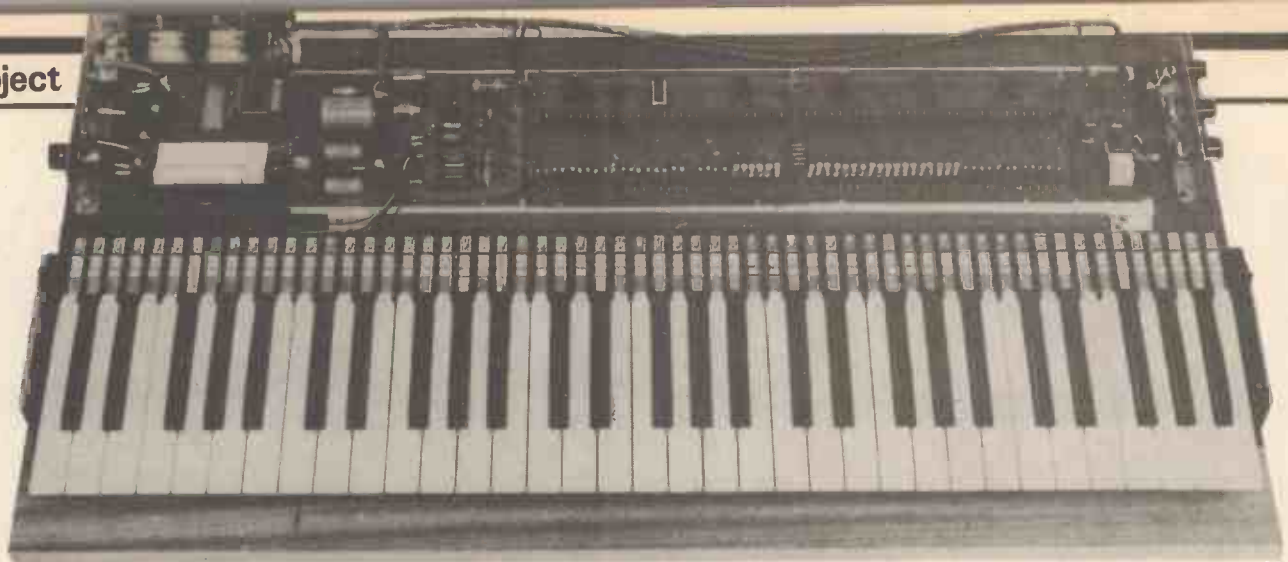


Figure 4. Circuit of Board 4





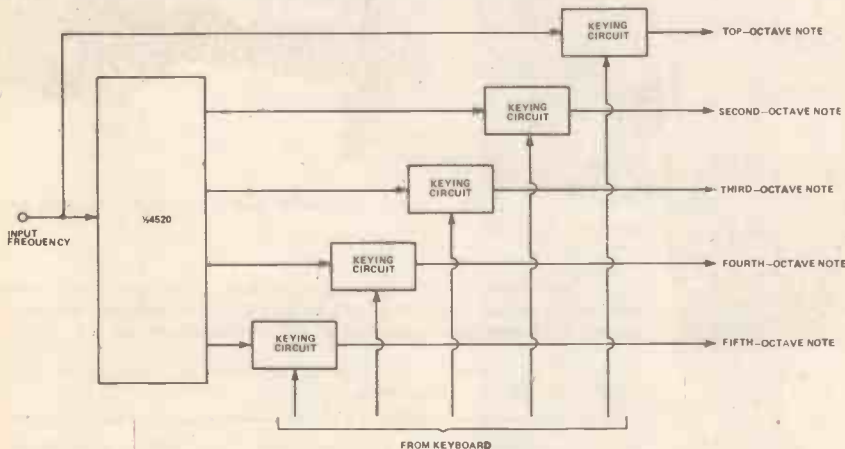
How It Works

Boards 3 and 4 comprise all Dividing and Keying Circuits.

Twelve notes comprising the semitones of the top-octave are fed from Board 2 to the six ICs of Boards 3 and 4.

Each note is divided by 2,4,8 and 16 by the circuit thus making five complete octaves.

As a key on the keyboard is pressed, one transistor key circuit allows an envelope of sound through to the output.



The divider circuitry is made up of six 4520 ICs which bear the official title 'Programmable, Divide-By-N, 4-Bit BCD Counters'. They are configured to divide any input frequency by 2,4,8, and 16, thereby producing one octave, two octaves, three octaves and four octaves below that of the input. Each IC divides down two separate input frequencies.

At the output of this part of the circuit all 60 notes of the organ are permanently available.

Depressing the key on the keyboard

allows a +12 V pulse to trigger one keying circuit built up by a transistor, five resistors and a capacitor. Each keying circuit is essentially a simple envelope generator with a set attack and decay time defined by the value of the capacitor. To give a realistic organ sound the bass notes should have a longer attack/decay time than that of the treble notes, thus the capacitor values of the bass notes are correspondingly higher.

Figure 5. The HE Electronic Organ after this month's constructional stage

Buylines

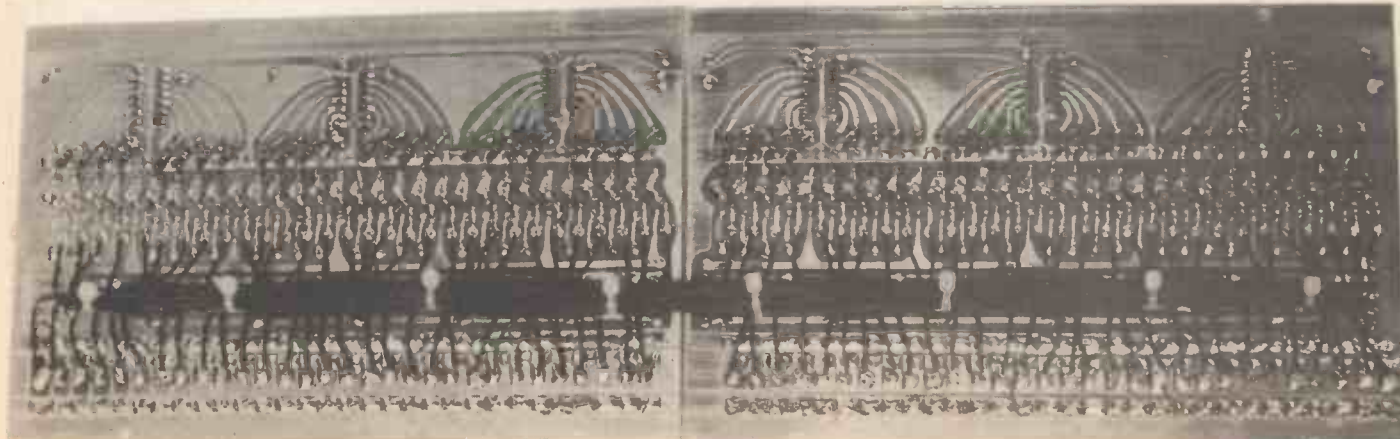
A limited number of kits for the HE Organ can be obtained from:

Mr A T Hawkins
23 Blenheim Road
St Albans
Herts AL1 4NS

for £99 inclusive. The kits contain all metalwork, hardware and PCBs, as well as the keyboard and components. You only need to supply your own baseboard and case.

For those readers who prefer to buy the components themselves, Mr Hawkins is willing to supply the keyboards separately. None of the other items should be difficult to find.

Figure 6 (Below). Underneath our two prototype printed circuit boards. Note how the 48 resistors have been positioned diagonally on the boards. The 60 multi-strand connecting leads should be cable-tied together at a few points



HE

For HE Readers High-quality Furniture Kits For Your Hi-fi

**EXCLUSIVE
OFFER**



▲ Kit 2 This comes with one tinted Perspex door and without the metal divider

◀ Kit 1 Two tinted Perspex doors are provided, together with a metal divider for separating two of the cabinets. In the example shown, a record deck has been mounted on the connecting shelf

A LIMITED NUMBER of self-assemble modular furniture kits have been specially reserved at low prices for HE readers. This is your chance to mount your hi-fi equipment in attractive *real teak* veneered cabinets, complete with tinted Perspex doors and adjustable shelves.

These easily-assembled kits enable you to configure the equal-sized cabinets to *your* choice and to suit *your* room space requirements.

Kit 1 costs only £79 and consists of three cabinet modules, 547 mm (1 ft 9½ in) wide by 375 mm (1 ft 2¼ in) high by 413 mm (1 ft 4¼ in) deep, complete with two tinted Perspex doors, four shelves and two matt black plinths. Also included is a metal divider finished in matt black which takes a fixed shelf and a back panel. One of the shelves can be used between two of the cabinets as shown.

Kit 2 costs only £73 and consists of three cabinet modules, complete with one tinted Perspex door, three shelves and two matt black plinths. (No metal divider assembly is supplied with this kit.)

The above prices include VAT and delivery to your door.

Each kit comes with all screws, fittings and easy-to-follow instructions. Items from Kit 1 and Kit 2 can be used together to suit your requirements.

When assembled, this furniture is ideal for:

- mounting most types of audio equipment, with the advantage that unsightly leads are hidden from view
- holding your LP or cassette collection
- use as room furniture to hold books, ornaments, crockery, etc.

The pictures show how the two kits can be used to mount and display your audio equipment

We stress that this is a *limited* offer. Once this consignment has gone it cannot be repeated.

Send your order today to:

**HE Furniture Offer, Modmags Limited,
145 Charing Cross Road, LONDON WC2H 0EE**

Please send me of Kit 1 at £79 each
. of Kit 2 at £73 each

I enclose a cheque made payable to Modmags for a total of £

OR

I wish to pay by Barclaycard. Please charge to my account number

BARCLAYCARD NO.

VISA 4 9 2 9 | | | | | | | |

Signature

Name
(BLOCK CAPITALS)

Address
(BLOCK CAPITALS)

Please note that the offer applies to UK mainland only; allow 28 days for delivery

Radio part two

In the second part of this article Ian Sinclair describes the operation of tuned-radio frequency (TRF) and superheterodyne (superhet) receivers, and how signals are demodulated. He also looks at a practical radio

WE ENDED LAST MONTH having described what happens when a charged capacitor is connected in parallel with a coil. Figures 11a to 11f are shown again this month to remind you of how the see-saw action described in the first part takes place. The kind of waveform you would obtain if an oscilloscope was connected across the circuit is shown in Fig. 11g. The important point is that this circuit has generated a signal at a frequency which is set by the coil and the capacitor. This frequency is called the *resonant frequency*, and its importance is that it is the *natural* frequency of oscillation of this circuit. We can make this circuit into a continuous generator of oscillations simply by continually replacing the small amount of energy which is lost because of the resistance of the coil.

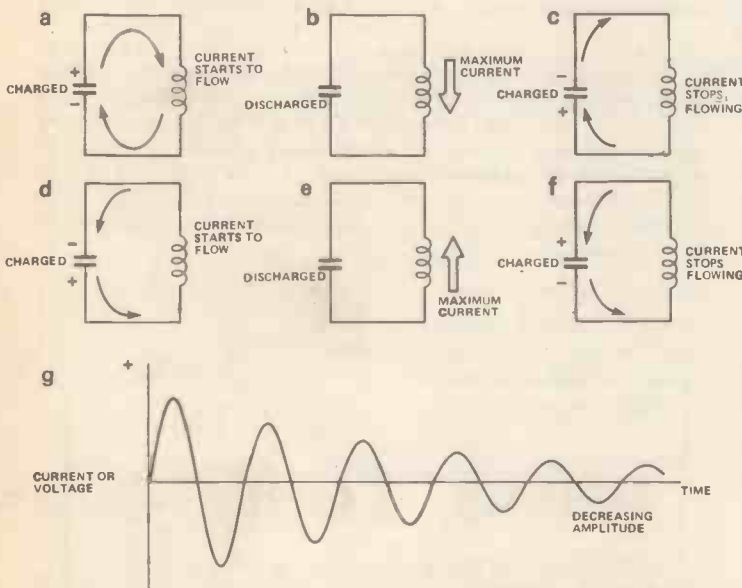


Figure 11. A charged capacitor in a resonant circuit. Figures 11a to 11f show how the charge produces a current which then charges the capacitor in the opposite direction, reversing the current until the charge is almost at its original value

From the point of view of radio reception, the interesting action of this circuit occurs when we try to feed a signal into it, as in Fig. 12. If the signal that we feed in is at the same frequency as the natural or resonant frequency of the coil-capacitor circuit, then the coil and capacitor will resonate — currents will start to circulate to and fro until there is a comparatively large amount of signal present, keeping in step with the input signal. If we feed a number of different signals into this circuit, the only one which will have any effect will be the signal whose frequency is the same as the resonant frequency of the coil and capacitor combination, which is called a 'tuned circuit'. The action can be neat-

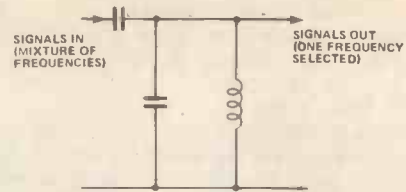


Figure 12. Feeding a signal into a parallel resonant tuned circuit

ly illustrated practically by the circuit shown in Fig. 13. The signal generator supplies signals at a constant amplitude, but at a frequency which can be varied. The oscilloscope detects the amount of signal across the tuned circuit and as the frequency of the signal generator is altered, the amplitude of signal across the resonant circuit rises to a peak and then falls again. What is happening is that the resonant circuit responds mainly to that frequency represented by the peak of the graph. It is as if the circuit had a high resistance for the signals at the correct frequency, but a low resistance for all other signals. It is called the 'dynamic resistance' of the tuned circuit.

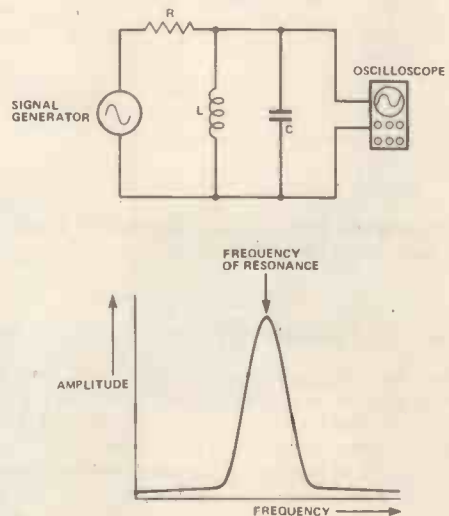


Figure 13. Experimental method (a) of observing the action of circuit in Fig. 12. The frequency of the signal from the signal generator is varied, and the amplitude of the output measured on the oscilloscope. The resulting graph (b) has a steep peak at the resonant frequency

You can see that resonant or tuned circuits allow us to sort out one frequency from another, and we can alter the frequency of resonance either by altering the capacitance or the inductance value (see Fig. 14), which is what we do when we tune a radio. The trouble is that one tuned circuit isn't selective enough to sort out the signal from all the nearby signals that exist on the crowded airwaves these days. In the days when there were only two or three transmitters on the whole of the medium-wave band around (550 kHz to 1.3 MHz) one tuned circuit was sufficient.

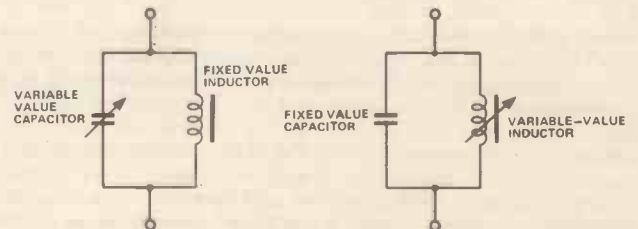


Figure 14. Varying the tuning. This can be done using (a) a variable capacitor or (b) a variable inductor

Adding Extra Stages

The obvious solution is the one that was used in the early days of radio; that is, to have several resonant circuits, each with variable tuning. The arrangement shown in Fig. 15 is of a tuned-radio-

frequency (TRF) receiver, the type used in the 20s and 30s, and still built even today. There are two tuned circuits, each tuned by a variable capacitor. The circuit can be tuned with one control because the variable capacitors are 'ganged' (connected to the same shaft so that both capacitors can be varied together).

The TRF receiver with one stage of (valve) amplification was such an improvement over the single tuned circuit receivers of the day that its development resulted in more receivers being sold, so that more transmitters opened up to fill the demand for radio broadcasting. Soon it became painfully obvious that two tuned circuits were not enough to separate the signals from transmitters that were on frequencies close to each other. The obvious step was to add another tuned circuit and another stage of amplification, but this turned out to be much harder. The snag this time was instability. With three tuned circuits and two stages of amplification, the slightest amount of signal fed back from the final amplifier to the aerial would cause oscillation. This not only caused the receiver to make unpleasant squealing noises, but it also interfered with other receivers around making the TRF receiver a thoroughly unpopular device.

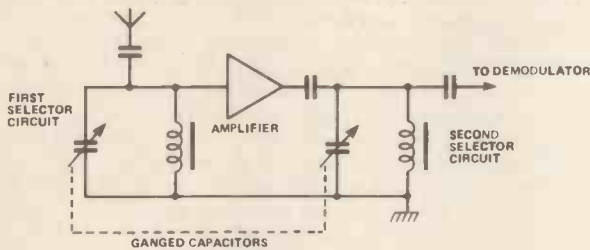


Figure 15. Outline of a TRF receiver. The signal is tuned, amplified and then selected by another tuned circuit

Supersonic Heterodyne

The answer lay in a different approach to receiver design, pioneered by the American engineer Edwin Armstrong. It was Armstrong's proposal that the first stage of a radio should be a frequency-converter, changing the frequency of the wanted input signal into a fixed frequency, the intermediate frequency (IF). Most of the amplification and selection could then be applied to this signal, with no need for variable tuning at this stage. Because there was no need to vary the tuning of the IF signal stages once set at the factory, the tuning components could be contained inside metal boxes, discouraging feedback of signals. In any case, feedback of signals to the aerial could cause few problems because the intermediate frequency was not the same as the frequency being received.

Armstrong called the principle the Supersonic Heterodyne — supersonic because the intermediate frequency is well above the highest frequency of sound we can hear, and heterodyne because this is the name for the action of mixing two frequencies together to produce one which is the difference between them (it's very similar to modulation). The name was soon shortened to superhet, and both the name and the principle have been the backbone of radio receivers ever since.

The arrangement of a typical modern superhet receiver is shown in Fig. 16. The tuning control affects two stages, the input tuned circuit, whose coil is the one around the ferrite rod itself, and the oscillator, which generates a signal at a frequency 465 kHz higher than the frequency to which the input is tuned. The mixer stage is the heterodyne part of the receiver. One input to the mixer is from the aerial, and consists mainly of the wanted signal together with signals at the frequencies close to the wanted one. The other input to the mixer is the oscillation at a frequency 465 kHz higher than the wanted signal. This oscillation is a sine wave, with no modulation, and as an economy measure is usually generated by having the mixer operate as an oscillator rather than having a separate oscillator stage.

Let's assume, for the sake of an example, that the wanted signal is at a frequency of 1 MHz. The oscillator signal then has to be at 1.465 MHz, and the signals from the output of the mixer will be at these two frequencies, along with a 465 kHz signal (the difference between 1.465 MHz and 1 MHz) and a 2.465 MHz signal (the sum of 1.465 MHz and 1 MHz). From this mixture it is easy to separate the lowest frequency signal of 465 kHz which, because of the action of the mixer, is modulated in exactly the

same way as the original 1 MHz at the input. This 465 kHz intermediate frequency can then be amplified, using several tuned circuits set permanently at 465 kHz to make sure that the bandwidth is narrow enough to avoid interference from transmitters broadcasting at frequencies close to the one we want.

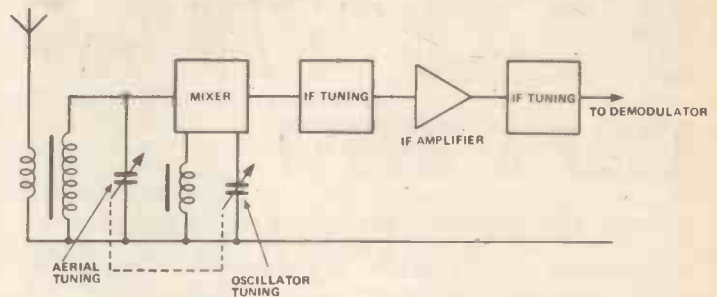


Figure 16. Block outline of a superhet receiver. The signals from the aerial are filtered by the first tuned circuit to select just a few. These are mixed with a sine wave from an oscillator. The mixing generates an intermediate frequency, which can then be amplified and selected by several tuned circuits. A much narrower bandwidth can be selected and much more amplification can be used than with a TRF receiver

When the tuning control is altered, the ganging of the variable capacitors ensures that the oscillator tuning is also changed, keeping the oscillator frequency 465 kHz above the signal input frequency and ensuring that the IF remains constant. Using the superhet principle then, we can have plenty of amplification and many tuned circuits without the risk of the oscillation which always haunted TRF receivers. The superhet principle is used, not surprisingly, for all types of receivers ranging from the humble medium-wave tranny to the early-warning radar receiver and — yes, your TV as well.

Extracting The Original Sound

No matter how much tuning and amplification you apply to a radio signal, it's still a radio frequency signal which, because of its modulation, is continually changing in amplitude. Loudspeaker cones cannot vibrate at the frequency of a radio signal, whatever its amplitude, and even if they could we would not be able to hear the sounds. We need some method of extracting the audio frequency signals from the modulated radio frequency (or more correctly, since we invariably use a superhet, IF) signal. The method of extraction is called demodulation, and for amplitude-modulated signals it almost invariably takes the form of a diode demodulator.

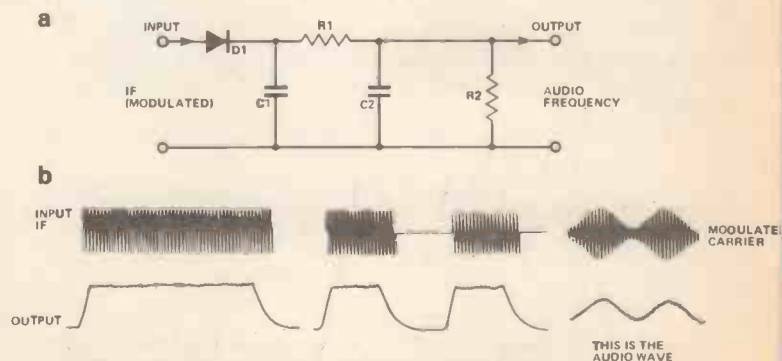


Figure 17. Diode demodulator (a) with the waveforms (b) produced by various inputs at IF

A typical diode demodulator circuit is shown in Fig. 17. The important components are the diode D1, the capacitor C1, and the resistors R1 and R2. The action is a combination of rectification and charge storage. To understand what happens, you need to know that the time-constant of C1 with R1 and R2 is greater than the time between IF waves, but is much shorter than the time between AF waves. This means that the voltage across the capacitor C1 will not change noticeably when the diode is cut off during the negative cycle of the IF, but will fall fast enough if the diode does not conduct for several IF cycles. If the amplitude of

the IF was steady, C1 would charge up to the peak voltage of the IF and stay at that voltage with the diode conducting only at the peak of each wave to keep the capacitor charged, compensating for the loss of charge through R1 and R2. The amplitude of the IF is not steady, however, when the signal is modulated: it is changing at an audio frequency rate, and the voltage across C1 will alter at the same rate because the time-constant of C1 with R2 and R3 is not long enough to keep C1 charged for the time of one audio frequency wave.

You might gather from all this that the values of C1, R1 and R2 are fairly critical, and you'd be about right. Only about right, mark you, because there is a reasonable bit of leeway. You see, the IF for an AM radio is 465 kHz, which means a time of 2 microseconds (2 us) between wavepeaks, but the highest audio frequency we can transmit on the crowded medium wave is 5 kHz, a time of 200 us between peaks. We only have to choose a time-constant which is greater than 2 us and less than 200 us and we're there. In practice, we usually make the time-constant on the small side, and then smooth out the waveform with an additional capacitor (C2 in Fig. 17).

What we have now is a demodulated signal which we can amplify and use to operate a loudspeaker. This signal consists only of positive voltages when the circuit shown in Fig. 17 is used, because of the diode, so that a DC voltmeter connected across C2 would read a positive voltage whenever a signal, *modulated or not* was received. We make use of this DC signal as well. The amplitude of the carrier signal from a radio transmitter, unless the receiver is very close to it, is seldom steady. This is because radio signals are reflected from the ground, from large metal objects and, most important, from a layer of charged particles called the ionosphere (see Fig. 18) well above the Earth's atmosphere (at a height of 30 to 150 miles). Unless you are very close to the transmitter, a fair proportion of the signal that you receive will

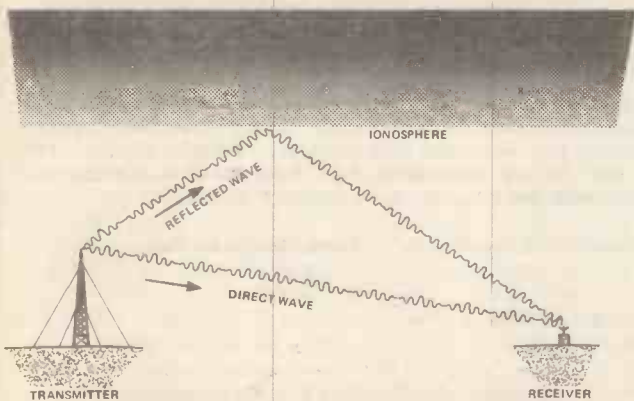


Figure 18. How reflections from the ionosphere cause more than one signal from a given transmitter to reach the receiver (not to scale)

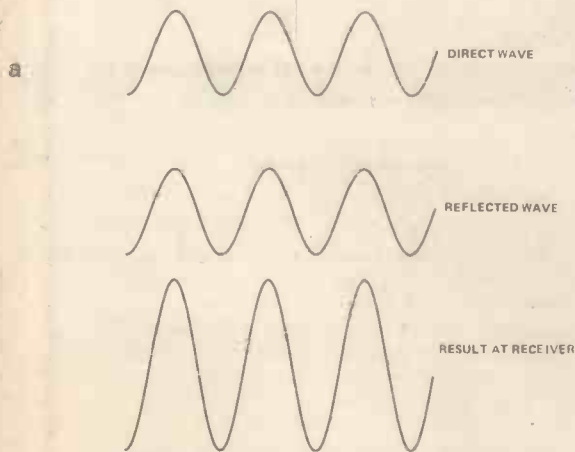
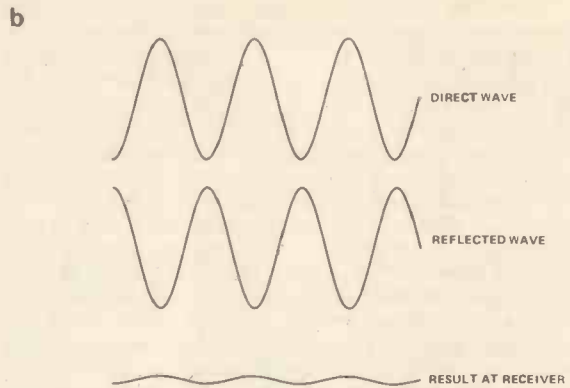


Figure 19. Direct wave and reflected wave add in phase (a), so that the signal at the receiver is stronger than normal. The two waves cancel in antiphase (b above right), so that the signal at the receiver is much weaker than normal



have bounced from this layer, and what reaches the aerial of the receiver depends on how far the reflected wave has travelled. If the reflected and a direct wave (Fig. 19a) from the same transmitter reach the receiver in phase (their peaks coinciding), then the two waves add to give a stronger-than-normal signal. If the reflected wave has to travel just a half a wavelength more or less, however, the waves that reach the receiver will be in *antiphase* (Fig. 19b) and the resulting signal will be much smaller. If the signal wavelength is 300 m, for example, then a half wavelength is 150 m, and the reflected wave would travel this much more or less if the ionosphere moved by just 75 m, which isn't much. Needless to say, the reflecting ionosphere, being a layer around the spinning earth, is continually moving so that the radio signals are continually changing in amplitude.

Automatic Gain Control

This would make the reception of all but the nearest radio stations useless if it were not for that DC voltage at the demodulator! As the signal strength fades, so the DC voltage (which has nothing to do with the modulation, remember) drops, and we can use this DC voltage to control the gain (amplification) of the IF amplifier or amplifiers of the receiver. By doing this we step up the gain when the signal strength is small, and step it down again when the signal strength is high, compensating for the continual changes in strength. Only if you have attempted to listen to a radio in which this feature, called automatic gain control (AGC) has been switched off, can you appreciate how useful it is!

Practical Receiver

Having been over the sections of an AM radio receiver, we need to finish off by looking at the complete circuit. Fig. 20 shows a typical pocket tranny circuit, medium wave only for simplicity, which we can use to illustrate the circuits used.

Inductor L1 is the main tuning-coil wound on the ferrite rod that acts as an aerial. This coil is tuned by the variable capacitor VC2, part of a twin-gang arrangement (indicated by the dotted lines), and by a 'trimmer' capacitor VC1 which is set at the factory. The signal we want to receive will be across the ends of L1, but connecting a circuit to L1 will disturb the tuning so we use a separate winding, L2, of fewer turns than L1. The two windings act like the windings of a transformer so that L2, with fewer turns, has a lower voltage signal than L1, but one which can provide more current into the base of Q1.

Transistor Q1 is the mixer/oscillator. The signal from the ferrite-rod aerial is fed into the base of Q1, along with the DC bias current from R1. The emitter, however, is connected to the coil L4, which is coupled to the coil L3 in the collector circuit. These windings are arranged to provide positive feedback so that Q1 oscillates, and the frequency of oscillation is set by the tuned circuit comprising L4, VC4 and VC3. Variable capacitor VC4 is the other section of the ganged tuning capacitor, and VC3 is another trimmer capacitor, preset so that there is a 465 kHz frequency difference between the input signal and the oscillator frequency all over the range of tuning.

The IF is extracted from the mixture of frequencies by using IFT1, which is tuned to 465 kHz. The secondary winding of the transformer passes the IF signal to Q2, the IF amplifier, biased through R3. A second IF transformer IFT2 keeps the bandwidth

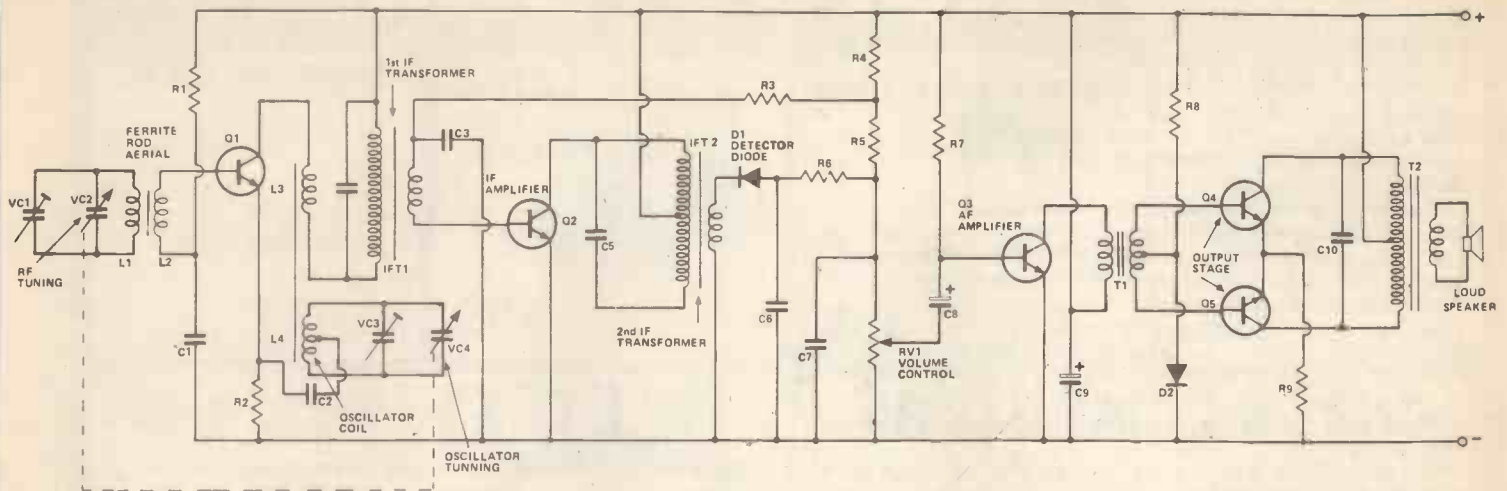


Figure 20. Typical portable transistor radio receiver (medium wave only)

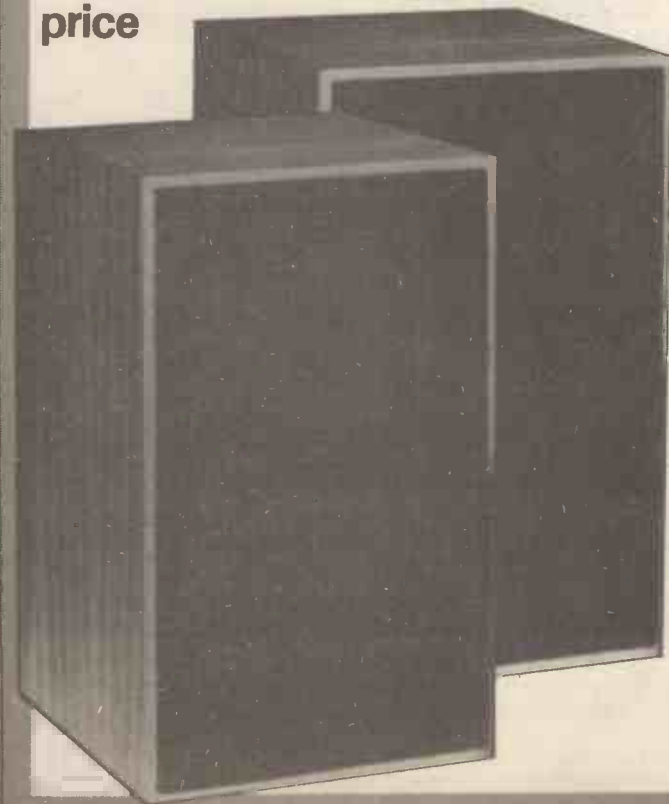
narrow, at about 5 kHz, and its secondary winding provides a signal to the demodulator diode D1. The DC which is present as a result of demodulation (negative in this example, because the anode of D1 is connected to C6) changes the voltage at the point where R3, R4 and R5 join, and so changes the bias on Q2.

Because the gain of a transistor amplifier depends on the amount of current that flows through the transistor, the whole arrangement constitutes a simple form of AGC. Capacitor C3 has a large value and thus removes any traces of audio modulation from the AGC voltage. The rest of the circuit is now plain sailing — a volume control, an output stage, a loudspeaker, and that's your AM radio.

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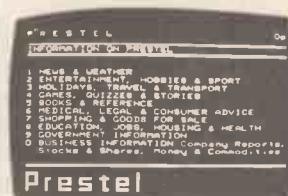
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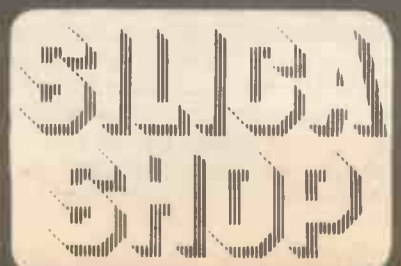
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GGADGETS & GAMES & KITS

Two do-it-yourself kits are featured in this month's GG&K. The first is the Sinclair ZX81 microcomputer – now available in kit form. The second is SoundLink, supplied as two modules from IMP Electronics. When built up, it couples your hi-fi system to an extension speaker – without trailing wires. We also review the Chess Partner 2000 game.

ZX81 Kit Review

In Monitor in the May '81 issue of HE we described the ZX81 microcomputer from Sinclair Research, launched in March as successor to the well-established ZX80.

Although it was said at the time that the ZX81 was available ready-built or as a kit, we had to wait some weeks before one of the first kits was available for review in GG&K.

At last it arrived, complete with mains-plug-mounted power supply. (This power supply is normally only supplied with the ready-built ZX81.)

Contents Of The Kit

The kit comprised separate bags of components (resistors, capacitors, discrete semiconductors and fittings), with the ICs and IC holders plugged into a protective strip of conductive foam plastic. All discrete components came with pre-formed leads, which took the pain out of bending and lining up the leads with the holes in the board.

Component numbers and outlines were clearly printed on the PCB. The underside of the PCB was coated with green solder-resist, which cut down the risk of bridged tracks by confining applied solder to the exposed pads. To aid checking of the layout, a blown-up drawing of the printing on the component side



of the PCB was included on the instruction sheet.

Remaining items in the kit included the case halves, keyboard strip, connecting leads with fitted plugs and operating manual.

Documentation

We found the instruction sheet (fold-out A2-size) easy to follow.

The section on Preparations gave details of where you should build your kit ('... a clean, dry and well lit workspace') and a list of the tools and other items you were likely to

need. Under the heading Precautions you were advised on how to treat your ICs; that is, to be careful to avoid static electricity discharges during handling. Sections on Component Identification, Circuit Board Assembly and Case Assembly were accompanied by some helpful line drawings.

To avoid any confusion, we took the step of adding three component changes given on a separate errata sheet to the main component list.

After reading the instructions carefully (as recommended in bold

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| K107 | 18 BC213L transistors |
| K108 | 8 2N5060 thyristors, 30V 0.8A TO92 case |
| K109 | 15 BC114 transistors |
| K110 | 4 BD131 transistors |
| K111 | 4 BD132 transistors |
| K112 | 12 3A 100V reeds, wire ended |
| K113 | 30 DA002 reeds 150V 0.5A |
| K114 | 15 XK81 16 (B241) transistors |
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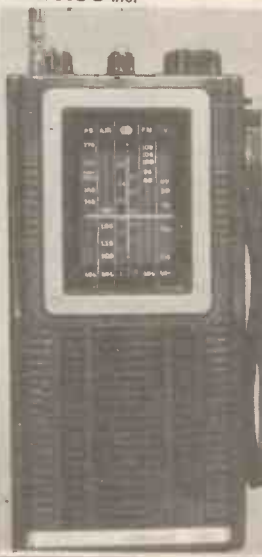
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letters at the top of the sheet) we were ready to start assembly.

Down To Business

In true hobbyist style, the kit was assembled on the kitchen table (within easy reach of a supply of coffee). To aid identification of the components (and to avoid losing any), the small packet of discrete components was tipped into a handy saucer.

After all the resistors had been inserted and soldered (we appreciated those pre-formed leads), it was found that a horizontal-mounting 1k0 resistor had been supplied instead of a vertical-mounting one. With a little improvisation it was found possible to nudge the resistor supplied into the PCB. As a prize, one spare 680R resistor was left in the saucer.

The remainder of the components were inserted into the board and the only problem experienced was with the regulator IC. When its leads were bent as instructed, it didn't line up with the holes in the board. It was necessary to bend the leads very sharply in a zigzag fashion to enable the regulator to be dropped into place, which could result in lead fracture for the unlucky constructor.

As recommended under the instructions for Testing, the board was checked very thoroughly and all components were checked back against the list.

All that remained was to connect the keyboard 'tails' to the edge connectors on the PCB. Some difficulty was found in inserting the narrower of these two tails into its socket, possibly because the socket was slightly distorted. These tails, carrying flat conductive ribbons on thin plastic tapes, are very fragile.

On Test

After three or four hours of soldering and coffee drinking, we considered that the PCB with keyboard attached was ready for testing. Because all the sockets are mounted on the board, it was only necessary to link the PCB to the aerial socket of a TV receiver and to the power supply.

Mains was applied to the power supply and a furtive search was made with the TV tuner to find the signal produced by the modulator mounted on the PCB. Suddenly the picture synchronised and went white — all except for a black letter K in the left-hand corner of the screen. A few tests proved that our kit worked first time.

It was noticed while the PCB was exposed during the test that a fair amount of heat is produced by the ICs. Perhaps this is not surprising



since the specification for the power supply is given as 12 V maximum and about 8 V minimum (depending on smoothing), with current consumption not less than 600 mA. (This increases to 1.2 A if the printer — yet to become available from Sinclair Research — is run from the same supply.)

Tidying Up

The final job was to insert the PCB into its case, stick the keyboard in place (its underside is self-adhesive), link up the keyboard tails again and bolt the whole lot together.

Comment

Construction of the kit shouldn't be too difficult for those of our readers who have already had some experience with PCB construction and who take heed of the special precautions required when handling the ICs.

The penultimate section on the instruction sheet deals with fault-finding, and perhaps the best advice given is to 'check it again' if it doesn't work first time. Sinclair Research Service Department will

repair completed ZX81 kits . . . for a fixed fee of £10. In exceptional cases, say if the ICs have been damaged by being inserted the wrong way round, there may be an additional payment. If the trouble is traced to faulty components then the full service fee is refunded. You can see why there is a need for careful checking!

The only niggle we had with the finished computer was about its keyboard. It is a compromise between a touch-sensitive keyboard and a switch-operated one: definite pressure is required to activate each key but there is no accompanying 'click' or 'bleep'.

On the other hand, at £49.95 for the kit (power supply £8.95 extra) or £69.95 ready-assembled (complete with power supply) there is a limit to what you can expect.

In a future GG&K we will comment on how we found the ZX81 to use and to program. We also hope to review the 16K plug-in RAM memory available for use with the ZX80 and the ZX81. And we hope to try out the printer, scheduled for launch in June 1981.

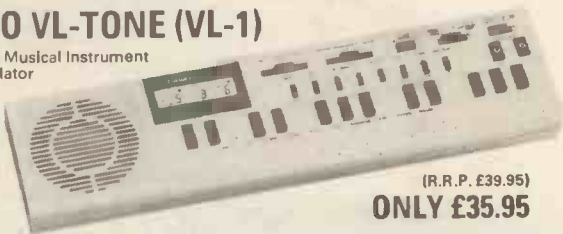
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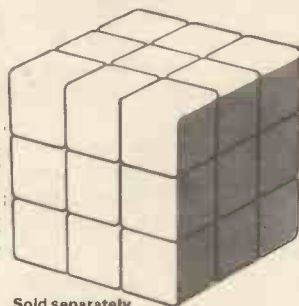
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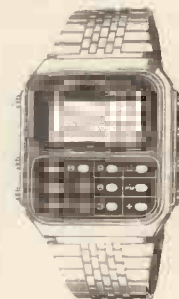
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Extend Your Hi-fi ... Without Wires

Fitting an extension speaker to your hi-fi system can present problems, either because of the need to route wires around the house or because of the electrical connections you must make to the system. With such difficulties in mind we looked at SoundLink, a system which couples your amplifier to an extension speaker through the house's existing 240 V ring main circuit.

Soundlink comes as a kit comprising two ready assembled, pre-aligned printed circuit boards (PCBs), together with detailed layout, wiring and setting up instructions. Additional components are required, however, such as two 240 V/12.0-12 V transformers, switches, potentiometers, sockets, 13 A 3-pin plugs, an extension speaker and so on.

As the two PCBs form two separate units, and it is necessary to make connections to the 240 VAC mains from each, it is essential for safety reasons to house both in suitable boxes. The instructions suggest that the output module can be fitted inside the enclosure of the speaker it is driving, and this can save on outlay.

How It Operates

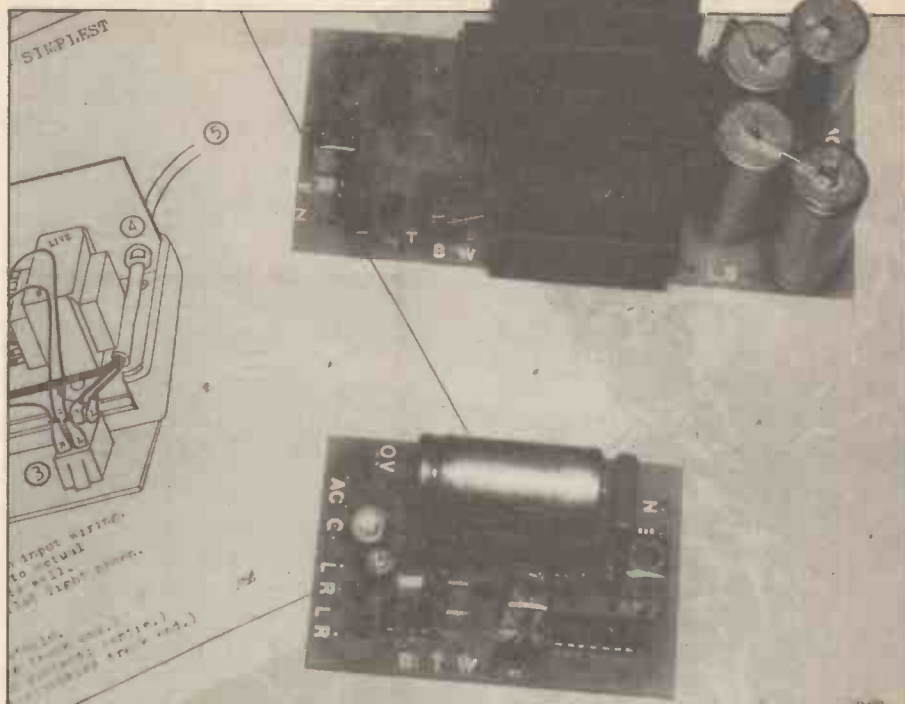
The input module is connected to the 'tape record' socket of an audio amplifier. When the input module is coupled to the AC mains it inserts a low-level high-frequency signal between the neutral and earth lines. The output module, coupled to a distant power point in the house, detects and demodulates this signal and amplifies it to drive the extension speaker. An output power of around 10 W is available from the output module.

How We Assembled It

We built the input module into a case (cost around £4) from Vero Electronics. For the purpose of the test, the output module was mounted on a wooden board, with an aluminium panel fitted on one side. We found the instructions easy to follow and the drawings were of assistance in the layout of components. All connection points were printed clearly on the PCBs.

How It Worked

The SoundLink system was tested on two different hi-fi audio systems. Each amplifier was found to have a different tape output signal voltage. A small sensitivity switch is fitted to the input module PCB and this,



together with the volume control, allowed the correct signal level to be set for each. If the volume control on the input module was advanced too far, then the sound from the extension speaker became distorted. Setting the control too low resulted in excessive background hiss.

It was also found necessary to trim the preset potentiometer on the output module to prevent distortion caused by the unit being de-tuned from the incoming signal. This trimming was critical.

With a good quality record deck as the signal source, and a three-unit, medium-sized enclosure as the extension speaker, the sound output was reasonable though not quite as good as that produced from the directly-coupled speaker. With the volume turned up high on the output module, and in the absence of a signal, a background hiss along with any severe bursts of mains-borne interference (deliberately injected for our tests) could be heard.

Is It Worth The Cost?

The two SoundLink modules cost £45.50, including VAT and post and

packing. As mentioned, it is necessary to buy additional hardware which could, we estimate, add between £10 and £20 to the cost. You have to weigh this against the convenience of being able to site an extension speaker wherever there is a ring main socket in the house. This flexibility has obvious advantages for events such as parties (no leads to trip over) or more permanent installations such as in bedrooms or workshops.

Our test was a critical one, using hi-fi equipment. When a 'bookshelf' loudspeaker, with not quite the dynamic range of the much larger three-unit speaker system, was coupled to the output module the sound produced was very pleasing. It is envisaged that the extension speaker used with SoundLink is likely to be of the bookshelf type.

SoundLink is supplied by IMP Electronics, 34 Caraway Road, Fulbourn, Cambridge CB1 5DU (tel 0223 881105).

Chess Partnership

Here is yet another edition to the Chess Computer family. It is of the larger table-top variety and comes complete with mains adaptor for £77.50.

This innovative machine, called the Chess Partner 2000, works using sensors. This means that the

moves are communicated to the computer by the pressure of the pieces on the squares of the chess-board as you play. The chess pieces for this game are of more or less normal size and have a reasonably attractive finish, as does the board and case.

Among the capabilities of the Chess Partner 2000 are eight levels of skill which can be changed at any point during the game, and a multi-

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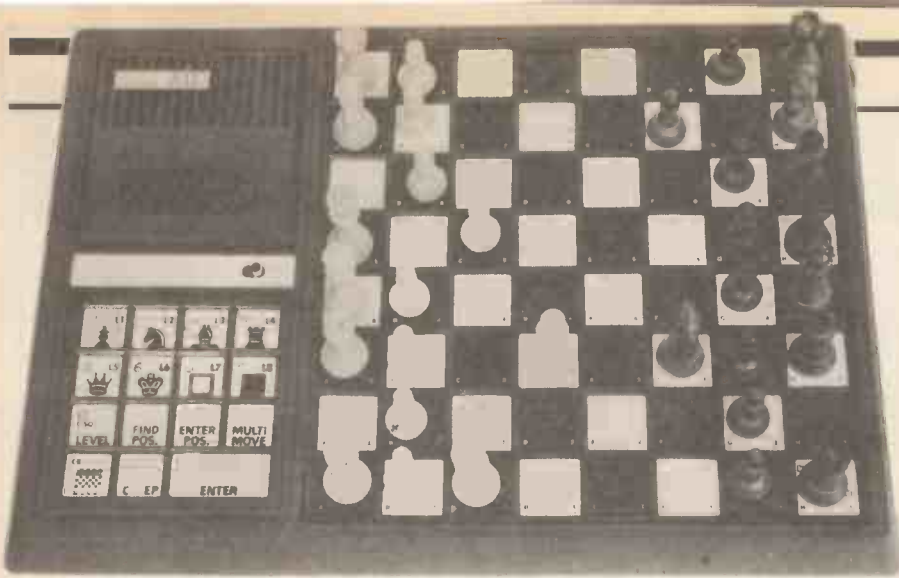
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move key for setting up book openings as well as a simple way of setting up and verifying any position. It will also castle, make en passant captures and will play against itself. Sounds impressive doesn't it? So how does it work?

Setting up the board for a standard game is quite simple: you just press a button and the computer locks in. You then choose your level — if you don't, it will automatically play you on level 1, the simplest level. The first move, being white is yours, so you make it by pressing your piece on its original position until you hear a bleep, and then you

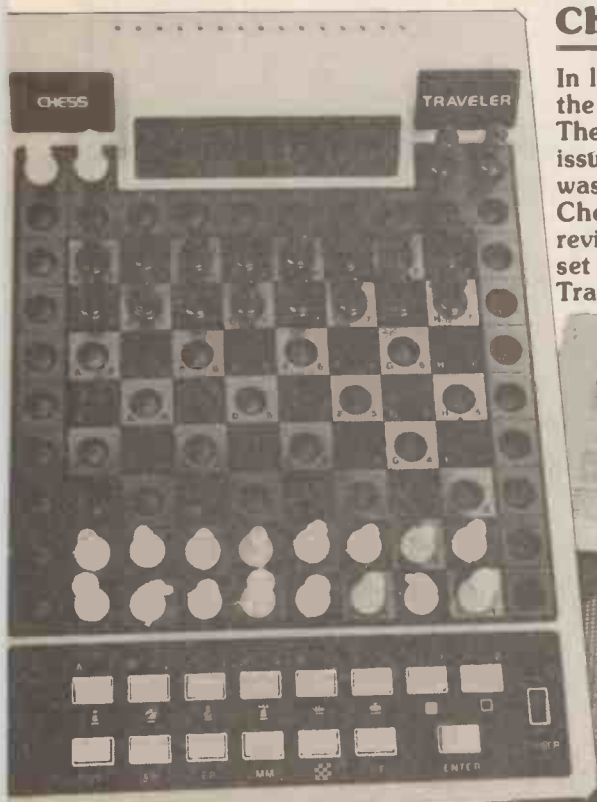
move it, pressing again on the square. When you're satisfied that it's the right move you press ENTER on the keyboard and the computer will display its move. You must carry this out pressing the squares again, but you *don't* press ENTER for the computer's move. This is how it's done. Quite simple, you might think.

The complications set in after the first few moves. When a piece is taken you must press *twice* on the square which the piece has been taken from or chaos ensues, as it will do if you accidentally press ENTER on the computer's move, as

pressing this key also changes the side the computer is playing on! This can be very confusing as the computer doesn't actually display the side it's playing on, on the LED readout.

Castling can be equally as bewildering, as you must press the four squares in exactly the right sequence — the machine will bleep its discontent at you until you do. If you accidentally make an incorrect move you must repeat it backwards to clear the display before you try it again. It is unfortunate that there is no CLEAR ENTRY key, particularly useful when you're making a mess of castling and you feel like throwing the machine against the nearest wall!

In summary, this isn't really the right machine for a beginner, as it is an art in itself to master the idiosyncrasies of the machine before you can even contemplate playing chess with it. However, the fanatical chess-player would find it a great machine once the controls are mastered as it has eight brain-boggling levels to choose from. It is unfortunate that it doesn't have a built-in printer on the machine as, to avoid confusion, it's always useful to have notes of the moves that you are making.



Chess Boob

In last month's GG&K we reviewed the Chess Traveler (see Moves On The Move on page 37 of the June issue). The game shown, though, was not the Chess Traveler but the Chess Partner 2000, which is reviewed in this month's GG&K. To set the record straight, the Chess Traveler is shown below.



Both games are available from Silica Shop Limited, 1-4 The Mews, Hatherley Road, Sidcup, Kent DA14 4DX (tel 01 301 1111 or 01 309 1111).

Coming Kit Review

We received a sample of Adventures With Microelectronics, a kit from Unilab which teaches you about electronic devices and how they are used in circuits.

A quick look in the box and in the accompanying instruction book revealed that you can build a variety of different projects on Bimboard (no soldering required), ranging from simple logic circuits to a medium wave and long wave radio receiver.

We hope to review this kit in the August GG&K supplement.

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AC125	30	BC107C	12	BC174	15	BC550	14	BD201	80	BF164	50	BFR52	25	MPSA06	20	2N708	14	2N2714	22	2N3823	60	
AC126	22	BC108	10	BC175	35	BC556	14	BD202	80	BF165	50	BFR52	25	MPSA06	20	2N709	14	2N2714	22	2N3823	12	
AC128	22	BC108A	11	BC177	14	BC567	13	BD207/202	24	BF167	24	BFR52	25	MPSA06	20	2N711	30	2N2714	22	2N3823	12	
AC128K	37	BC108C	12	BC179	14	BC568	13	M/P	1.70	BF173	24	BFW10	55	ND120	18	2N718	25	2N2714	22	2N3823	12	
AC132	26	BC109	10	BC180	12	BC569	14	BD203	80	BF176	36	BFX29	25	OC19	85	2N718A	40	2N2714	22	2N3823	12	
AC141	26	BC109A	11	BC181	10	BC570	80	BD204	80	BF177	24	BFX30	30	OC20	1.85	2N726	29	2N2714	22	2N3823	12	
AC141K	26	BC109B	11	BC182	10	BC571	85	BD207/204	80	BF178	25	BFX84	24	OC22	1.50	2N727	29	2N2714	22	2N3823	12	
AC142	26	BC109C	12	BC182L	10	BC572	85	M/P	1.70	BF179	30	BFX85	26	OC23	1.35	2N729	29	2N2714	22	2N3823	12	
AC142K	40	BC113	16	BC183	10	BC573	80	BD205	80	BF180	30	BFX86	26	OC24	1.50	2N730	29	2N2714	22	2N3823	12	
AC176	24	BC114	17	BC183L	10	BC574	80	BD206	80	BF181	30	BFX87	26	OC25	1.00	2N732A	40	2N2714	22	2N3823	12	
AC176K	40	BC115	18	BC184	10	BC575	15	BD207	80	BF182	30	BFX88	26	OC26	1.00	2N733	44	2N2714	22	2N3823	12	
AC187	25	BC116	19	BC184L	10	BC576	15	BD208	80	BF183	30	BFX90	55	OC28	95	2N734	46	2N2714	22	2N3823	12	
AC187K	40	BC116A	20	BC185	15	BC577	15	BD222	47	BF184	22	BFY50	20	OC29	95	2N735	46	2N2714	22	2N3823	12	
AC188	25	BC117	20	BC187	18	BC578	15	BD225	47	BF185	22	BFY51	20	OC30	95	2N736	46	2N2714	22	2N3823	12	
AC188K	40	BC118	17	BC207	11	BC579	10	BD232	85	BF186	26	BFY52	20	OC36	90	2N737	46	2N2714	22	2N3823	12	
ACY17	50	BC119	29	BC208	11	BD106	50	BD233	65	BF187	26	BFY53	20	OC41	20	2N738	46	2N2714	22	2N3823	12	
ACY18	50	BC120	35	BC209	12	BD115	50	BD234	55	BF188	32	BFY90	80	OC42	22	2N739	46	2N2714	22	2N3823	12	
ACY19	50	BC126	26	BC212	10	BD116	50	BD235	55	BF194	10	BP19	38	OC44	24	2N740	46	2N2714	22	2N3823	12	
ACY20	50	BC126	26	BC212L	10	BD121	65	BD236	58	BF195	10	BP20	38	OC45	20	2N741	46	2N2714	22	2N3823	12	
ACY21	50	BC132	18	BC213	10	BD123	65	BD238	65	BF196	12	BP19/20	20	OC71	15	2N742	46	2N2714	22	2N3823	12	
AD130	75	BC135	18	BC214	10	BD124	75	BD239A	50	BF199	15	BRY39	39	OC72	24	2N743	46	2N2714	22	2N3823	12	
AD140	70	BC136	20	BC214L	10	BD132	35	BD240A	50	BF199	15	BRY39	39	OC72	24	2N744	46	2N2714	22	2N3823	12	
AD142	85	BC137	20	BC225	26	BD131/132	80	M/P	1.00	BF222	30	BSX20	10	OC75	35	2N745	46	2N2714	22	2N3823	12	
AD143	85	BC138	20	BC226	36	M/P	1.00	BD241	45	BF224	20	BSX21	12	OC76	35	2N746	46	2N2714	22	2N3823	12	
AD143K	85	BC139	20	BC227	13	BD133	40	BD242	45	BF240	45	BSY95A	13	OC79	40	2N747	46	2N2714	22	2N3823	12	
AD161	40	BC140	25	BC238	14	BD135	40	BD243	45	BF241	18	BU105	1.60	OC81	22	2N748	46	2N2714	22	2N3823	12	
AD162	40	BC141	28	BC239	15	BD136	35	BD244	45	BF242	18	BU105/08	1.60	OC82	24	2N749	46	2N2714	22	2N3823	12	
AD161/162	M/P	30	BC142	25	BC251	15	BD137	35	BDX32	2.20	BF257	30	02	1.95	OC82	24	2N750	46	2N2714	22	2N3823	12
AF14	50	BC144	40	BC261	10	BD138	36	BDY11	1.30	BF258	30	MJ480	95	OC82D	30	2N751	46	2N2714	22	2N3823	12	
AF15	50	BC145	46	BC262	10	BD139	36	BDY12	1.80	BF259	35	MJ481	1.05	OC83	30	2N752	46	2N2714	22	2N3823	12	
AF16	50	BC147	09	BC301	28	BD139/140	80	BDY55	1.40	BF263	60	MJ481	1.05	OC83	30	2N753	46	2N2714	22	2N3823	12	
AF17	50	BC148	09	BC302	29	M/P	80	BDY56	1.60	BF270	36	02	2.25	OC139	80	2N754	46	2N2714	22	2N3823	12	
AF18	65	BC149	09	BC303	28	BD155	50	BF115	25	BF271	31	GP300	40	OC169	80	2N755	46	2N2714	22	2N3823	12	
AF124	50	BC150	20	BC304	28	BD175	60	BF117	50	BF273	38	MJ480	95	OC170	80	2N756	46	2N2714	22	2N3823	12	
AF125	50	BC151	22	BC307	13	BD176	68	BF119	75	BF274	38	MJ481	1.05	OC171	80	2N757	46	2N2714	22	2N3823	12	
AF127	50	BC153	25	BC328	13	BD178	68	BF121	90	BF324	34	MJ491	1.15	OC201	46	2N758	46	2N2714	22	2N3823	12	
AF139	50	BC154	19	BC337	13	BD179	75	BF123	60	BF327	34	MJ2955	90	OC202	1.20	2N759	46	2N2714	22	2N3823	12	
AF239	42	BC157	10	BC338	13	BD180	75	BF125	50	BF338	38	MJ340	50	OC203	85	2N760	46	2N2714	22	2N3823	12	
AL102	1.90	BC158	10	BC344	14	BD185	88	BF127	60	BF371	27	MJ370	25	OC204	90	2N761	46	2N2714	22	2N3823	12	
AL103	1.80	BC159	10	BC345	14	BD186	88	BF128	60	BF372	27	MJ370	25	OC204	90	2N762	46	2N2714	22	2N3823	12	
ASV26	50	BC160	26	BC380	10	BD187	75	BF153	25	BF458	37	MJE520	45	R2008B	2.50	2N763	46	2N2714	22	2N3823	12	
ASV27	50	BC161	38	BC460	32	BD188	75	BF154	22	BF459	38	MJE521	65	R2010B	2.60	2N764	46	2N2714	22	2N3823	12	
ASV28	50	BC167	11	BC461	32	BD189	78	BF155	35	BF594	30	MJE2955	90	TC44	29	2N765	46	2N2714	22	2N3823	12	
ASV29	50	BC168	10	BC477	20	BD190	78	BF156	28	BF595	28	MJE3055	85	TC45	35	2N766	46	2N2714	22	2N3823	12	
AU104	1.90	BC169	10	BC478	20	BD195	90	BF157	28	BF596	28	MJE3440	52	TP29	30	2N767	46	2N2714	22	2N3823	12	
AU110	1.90	BC169C	10	BC479	20	BD196	90	BF158	28	BF597	28	MP129A	55	TP29A	35	2N768	46	2N2714	22	2N3823	12	
BC107	10	BC171	09	BC546	10	BD197	95	BF159	28	BF640	25	MPF102	60	TP29B	42	2N769	46	2N2714	22	2N3823	12	
BC107A	11	BC172	09	BC548	10	BD199	99	BF162	24	BF650	25	MPF105	35	TP30	38	2N770	46	2N2714	22	2N3823	12	

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AA230	09	BY100	22	BY210	45	OA91	07
AA231	15	BY101	22	BY211	45	OA91	07
AA217	15	BY105	22	BY212	40	OA95	07
BA102	10	BY114	46	BY219	13	OA182	13
BA102A	20	BY124	22	BY216	41	OA200	08
BA144	09	BY126	11	BY217	36	OA202	08
BA148	15	BY127	12	BY218	36	IN34A	07
BA154	12	BY128	16	BY219	36	IN60	06
BA155	14	BY130	17	OA15	35	IN614	04
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7407	28	7445	90	7494	70	74162	90
7408	28	7446	90	7495	85	74163	90
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7412	22	7451	15	74105	50	74167	2.30
7413	30	7452	15	74107	32	74174	90
7414	50	7453	15	74110	46	74175	85
7416	28	7454	15	74111	60	74176	85
7417	28	7460	15	74118	95	74177	85
7420	14	7470	32	74119	1.20	74180	90
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Building Site

Keith Brindley gives more hints and tips on project construction

A QUICK LOOK at the projects in any issue of HE will show you that a project can be in one of two groups: mains- or battery-operated. A small project, such as this month's Ultrasound Burglar Alarm or the Treble Booster, requires only a low-voltage, small-current supply, and a battery is an ideal power source. On the other hand large projects, such as the Power Amplifier or the Organ, require a relatively high-voltage, large-current power supply and usually the only way to provide this is through the use of mains electricity.

Used properly, mains allows a convenient and, in the long run, cheap source of power — you don't need to keep changing batteries every so often. But, I'm sure I don't need to stress that, *handled incorrectly*, mains can be dangerous — *it can kill!* Whenever you use mains, the moral is to use it carefully and correctly.

Getting It In

One of the places where a problem can arise is the point where the mains cable gets into the project — normally through a drilled hole in the back panel of the case. Cable should never be allowed to go through an unprotected hole, because the sharp edges of the hole will rub against the cable and, through time, will cut the cable's insulation until the inside mains-carrying wires become exposed. At best, a fuse will blow but at worst, *part or all of the project will become live.*

Various methods of protecting the cable at this point exist and I've selected a few for you to look at. The simplest (and cheapest!) is a rubber grommet (see Fig. 1) which pushes into the drilled hole before you feed the cable through. To prevent the cable from being pulled out, fasten a plastic cable tie tightly round it.

Secure And Safe

Plastic strain relief bushes, clamps or glands such as those

shown in Figs. 2, 3 and 4 are available which clamp the cable securely while simultaneously preventing rubbing. The sort shown in Fig. 2 are very cheap — only a few pence each — but are quite fiddly to use. They nevertheless do their job well. The bush is in two parts connected by a thin plastic tie. The two parts are clamped together, with a cable in between, and the bush is pushed into the drilled hole. The outside ridge of the bush engages with the inside edge of the hole and the bush is then securely held.

Figure 3 shows a slightly more expensive (but still costing no more than about 20p) device which is operated by a screw-adjusted clamp. We've used this in the Power Amplifier this month and it is a very successful and safe method. The beauty of it is that if you need to disconnect or adjust the mains cable you can do so easily.

Another type of cable clamp (about 30p per device) is shown in Fig. 4. This is a plastic gland with a compressible rubber washer inside. At one end of the gland is a nut and bolt arrangement which fastens to the panel of the project. At the other end is a similar nut and bolt which tightens the internal rubber washer onto the cable (which goes through the middle of the gland). This variety again allows you to remove or adjust the cable if you wish.

Finally, if you feel like doing the job professionally, you can use a plug and socket arrangement such as that shown in Fig. 5. Inevitably, the cost is higher — over £1 for the two parts. This method is useful if you have a number of items of test equipment and you only use a couple at a time. Because any mains lead with the socket on can fit into any chassis plug, you only need a couple of made-up leads.

Well, that's given you a few tips on how to do it properly, and above all, *safely*. I'll be giving some more advice on mains, in future Building Sites, but that's all for now. See you next month.

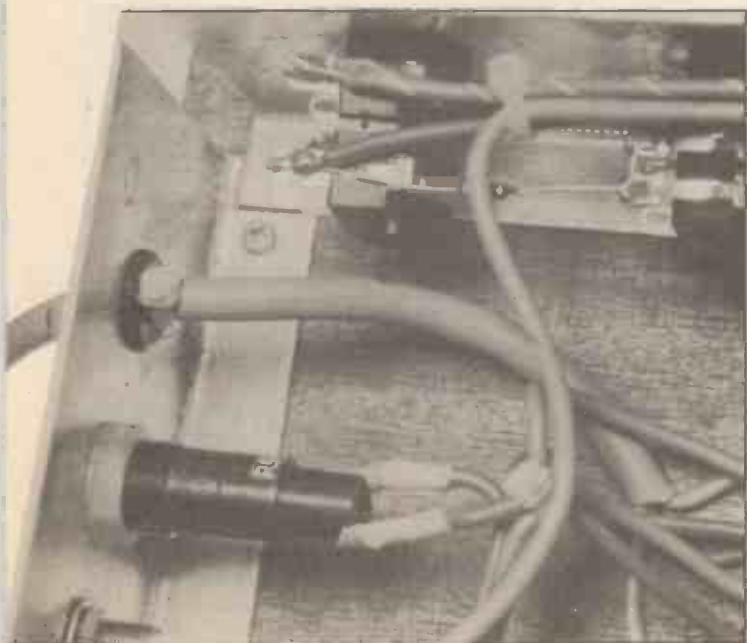


Figure 1. A rubber grommet used in the HE Electronic Organ. Note the plastic cable tie used to prevent the cable from being pulled out

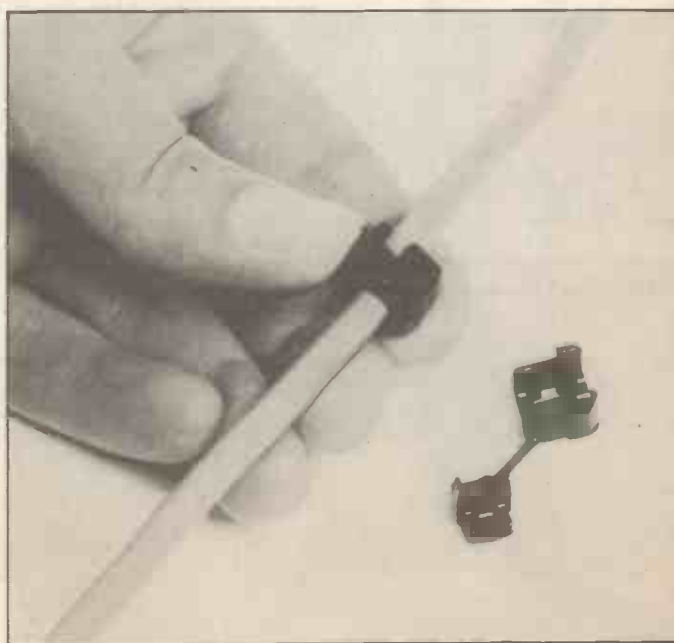


Figure 2. Two-part cable bushes. Once pushed into the drilled hole of a case, these bushes hold the cable securely

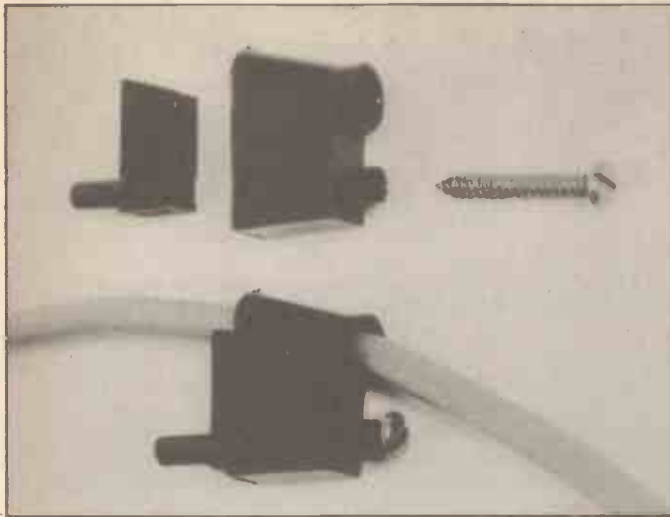


Figure 3. Screw operated cable clamps



Figure 4. Cable glands. The cable is tightly held by a compressible rubber washer inside the gland body

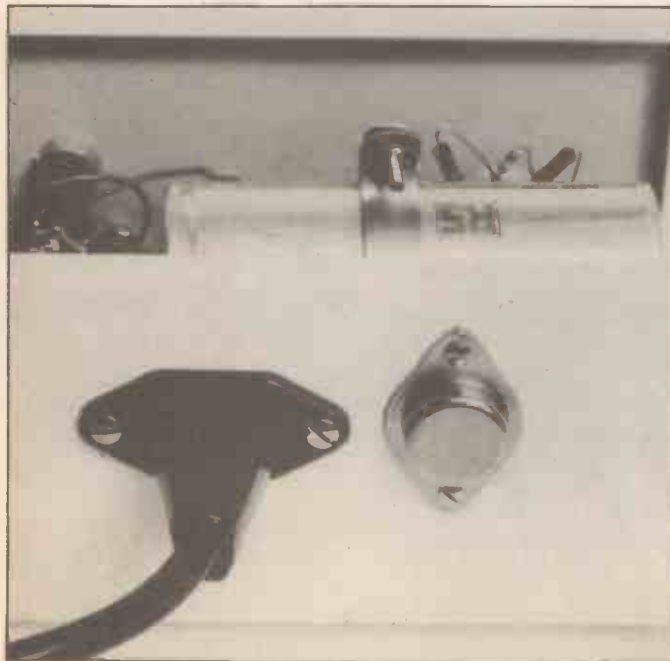


Figure 5. A mains plug and socket connector

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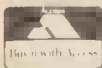
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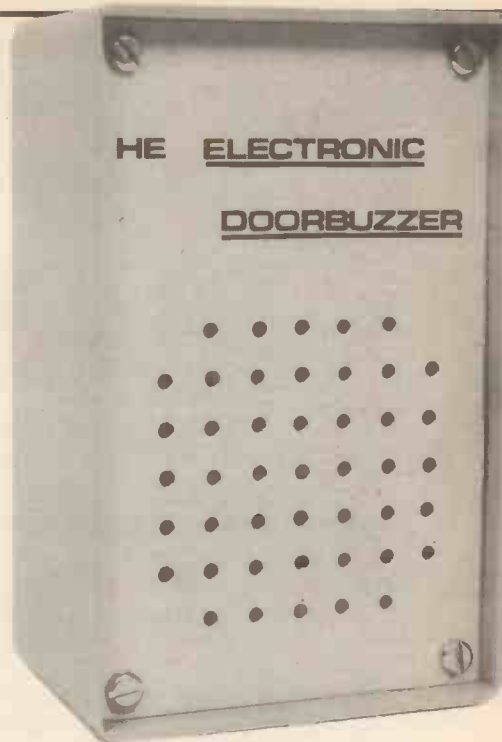
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Veroboard 0.1" copper
10 strips, 24 holes £1.20 per 5. 24S 37H 78p. 24S 50H 89p. 36S 37H 89p. 36S 50H 99p. Terminal pins 49p/100. Pin insertion tool £1.69. Spot face cutter £1.23.

Electronic Doorbuzzer



This easily-built project for the home is an ideal alternative to the more expensive, commercially available door-chimes. Build it and it'll provide you and your visitors with a tremendous conversation piece!

ALTHOUGH AT FIRST sight an electronic doorbuzzer may seem to have no advantages over electromagnetic types, it will probably be more reliable and longer lasting. A further advantage is that you can build it yourself at low cost. Our electronic doorbuzzer produces a warbling tone that is quite attention-catching, but should not prove to be objectionable to other members of the household! For simplicity of construction and installation the HE Electronic Doorbuzzer is battery-powered, and a PP3-size battery should have virtually its shelf life (typically about six months or more) within the project.

Construction

Start construction with the Veroboard by cutting the tracks underneath the board, where shown in Fig. 2. Use a cutting-tool or a small ($\frac{1}{8}$ ") hand-held drill bit for this job. Hold the cutting edge onto the hole in question. Press gently and then rotate the tool or bit clockwise, until the copper track has broken in a clean-edged circle. Make sure no loose pieces of copper swarf bridge across to adjacent tracks.

Insert and solder all resistors and capacitors in the positions indicated in Fig. 2. Now solder in the IC socket, if you intend to use one, and transistor Q1. Push fit the IC into its socket (or solder it into the board).

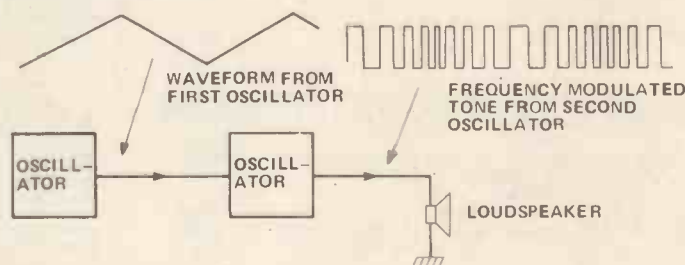
Following the connection details of the project, wire-up the board into its box.

Glue the speaker to the rear of the front panel of the box, behind a grille of some kind. This can be a cutout with a piece of speaker fret fitted behind it, or a simpler solution is to drill a neat matrix of small holes. Make sure you don't get any glue on the speaker cone itself — only on the outside rim.

The hole for the lead to the bell push must be made in the casing, and it is a

How It Works

The circuit is based on two oscillators, one of which is used to produce the tone which is fed to the loudspeaker. The other is used to frequency-modulate the tone generator, and it is this variation in pitch that gives the warbling effect.



Integrated circuit IC1 is used as the basis of the tone generator, and it is a standard 555 used as a free-running oscillator. Capacitor C4 charges to about $\frac{2}{3}$ of the supply voltage via R5 and R6, and then discharges down to approximately $\frac{1}{3}$ supply by way of R6 and IC1. This process repeats indefinitely, with the main output at pin 3 of IC1 going high while C4 is charging, and low while it is discharging. The waveform produced here is fed to a loudspeaker which consequently emits an audio tone.

The $\frac{2}{3}$ supply voltage threshold at which C4 starts to discharge is modified by applying a control voltage to pin 5 of IC1. When this voltage increases the charge and discharge times of C4 are lengthened, giving decreased operating frequency. As the voltage reduces the charge and discharge times of C4 also reduce, so that a higher operating frequency results. The tone produced by the second generator is therefore frequency-modulated by means of a control voltage applied to IC1 pin 5.

The warbling effect is obtained by using a control voltage that rises and falls a few times per second. The character of the output signal depends to a large extent on the waveshape of the modulating signal, and a waveform similar to a sawtooth is used in this circuit. This is of the type that rises fairly steadily in voltage and then suddenly falls back to its minimum level. This actually gives a steady decline in output frequency followed by a rapid return to the initial frequency although this action occurs too rapidly to be clearly heard, and a pleasant warbling effect is produced.

A unijunction relaxation oscillator is used to generate the modulating signal. Capacitor C2 charges through resistor R3 until a charge voltage of about 7 V is achieved, whereupon C2 rapidly discharges through Q1 and R2. Transistor Q1 then switches off, C2 commences to charge once again, and so on. R4 couples the output of Q1 to pin 5 of IC1.

good idea to fit this with a small grommet which gives a neat finish and protects the lead.

Finally, mount the case securely to the wall where it is required, and wire it to the bell push.

Parts List

RESISTORS (All 1/4W, 5%)

- R1,R2 100R
- R3,R5 10k
- R4 27k
- R6 82k

CAPACITORS

- C1,3 100u, 10 V electrolytic
- C2 4u7, 25 V electrolytic
- C4 22n polyester

SEMICONDUCTORS

- IC1 555 timer
- Q1 2N2646 unijunction transistor

MISCELLANEOUS

- LS1 miniature 40-80R loudspeaker
- Veroboard 24 hole x 10 strip, 0.1" matrix
- Case to suit
- PP3-size battery + clip
- Bell push and connecting cable

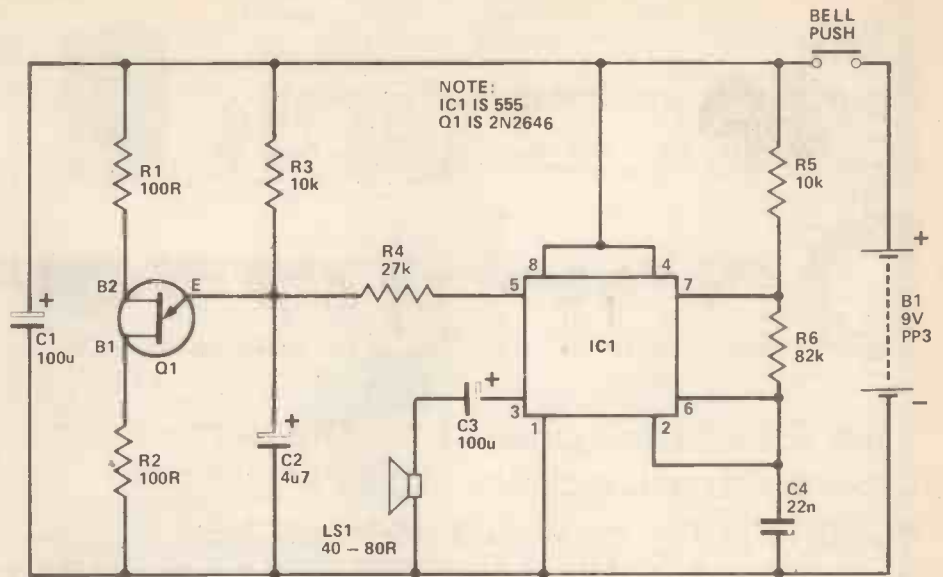


Figure 1. Circuit of the HE Electronic Doorbuzzer

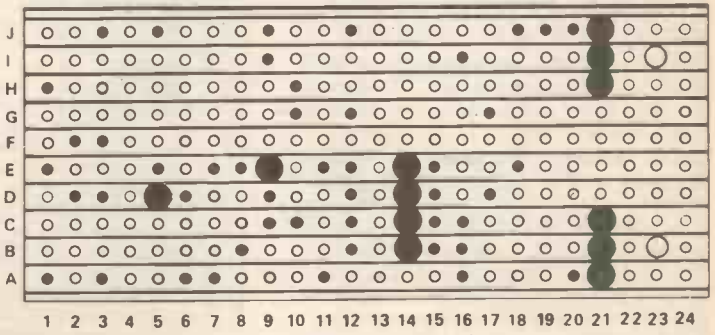
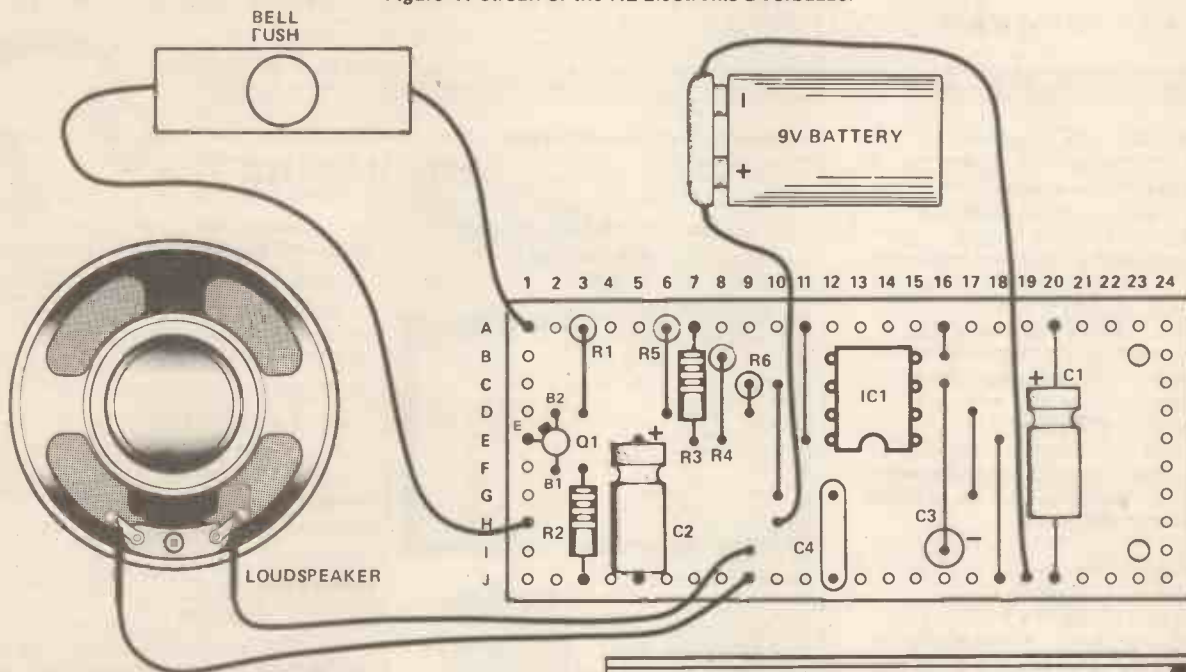


Figure 2. Veroboard overlay, underside track breaks and component locations, and connection details

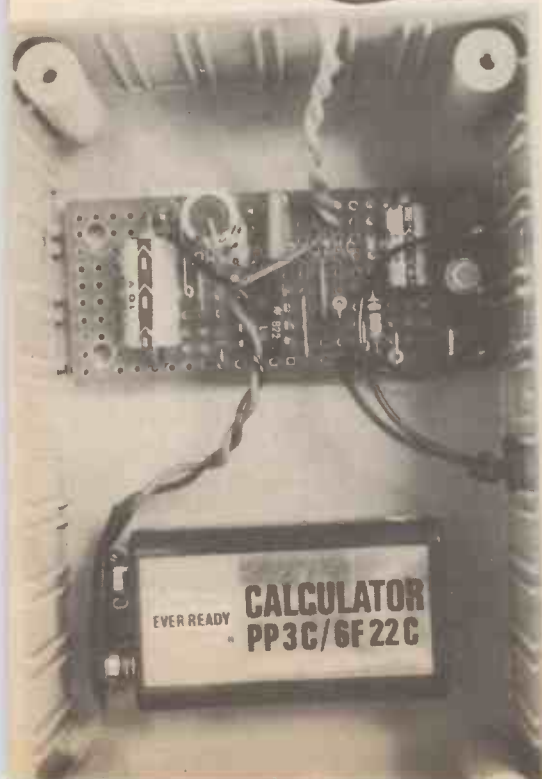
HE

Buylines

The loudspeaker can be of any variety having an impedance between about 40 and 80R (low impedance types are not recommended), and types with a large-diameter cone are best if greater volume

is required. The other components are all standard, readily available types.

Cost of all parts (excluding case and Veroboard) is approximately £4.



FREE OUR CURRENT BARGAIN LIST WILL BE ENCLOSED WITH ALL ORDERS.

TRANSMITTER SURVEILLANCE*

Tiny, easily hidden but which will enable conversation to be picked up with FM radio. Can be made in a matchbox - all electronic parts and circuit. **£2.30.**

RADIO MIKE*

Ideal for discos and garden parties, allows complete freedom of movement. Play through FM radio or tuner amp. **£6.90 comp. kit.**

SAFE BLOCK

Mains quick connector will save you valuable time. Features include quick spring connectors, heavy plastic case and auto on and off switch. Complete kit. **£1.95.**

LIGHT CHASER

Gives a brilliant display - a psychedelic light show for discos, parties and pop groups. These have three modes of flashing, two chase patterns and a strobe effect. Total output power 750 watts per channel. Complete kit. Price **£16.** Ready made up **£4 extra.**

FISH BITE INDICATOR

Enables anglers to set up several lines then sit down and read a book. As soon as one has a bite the loudspeaker emits a shrill note. Kit. Price **£4.90.**

6 WAVEBAND SHORTWAVE RADIO KIT

Bandspread covering 13.5 to 32 metres. Based on circuit which appeared in a recent issue of Radio Constructor. Complete kit includes case materials, six transistors, and diodes, condensers, resistors, inductors, switches, etc. Nothing else to buy if you have an amplifier to connect it to or a pair of high resistance headphones. Price **£11.95.**

SHORT WAVE CRYSTAL RADIO

All the parts to make up the beginner's model. Price **£2.30.** Crystal earpiece 65p. High resistance headphones (gives best results) **£3.75.** Kit includes chassis and front but not case.

RADIO STETHOSCOPE

Easy to fault find - start at the aerial and work towards the speaker - when signal stops you have found the fault. Complete kit **£4.95.**

INTERRUPTED BEAM

This kit enables you to make a switch that will trigger when a steady beam of infra-red or ordinary light is broken. Main components - relay, photo transistor, resistors and caps etc. Circuit diagram but no case. Price **£2.30.**

OUR CAR STARTER AND CHARGER KIT

has no doubt saved many motorists from embarrassment in an emergency you can start car off mains or bring your battery up to full charge in a couple of hours. The kit comprises: 250W mains transformer, two 10 amp bridge rectifiers, start/charge switch and full instructions. You can assemble this in the evening, box it up or leave it on the shelf in the garage, whichever suits you best. Price **£11.50 + £2.50 post.**

GPO HIGH GAIN AMP/SIGNAL TRACER.

In case measuring only 5 1/2in x 3 1/2in x 1 1/2in is an extremely high gain (70dB) solid state amplifier designed for use as a signal tracer on GPO cables, etc. With a radio it functions very well as a signal tracer. By connecting a simple coil to the input socket a useful mains cable tracer can be made. Runs on standard 4.5v battery and has input, output sockets and on-off volume control, mounted flush on the top. Many other uses include general purpose amp, curing amp, etc. An absolute bargain at only **£1.85.** Suitable 80ohm earpiece 65p.

NEW KIT THIS MONTH!

CB RADIO - Listen in with our 40-channel monitor. Unique design ensures that you do not miss sender or caller. Complete kit with case and instructions only **£5.99.**

8 POWERFUL BATTERY MOTORS

For models, Meccanos, drills, remote control planes, boats etc. **£2.50.**

WATERPROOF HEATING WIRE

60 ohms per yard, this is a heating element wound on a fibre glass coil and then covered with p.v.c. Dozens of uses - around water pipes, under grow boxes in gloves and socks. **23p per metre.**

COMPONENT BOARD Ref. W0998

This is a modern fibreglass board which contains a multitude of very useful parts, most important of which are: 35 assorted diodes and rectifiers including 4 3amp 400v types (made up in a bridge) 8 transistors type 8C107 and 2 type BFY-51 electrolytic condensers, SCR ref 2N 5062, 250uF 100v DC and 100uF 25v DC and over 100 other parts including variable, fixed and wire wound resistors, electrolytic and other condensers. A real snip at **£1.15.**

FRUIT MACHINE HEART. 4 wheels with all fruits, motorised and with solenoids for stopping the wheels with a little ingenuity you can defy your friends getting the "jackpot". **£9.95 + £4 carriage.**

4-CORE FLEX CABLE

White pvc for telephone extensions, disco lights, etc. 10 metres **£2.** 100 metres **£15.** Other multicore cable in stock.

MUGGER DETERRENT

A high-note bleeper, push latching switch, plastic case and battery connector. Will scare away any villain and bring help. **£2.50** complete kit.

EXTRACTOR FANS - Mains Voltage

Ex-computer, made by Woods of Colchester, ideal as blower; central heating systems, fume extraction etc. Easy fixing through panel, very powerful 2,500 rpm but quiet running. Choice of 2 sizes: 5" **£5.50.** 6" **£6.50.** post **£1** per fan.

KEYBOARD BARGAIN

50 computer type keys, together with 5 miniature toggle switches, all mounted on a p.c.b. together with 12 i.c.'s and many transistors and other parts, in a case but the case may be cracked or otherwise damaged.

£11.50 + £2 post. This is far less than the value of the switches alone. Diagram of this keyboard is included if you request it, or it is available separately. Price: **£1.**

* (Not licenceable in the U.K.)

SUPER HI-FI SPEAKER CABINETS

Made for an expensive HI-FI outfit - will suit any decor. Resonance free cut-outs for 8" woofer and 4" tweeter. The front material is carved Dacron, which is thick and does not need to be stuck in and the completed unit is most pleasing. Colour black. Supplied in pairs, price **£6.90** per pair (this is probably less than the original cost of one cabinet) carriage **£3.50** the pair.



Vu METER SNIP.

Approximately 1 5/8" square, suitable for use as a recording level meter power output indicator or many similar applications. Full vision front, cover easily removable if you wish to alter the scale. Special snip price **£1.00**, or 10 for **£9.00.**



MOTORIZED DISCO SWITCH

With 10 amp changeover switches. Multi-adjustable switches all rated at 10 amps, this would provide a magnificent display. For mains operated 8 switch model **£6.25.** 10 switch model **£6.75.** 12 switch model **£7.25.**

3 CHANNEL SOUND TO LIGHT KIT

Complete kit of parts for a three-channel sound to light unit controlling over 2000 watts of lighting. Use this at home if you wish but it is plenty rugged enough for disco work. The unit is housed in an attractive two-tone metal case and has controls for each channel, and a master on/off. The audio input and output are by 1/4" sockets and three panel mounting fuse holders provide thyristor protection. A four-pin plug and socket facilitate ease of connecting lamps. Special snip price is **£14.95** in kit form or **£19.95** assembled and tested.



FLUORESCENT TUBE INVERTER

For camping - car repairing - emergency lighting from a 12v battery you can't beat fluorescent lighting. It will offer plenty of well distributed light and is economical. We offer Phillips inverter for 12" 8 watt miniature tube for only **£5.25.** (With tube and tube holders as well.)



THIS MONTH'S SNIP

1/2 PRICE CABLES! Flat P.V.C. covered mains cables - for lighting and power installations.

SIZE	TYPE	100 Metres	CARRIAGE
1.5mm	Single	£ 3.95	£2.00
1.5mm	Flat twin	£ 6.50	£2.50
1.5mm	Flat three core & E	£ 9.85	£3.00
6mm	Single	£ 7.50	£2.50
4mm	Flat twin	£11.50	£3.50
6mm	Flat three core	£34.50	£4.50
16mm	Twin & E	£65 + £9.75	£10.00

12v MOTOR BY SMITHS

Made for use in cars, these are series wound and they become more powerful as load increases - they will in fact burn themselves out if overloaded to stopping point. Size 3 1/2" long by 3" dia. These have a good length of 1/4" spindle - price **£4.45.** Ditto, but double ended **£4.25.**



SOLENOID WITH PLUNGER

Mains operated **£1.99** 10 - 12 volts DC operated **£1.50.**

MINI-MULTI TESTER Deluxe pocket size precision moving coil instrument. Jewelled bearings - 2000 o.p.v. mirrored scale. 11 instant range measures: DC volts 10, 50, 250, 1000. AC volts 10, 50, 250, 1000. DC amps 0 - 100 mA.



Continuity and resistance 0 - 1 meg ohms in two ranges. Complete with test prods and instruction book showing how to measure capacity and inductance as well. Unbelievable value at only **£6.75 + 50p post and insurance.**

FREE Amps range kit to enable you to read DC current from 0 - 10 amps, directly on the 0 - 10 scale. It's free if you purchase quickly, but if you already own a Mini-Tester and would like one, send **£2.50.**

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 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 **£16.75** including VAT and post. **FREE GIFT** - buy this month and you will receive a pair of Goodman's elliptical 8"x5" speakers to match this amplifier.



VENNER TIME SWITCH

Mains operated with 20 amp switch, one on and one off per 24 hrs. repeats daily automatically correcting for the lengthening or shortening day. An expensive time switch but you can have it for only **£2.95.** These are new but without case, but we can supply plastic cases (base and cover) **£1.75** or metal case with window **£2.95.** Also available is adaptor kit to convert this into a normal 24hr. time switch but with the added advantage of up to 12 on/off per 24hrs. This makes an ideal controller for the Immersion heater. Price of adaptor kit is **£2.30.**



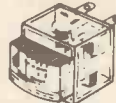
DELAY SWITCH

Mains operated - delay can be accurately set with pointers knob for periods of up to 2 1/2 hrs. 2 contacts suitable to switch 10 amps - second contact opens a few minutes after 1st contact. **£1.95.**



LEVEL METER

Size approximately 1 1/2" square, scaled signal and power but cover easily removable for rescaling. Sensitivity 200 uA. **75p.**



STEREO HEADPHONES

Japanese made so very good quality. 8 ohm impedance, padded, terminating with standard 1/4" Jack-plug. **£2.99** Post 60p.



BRIDGE RECTIFIER

1 amp 400v 30c each. 10 for **£2.50.** 100 for **£20.00**

BURGLAR ALARM CONTROL PANEL

Contains labelled connection block, latching relay, test switch and removable key control switch. Simplifies the whole installation, all you have to do is to take wires to pressure pads and to alarm bell. Price **£7.95**, with complete diagram.

PRECISION MAINS OPERATED CLOCK

For only **£1.99.** Sounds unbelievable but that's what you can have if you send your order right away. The clocks which have large clear dials were made by the famous Smiths Company for use with domestic cooker/switch, brand new and guaranteed.

12V SUBMERSIBLE PUMP

Just join it to your car battery, drop it into the liquid to be moved and up it comes, no messing about, no priming, etc. and you get a very good head. Suitable for water, paraffin and any non-explosive non-corrosive liquid. One use if you are a camper, make yourself a shower. Price: **£8.50.**

POPULAR SNIP - STILL AVAILABLE

And it still carries a free gift of a desoldering pump, which we are currently selling at **£6.35.** The snip is perhaps the most useful breakdown parcel we have ever offered. It is a parcel of 50 nearly all different computer panels containing parts which must have cost at least **£500.** On these boards you will find over 300 IC's, Over 300 diodes, over 200 transistors and several thousand other parts, resistors, condensers, multi-turn pots, resistors, SCR, etc. If you act promptly, you can have this parcel for only **£8.50**, which when you deduct the value of the desoldering pump, works out to just a little over 4p per panel. Surely this is a bargain you should not miss! When ordering please add **£2.50** post and **£1.27** VAT.

MAINS MOTORS Precision made as used in record players, blow heaters, etc.

Speed usually 1,400. All have ample spindle length for coupling fan blade, pulley, etc. Power depends on stack size. 5/8" stack **£2.00;** 3/4" stack **£2.50;** 7/8" stack **£3.00;** 1" stack **£3.50;** 1 1/4" stack **£4.50.** Add 25% to motor cost to cover postage, and then add 15% VAT.

YOUR LAST CHANCE FOR THIS BARGAIN

100 twist drills, regular tool shop price over **£50**, yours for only **£11.50.** With these you will be able to drill metal, wood, plastic, etc. from the tiniest holes in P.C.B. right up to about 1/4". Don't miss this snip - send your order today.

MINI MONO AMP on p.c.b., size 4" x 2" approx. Fitted volume control and a hole for a tone control should you require it. The amplifier has three transistors and we estimate the output to be 1 W rms.

More technical data will be included with the amplifier. Brand new, perfect condition, offered at the very low price of **£1.15** each, or 10 for **£10.00.**



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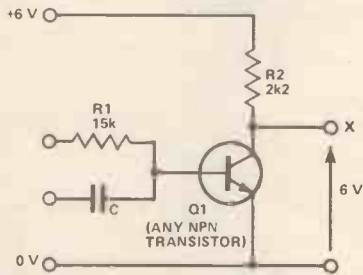
0 Level Q&A

This month Nick Walton rounds off the series with a look at multivibrators and the storage of information in various ways, chiefly on disc and tape

MULTIVIBRATORS ARE A FAMILY of circuits whose importance has been much enhanced by the 'digital explosion' — that is, the huge increase in the use of electronic calculators, computers of all sizes and digital watches, all of which use the transistor as a switch and not as an amplifier. Hopefully when you have read this section you will begin to see why.

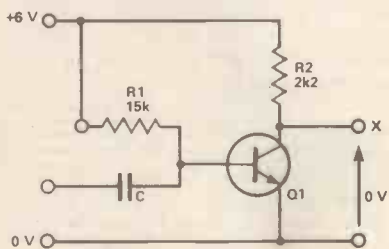
Let us begin by looking at how we can use a very simple transistor circuit to produce a single pulse. Consider Fig. 1, which is similar to a circuit we saw in our study of amplifiers in the May 1981 issue of HE, but now we are only interested in whether the transistor is conducting or not, ie whether it is switched on (by supplying base current) or switched off (by absence of base current). We did not actually have the capacitor there before but we shall need it in a moment.

Figure 1. Basic transistor circuit. (Transistor not conducting and X is at 6 V)



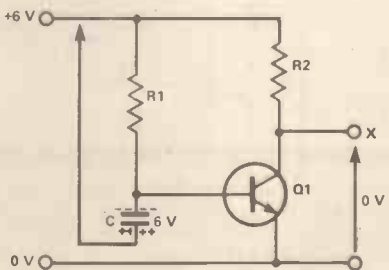
In Fig. 1 nothing much is happening. The transistor is not conducting because no base current is being provided, so just about all the supply voltage of 6 V is dropped across the transistor and so the potential at the point X is 6 V. When we get to Fig. 2 the resistor R1 on the base of Q1 has been

Figure 2. Transistor conducting. (X is at 0 V)



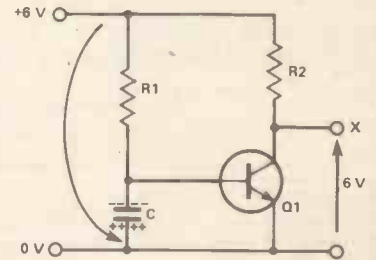
connected to the positive supply line, base current is provided and the transistor is switched on. As a result 6 V is dropped across R2 and the potential at X is just about 0 V. In Fig. 3 much the same is happening but we have connected the capacitor to the positive line as shown so it charges up to 6 V. Notice which way round it is — the positive charge is on the lower of its two plates. Incidentally, we have also turned R1 round through a right angle but the transistor doesn't notice that.

Figure 3. As Fig. 2 but capacitor C1 is charging up



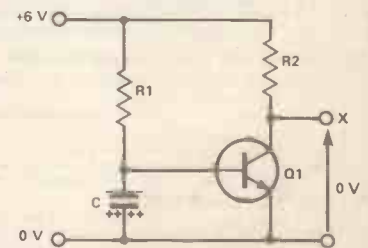
The next thing to do is to change the connection of the capacitor from the positive supply line to the zero line as

Figure 4. Situation immediately the lower (positive) end of C is taken from the +6 V line to the 0 V line. C is conducting as if it were a short circuit



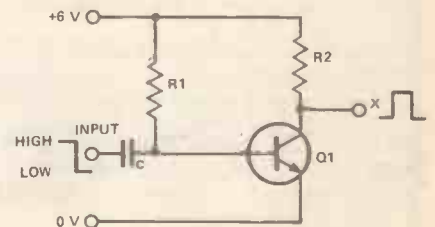
shown in Fig. 4. To begin with the capacitor conducts so easily that the current prefers to flow down to the zero line through it, rather than through the transistor. You see, a transistor will not conduct until there is about 0.5 V between its base and emitter, and initially the capacitor is letting current pass as though it were effectively a short circuit; so there won't be as much as 0.5 V across the transistor's base-emitter junction. But the charge soon builds up on the capacitor plates as shown in Fig. 5 (opposite to before), the transistor will once again conduct and the voltage at X will return to zero. This little cycle of operations can be summarised by saying that the act of changing the capacitor connection from high to low voltage will make the voltage of point X go from low to high and back to low again. This is

Figure 5. Base current is now provided again, Q1 conducts, and X goes to 0 V



what Fig. 6 is showing. The input voltage pattern is sometimes called a negative going edge because it starts high and goes down (negatively) to zero.

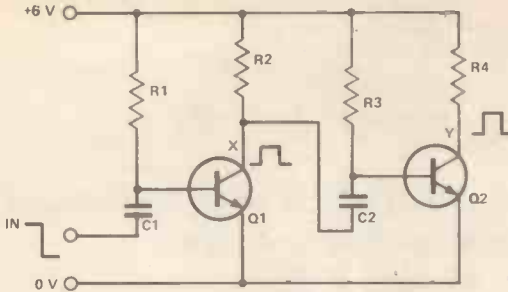
Figure 6. The high-to-low input pattern gives rise to the X output pattern of low-high-low



Around We Go

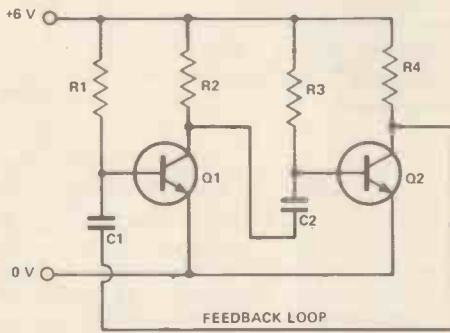
Now comes the clever bit. Notice that the output voltage pattern contains its own built-in negative edge (it finishes high to low) so we could use this to initiate the same thing on another stage. This idea is put into practice in Fig. 7. The two stages are connected together via the capacitor and the negative edge applied at the input on the far left triggers off a pulse at X whose own negative edge triggers off a similar pulse at Y. Actually you could have a string of these stages, one passing a pulse along to the next — like knocking down a row of dominoes. You could also feed the pulse you get from Y back to the original input and that would activate a pulse at X again which would give you a pulse at Y which would produce another at X and so on till you switch off or get fed up — or both. This is shown in Fig. 8, with the feedback loop

Figure 7. Production of two pulses, one after the other by the same input pattern as Fig. 6



coming round and down below the 0 V supply line and up to C1. Figure 9 shows how the circuit is usually drawn. Check

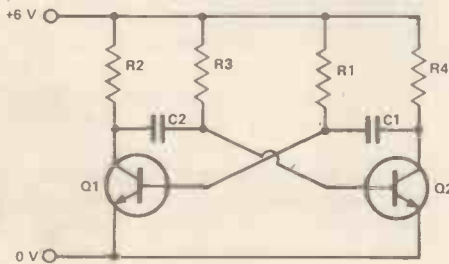
Figure 8. The arrangement whereby the pulse from Q2 is fed back to the input of Q1



carefully for yourself that Fig. 9 is, in fact, exactly the same as Fig. 8. (I bet you never knew that there were right-handed and left-handed transistors!) The speed at which the pulses get passed round the circuit depends on the rate at which the capacitors change their voltage, and that in turn depends on the capacitance and the resistance values in the circuit. You can have a pretty wide variation in pulse rate, from one every few seconds to hundreds of thousands per second. So this pulsing multivibrator finds application wherever you need a series of pulses (eg, in computers and calculators where the operations are initiated by pulses).

The kind of multivibrator we have just looked at is called

Figure 9. The usual representation of the circuit of Fig. 8



an astable multivibrator; that is, it has no stable state but just keeps pulsing to and fro. The astable has a close relation called a bistable which is a device that is stable in either of two states. Consider Fig. 10 and suppose that we start things off by connecting the flying lead of R1 to the high voltage line. This will make Q1 conduct so the point X will be at low voltage (since 6 V will be across R2). This in turn means that

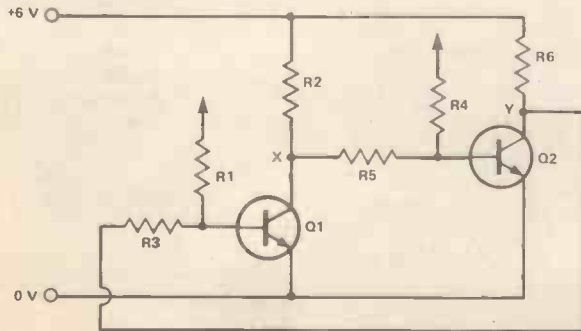


Figure 10. A bistable multivibrator arrangement

Q2 has no base current, so that it doesn't conduct and the point Y will be at high voltage. Now, by means of the feedback loop from Y round to R3 this high voltage is fed to R3, and so Q1 is maintained in the conducting state. Even if we disconnected R1 from the positive line, the system would stay in this state! It is stable.

If, however, we were to touch the free end of R4 to the positive line, think what would happen. (No, don't read on — have a think first!) The immediate result would be that Q2 would now conduct, making Y a low voltage point. The feedback loop from Y to R3 would no longer provide any base current and so Q1 would be switched off, making X a high voltage point which feeds R5 with base current for Q2 — the circuit is stable again but Q2 is conducting — not Q1.

Memory

So it is stable in either of two states, hence the name bistable. We can flip it over into one state with ease and with equal ease get it to flop back again; so for this reason it is sometimes known as a flip-flop. The circuit can be thought of as 'remembering' which of R1 or R4 was the last resistor to be touched to the positive line and this is the basis of at least one form of computer memory. As with the astable, this circuit can be more neatly represented by turning one of the transistors round, as shown in Fig. 11. This also shows a small modification with R1 and R4 made redundant and their job of touching the positive line being taken over by the two flying leads shown.

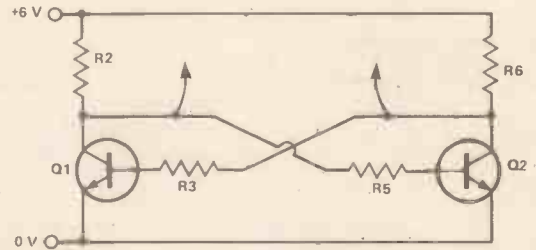


Figure 11. The usual representation of the bistable multivibrator

There is one other important modification of the bistable and this is one which enables it to act as a counter. If we now add the diodes D1 and D2, the resistors R7 and R8, bulbs in place of R2 and R6, and the capacitors C1 and C2 as shown in Fig. 12, we can make the circuit flip from one state to the other by means of a single flying lead connected to point X and watch it happen. Space does not really permit me to analyse what is happening, but it would be an excellent logical brainteaser exercise for you to puzzle out, and it is not difficult. Start with the bulb R2 on (ie, Q1 conducting) and the point X at 6 V. Consider whether C1 will charge up (and why), and whether D1 will be conducting or not. Then consider what happens when X goes to 0 V and finally back to 6 V again.

Whether or not you do the brainteaser bit, or understand it or not, the overall result is, quite simply, that the circuit changes state (it flips or perhaps flops) only when the voltage at X drops from 6 V down to 0 V. When X goes from 0 V to 6 V, no change of state occurs. It is when X goes from 6 V to 0 V that it flops over (or perhaps flips).

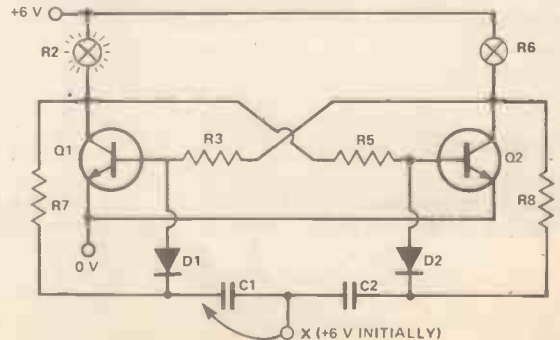
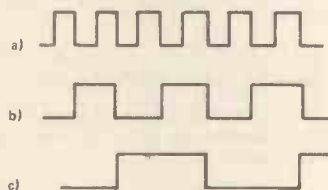


Figure 12. Modified bistable with single input

Dividing By Two

Behind this apparently innocent pastime of the bistable lies its ability to divide by two. It works like this. Suppose you feed a series of pulses into a bistable (to the point X which is sometimes called the trigger) then it will change states only when the voltage goes from high to low ie, on each negative-going edge. Thus a pulse train fed in looking like Fig. 13a will come out looking like Fig. 13b, where you will notice that each positive-going, then negative-going edge coincides with every negative-going edge of 13a — the pulse train of 13b has half the frequency of 13a. And if this in turn is fed into a second bistable the output is again half the frequency of what went in, like Fig. 13c.

Figure 13. Pulses fed to a hungry bistable multivibrator. It eats every other pulse of a) and gives b) at the output



If you look closely at Fig. 14 and imagine all the bulbs are off to start with and we produce the pulses by turning bulb B1 on and off by means of switch SW1. Table 1 shows what happens to the bulbs as this happens. You should notice that B2 changes state only when B1 goes from the on state to the off state; similarly B3 changes state only when B2 goes off, and similarly for B4.

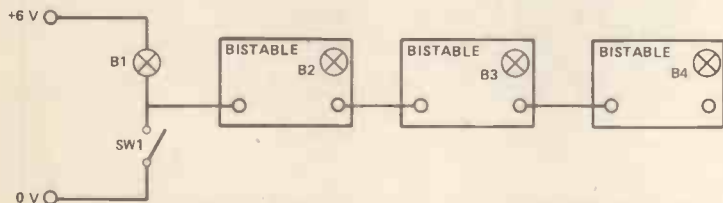


Figure 14. A binary counter

If we represent the off state by a zero and the on state by a one, then the table takes on the appearance of the binary series of numbers as Table 2 shows. This function of a series of bistables to act as a binary counter is extremely useful in computer circuits and calculators.

B4	B3	B2	B1
OFF	OFF	OFF	OFF
OFF	OFF	OFF	ON
OFF	OFF	ON	OFF
OFF	OFF	ON	ON
OFF	ON	OFF	OFF
OFF	ON	OFF	ON
OFF	ON	ON	OFF
OFF	ON	ON	ON
ON	OFF	OFF	OFF
ON	OFF	OFF	ON
ON	OFF	ON	OFF
ON	OFF	ON	ON
ON	ON	OFF	OFF
ON	ON	OFF	ON
ON	ON	ON	OFF
ON	ON	ON	ON

Table 1. What happens to the bulbs of Fig. 14

B4	B3	B2	B1
0	0	0	0
0	0	0	1
0	0	1	0
0	0	1	1
0	1	0	0
0	1	0	1
0	1	1	0
0	1	1	1
1	0	0	0
1	0	0	1
1	0	1	0
1	0	1	1
1	1	0	0
1	1	0	1
1	1	1	0
1	1	1	1

Table 2. The binary series of numbers (where an ON bulb gives a 1)

Memory Banks

The final item is the storage of information. This is a field which is changing rapidly and it has been said that the impact of the electronics revolution depends partly on the way information storage develops. The memory of a microcomputer may take all sorts of forms from special integrated circuits — in some cases containing literally thousands of bistables all on one little chip — to external memory banks like ordinary cassette tapes, the floppy disc, and looming up on the horizon some pretty unlikely sounding methods like magnetic bubbles or even the hologram —

which is a sort of photographic plate giving rise to a three-dimensional image.

Of course, information storage is not restricted to computers and indeed a record or tape of your favourite pop group or classical symphony is really just a collection of a large number of bits of information. In the article on transducers we saw the way in which the wiggly track of a record's groove could be turned into audible information. The stylus was connected to a coil which moved in a magnetic field, thus inducing a current which was fed to an amplifier and then a speaker.

Making A Disc

The way the disc is made in the first place constitutes quite a story in its own right. Originally a tape recording is made of the performance and this is played back to produce a master disc copy of it using a diamond stylus. Then a layer of silver (followed by copper for strength) is electroplated onto the disc, which when it is removed is, of course, a negative. A further positive is made from which come at least two more negatives and it is these which are used to print the records which end up on your turntable.

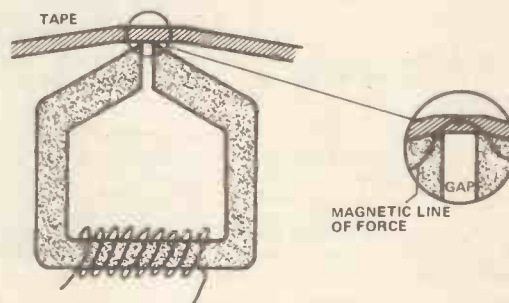


Figure 15. A tape record or playback head

Now you might wonder how the tape caught all the original information. That is no great problem to understand if you can think back to electromagnets and induction. The sounds from the orchestra or group are picked up by a microphone and after suitable amplification are fed to an electromagnet as shown in Fig. 15. This electromagnet has a small gap of the order of a thousandth of a millimetre. Magnetic tape is drawn past this gap and the lines of force by preference go through the magnetic tape rather than across the non-magnetic gap. Thus the tape emerges with a series of regions like small magnets impressed on it as shown in Fig. 16.

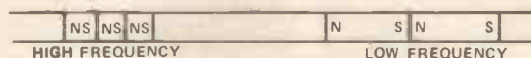


Figure 16. The way a tape is magnetised

Having magnetised the tape in this way, the information is recaptured by the process in reverse. As the tape passes the gap of the pickup head the little magnets ingrained on it induce small currents in the coil and it is these which are fed to an amplifier and speaker.

Our Time Is Over

Well, friends, that winds up this article and indeed the whole series. I hope you have enjoyed studying it as much as I have enjoyed writing it, and a special good luck to anyone taking the exam. I hope you will pass with flying colours; I'm sure you will if you: revise the basics (which you could do by re-reading the series); read the questions carefully; and answer what they ask and not the question you would have liked them to ask! One final bit of advice — enjoy your involvement in electronics. The best ski instructor I ever had said he had come to teach us to enjoy the mountains and then we couldn't help learning to ski. The more you enjoy your involvement, the better your involvement will be. I'd like to finish by quoting Tom Lehrer, the cynical American mathematician and songwriter very much in vogue a few years ago. He said, "Life (but he could equally well have said enjoyment/involvement in electronics) is like a sewer; what you get out of it depends on what you put into it." Cheers! **HE**

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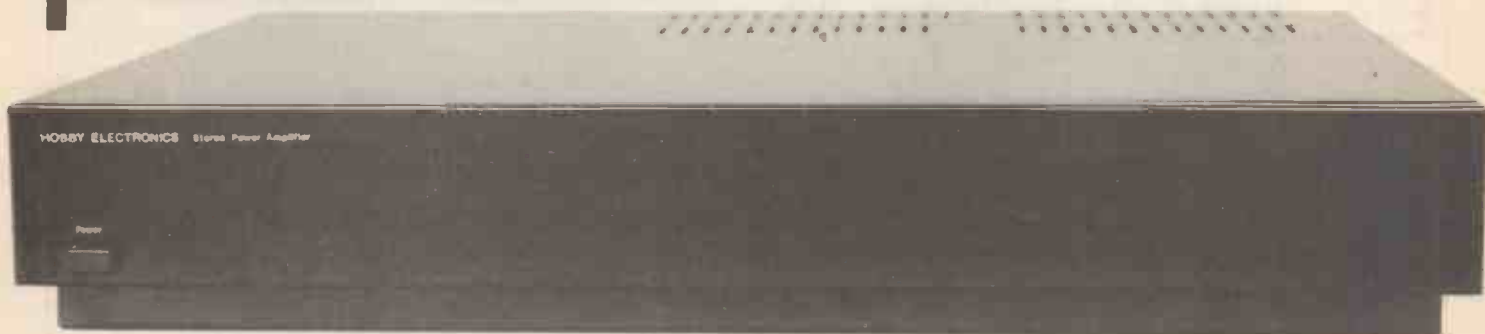
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Power Amplifier

part two



This month we conclude the HE Power Amplifier with details of wiring

HAVING CAREFULLY followed the constructional details of the HE Power Amplifier last month, you should have an amplifier chassis complete with all hardware including amplifier PCBs, mains transformer, bridge rectifier, capacitors and other fittings. It only remains to wire up your project.

You can see from the pictures of the inside of the amplifier that most connections are made neatly to wires contained in one main cable-form. The only wires not included in this cable-form are those associated with the 240 VAC mains. These have been kept clear for safety and to prevent the injection of any audible 'hum' into the circuit. For neatness, the mains leads should also be tied into a 'mini' cable-form.

The main cable-form consists of a collection of either heavy-gauge multi-stranded wire or screened cable. The multi-stranded wire is used for all power supply and output connections — the screened cable is used purely for input connections from the input phono sockets to the PCBs.

Construction

Follow a colour-code of some sort (Table 1 shows the colour code we used) when wiring up the amplifier. This not only eases the procedure as you do it, but also makes any necessary fault-finding easier.

Start the wiring-up of your project with the mains circuitry. Follow the diagram in Fig. 1. Note that this is only a diagram — the actual lengths of leads should be cut to fit exactly, going around the outside, internal edge of the chassis.

Next, wire up the power supply leads from transformer to bridge rectifier, capacitors to bridge rectifier,

and transformer to 5-pin DIN socket etc.

Now make all power supply connections to and from the PCBs. This stage is easier to follow if you wire one power supply rail (ie, + V, 0 V, - V) at a time and finish all connections using each separate colour before starting the next.

Make all input and output connections to the correct back panel

fittings.

Finally, tie the cable-form together neatly using either lacing cord (as we used), plastic cable ties spaced at about 50 mm intervals, or simply string.

The false front panel can now be fitted, after which the case lid should be slid on from the rear and bolted on. You now have a complete and (with luck) working Power Amplifier.

Grey multi-stranded wire	— earth (0 V)
Blue multi-stranded wire	— output and mains neutral
Red multi-stranded wire	— positive (+ V)
Black multi-stranded wire	— negative (- V)
Screened cable	— signal (input)
Brown multi-stranded wire	— mains live
Green/yellow multi-stranded wire	— mains earth

Table 1. Suggested colour-code for cable-form

Buylines

A complete kit of parts for the HE Power Amplifier project is available from:

Capricorn Electronics
281 Balmoral Drive
Hayes
Middlesex UB4 8HD
(Tel 01 573 1566)

for £155.

If you prefer to build the amplifier into a case of your own choice, Capricorn can supply all parts (excluding the case) for £125.

The case is also available (complete with all rear panel fittings) for £35.

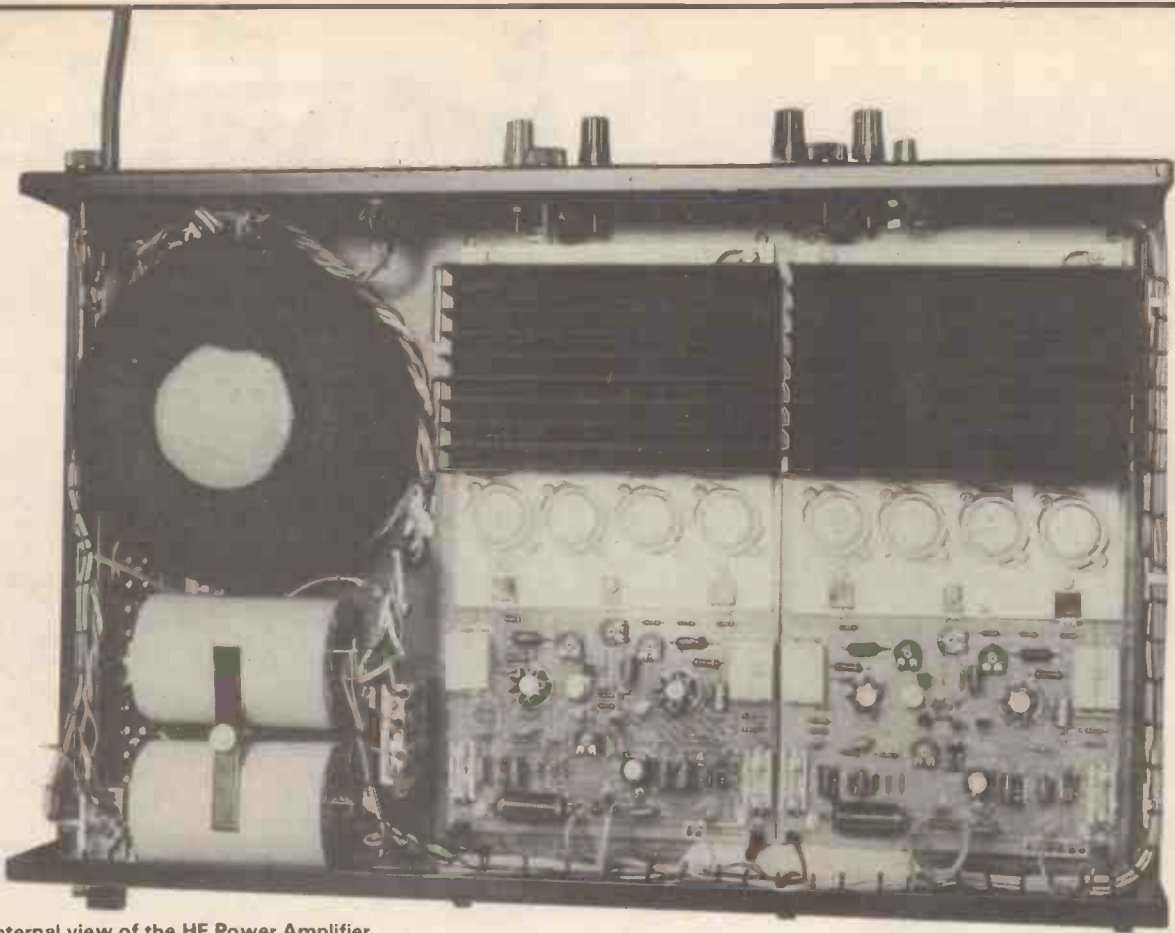
Complete ready-built PCBs for an amplifier are £38.50 each. Kits of all components to build your own PCBs are £28.

For those readers wishing to

purchase individual items used in the Power Amplifier, the following list gives a few examples of price.

Power Amp PCB + sub-heatsink	£12.00
Thermal cut-out	£3.00
Toroid transformer 43-0-43 VAC	£20.00
Toroid transformer 45-0-45 VAC	£25.50
Toroid transformer 50-0-50 VAC	£34.50
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Capacitor 10000u, 63 V	£5.50
Bridge rectifier 10A, 400 V	£5.00

Contact Capricorn for other details. Please remember to add £1.50 to your order to cover p&p.



Above. Internal view of the HE Power Amplifier

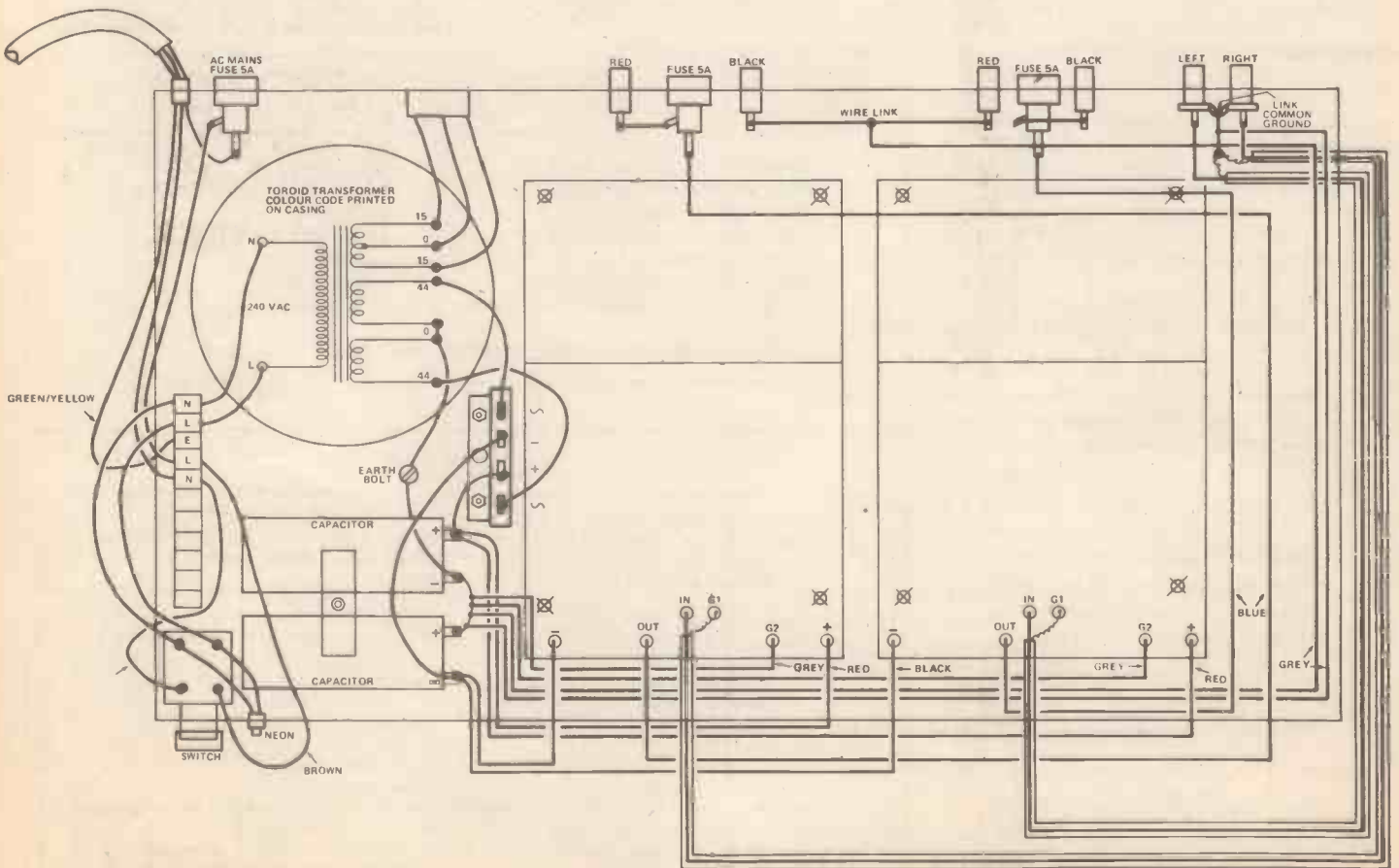
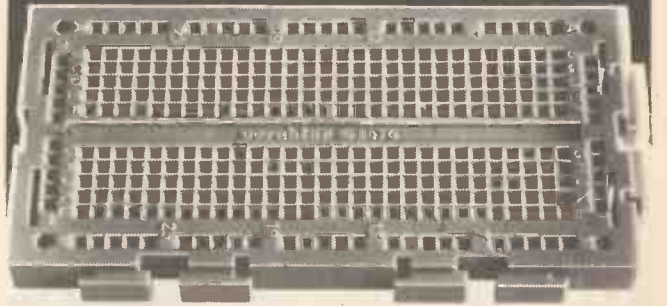


Figure 1. Wiring and connection details of the project. Use a colour code such as the one we used (Table 1) and route all the wire around the inside edge of the case

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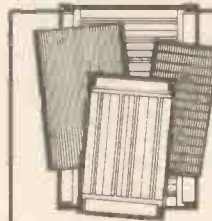


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All kits contain components as specified plus Texas I.C. sockets, where required, also connecting wire.

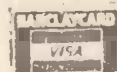
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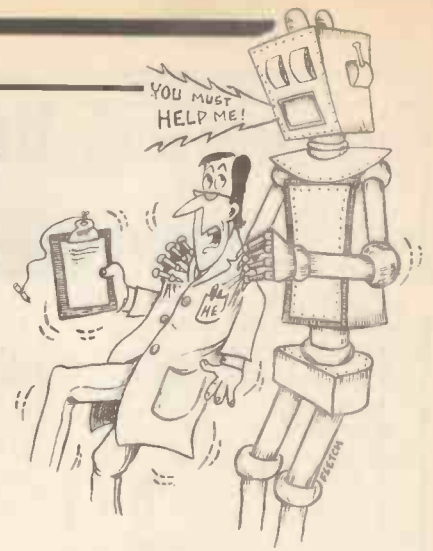


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Clever Dick

DESPITE the fact that July is printed on the cover, this CD is being compiled in May. (And just to confuse you further, the press day for this issue is in May, about a week after the *June* issue comes out.) And despite the bad weather in many parts of the country, those letters haven't stopped coming in.



On your bike for the first two.

Dear CD

I have become a regular reader of HE since December last year and am disappointed at the fact that both the digital speedometer and digital bike speedometer are both in mph. How can I convert them to km/h?
D. Basson,
Natal, South Africa

Both of these speedos can be converted to read km/h. Taking the Digital Speedo first, refer to the circuit in Fig. 1 on page 14 of the December '80 issue. Increase the value of resistor R2 (you'll need to experiment with different values, starting with, say 3M3) and you should be able to calibrate the speedo in km/h by adjusting RV1 (coarse) and RV2 (fine).

Coming to the Bicycle Speedometer, refer to the circuit in Fig. 1 on page 38 of the March '81 issue. The same operation as described above for the Digital Speedo is required here, this time with resistor Rx. Follow the instructions given in the text.

Another query on the Bicycle Speedometer came up next.

Dear CD

I am thinking about making the bike speedo in the March issue. But it says "and adjust the pot until you get the right speed reading". All very well, but how do you know what the right speed is? Unless you already have a speedo — and I haven't. Please could you help.

James Byrne
Peterborough

Someone woke up here and suggested roping your bike to the hand rail of a bus — but it's much too dangerous, illegal — and how would you know the speed of the bus anyway? Seriously, the only way to calibrate the speedometer is to compare it with the speed of another vehicle, such as a moped, travelling at a known speed. It obviously needs great care — preferably it should be done in an open space away from any vehicles or pedestrians — but once the potentiometer is set for one known speed, that's the job done. You just substitute it for an equivalent fixed value in the Rx position.

We've got an aspiring radio ham next.

Dear CD,

Please could you tell me where I could get information about becoming an amateur radio operator and if possible a place where I could get plans from which I can make a transceiver or where I could buy one from?
Michael Nelson
Barrow-in-Furness, Cumbria

First things first: Information on becoming an amateur radio operator is available from the Radio Society of Great Britain, 35

Doughty Street, London WC1 (tel 01-837 8688). One of its publications, *Beginners Handbook of Amateur Radio* (£8.26 including post and packing) is worth looking at. Unless you intend operating a transceiver illegally, you will certainly have to learn about becoming a radio ham — and pass the necessary examination (the Radio Amateurs' Examination) before you can think about making or buying one.

Dear Clever Dickypoos,

I built your car booster amp but I have a problem: it will only work with about a 20R speaker. With 8 or 4R I get a continuous popping, and the output is very distorted. Please can you help?

David Harrington
Farnham, Surrey

Unfortunately, a 'bad' batch of HA1388 ICs — the device used in the project — was produced which, although the devices functioned correctly, could become unstable. First check that your wiring to the PCB is tidy, with no unnecessarily long leads. Second ensure that screened cable has been used at the input. Third make sure that the supply leads are of a heavy gauge (the peak current can be as high as 4 A). If all else fails, try adding a 100R resistor in series with capacitor C7 and one in series with C8.

The next letter must hold the record for being the shortest so far.

Dear CD,

How much is a binder?
Ben Chaston
Enfield, Middlesex

Can anyone beat that *and* make sense? A binder costs £3.95 including p&p, from Easibind Ltd, 4 Uxbridge Street, London W8 7SZ (add 30p for overseas orders).

Can anyone help this next reader?

Dear CD,

Please can anybody help me. After buying all the electronic components for your Hebot I phoned up Remcon Electronics (who produced the mechanics) only to be confronted with "Sorry — we don't do that anymore". Now I'm left with £30 worth of electronics so if anyone has any spares or ½ started ones I would be glad to hear from them.

Martin Portman
Godalming, Surrey

PS is the info. about ETI bringing out a new robot in September true and how much will it cost?

The designer of HEBOT left HE about a year ago, so we have been unable to answer any technical enquiries about it. If anyone can help Martin, drop me a line. As to a new ETI robot coming out in September, who told you that? If there is one coming, there's no telling when — yet.

We have some observant readers, as shown by the next letter.

Dear CD,

I think, after reading May 81 issue of Hobby Electronics I ought to point out to you and N J M Freeland that the guitar pre-amp, as in the overlay shown does have a fault. The interwiring does not show the -ve connection, that is the OV screen to anywhere along the track. This is the reason why he cannot get the pre-amp to work.

Although the circuit is supposed to be active, it lacks any real boost and cut (it sounds like a very good passive tone control network).

I would very much appreciate it if you could give some different values for the tone control network to give a good bass and treble, cut and lift.

Mark Ian Arnold
Kings Lynn, Norfolk
PS Now ain't that worth a binder!

We looked at the overlay on page 37 of the May '81 issue and saw Mark's comments to be true — the outer screen of the cable from the volume potentiometer should have been connected to the ground track (point H14). Unless this screen is grounded, the negative terminal of the battery remains unconnected to the board. Now the bad news and the good news. The bad news is that we think you've got a faulty pre-amp there, because ours has plenty of cut and lift on the bass and treble. And the good news? We'll send you a binder.

Dear Clever Dick,

Whilst idling through a pile of HES, we decided to carry out a survey of the cost of each page in HE. From the enclosed graph you will see very varied results and the cost does not appear to be consistent. We do not feel that we are getting the greatest possible value... maybe there are too many pay rises in the HE office! — but nothing would stop us ordering our regular copies of HE.

Peter Durrant & Mark Hayter
Malvern, Worcestershire
PS How about slipping a couple of binders into the post to us, go-on be devils

Thanks for the survey — you must both be born statisticians. Although we haven't space to print it here, the graph shows the inevitable rise over the last two years or so — but then what hasn't suffered price increases during this time? Nice to know that despite the recession, inflation, cuts and closures we still have some loyal readers. We'd be slipping if we sent out binders willy-nilly.

That's the lot for another month. Watch this space in the August issue. Until then take care of yourselves.

HE

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Quick Project: Electronic Metronome

This month's Quick Project is a metronome — specially designed for all our readers who are budding musicians — to help you keep your time while playing your instrument

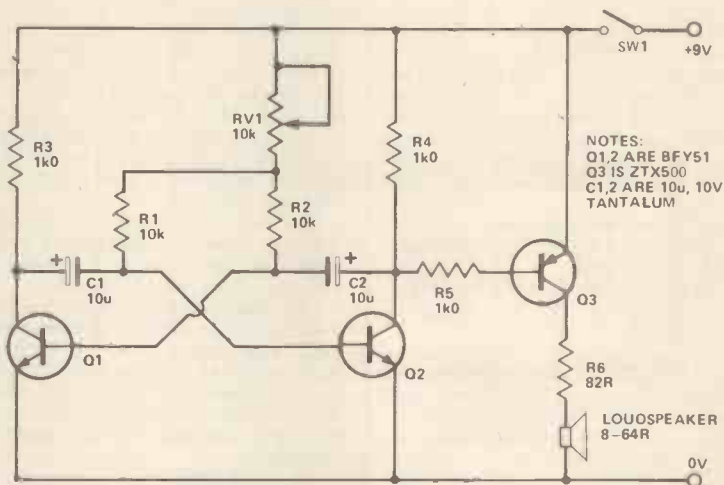
This simple circuit produces a tick-tock sound, through the speaker, the speed of which can be varied by adjustment of RV1.

Transistors Q1 and Q2 are connected in a standard astable multivibrator circuit. Potentiometer RV1 controls the charge rates of capacitors C1 and C2 and thus the operating frequency. Transistor Q3 amplifies the pulse produced by the astable and drives the loudspeaker.

You can build the project into any suitable metal or plastic box and power it from a PP3-sized 9 V battery. Speed control RV1 and the on/off switch SW1 should fit on the box front.

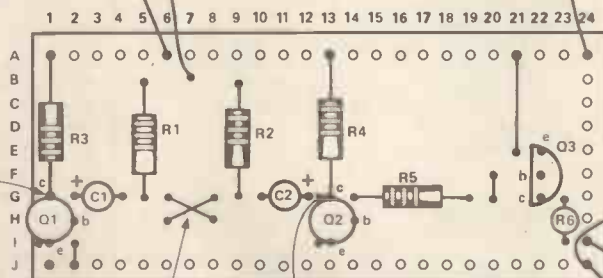
If you require an on/off indicator, a small bulb (such as an LES type) can be wired between the +9 V and 0 V power connections on the board.

Most speaker impedances will suit the circuit although higher impedance types may not give much volume. In this case reduce the value of resistor R6 to about 27 R.



NOTES:
Q1,2 ARE BFY51
Q3 IS ZTX500
C1,2 ARE 10μ, 10V
TANTALUM

Figure 1. Circuit diagram

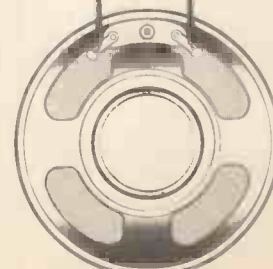
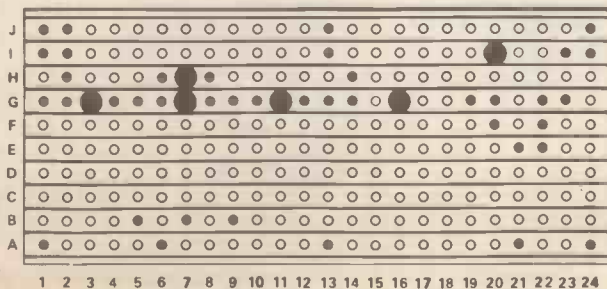


NOTE:
Q1 COLLECTOR
AND R3 LEAD GO
INTO THE SAME HOLE

NOTE:
BOTH LINKS TO
BE MADE WITH
INSULATED WIRE

NOTE:
Q2 COLLECTOR
AND R4 LEAD GO
INTO THE SAME HOLE

Figure 2. Veroboard layout, underside track breaks and connection details



LOUDSPEAKER
8-64R

HE

Your Letters

A selection of
your letters to
the Editor

BOTH THE YOUR LETTERS page and Clever Dick's page can provide a useful means of exchanging your views. This first letter should help to answer J.A. Pearson's plea under Your Letters in the May '81 issue of HE.

Dear Mr Davies,
I was interested to read the letter from Mr Pearson concerning old television receivers.

I thought you might be interested in seeing an article I wrote which appeared in February Scottish Field, about Benjamin Clapp, who was chief assistant to John Logie Baird. I have sent a copy of Mr Pearson's letter and the article to which he refers, to Mr Clapp.

I suggest your reader contacts Wireless World at Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS.

I hope this letter might be of some help.
Janet Thomas
Coulston, Surrey

Thanks for taking the trouble to forward Mr Pearson's letter and for the information. I will send a copy of your article to Mr Pearson.

Dear ED or C Dick
Looking through the 'Your Letters page' I was stunned at R Sawyer's letter. ED said try the Doorbell monitor (in the March issue. What Doorbell monitor? I am only twelve — don't I deserve a binder?

I've been trying the Chuffer project for weeks (January) and I've checked all the wiring and components. Where have I gone wrong? Was there a fault?
P. Prodomov
Southgate, London N14
PS Don't I deserve a binder?
PPS I think your mag should have something about computers in it.

It was my mistake — the Doorbell Monitor project was on pages 32-33 of the April '81 issue.

The only error we have on file for the Chuffer project was a misprint on the overlay shown on page 56 of the January '81 issue. In the lower right-hand corner of the overlay, the electrolytic capacitor is numbered C9 — it should have been numbered C8. Otherwise it's difficult to say where you could have gone wrong. (Faulty component perhaps?)

We're not offering binders on this page yet but we'll consider your request for something about computers. (See the review of the Sinclair ZX81 — in kit form — in the Gadgets, Games & Kits supplement on page 31).

I'll let this next letter speak for itself.

Dear Sirs,
May I start by congratulating you on a magazine that brings electronics within everybody's reach.

That is the praise, the rest isn't.
If you are passing my way do drop in and see the pile of scrap that is all that is left of a model plane that took me weeks to build, cover etc. It took time to save for the radio equipment and it has now been all ruined by some B----- with a CB set.

My monitor showed that this 'accident' was not pilot error.

How can you possibly justify trying to promote something that is both illegal and causes so much damage to other people's

property? Your Article in May 1981 issue is proud of the 20,000 turn out at Donington and amused at the trader selling "straight 40-channel AM rigs for £120".

Every one sold is illegal and that should be made quite clear. Every one used is illegal and that should be made quite clear. Every one sold will have a good chance of affecting a legal radio modeller and that is not funny and that should be made quite clear.

You should not compare whether AM or FM is better or worse for service . . . there is NO choice. FM will be legal, AM will not.

At the top of the page you cover yourselves by pointing out the 1949 Wireless Act and then in the last line you congratulate the organisers.

Let me make it clear I am not anti-CB and when it is legal I will have a set but the children using it (children in mentality at least) give the whole thing a bad name.

My monitor has picked up conversations treating the damage to radio modellers as a joke. How funny would it be if someone destroyed their property? Another conversation wondered what the buzzing noise was on their set. Are they that daft not to know when they are interfering with a totally legal radio modeller?

You and other electronic magazines have been a powerful force in making CB legal, commendable I agree, but understand the power you have and the damage you do and have done.

The whole frequency system is cock-eyed but 'facts is facts' and I and thousands of others either have to write off hundreds of pounds worth of planes, motors, servos etc, sell our transmitters and receivers and knock down prices as nearly obsolete to buy new equipment for the new frequency allocated to aero-modellers. What a Catch-22.

I hope the government choosing the frequency and you for lobbying for it are pleased with the damage and cost you have put thousands of people to.

I doubt writing this will have any effect or you will risk publishing it but looking at a pile of scrap balsa, cracked receivers and a pile of wires I felt someone should know.

D. Reed
Leatherhead, Surrey

I had received similar reports of sabotage to model aircraft by irresponsible (and illegal) CBers . . . but I doubted whether thousands of RC modellers had been affected.

I spoke to Pete Christy, technical consultant to a radio control equipment manufacturer, who said: "It's difficult to put an actual number on it. A thousand or so might be a reasonable estimate for the last year."

He considered that the problem of CB interference to radio modellers was usually restricted to major urban areas or city centres. To give some idea of the potential targets for such interference, he said that up to the time that radio model licences were suspended in January 1981, about 100,000 licences had been issued.

Items published under Breaker One Four in HE contain the personal views of Rick Maybury, who is the Editor of Citizens' Band magazine. I share Rick's opinion that if successive governments over the last 10 years had not stalled in the allocation of different frequencies for CB and radio-controlled models, we would not have had the present chaos on 27 MHz and other bands.

Dear Sir,
I have recently constructed the Public Address Amplifier from your March issue and at long last got it to work.

I am appalled at the mistakes, both in the layout and method of construction, it could never be made to work from your published article.

First corrections to the layout:
Move the top end of R5, C3 and R6 up one hole from K to J.

Move the top end of R4 and the bottom end of C2 from J to I.

Move the lead from the centre of the Mic Vol on/off control and the top end of R8 from H to G.

Having corrected the above errors the output waveform distortion (due to incipient instability) was completely unacceptable. Investigation showed that the Veroboard tracks are not capable of carrying the circulating earth currents present and it was necessary to re-inforce these with soldered-on heavy gauge copper wire, the holes for the wire links were drilled out and these also replaced with heavy gauge wire.

I might add that two samples were constructed, both showed the same faults and both responded to the same cures.

A.D. Poupard
Edenbridge, Kent

We agree with the errors listed in your letter, and these apply to the Veroboard layout shown in Fig. 2 on page 14 of the March '81 issue. We cannot, however, agree with your comments about the method of construction and the 'incipient instability'. The project was designed to avoid large currents passing through the Veroboard tracks, and if you refer to Fig. 2 you will see that the 0 V supply lead goes directly to one of the solder tags on IC1. Thus the supply current to the board is only a few milliamperes.

Thanks for pointing out the layout errors.

Dear Sir,
Referring to page 16 of the May issue of Hobby Electronics, what technique of playing is required with regard to the annotation of the notes from the tone generators and the keyboard adjacent?

As a professional (retired) arranger and pianist etc (I was at one time staff arranger with Francis, Day and Hunter in Charing Cross Road) I would love to hear what would come out of the instrument played normally but connected as annotated.

Of course it is a slip but how it could get past so many people I cannot understand. (I had a few years correcting printers errors etc.)

Ivan E. Gray
Bidlington, East Yorks
PS I enjoy reading HE — it is my favourite.

We discussed your letter in the HE office and came to the conclusion that you had misunderstood the drawing under How It Works on page 16 of the May '81 issue. Here the dividers have been shown linked to the note outputs from the top octave generator IC, but not in chromatic order. In the final wiring up, the correct notes are coupled to the correct outputs from each divider IC. To show this in the drawing on page 16 would have meant showing a lot of wires crossing over each other.

And that's the last letter of the month. **HE**

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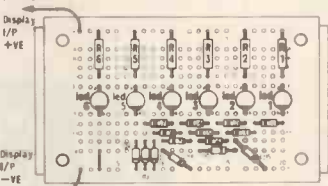
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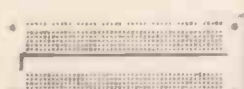
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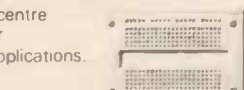
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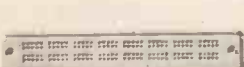
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Treble Booster

Another design in our range of musical effects. This project lets you boost your guitar's high notes by two different amounts



WITH THE AID of our Treble Booster you can liven up the sound of your electric guitar and obtain what guitarists call a 'brighter' sound. Conventional treble boost circuits are readily obtainable and most guitarists who play electric guitars will have used the effect at some time or another. The standard effect relies on amplification of frequencies around 4 kHz much more than those frequencies below and above this point. Our treble booster does this, of course, and the response of this 'normal' booster mode of the circuit 'peaks' at approximately 4 kHz with a maximum boost of 25 dB (a gain of about 18). However, in 'superboost' mode the circuit can be used to provide a more extreme effect, with a peak of around 40 dB (a gain of 100) at 10 kHz, for those who do not believe in doing things by halves! Figure 1 shows the two responses that are available. When not required, the frequency boost can be completely removed (ie, for a flat response) so that the guitar sound is unaffected.

The booster is completely self-contained, and is connected between the guitar and amplifier using a standard guitar lead terminating in a 1/4" jack plug. Regular readers will recognise the case we have used as being of the same type housing the HE Fuzzbox in the March issue and the HE Envelope Generator in the June issue — it's such an ideal case for a guitar effects pedal that we couldn't resist using it yet again.

Construction

Make all necessary breaks in the copper tracks of the board, as indicated in the underside view in Fig. 3. These can be done with either the specially designed tool from Vero, or a small hand-

held drill bit (about 1/8" is ideal). Press the cutting edge onto the hole in question and twist clockwise until the copper breaks away in a clean circle. Make sure no loose swarf bridges across to adjacent tracks.

Insert and solder the 8-pin DIL (dual-in-line) IC socket where shown and also solder in Veropins where external component-to-board connections are to be made.

Next, the link, resistors and capacitors should all be inserted and soldered. Make sure you have positioned all polarised capacitors the right way round. Push the IC into its socket, checking first that it is correctly aligned.

Now, mark and drill the case to take the input jack socket and SW1, and then mount them both into their places.

Wire up your project, carefully following the connection details in Fig. 3, using screened cable for input and output leads to reduce the chance of interference. All other connections are made with thin multi-strand wire.

Finally, screw on the bottom of the case, plug in your guitar — and boost.

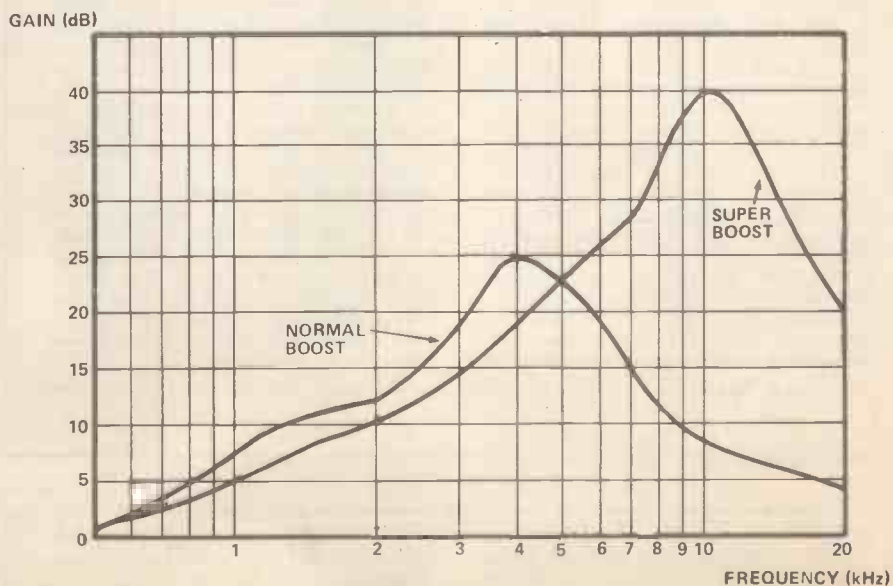


Figure 1. Measured frequency responses of our prototype Treble Booster. Switch SW1 allows you to choose the response required

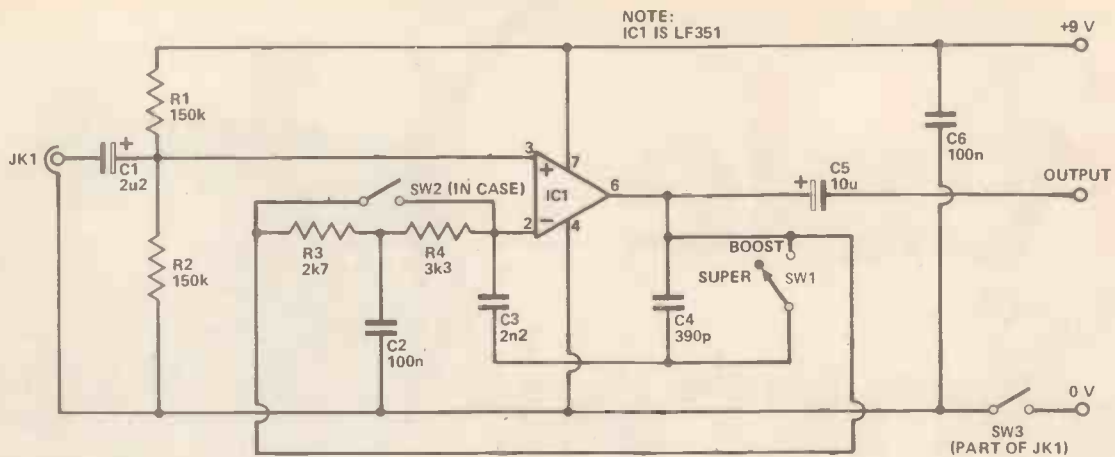


Figure 2. Complete circuit of an HE Treble Booster.

How It Works

Without the capacitor shown connected by broken lines, the circuit basically consists of an amplifier whose response is flat.

In this circuit, by inserting the capacitor into a positive feedback loop around the amplifier the response can be changed. As the reactance (you can think of reactance merely as AC resistance) of the capacitor falls at higher frequencies, more signal is fed back and is thus re-amplified. The gain of the system therefore increases as the frequency goes up.

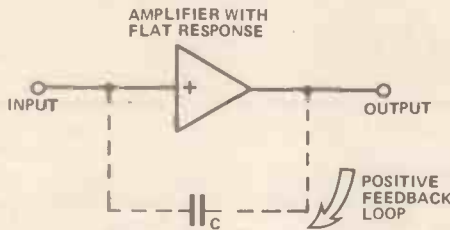


Figure 2 shows the circuit of the treble booster, and it is based on an LF351 or similar (TL071CP, TL081CP, etc) low-noise, JFET operational amplifier. Integrated circuit IC1 is used in the non-inverting mode, and has its non-inverting input biased to half the supply potential by R1 and R2. Capacitor C1 couples the signal from the guitar to the non-inverting input of IC1.

The voltage gain of IC1 is controlled by the amount of negative feedback from the output to the inverting input. At DC and low frequencies there is virtually 100% negative feedback through R3 and R4 due to the very high input impedance of IC1, and the circuit therefore has unity voltage gain. At higher frequencies the impedance of C2 becomes significant and it tends to decouple some of the feedback, giving the circuit a response which steadily rises with increased signal frequency. It is normal to tame the high frequency response somewhat to prevent excessive boost

at the highest audio frequencies and to reduce the risk of instability. With SW1 in the 'normal' position C3 is shunted across R3 and R4, and its fairly low impedance at high frequencies gives increased feedback at frequencies above about 4 kHz, with a consequent 'rolling off' of the response. If SW1 is set to the 'high' position C4 is added in series with C3 giving reduced capacitance and higher boost at frequencies above approximately 5 kHz.

If SW2 is closed the output of IC1 is connected directly to the inverting input, giving 100% negative feedback and unity voltage gain. Switch SW2 can therefore be used to switch out the treble boost and give a flat response when the boost is not required. On/off switching is provided by SW3, which is part of the input jack socket. The treble booster is turned on by insertion of a jack plug. Total current consumption is less than 2 mA so long battery life can be expected from this project.

Parts List

RESISTORS (All 1/4 W, 5%)

R1, 2	150k
R3	2k7
R4	3k3

CAPACITORS

C1	2u2, 16 V electrolytic
C2, 6	100n polyester
C3	2n2 polystyrene
C4	390p ceramic
C5	10u, 16 V electrolytic

SEMICONDUCTOR

IC1	LF351 JFET operational amplifier
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MISCELLANEOUS

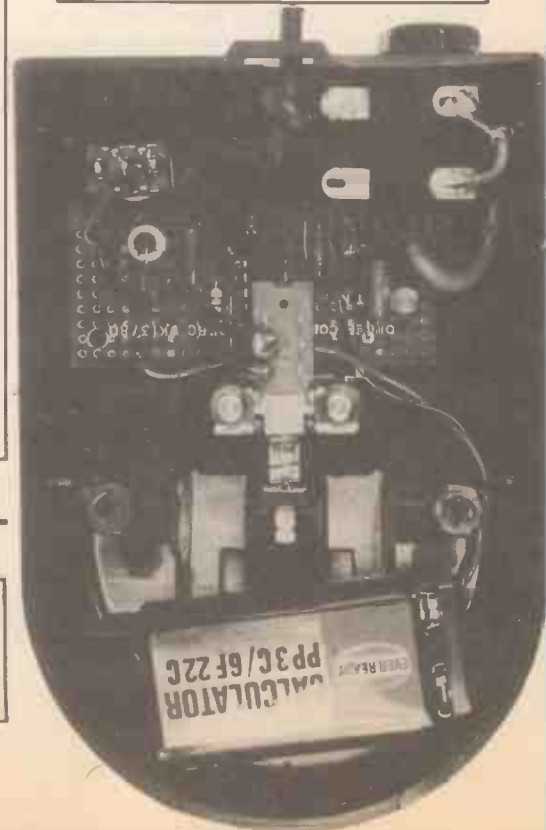
SW1	single-pole, single-throw latching push-button switch (includes SW2 — see Buylines)
Case to suit	
SK1	1/4" jack socket (with SW3)
PP3-size battery + clip	
Veroboard, 10 strip x 24 hole, 0.1" matrix	

Buylines

A full kit of parts for this project, including foot pedal and Veroboard, has been produced by Magenta Electronics for £9.94. This price includes VAT but not p&p.

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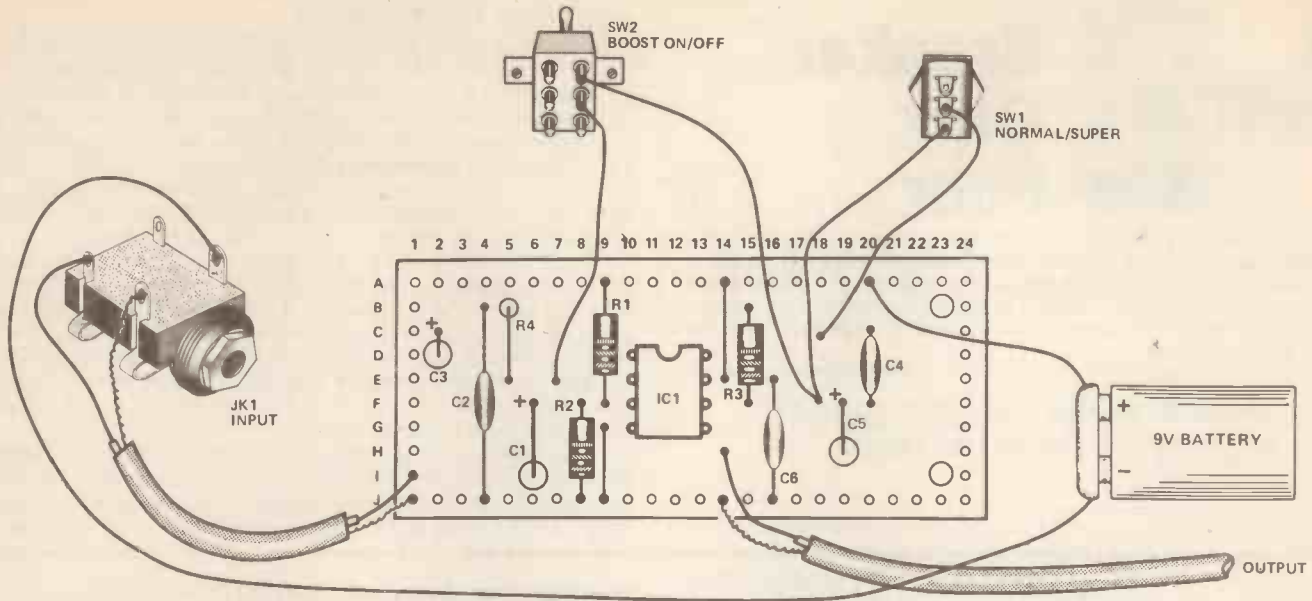


Figure 3. Veroboard overlay, underside track breaks and component locations, and connection details. Note the use of screened cable for input and output connections

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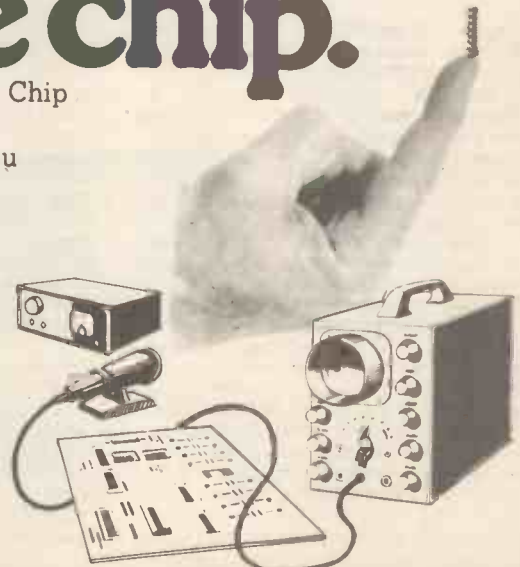
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CB Breaker One Four

The publishers of HOBBY ELECTRONICS would like to point out that it is at present a contravention of the Wireless Telegraphy Act of 1949 and 1968 to use, manufacture, install or import CB transmitting equipment. It is not the intention of Modmags Ltd to incite, encourage or condone the use of such equipment.

The battle over the FM spec goes on. Rick Maybury looks at the latest developments

IT WILL COME as no surprise to learn that within three weeks of the UK CB draft specifications being published at least one Japanese manufacturer had working examples of their wares in the country. On the other side of the coin, all the various legalisation groups are running around doing their utmost to get the spec changed.

At the epicentre of the discontent is the new frequency and the use of FM instead of good old AM. Without wishing to be a bore, we have had the opportunity to try out the new equipment and I can confirm, whether you like it or not, that the range is just as good and the quality of speech several times removed from what we are accustomed to. As reported last month, the equipment cost, a very touchy subject at the best of times, will at worst be the same as that already on the black market and at best, less than we are used to. To date the cheapest basic 40-channel 4 W FM mobile rig will cost under £50.

Antenna Restrictions

However, it's not all smooth sailing. There is one area of contention: the ERP (effective radiated power) of the new equipment is likely to cause a few problems with antennas. A spokesman at the Home Office has told me that it is almost certain that it will only permit one type of antenna. It looks as though the standard CB antenna will consist of a stainless steel whip with a loading coil at the bottom of the whip. Sounds familiar? It should do, as it will look like the radio telephone antenna used by cab companies and by those rich enough to afford radio telephones.

There's more to come, though. It looks as though legislation will be introduced to specifically outlaw helically-wound antennas (just like DV27s, Firestiks, Roadhogs, etc) and as for base stations, well you can forget beams, gain antennas, or in fact anything that would transgress the 2 W ERP rule. All is not lost though, as steady pressure from NATCOLCIBAR and several other groups has been bending the ears of the Home Office in order to get this ruling changed.

This rather shortsighted legislation could make the difference between a workable system and a poor alternative to the illegal system already in use. I'll be reporting on the outcome of a very important meeting at the Home Office next month, hopefully with some good news.

Important Announcement

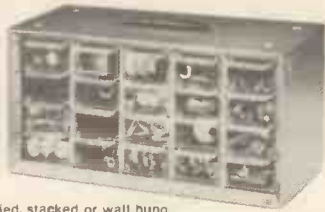
Just a couple of weeks before the legislation date good old Modmags will be organising the most important CB exhibition of the whole year. Already several very large importers and manufacturers of CB equipment will be exhibiting their wares. We plan to allow visitors to the show to purchase rigs but we can't say too much until our plans are finalised. In the meantime, if you want to see what the new system is all about, see the very latest equipment, eyeball all the CB personalities or just racket with the dozens of accessory dealers who will be there, get yourself along to the Horticultural Hall in London on the 11th, 12th and 13th September. We at CB will be there to answer your questions and sell you magazines, etc so come along and make a day of it. **HE**

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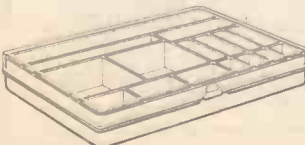


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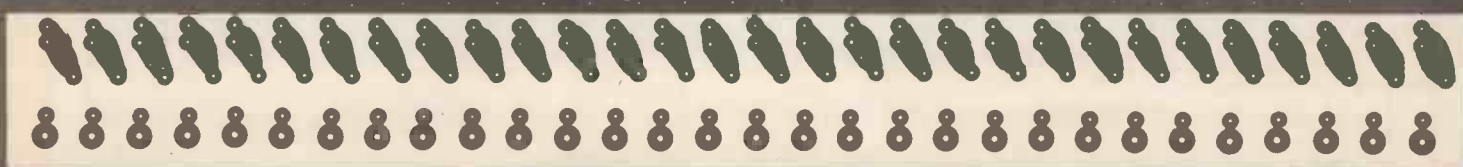
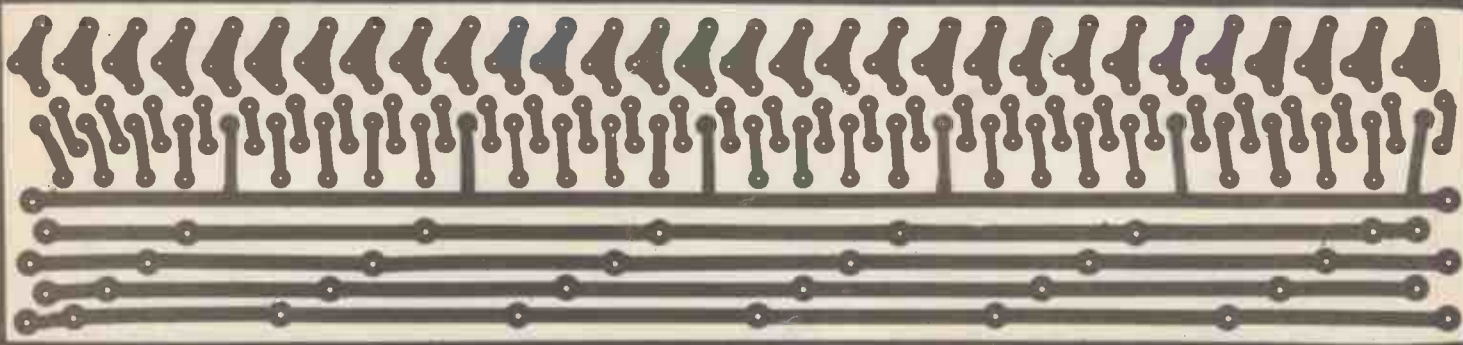
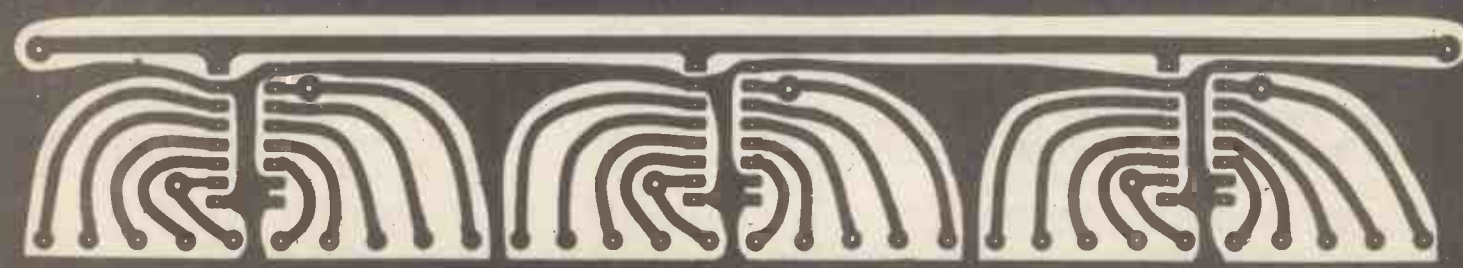
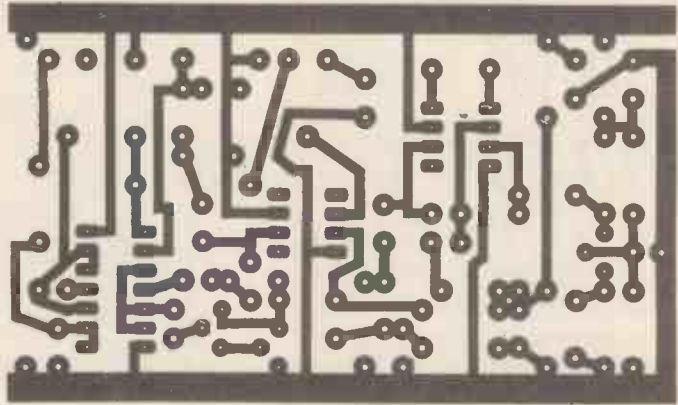
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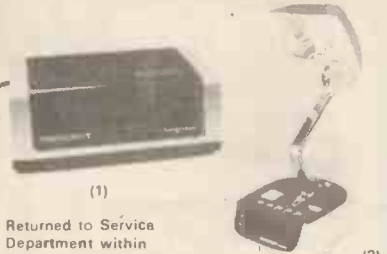


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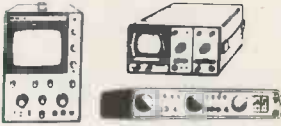
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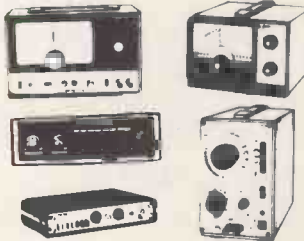
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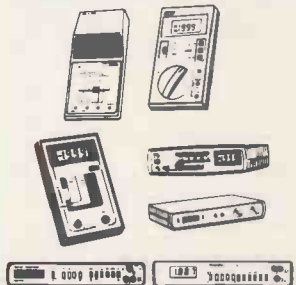
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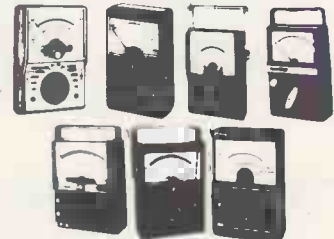
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