CB RADIO – NEWS AND VIEWS INSIDE

Hobby Electronics

April '81

ISSN 0142-6192

60p

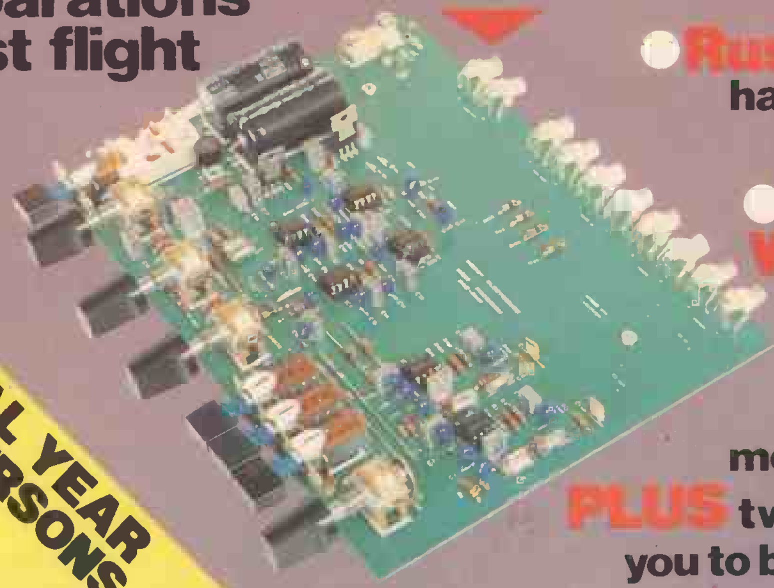
For A Dow[illegible] Appro[illegible] To Electronics

Space Shuttle

Special feature on preparations for first flight

Hi-fi Amplifier System

can be used with other audio systems
special kit offer • no circuit wiring



- **Russian Roulette** harmless version of a deadly game
- **Windscreen Washer Alarm** Warns you of low fluid level
- **Tremolo** modulates your music

PLUS two other projects for you to build – see inside

INTERNATIONAL YEAR OF DISABLED PERSONS

Competition: design an electronic project for a disabled person


Ever wondered who buys electronics today? You'd be surprised!
...ectronics market is rapidly expanding. Whether it's ...-equipment, accessoiries or what have you, it's be...ng increasingly difficult to keep up with the latest developments. Or to get them.
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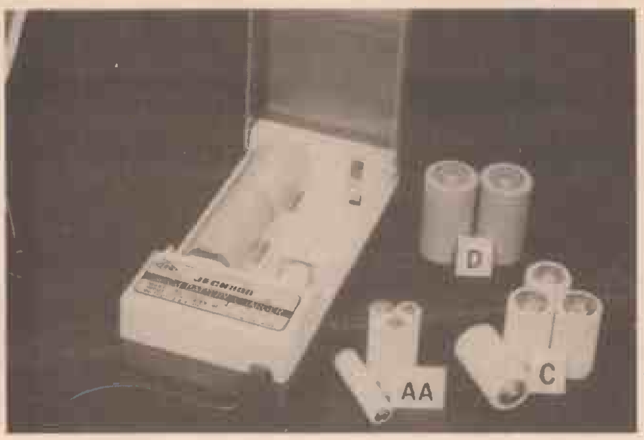
Or just simply call us.
TON AHLERS
ELEKTRONIKA B.V.
Aalsmeerderdijk 349, 1436 BH Rijsenhout - Holland, tel. 010 31 2977-2 86 11 (4 lines), telex 15181 tonel nl. (near Schiphol Airport).
Even the old boys circuit is getting electronicized. With our help.
80-92

Hobby Electronics

APRIL 1981
Vol. 3 No. 6

Editor: Hugh Davies **Assistant Editor** Keith Brindley
Drawing Office Manager: Paul Edwards **Group Art Editor:** Paul Wilson-Patterson BA
Managing Editor: Ron Harris BSc



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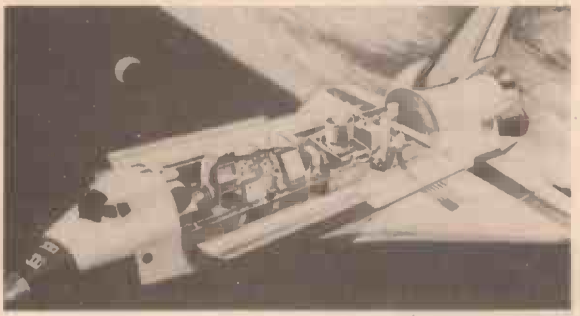

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I.L.P

SIMPLY AHEAD and staying there

The range grows bigger... better...

New Profile Amplifiers - Two New Series

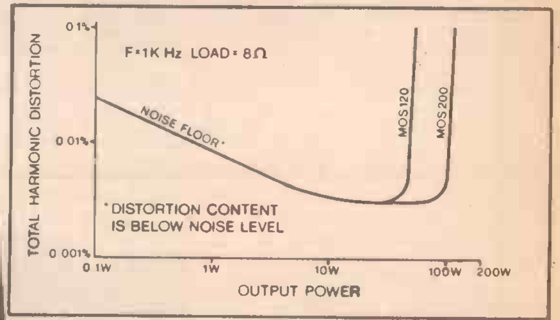

HY120


HY60

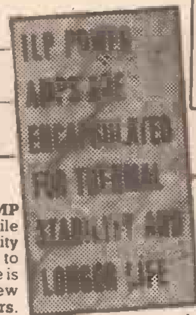
MOSFET

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. Connection is 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



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

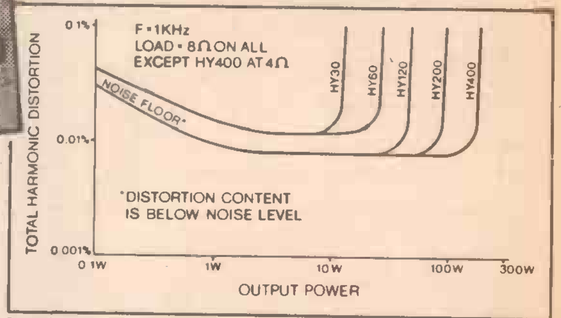


BIPOLAR

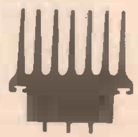
(Standard O-P Transistors)

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 + £1.25
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

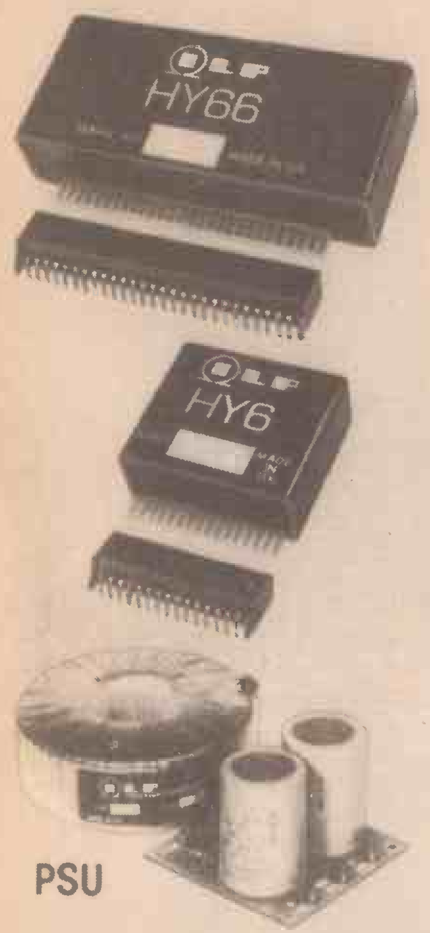


Load impedance all models 4Ω-∞ Input sensitivity all models 500mV
Input impedance all models 100KΩ Frequency response all models 15Hz-50KHz – 3dB



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.



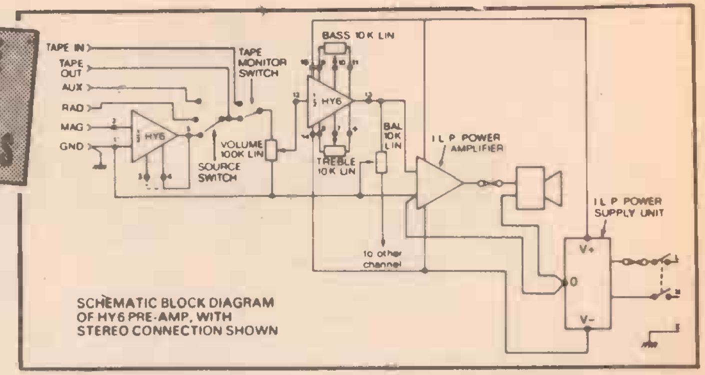
NEW PRE-AMPS

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 ±12dB 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 £6.44 + 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

COMPATIBLE WITH ALL ILP MODULES



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**
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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 ±15V at 100mA to drive up to 12 x HY6 or 6 x HY66	£4.50 + 0.68p VAT
● *THE FOLLOWING WILL ALSO DRIVE I.L.P PRE-AMPS*	
PSU36 for use with 1 or 2 HY30's	£8.10 + £1.22 VAT
● *ALL THE FOLLOWING USE TOROIDAL TRANSFORMERS*	
PSU50 for use with 1 or 2 HY60'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

1971-1980
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4

Monitor

Miniature Flat Screen TV

Clive Sinclair, managing director of Sinclair Research, announced in February that his flat screen TV tube was about to go into production.

This tube, which is only about 4" by 2" by ¾" deep, will be incorporated in a miniature monochrome set, combining FM radio.

The prototype receiver is only about 6" by 4" by 1", so it's truly pocket-sized. The production model is expected to be on sale early next year, at a cost of about £50. It is estimated that the set's batteries should give more than 15 hours viewing time.

Research and development, in conjunction with the National Research and Development Corporation, has taken five years.

A total investment of £5m is to be spread over four years up to 1985. Phase one (up to 1982) will require £1.25m investment. The Scottish Economic Planning Department will supply £1.5m, while £1.1m will be made available from a Regional Development Grant. Sinclair Research is to supply the remainder.

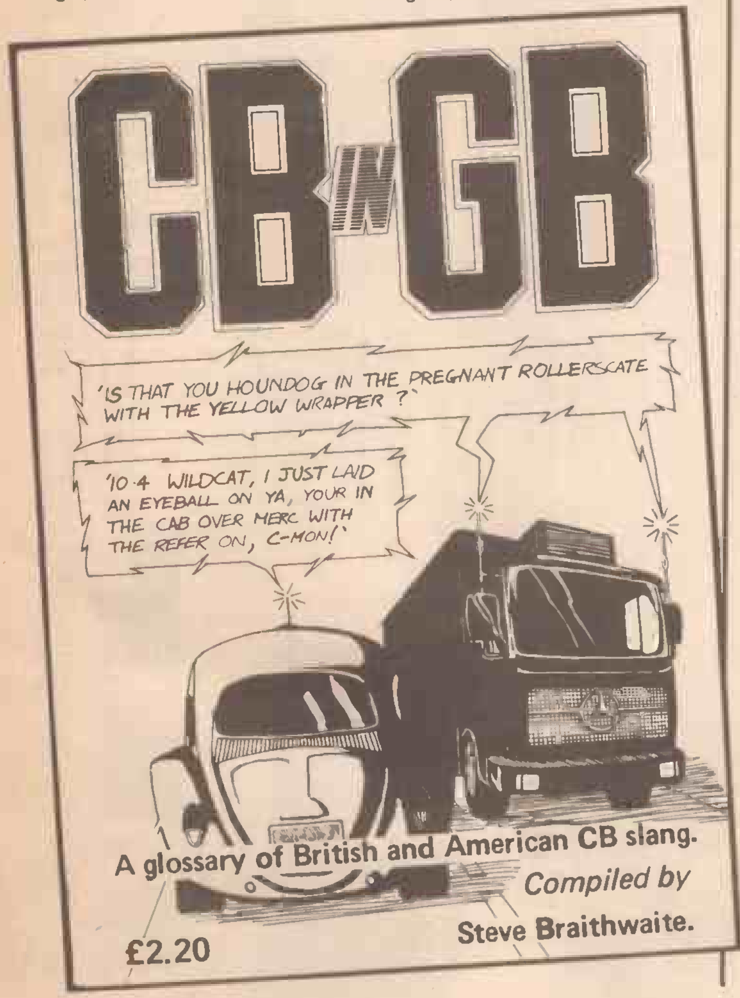
Production of the tubes and the sets will start in 1982 in Dundee, providing employment for an estimated 250 people in the first year. This figure could rise to 1000 by 1985.

Guide to CB Language

Small enough to tuck into your pocket (105 by 150 by 8 mm), CB In GB gives you a comprehensive guide to CB slang.

Of course, until CB becomes legal, it is doubtful whether more than (what is the latest estimate?) say, 800 000 people would find a use for it! But a least you can get some practice with the lingo — at a cost of £2.20.

CB in GB was compiled by Steve Braithwaite, and is published by The Cherwell Press, 2 Station Field Industrial Estate, Kidlington, Oxford OX5 1JD.



British Toy & Hobby Fair

So many toys and kits were on display at the British Toy & Hobby Fair, held at Earls Court, London between 31 January and 4 February, that we couldn't possibly give a fair coverage in such limited space. The interest for HE, as you can imagine, was in electronic games rather than cuddly toys, two examples of these games being Split Second from Palitoy and Milton from Milton Bradley.

Split Second incorporates a LED display screen and provides a variety of maze games of varying degrees of difficulty. (These are especially difficult when the obstacles are made invisible!) It costs around £37.50.

Milton is what is claimed to be a 'talking computer'. It begins with: 'You've turned me on. I'm Milton — who's out there? Hee hee hee — pick your play'. And you can select one of three word games for one or more players. Price is around £48.

More electronic toys will be included in next month's Gadgets, Games & Kits supplement.

HE Electronic Organ On Display

Starting next month in HE will be an exciting new project for you to build: a five-octave electronic organ *for under £100.*

A special demonstration of this organ has been arranged by the Electronic Organ Constructors Society. It will take place at 2.30 pm on Saturday 16 May at:

St. David's Church Hall,
Lough Road,
London N7

The nearest Underground station is Caledonian Road (Piccadilly line): so don't miss this opportunity to see and hear a project before you build it.

Selectavision For United States

Selectavision — RCA's video disc system — is due for its launch in the US on 22 March 1981. (Details of the system were given in View Into Video Discs, HE December 1980, pp 18 to 22.)

RCA gave a special presentation to 5000 dealers throughout the US during February this year — using satellite transmission from New York.

Initial price for the system is estimated as being 'just below $500'.

The CED (capacitance electronic disc) can store a two hour programme (that is, 60 minutes/side), but it is expected that average programme length will be 90 minutes. Discs will cost initially between $15 to $25 depending on programme material. A total of 100 titles will be launched initially.

As mentioned in View Into Video Discs, the Selectavision machines will be for *mono* sound. But a stereo version is to be launched in Europe during 1982. (The Japanese will probably have stereo versions by this time too.)

A mono launch has been made in the US because there are no stereo TVs, most films are in mono and it has helped to keep the cost of the system down.

We plan to take another look at video discs later this year, to keep you informed of developments.

We've Had Enough

That's it! We can't take anymore.

Our technical department is so overloaded that we have had to make the decision to call a halt to telephoned technical enquiries. However, our written technical enquiry service is still operating.

But *please* remember, if you have a project enquiry we can only answer it if you send a SAE with it.

We cannot answer any queries regarding modifications to our designs.

Note For Our Overseas Readers

Payments for backnumbers, subscriptions, specials etc arrive at Modmags in an interesting variety of forms.

We'd like to make it clear that we can only accept payments from overseas in one form: *Sterling Banker's Orders*, made payable to Modmags Ltd.

Not quite Electronics News, but it will help speed up our service to outside the UK.

Keeping Things Tidy

Three products from Edward Roland's recently-introduced range should help you keep your electronic components and odds and ends in order: a multi-drawer storage cabinet and 10- and 14-compartment cases.

Overall size of the cabinet is 11¾" by 5½" by 5½", and it contains 10 see-through drawers mounted in a dark brown cabinet. Cost is £7.75.

The 14-compartment case is 13¾" by 9½" by 2", finished in beige and has a clear lid with a clasp. It has various-sized compartments. Cost is £5.75.

The smaller case (10½" by 5½" by 1¼") has 10 equal-sized compartments, a hinged lid and it costs £2.40.

All the above prices include VAT and post and packing in the UK.

Edward Roland Ltd., 215 Putney Bridge Road, London SW15 2NY.

Important Notice

Readers have recently confused Electronics Today Limited as being associated with the ownership of our Magazine, Electronics Today International. Our Magazine is owned by Modmags Limited, part of the Argus Press Holdings Limited Group of Companies.

Electronics Today Limited advertises in our Magazine as "Metac", but so as to prevent any further confusion we wish to make it clear that Electronics Today Limited is not owned or managed by any member of the Argus Press Holdings Limited Group of Companies.

Errata

And now for a compilation of the errors arising in January's projects.

In the Ladder-of-Light sound-into-light module there should be a link joining pins 6 & 7 of IC1 and there should also be a track break under C5.

The Bench Amplifier has two faults — the battery clip is shown reversed (oops) and transistor Q1 should be moved down one complete strip, ie it should mount into strips E,F and G *not* D,E and F.

Finally, the Chuffer project suffered wrong numbering — the left-hand capacitor C9 in Fig.3 should in fact, be C8.

Another Thandar Digital Multimeter

The last Thandar DVM that we looked at in Monitor was the TM352, in the November 1980 issue. (We compared the TM352 with the TS1000 from Eagle International.)

Latest from the Thandar stable is the TM354 which, at £39.95 plus VAT, is seen by Sinclair Electronics as one of the lowest-priced hand-held multimeters on the market.

Main features are a 2000 hour battery life and protection on all 14 ranges. It has a 3½-digit LCD display (0.5" characters) and is supplied with test prods and an ABS case 155 by 75 by 30 mm. Weight is 165 g without batteries. It uses a 9 V alkaline battery (not supplied). Diode check facility is included.

A brief specification is given below:

Input Impedance	10M (DC), 4.5M (AC)
DC voltage	0 V to 1000 V in four ranges
AC voltage	0 V to 500 V in two ranges
DC current	0 mA to 2000 mA in four ranges
Resistance	0R to 2000k in four ranges
Accuracy	Example: '±0.75% of reading +1 digit' on 2 V and 20 VDC ranges

Further details from: Sinclair Electronics, London Road, St Ives, Huntingdon, Cambs PE17 4HJ (tel. 0480 64646)

. NEXT MONTH. NEXT MONTH. NEXT MONTH. NEXT MONTH. NEXT MONT

Hobby Electronics

THE MAY ISSUE IS ON SALE APRIL 10th

EXTRA EXTRA — READ ALL ABOUT IT!

Judging by the telephone queries and the reader response we get every time we publish articles on new electronic games or gadgets, you obviously reckon that we are the undisputed experts on the subject (we don't disagree!). Well, starting from next month you'll get an added bonus whenever you buy HE in the form of an 8-page pull-out supplement on the latest in gadgets, games — *and kits*. And we're calling it just that — Gadgets, Games & Kits.

In this new monthly feature we'll be covering all the latest devices on the scene — we'll keep you right up to date on this rapidly moving area in electronics, with reports, tests and news.

ELECTRONICS IN MUSICAL INSTRUMENTS

We invited Tim Orr to write this special feature on how electronic instruments have made dramatic changes over the last few decades. He describes, for instance, the functions of active devices (valves, transistors and ICs) during this time, and the impact of speciallised large-scale ICs. (The circuit of a complete musical instrument now can be contained in a handful of these ICs.) He also gives a round-up of some of the latest instruments to hit the music world.

INFRA-RED CONTROLLER

Our IR Controller project consists of two parts: a transmitter which emits invisible beams of infra-red light and a receiver to detect them. Connect the receiver to any mains-powered electrical equipment, up to 500 W (eg your hi-fi, TV, bedside lamp, etc) and you can switch them on and off remotely.

ELECTRONIC ORGAN

At last! A home-constructor's dream come true — a cheap-to-build (under £100) *five-octave* organ!

It features a 2 watt monitor amplifier with headphone output for home and private use, and a pre-amp output to play it through a higher powered amplifier for concert use. Five voices and a tremolo effect are also included. Interwiring is kept to an absolute minimum and the four circuit boards have easy layouts. Don't miss it!

PLUS PROJECTS:

Things to do, things to build, test equipment, musical effects, etc, etc.

PLUS FEATURES:

What to do when a transistor stops working, your very own letters, constructional hints & tips and theory.

PLUS, PLUS, PLUS

News, views, circuits, CB, all in next month's information-packed issue of Hobby Electronics — the magazine that's written for the electronics enthusiast and hobbyist.

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

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POLYESTER RADIAL LEAD CAPACITORS: 250V: 10nF, 15n, 22n, 27n 6p; 33n, 47n, 68n, 100n 7p; 150n, 220n 10p. 330n, 470n 13p; 680n 19p; 1µF 23p; 1µ5 40p; 2µ2 46p; 4µ7 60p.

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ELECTROLYTIC CAPACITORS: (Values are in µF). 500V: 10 52p; 47 78p; 250V: 100 65p; 63V: 0.47, 1.0, 1.5, 2.2, 2.5, 3.3 8p; 4.7 9p; 6.8, 10 10p; 15, 22 12p; 33 15p; 47 12p; 100 19p; 1000 70p; 50V: 47 12p; 68 20p; 220 24p; 470, 32p 2200 90p; 40V: 4.7, 15, 22 9p; 3300 90p; 4700, 120p; 25V: 1.5, 6.8, 10, 22 8p; 33 9p; 47 8p; 100 11p; 150 12p; 220 15p; 330 22p; 470, 25p; 680, 1000 34p; 2200 50p; 3300, 76p; 4700 92p; 16V: 40, 47, 100 9p; 125 12p; 220 13p; 470, 20p; 680 34p; 1000 27p; 1500, 31p; 2200, 36p; 3300 74p; 4700 79p.
TAG-END TYPE: 450V: 100µF 65p; 70V: 4700, 245p; 64V: 3300 198p; 2200 139p; 50V: 3300 164p; 2200 110p; 40V: 4700 160p; 25V: 10,000 320p; 15,000 345p.

TANTALUM BEAD CAPACITORS 35V: 0.1µ, 0.22, 0.33 15p; 0.47, 0.68, 1.0, 1.5 16p; 2.2, 3.3 18p; 4.7, 6.8 22p; 10 28p. 16V: 2.2, 3.3 16p; 4.7, 6.8, 10 18p; 15 36p; 22 30p; 33, 47 40p; 100 75p. 10V: 15, 22 26p; 33, 47 35p; 100 55p.

MYLAR FILM CAPACITORS 100V: 1nF, 2, 4, 4n7, 10 6p; 15nF, 22n, 30n, 40, 47 7p; 56 100n, 200 8p; 470n/50V: 12p.

MINIATURE TYPE TRIMMERS 2-6pF; 2-10pF; 22p; 2-25pF, 5-56pF 30p; 10-88pF 38p

COMPRESSION TRIMMERS 3-40pF; 10-80pF 20p; 20-250pF 28p; 100-580nF 39p; 400-1250pF 48p

POLYSTYRENE CAPACITORS: 10pF to 1nF 8p; 1.5nF to 10nF 10p

SILVER MICA (Values in pF) 2, 3.3, 4.7, 6.8, 8.2, 10, 15, 18, 22, 27, 33, 39, 47, 50, 56, 68, 75, 82, 85, 100, 120, 150, 180pF 15p each; 200, 220, 250, 270, 300, 330, 360, 390, 470, 600, 800, 820 21p each; 1000, 1200, 1800, 2200 30p each; 3300, 4700pF 60p each.

CERAMIC CAPACITORS 50V: 0.5pF to 10nF 4p; 22n to 47n 5p. 100n 7p.

EURO BREADBOARD £5.20.

POTENTIOMETERS: Rotary, Carbon, Track, 0.25W Log & 0.5W Lin. 500Ω, 1KΩ & 2KΩ (Linear only) Single Gang 29p
5KΩ-2MΩ Single Gang 29p
5KΩ-2MΩ Single Gang D/P Switch 78p
5KΩ-2MΩ Double Gang 88p

SLIDER POTENTIOMETERS
0-25W log and linear values 60mm
5KΩ-500KΩ single gang 70p
10KΩ-500KΩ dual gang 110p
Self Stick Graduated Bezels 36p

PRESET POTENTIOMETERS
Vertical & Horizontal
0.1W 50Ω—5MΩ Miniature 7p
0-25W 100Ω—3.3MΩ horiz. 10p
0-25W 200Ω—4.7MΩ vert. 10p

RESISTORS — Carbon Film, High Stability, Low Noise, Miniature Tolerance 5%.

	RANGE	VAL	1-99	100+
¼W	2Ω2—4M7	E24	2p	1p
½W	2Ω2—4M7	E12	2p	1p
1W	2Ω2—10M	E12	5p	4p
2%Metal Film 10Ω-1M			6p	4p
1%Metal Film 51Ω-1M			8p	6p

100+ price applies to Resistors of each value not mixed.

S-Dec 350p U-Dec 'B' 699p
U-Dec 'A' 465p Euro Breadboard 520p

OPTO ELECTRONICS

LEDs plus clips	
TIL209 Red	13
TIL211 Grn.	17
TIL212 Yel.	18
.2 Red	14
.2 Yel. Grn.	18
Square LEDs	29
ORP12	86
2N5777	45
LD271	40
SFH205	98
TIL32	58
TIL78	60
7 Segment Displays	
TIL321 C.A .5	115
TIL322 C.C .5	115
DL704 C Cth .3	99
DL707 C A .3	99
.3" Green CA	120
DL747 C.A .6	180
FND357	120
MAN3640	175
10 Seg Bargraph	225
LCD 3½ Digit	675

SWITCHES
MEC, Black body, Red, Grn, Blue,
SRL Latching 95
SRM Momentary 95
TOGGLE: 2A 250V
SPST 33
DPDT 44
4 Pole on/off 54

SUB-MIN TOGGLE
SP changeover 60
SPST on/off 54
DPDT 6 tags 75
DPDT c/of 80
DPDT Biased 145

SLIDE 250V:
1A DPDT 14
1A DP c/off 15
½A DPDT 13
4 pole c/over 24

We stock parts for most of the projects in this magazine.

ACCESS
Just phone your order through. We deal with the rest (but min. £10 please).

SWITCHES Miniature Non-Locking
Push to Make 15 Push Break 20
ROCKER: SPST on/off 10A/250V 28
ROCKER: Illuminated (black) chrome bezel, lights when on: DPST 3A 240V 85
ROTARY: (ADJUSTABLE STOP) 1 pole/2-12 way, 2p/2-6 way, 3p/2-4 way, 4p/2-3 way 45
ROTARZ: Mains 250V AC, 4 Amp 62

DIL SOCKETS (Low Profile — Texas) 8 pin 10p; 14 pin 12p; 16 pin 13p; 18 pin 16p; 20 pin 22p; 24 pin 30p; 28 pin 35p; 40 pin 42p.

VOLTAGE REGULATORS

1A	TO3	+ ve		−ve	
5V	7805	145p		7905	220p
12V	7812	145p		7912	220p
15V	7815	145p		—	
18V	7818	145p		—	
1A	TO220	Plastic Casing			
5V	7805	60p		7905	65p
12V	7812	60p		7912	65p
15V	7815	60p		7915	65p
18V	7818	60p		7918	65p
24V	7824	60p		7924	65p
100mA	TO92	Plastic Casing			
5V	78L05	30p		79L05	65p
6V	78L62	30p		—	
8V	78L82	30p		—	
12V	78L12	30p		79L12	65p
15V	78L15	30p		79L15	65p

CA3085	95p	LM323K	625p	TAA550	50p
LM300H	170p	LM325N	240p	TBA625B	95p
LM305H	140p	LM326N	240p	TDA1412	150p
LM309K	135p	LM327	270p	78H05	595p
LM317K	350p	LM723	39p	78HG5	650p

JACKSONS VARIABLE CAPACITORS

Dielectric
100/300pF 195p
500pF 250p
6:1 Ball Drive 4511/DAF 160p
Dial Drive 4103 6:1/36:1 775p
Drum 54mm 59p
0-1.365pF 325p
00-2.365pF 395p
0 2 365pF with slow motion Drive 450p
00 208/176 395p
00 208/176 with slow motion drive 450p
C804-5pF 10: 15: 25: 50pF 278p
100, 150pF 350p
'L' 3x310pF 725p
00.3x25pF 550p

DENCO COILS
'DP' VALVE TYPE
Range 1 to 5 Bl., Rd., Tl., Wht. 106p
6-7 BYR 95p
1.5 Green 130p
'T' type 1 to 5, Bl, Rd. Wht. Yl 130p
B9A Valve Holder 38p
RDT2 120p
RFC 5 chokes 120p
RFC 7 (19mH) 133p
13; 14; 15; 16; 17 110p
18/1.6 120p
18/465 135p
TOC 1 110p
MW5FR 112p
MW/LW SFR 136p

VEROBOARD

0.1" Pitch	clad	plain
2½ x 3¾"	66p	47p
2½ x 5"	75p	—
3¾ x 3¾"	75p	—
3¾ x 5"	86p	72p
3¾ x 17"	290p	192p
4¾ x 17"	390p	—
Pkt of 100pins	50p	
Spot face cutter	107p	
Pin insertion tool	147p	

COPPER
Clad Boards
Fibre glass
6x6" 90p
6x12" 150p
S.R.B.P.
9"x8" 95p
Ferric Chloride, 1lb Anhydr. 195p

DIODES

BY126	12
BY127	12
CR033	250
OA9	40
OA47	12
OA70	12
OA79	15
OA85	15
OA90	8
OA91	8
OA95	8
OA200	8
OA202	8
IN914	4
IN916	5
IN4001/2	5
IN4003	6
IN4004/5	6
IN4006/7	7
IN4148	4
IN5401/2	15
IN5404	16
IN5406	17
IN5408	19
IS44	9
1S921	9
6A/100V	40
6A/400V	50
6A/800V	65

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ZENERS

Range: 2V7 to 39V 400mW 8p each
Range: 3V3 to 33V, 1.3W 15p each

NOISE

Z5J 180p

BRIDGE RECTIFIERS

(plastic case)	p
1A/50V	20
1A/100V	22
1A/400V	29
1A/600V	34
2A/50V	35
2A/200V	40
2A/400V	46
2A/600V	65
6A/100V	83
6A/400V	95
6A/600V	125
10A/200V	215
10A/600V	350
25A/200V	240
25A/600V	395
BY164	56
VM18	50

DIAC

ST2 25

SCRs Thyristors

1A200V	58
1A400V	70
5A40V	32
5A/400V	40
5A/600V	48
8A/300V	60
8A/600V	95
12A/100V	78
12A/400V	95
12A/800V	188
BT106	150
BT116	180
C106D	38
TIC44	24
TIC45	29
TIC47	35
2N5062	32
2N5064	38
2N4444	130

TRIACS

3A100V	48
3A200V	54
3A400V	56
8A100V	60
8A400V	69
8A800V	115
12A100V	78
12A400V	82
12A800V	135
16A100V	103
16A500V	115
25A800V	220
25A1000V	480
T28000D	120

TTL 74

7400	11
7401	11
7402	11
7403	14
7404	14
7405	18
7406	38
7407	36
7408	17
7409	20
7410	17
7411	25
7412	20
7413	32
7414	38
7416	30
7417	30
7420	19
7421	38
7422	25
7423	28
7425	28
7426	43
7427	32
7428	35
7430	19
7432	27
7433	36
7437	35
7438	32
7440	20
7441	68
7442	58
7443	120
7444	116
7445	105
7446	132
7447	72
7448	75
7450	20
7451	20
7453	20
7454	20
7460	20
7470	40
7472	30
7473	35
7474	34
7475	56
7476	40
7480	52
7481	120
7482	75
7483	90
7484	99
7485	105
7486	33
7489	205
7490	42
7491	84
7492	50
7493	57
7494	85
7495	70
7496	80
7497	176
74100	130
74104	62
74105	62
74107	34
74109	60
74110	54
74111	68
74112	170
74116	160
74118	85
74119	120
74120	75
74121	35
74122	50
74123	65
74125	50
74126	45
74128	65
74132	55
74136	65
74141	75
74142	185
74143	250
74145	90
74147	150
74148	125
74150	130
74151	70
74153	70
74154	120
74156	75
74157	70
74159	165
74160	99
74161	99
74162	99
74163	99
74164	120
74165	120
74166	130
74167	205
74170	205
74172	375
74173	110
74174	100
74175	82
74176	80
74177	85
74178	110
74180	90
74181	280
74182	85
74184	130
74185	130
74188	310
74190	130
74191	120
74192	120
74193	120
74194	102
74195	75
74196	99
74197	88
74198	160
74221	150
74246	150
74247	151
74248	189

74LS

74LS00	13
74LS01	13
74LS02	15
74LS03	15
74LS04	16
74LS05	23
74LS08	22
74LS09	23
74LS10	20
74LS11	32
74LS12	32
74LS13	40
74LS14	60
74LS15	40
74LS20	21
74LS21	32
74LS22	35
74LS26	44
74LS27	35
74LS28	35
74LS30	20
74LS32	25
74LS42	66
74LS47	85
74LS48	105
74LS55	30
74LS63	150
74LS73	45
74LS74	35
74LS75	45
74LS76	45
74LS83	105
74LS85	80
74LS86	38
74LS90	50
74LS92	75
74LS93	60
74LS95	115
74LS96	120
74LS107	45
74LS109	75
74LS112	40
74LS113	75
74LS114	40
74LS122	70
74LS123	75
74LS124	180
74LS125	45
74LS126	45
74LS132	60
74LS136	55
74LS138	70
74LS139	70
74LS145	120
74LS147	210
74LS148	170
74LS151	90
74L+153	85
74LS155	75
74LS157	70
74LS158	70
74LS160	90
74LS161	98
74LS162	110
74LS163	95
74LS164	115
74LS165	145
74LS166	175
74LS173	105
74LS174	110
74LS175	110
74LS181	295
74LS190	95
74LS191	95
74LS192	95
74LS193	99
74LS195	130
74LS196	120
74LS197	85
74LS221	120
74LS240	165
74LS241	165
74LS242	165
74LS243	165
74LS244	195
74LS245	190
74LS247	135
74LS248	135
74LS249	135
74LS251	130
74LS365	65
74LS367	65

CMOS★

4000	14
4001	14
4002	15
4006	86
4007	19
4008	76
4009	46
4010	50
4011	18
4012	24
4013	43
4014	80
4015	82
4016	35
4017	70
4018	76
4019	42
4020	85
4021	90
4022	85
4023	24
4024	60
4025	24
4026	170
4027	45
4028	92
4029	98
4030	55
4031	185
4032	125
4033	175
4034	213
4035	95
4036	275
4037	115
4038	110
4039	299
4040	85
4041	80
4042	70
4043	80
4044	80
4045	175
4046	96
4047	98
4048	65
4049	35
4050	38
4051	86
4052	86
4053	86
4054	130
4055	130
4056	136
4057	2850
4059	575
4060	110
4061	1225
4062	995
4063	120
4066	46
4067	430
4068	26
4069	22
4070	26
4071	25
4072	25
4073	25
4075	23
4076	85
4077	30
4078	28
4080	25
4081	26
4082	26
4085	90
4086	90
4089	150
4093	55
4094	210
4095	95
4096	95
4097	340
4098	115
4099	150
4160	115
4161	115
4162	115
4163	115
4174	110
4175	120
4194	115
4408	790
4409	790
4410	750
4411	950
4412F	1250
4412V	1520
4415F	480
4415V	480
4419	280
4422	570
4432	1050
4433	995
4435	850
4440	999
4450	350
4451	350
4452	—
4490F	350
4490V	350
4501	28
4502	105
4503	65
4506	75
4507	48
4508	280
4510	85
4511	98

LINEAR ICs

2102-2	225
2114	175
2708	350
2716	450
4116	200
6502	650
709C-8 pin	35
710	67
733	75
741C 8 pin	17
747C	78
748C	36
753	150
810	159
81LS95	135
81LS96	135
81LS97	140
AY-1-0212	595
AY-1-1313A	660
AY-1-1320	225
AY-1-5050	99
AY-1-5051	160
AY-3-8500	390
AY-3-8910	850
AY-5-1224A	235
AY-5-1230	450
CA3018	68
CA3020	186
CA3023	191
CA3028A	80
CA3035	235
CA3045	365
CA3046	70
CA3048	214
CA3059	195
CA3080E	65
CA3081	190
CA3085	95
CA3089E	215
CA3090AQ	375
CA3123E	150
CA3130	90
CA3140	48
ICL7106E	795
ICL7107	975
ICL8038CC	340
ICM7205	1150
ICM7216A	1950
ICM7217A	790
ICM7555	89
LD130	452
LF351	48
LF356	90
LM300HX	170
LM301A	26
LM308	95
LM318	200
LM324	50
LM339	68
LM348	90
LM349	115
LM379	375
LM380	80
LM381	145
LM382	125
LM386	99
LM387	120
LM1458	45
LM3900	60
LM3909N	70
LM3911	125
LM3914	240
LM3916	255
M252	625
M253AA	1150
MC1304P	260
MC1310	150
MC1458	45
MC1488	90
MC1489	90
MC1495	350
MC1496	92
MC1710	79
MC3340P	120
MC3360P	120
MC3401	52
MC3403	135
MFC6040	97
MK50398	635
MM5303	635
MM5307	1275
NE543	210
NE544	185
NE555	22
NE556	55
NE560	325
NE561	398
NE562	410
NE564	435
NE565	120
NE566	180
NE567	170
NE570	450
NE571	420
RC4136	99
S5568	265
SAB3209	425
SAB3210	275
SN76003	240
SN76013	170
SN76023	170
SN76033	195
SN76477	175
TAA621	250
TBA120	70
TBA641	250
TBA800	90
TBA810	95
TCA965	120
TDA1004	290
TDA1008	310
TDA1022	575
TDA1024	105
TDA1490	290
TDA2020	320
TL061	46
TL063	95
TL071CP	45
TL074	140
TL081	42
TL082	70
TL083	95
TL084	120
UAA170	170
UAA180	170
Z80	780
Z80A	899
Z80CTC	595
Z80P10	575
ZN1034E	200
ZN1040E	685
ZN414	95
ZN424E	130
ZN425E	415

TRANSISTORS

AC125	35
AC126	25
AC127	25
AC128	25
AC141	30
AC142	30
AC176	28
AC187	28
AC188	30
ACY17	70
ACY18	70
ACY20	75
ACY21	75
ACY22	60
AD140	120
AD149	79
AD161	42
AD162	42
AF115	60
AF139	40
AF178	75
AF180	70
AF186	70
AF239	78
BC107	10
BC108	10
BC108B	12
BC108C	12
BC109	10
BC109B	12
BC109C	12
BC117	24
BC119	38
BC137	40
BC140	30
BC143	30
BC147	9
BC148	9
BC149	9
BC153	27
BC154	27
BC157	10
BC158	10
BC159	11
BC160	45
BC167A	10
BC168C	10
BC169C	10
BC170	15
BC171	11
BC172	11
BC177	20
BC178	20
BC179	20
BC182	10
BC182L	10
BC183	10
BC183L	10
BC184	10
BC184L	10
BC187	26
BC212	10
BC212L	10
BC213	10
BC213L	10
BC214	10
BC214L	10
BC307B	14
BC328	95
BC338	15
BC441	34
BC461	34
BC477	40
BC516	40
BC517	40
BC547	14
BC548	14
BC549	14
BC556	15
BC557	45
BC558	15
BC559	15
BCY70	16
BCY71	18
BCY72	20
BD131	48
BD132	48
BD133	60
BD135	45
BD136	40
BD137	40
BD138	40
BD139	40
BD140	40
BD695A	85
BD696A	85
BDY17	195
BDY60	160
BDY61	160
BF115	35
BF167	29
BF173	27
BF177	25
BF178	30
BF179	35
BF180	38
BF194	12
BF195	12
BF196	12
BF197	12
BF198	16
BF200	30
BF224A	25
BF244	28
BF256	35
BF257	32
BF258	32
BF259	35
BF594	40
BF595	39
BFR39	23
BFR40	23
BFR41	23
BFR79	23
BFR80	25
BFR81	25
BFX29	28
BFX81	45
BFX84	26
BFX85	28
BFX86	28
BFX87	28
BFX88	28
BFY50	23
BFY51	23
BFY52	23
BRY39	40
BSX20	20
BSY65	35
BSY95A	25
BU105	170
BU205	190
BU208	200
E113	45
E176	50
E421	250
MJ2955	90
MJE340	54
MJE370	100
MJE371	100
MJE520	95
MJE521	95
MJE2955	99
MJE3055	70
MPF102	66
MPF103	36
MPF104	36
MPF105	36
MPF106	40
MPSA05	25
MPSA06	25
MPSA12	30
MPSA55	30
MPSA56	30
MPSU06	55
MPSU56	60
OC28	120
OC35	125
OC36	120
OC41	120
OC42	120
OC44	120
OC45	40
OC70	40
OC71	40
OC72	40
OC76	50
OC77	50
OC81	50
OC82	50
OC83	40
OC84	40
OC140	110
OC170	85
OC171	85
TIP29	34
TIP29C	60
TIP30	48
TIP30C	58
TIP31A	45
TIP31C	55
TIP32A	46
TIP32C	60
TIP33A	65
TIP33C	78
TIP34A	74
TIP34C	88
TIP35A	160
TIP35C	185
TIP36A	170
TIP36C	199
TIP41A	55
TIP41B	60
TIP42A	60
TIP42B	75
TIP120	90
TIP121	99
TIP122	99
TIP142	120
TIP147	120
TIP2955	60
TIP3055	60
TIS43	32
TIS44	45
TIS88A	50
TIS90	30
TIS91	32
ZTX107	11
ZTX108	11
ZTX109	12
ZTX300	13
ZTX301	16
ZTX302	16
ZTX303	25
ZTX304	17
ZTX314	25
ZTX326	30
ZTX341	30
ZTX500	14
ZTX501	15
ZTX502	15
ZTX503	18
ZTX504	25
ZTX531	25
ZTX550	25
2N526	58
2N696	30
2N697	23
2N698	40
2N699	48
2N706	19
2N708	19
2N918	35
2N930	20
2N961	65
2N1131	24
2N1132	24
2N1302	45
2N1304	65
2N1305	60
2N1671B	120
2N2160	350
2N2219A	28
2N2220A	23
2N2222	25
N2369A	18
2N2476	50
2N2484	27
2N2483	27
2N2497	63
2N2646	45
2N2894	30
2N2904	28
2N2905A	26
2N2906	26
2N2907	26
2N2926G	10
2N3053	26
2N3054	58
2N3055	48
2N3121	30
2N3133	45
2N3135	30
2N3252	46
2N3442	140
2N3568	25
2N3663	15
2N3702	10
2N3703	10
2N3704	10
2N3705	10
2N3706	10
2N3707	10
2N3708	10
2N3709	10
2N3710	10
2N3711	10
2N3713	140
2N3771	179
2N3772	195
2N3773	270
2N3819	22
2N3820	45
2N3822	65
2N3823	65
2N3866	90
2N3903	18
2N3904	18
2N3905	15
2N3906	17
2N4037	46
2N4058	10
2N4061	10
2N4062	10
2N4069	45
2N4859	78
2N4871	55
2N5135	20
2N5136	20
2N5138	18
2N5179	45
2N5180	45
2N5191	75
2N5305	24
2N5457	36
2N5458	36
2N5459	36
2N5485	36
2N5777	45
2N6027	32
3N128	112
3N140	112
40311	60
40313	130
40316	95
40317	60
40324	100
40326	60
40327	70
40348	120
40360	40
40361	50
40362	50
40407	60
40408	70
40411	285
40412	65
40467	130
40468	85
40594	105
40595	110
40603	110
40636	175
40673	95

New from Casio, world leaders in creative technology combined with high quality and reliability

A CLASSIC IN IT'S TIME

You don't have to be a highbrow to appreciate the beauty of this clock. Battery powered, it is ideal for office, lounge, bedroom, caravan or boat.

MA-1 ALARM CLOCK

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Large blue LCD display of full digital time. Symphonic alarm or buzzer, with snooze facility. Hourly time signal. Integral loudspeaker and amplifier with 3-position volume control. Built-in night time illumination. Alarm: "Symphonie Nr. 40 G moll" (W. A. Mozart, K.550) for about 30 seconds, or buzzer for 60 seconds. Three AA size batteries last approx. 15 months. Quartz accuracy. Dims: 43 x 115 x 76mm (1¾ x 4½ x 3 inches).

JOIN THE KEYBOARD REVOLUTION

By closely analysing the natural sound variations in the waves and pitches of different instruments, Casio have been able to trace the characteristics peculiar to each traditional instrument. Pitch, timbre and harmonics have been measured, digitalised and stored in electronic chip memory for faithful and exciting reproduction of the clarity and beauty of the originals.

CASIOTONE 401

RRP £345.

ONLY £295

Fully polyphonic. 8-note playing of 14 instruments and sounds over 4 octaves.
Rhythm accompaniment. 16 different rhythms with full-in auto-rhythm.
Casio Auto Chord. Allows one finger accompaniment. Just press one, two or three keys and play major, minor and seventh chords, with bass accompaniment, automatically. Combines with auto-rhythm for professional sounds.
Vibrato, delayed vibrato, sustain and hold are incorporated in the at-a-glance, simple to use operational panel. Pitch control makes group tuning easy.
Compact 4⅝ x 31⅜ x 12⅞ inches with integral amplifier and speaker. The lightweight (28.2lb.) allows playing anywhere there is an A.C. socket. Stand **£39.**

CASIOTONE 301

The same size and basic specification as the 401 above, the 301 does not have Casio Auto Chord or built-in sustain and hold facilities. There are 8 rhythm voices with a variation on each. Weight 27lbs.

£245

CASIOTONE MT-30

RRP £115.

ONLY £95

Fully polyphonic playing of 22 instruments and sounds over 3 octaves, 4-position sound memory lets you switch between pre-selected sounds without pause.
Built-in vibrato and sustain functions greatly enhance the overall musical effect.
Compact 2⅜ x 22¾ x 6½ inches, with built-in amplifier and loudspeaker.
Battery/mains power source and lightweight (6lb.) allows playing anywhere.

CASIOTONE 201 and M-10

Please telephone for availability.
201. Mains version of the MT-30, 29 instruments over 4 octaves. **£245.**
M-10. Four instruments over 2½ octaves. Battery/mains. **£69.**

CASIO CALCULATORS

BQ-1100 Biolator calculator, with calendar, two alarms, countdown alarm, stopwatch, time memory, three date memories (£17.95). £14.95.
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SEND 20p (postage) for our illustrated catalogue of Casio watches and calculators and selected Seiko watches.

KEEP A DATE WITH CASIO

Yo always wanted a musical calculator with date memories and date/time alarms – HERE IT IS!

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Clock, universal calendar, date memories, daily alarm, two daily or date/time alarms, hourly chimes, stopwatch, countdown alarm, time memory, calculator.
Clock display: Hours, minutes, seconds, am/pm, or hours, minutes, full calendar.
Calendar: Pre-programmed from 1901 to 2099. Full month display.
Date memories: Any day or days pre-setable within 12 month period. (Birthdays, etc.).
Alarms: Alarm 1 – Daily alarm. Alarm 2 & 3 – Daily alarms or time alarms on pre-set dates. (Pre-programmed melodies or electronic buzzer).
Stopwatch: 1/10 second to 24 hours; net; lap and first and second place. Or
Time memory: 24-hour system. The time of any other zone can be stored.
Calculator: Optional musical keys, full memory and percentage. Two silver oxide batteries last approx. one year. RRP £22.95. ¼ x 4½ x 2½ inches. Leatherette wallet with window.

£19.95

UC-360. Card-sized version of above. 7/32 x 3⅝ x 2⅜''. £19.95.
UC-3000. Office desk version. Angled display, 1¾ x 4 x 6¼''. £27.95.

CASIO'S AMAZING NEW

FX-3500P

Programmable. Non-volatile memories and stores. Statistical regression and integrals.
38 functional (non-volatile) steps, 2 programme storage capability. Unconditional and conditional jumps, 7 (non-volatile) memories, one independent, 6 constant memories, 18 pairs of parentheses, nestable in 6 levels.
61 built-in functions, including: Integrals (Simpson's rule). Linear regression, logarithmic regression, exponential regression and power regression. Hyperbolics, sexagesimal and co-ordinates conversions. 10 digit mantissa or 10+2 exponent. Two silver oxide batteries give approximately 1,000 hours' continuous use with power-saving automatic cut-off, with data and memory protection.
Dims: 9/32 x 2⅛ x 5¼ inches. Supplied with leatherette wallet.

ALL THIS FOR ONLY £22.95

FX180P. Hand held version without hyperbolics 2 x AA batteries, ¾x3x5⅞. £19.95
FX-2700P. As FX3500P but 8+2; without integrals, regression, 1 program... £19.95
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W150B

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12-MELODY CHRONOGRAPHS with countdown alarm. M-12 resin case/strap £24.95. M-1200 all stainless steel £29.95.
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NEW! F-500 sports chronograph. Resin case/strap £9.95.

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HE Hi-fi Amplifier System-1

Pre-amplifier

The first part of an exciting new stereo amplifier system, this high quality pre-amplifier adds a new meaning to the term 'wireless'. Its one-board construction means that it is easy to build with none of the wiring problems usually associated with audio projects

IT HAS BEEN over a year since we last published a high-quality stereo amplifier (5080 System, March 1980). But even that system, good as it is, does not compare with our latest amplifier, the first part of which (the pre-amplifier) is given here. In a couple of months' time, after we've dealt with the pre-amplifier, the power amplifier will be described. Either of these two units can be used with an existing system, so if you simply wish to upgrade your present hi-fi system with a higher quality pre-amplifier or power amplifier then this is your chance. The power amplifier is also ideally suited as a high power disco amplifier. However, if you build the complete HE Amplifier you will be rewarded with a low-distortion, low-noise (yet high-power — up to 100 W per channel) stereo hi-fi amplifier.

Board With Life

From the photographs you can see that the pre-amplifier is built totally on one board. All switches, pots, input and output connectors and the power supply are on this board, which means that there are no interconnections which might cause interference or wiring errors. The board is available with the component layout printed onto it so you shouldn't go wrong. You simply line up each component from the circuit diagram and insert it in its marked place on the board.

The pre-amplifier accepts inputs from the magnetic (phono) cartridge of a record deck, a tuner or a tape recorder (cassette or reel-to-reel). Switch SW2 selects the one required. Stereo (two physically separate channels) or mono mode (two channels with a common signal) is also selected by SW2. Bass, treble, balance and volume controls cater for individual tonal and volume requirements.

You Pays Your Money . . .

Designed around standard 8-pin operational amplifier ICs (op amps) the pre-amplifier will run happily on the good old 741s. But, if you want *really* top-class performance then we advise that you use the higher-quality op amps with the numeric coding 5534. These are, inevitably, more expensive but worth the difference if you can afford them. A suitable compromise is to use 5534s for the phono input stage (IC1 and IC101) with 741s as all other op amps. This is because the phono stage is a high-gain amplifier and any noise introduced by the op amp itself is thus amplified and made more apparent.

Construction

The pre-amplifier board from Capricorn Electronics is shown in **Fig. 1** and you can see that all component positions are printed in white. So using either the board's component markings or our own overlay shown in **Fig. 6** . the PCB can be built up. The following procedure applies to *our* overlay.

Insert and solder the components of the power supply first (ie, R20, 21 and 24, C25 to C30, IC4 and 5, SW1, the 100 mA fuse plus holder, BR1, and the link underneath the body of C29). If you have a transformer which supplies ± 12 VAC you should now connect it to the input of the power supply and

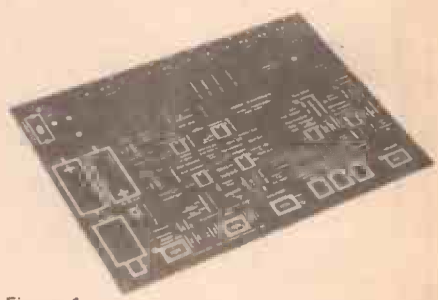


Figure 1.
The screened printed circuit board from Capricorn Electronics

check, using a multimeter, that you have ± 15 VDC at the output (ie, between the − 15 V rail and 0 V there should be a potential difference of 15 V, and between 0 V and the + 15 V rail also should be 15 V). The board at this stage is shown in **Fig. 2** .

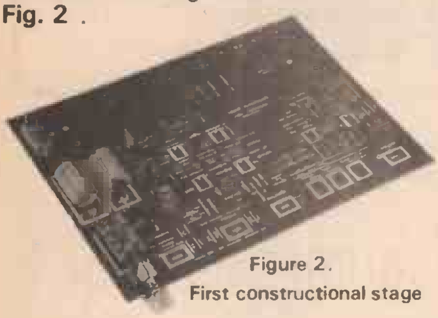


Figure 2.
First constructional stage

Next, insert and solder all links, IC sockets and the input/output phono connectors, followed by the resistors and capacitors for the rest of the circuit. All tantalum capacitors must be polarised as shown in the overlay.

The bank of three push-button signal switches (SW2) should be soldered into place, making sure that it is flush to the surface of the board. Now, with a small file (a needle file is ideal) carefully clean up the left-hand, outside edge of the switch bank so that it can be soldered. Just to the left of the switches is a solder point and you should now insert and solder a short link between this point and the switch body. This earthing of the switch body will help shield against interference.

Put the four pots in next, but make sure they are squarely lined-up before you solder them. Then, using your file, scrape a small notch in the centre-top of the body of each pot, of just sufficient depth to remove the plating. Solder a length of tinned, single-strand wire along the top of the pots; that is, to the notch prepared on each one. Just to the left of the Balance pot is a solder point on the board and a link between this point and the wire over the pots should now be made, again to help

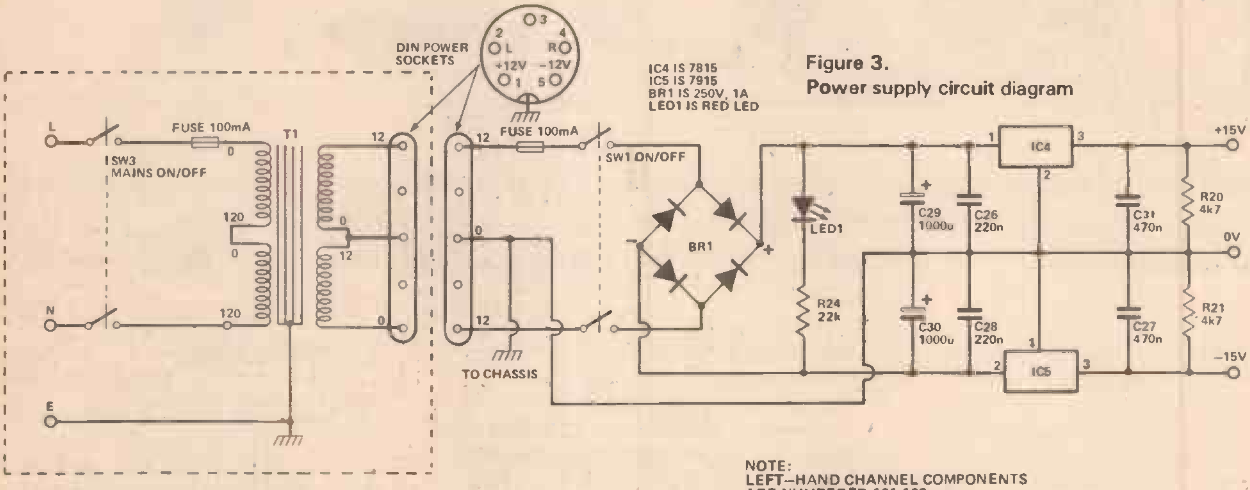


Figure 3.
Power supply circuit diagram

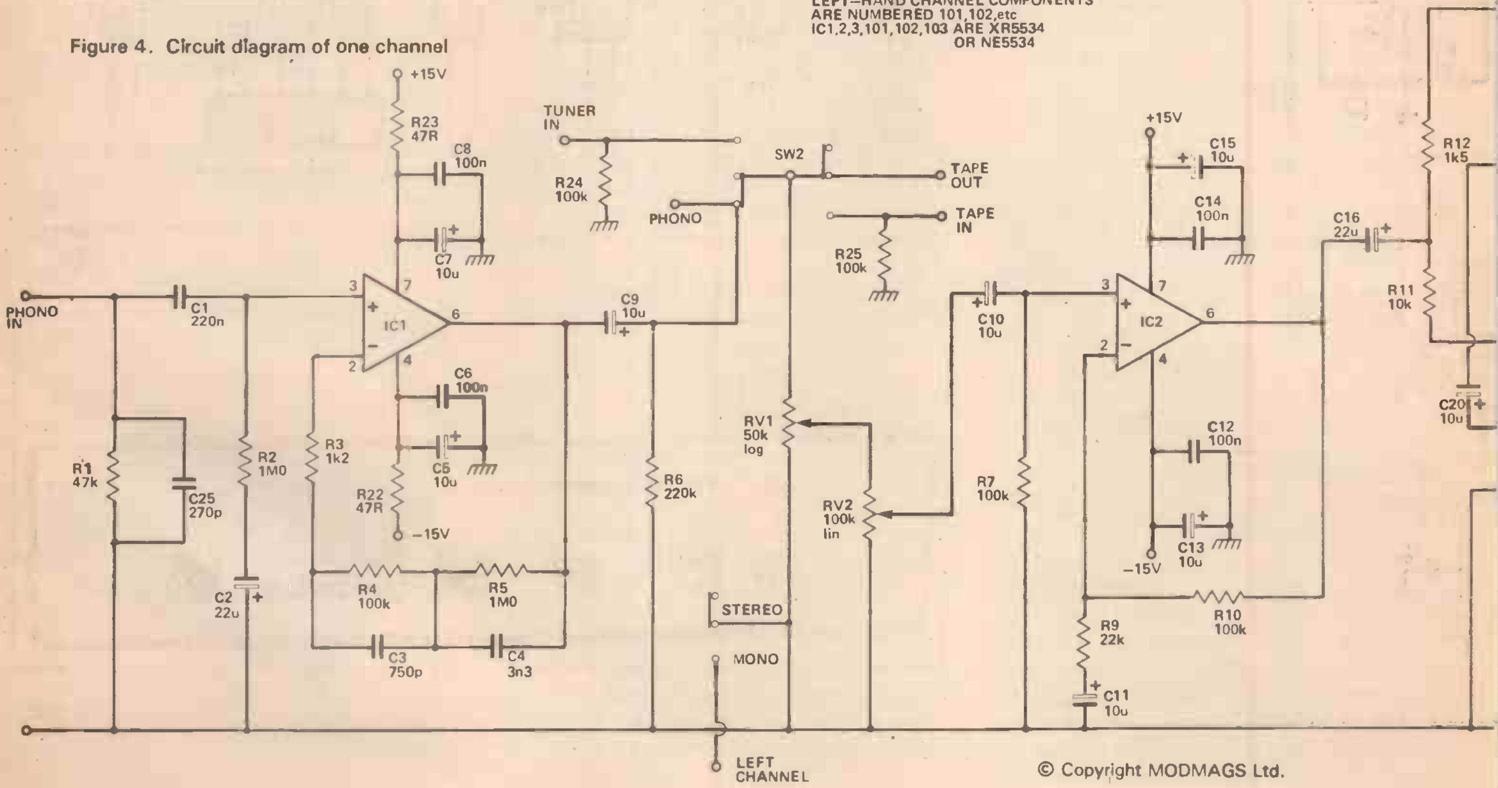


Figure 4. Circuit diagram of one channel

reduce interference.

Finally, insert the six op amps into their sockets and the board is finished. The photograph in **Fig. 5** shows the completed board and you should be able to see the earthing links to the pots and switch bank. That concludes the constructional procedure for this month. Next month we describe the housing of the pre-amplifier and also give details of a suitable AC supply to run it.

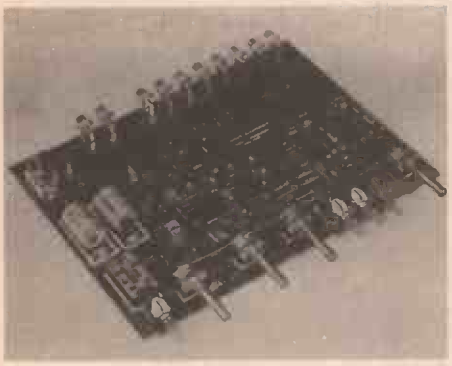
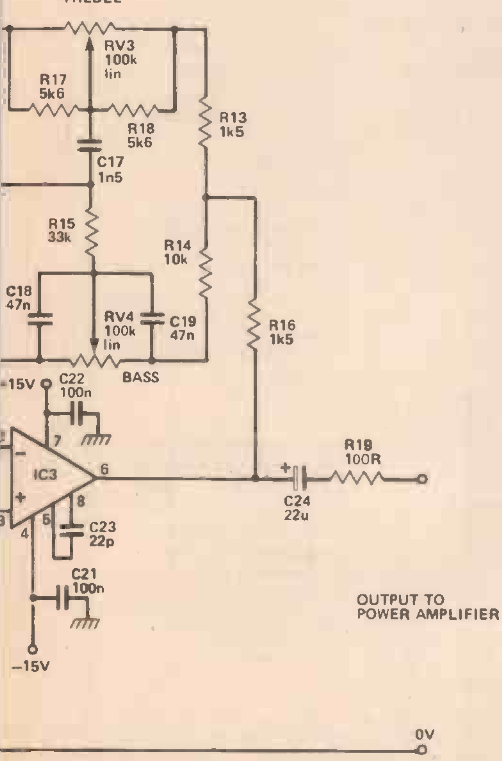


Figure 5. A completed pre-amplifier board



Buylines

Capricorn Electronics, of 281 Balmoral Drive, Hayes. Middx. is offering a variety of kits for the home constructor:

- Blank, fully labelled PCB £12
- PCB + switches, pots and phono connectors £24
- As above + all components except op amps £39
- XR/NE5534AN op amps (6 off) £15
- Undrilled case £12
- Mains transformer, suitable to power the pre-amplifier if you don't intend to build the power amplifier £4.50

Capricorn Electronics will supply a circuit diagram and parts list with each kit of parts.

Please add £1.50 for p&p.

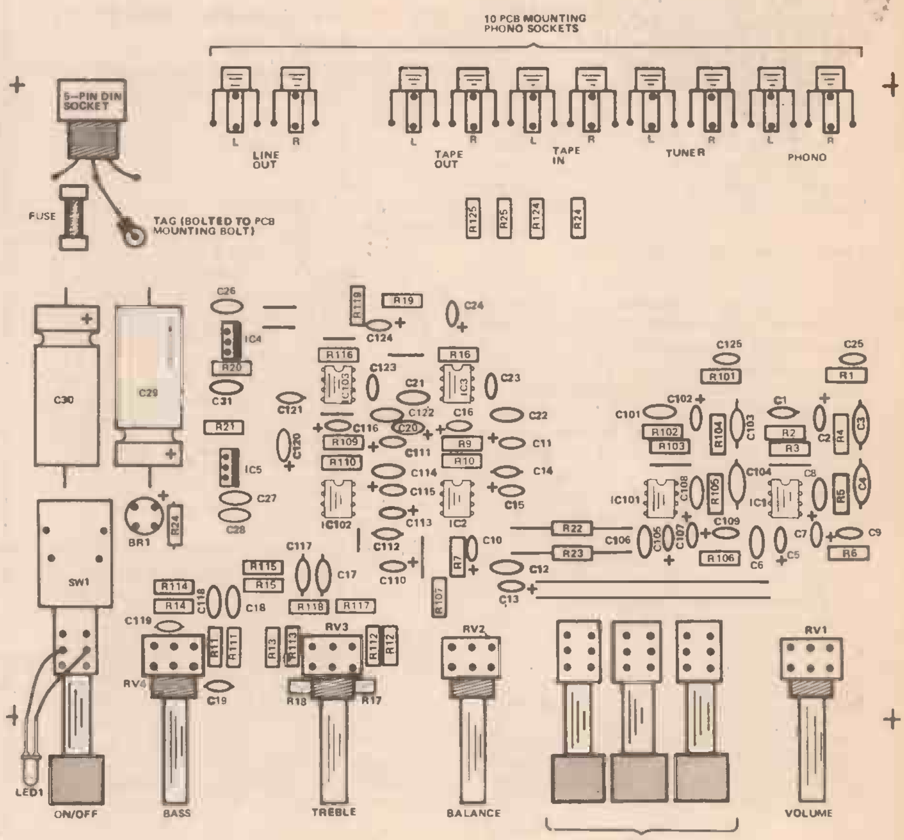


Figure 6. PCB overlay showing the positions of all components

How It Works

The main parts of an amplifier system are shown in Fig. 7 These separate parts exist in any system, whether it is of modular construction (like ours) or in one case.

The pre-amplifier introduces voltage gain; ie, the output signal *amplitude* is larger than at the input. But it takes a large amount of *power* to drive a loudspeaker (more than the pre-amplifier would be able to supply) so the signal now has to undergo power gain via the power amplifier.

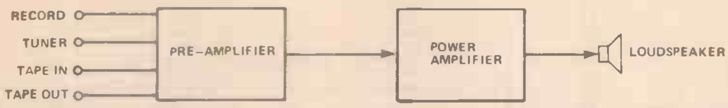


Figure 7

Figure 8 consists of a block diagram of one channel of the HE Pre-amplifier and this shows how the device can be broken down into smaller sections.

Phono pre-amplifier

The output from the magnetic cartridge of a record deck has not got what is termed a level response. In fact, the higher frequencies (treble) have a much greater amplitude than the lower (bass) frequencies. The phono pre-amp includes an equalisation network to counteract this amplitude difference and so its output has a level response. The cartridge signal is also amplified by this stage to a size similar to the signals from a tape deck or a tuner. Integrated circuit IC1 and its associated circuitry (IC101 for the other channel) provides the amplification and equalisation necessary, according to the RIAA (Record Industry Association of America) standard curve for record-playing equipment.

Input selection switch

Input selection between phono, tuner and tape inputs and tape output is made by switch SW2, and the chosen signal is passed onto the tone control stage. Part of SW2 can be also used to directly connect the two signals at this point so that it functions as a stereo/mono switch.

Tone control stage

This stage consists of two op amps per channel, the first of which, IC2 (IC102), is used as a buffer amplifier to produce a high-impedance input to match the output of a tuner, a tape player or the phono pre-amp. The buffer also has a low output impedance suitable to drive the next op amp circuit IC3 (IC103) which has a tone control network in its feedback loop. The network is a standard arrangement providing bass and treble control to suit individual listening requirements.

The power supply

Most op amp circuits (those in the HE Pre-amplifier being no exception) require a three-rail supply (ie +V, 0 V, −V,) and the power supply section uses two commonly-available ICs to provide this. These integrated circuits need only a smoothed DC voltage at their inputs to give a stable, fixed output voltage. An off-board transformer provides the pre-amplifier with ± 17 VDC (ie 12 V x 2). Integrated circuits IC4 and IC5 then stabilise and regulate this voltage to exactly ± 15 VDC.

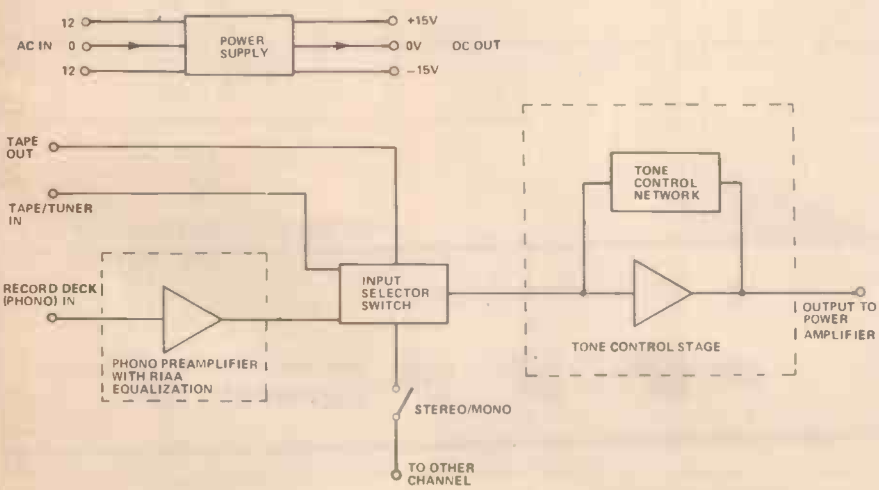


Figure 8

Parts List

RESISTORS *(All ¼ W, 5%)	
R1,101	47k
R2,102,5,105	1M0
R3,103	1k2
R4,104,7,107, 10,110,24, 124,25,125	100k
R6,106	220k
R9,109	22k
R11,111,14, 114	10k
R12,112,13, 113,16,116,	1k5
R15,115	33k
R17,117,18, 118	5k6
R19,119	100R
R20,21	4k7
R22,23	47R
POTENTIOMETERS	
RV1	50k logarithmic, dual printed circuit mounting + 40 clicks
RV2,3,4	100k linear, dual printed circuit mounting + centre click
CAPACITORS	
C1,101,26,28	220n polycarbonate
C2,102,16, 116,24,124	22u, 16 V tantalum
C3,103	750p polystyrene
C4,104	3n3 polystyrene
C5,105,7,107, 9,109,10,110, 11,111,13, 113,15,115, 20,120	10u, 16 V tantalum
C6,106,8,108, 12,112,14, 114,21,121, 22,122	100n polycarbonate
C17,117	1n5 polystyrene
C18,118,19, 119	47n polycarbonate
C23,123	22p polystyrene
C25,125	270p polystyrene
C27,31	470n polycarbonate
C29,30	1000u, 25 V electrolytic
SEMICONDUCTORS	
IC1,2,3,101, 102,103	NE5534 or XR5534 (see text)
IC4	7815, voltage regulator
IC5	7915, voltage regulator
BR1	1A, 250 V bridge rectifier
LED1	red LED
MISCELLANEOUS	
SW1	double-pole, double-throw, printed circuit mounting push switch
SW2	bank of three double-pole, double-throw, signal push switches

10 printed circuit mounting phono connectors
Printed circuit mounting fuseholder + 100 mA fuse 4 knobs to suit
Case to suit (see Buylines)
5-pin DIN socket

**Note:* in the series R1 to R25 (channel 1) there is no R8. In the series R101 to R125 (channel 2) there is no R121 or R122*

HE

TTLs by TEXAS

7400	11p	74290	150p	4020	100p
74S00	60p	74293	150p	4021	110p
7401	12p	74298	200p	4022	100p
7402	12p	74365	100p	4023	27p
7403	14p	74366	100p	4024	50p
7404	14p	74367	100p	4025	20p
7405	18p	74368	100p	4026	130p
7406	36p	74390	200p	4027	50p
7407	36p	74393	200p	4028	84p
7408	17p	74490	225p	4029	100p
7409	19p	**74LS SERIES**		4030	55p
7410	15p	74LS00	14p	4031	200p
7411	24p	74LS02	16p	4034	200p
7412	20p	74LS03	18p	4035	110p
7413	30p	74LS04	16p	4036	295p
7414	40p	74LS05	25p	4039	295p
74C14	90p	74LS08	22p	4040	100p
7416	27p	74LS09	21p	4041	80p
7417	27p	74LS10	20p	4042	80p
7420	17p	74LS11	40p	4043	90p
7421	40p	74LS13	40p	4044	90p
7422	22p	74LS14	50p	4046	110p
7423	34p	74LS20	20p	4047	100p
7425	30p	74LS21	40p	4048	55p
7426	40p	74LS27	38p	4049	45p
7427	34p	74LS30	20p	4050	45p
7428	36p	74LS32	27p	4051	80p
7430	17p	74LS37	30p	4052	80p
7432	30p	74LS38	38p	4053	80p
7433	40p	74LS42	50p	4054	150p
7437	35p	74LS47	75p	4055	125p
7438	35p	74LS51	24p	4056	135p
7440	17p	74LS55	30p	4059	600p
7441	70p	74LS73	50p	4060	115p
7442A	60p	74LS74	27p	4063	120p
7443	112p	74LS75	36p	4066	50p
7444	112p	74LS76	45p	4067	450p
7445	100p	74LS83	70p	4068	27p
7446A	93p	74LS85	80p	4069	20p
7447A	75p	74LS86	40p	4070	30p
7448	80p	74LS90	40p	4071	25p
7450	17p	74LS92	70p	4072	25p
7451	17p	74LS93	60p	4073	25p
7453	17p	74LS96	110p	4075	25p
7454	17p	74LS107	45p	4076	107p
7460	17p	74LS109	80p	4081	27p
7470	36p	74LS112	40p	4082	27p
7472	30p	74LS113	90p	4086	72p
7473	34p	74LS114	45p	4089	150p
7474	30p	74LS122	80p	4093	70p
7475	38p	74LS123	60p	4094	250p
7476	32p	74LS124	180p	4095	95p
7480	50p	74LS125	50p	4096	95p
7481	100p	74LS126	50p	4097	340p
7482	84p	74LS132	60p	4098	120p
7483a	90p	74LS133	30p	4099	200p
7484	100p	74LS136	55p	40100	220p
7485	110p	74LS138	65p	40101	132p
7486	34p	74LS139	75p	40102	180p
7489	210p	74LS145	120p	40103	180p
7490A	30p	74LS147	220p	40104	99p
7491	80p	74LS148	175p	40105	120p
7492A	46p	74LS151	80p	40106	90p
7493A	36p	74LS153	80p	40107	60p
7494	84p	74LS154	200p	40108	470p
7495A	70p	74LS155	80p	40109	100p
7496	65p	74LS156	90p	40110	300p
7497	180p	74LS157	60p	40114	250p
74100	130p	74LS158	60p	4502	120p
74107	34p	74LS160	90p	4503	70p
74109	55p	74LS161	75p	4507	55p
74116	200p	74LS162	140p	4508	290p
74118	130p	74LS163	100p	4510	99p
74119	210p	74LS164	90p	4511	120p
74120	110p	74LS165	140p	4512	80p
74121	34p	74LS166	180p	4514	250p
74122	48p	74LS173	110p	4515	300p
74123	60p	74LS174	100p	4516	110p
74125	75p	74LS175	100p	4518	100p
74126	60p	74LS181	320p	4520	100p
74128	75p	74LS190	100p	4521	250p
74132	75p	74LS191	100p	4526	108p
74136	75p	74LS192	100p	4527	150p
74137	50p	74LS193	100p	4528	100p
74141	50p	74LS195	140p	4532	140p
74142	200p	74LS196	120p	4534	550p
74145	90p	74LS197	90p	4536	375p
74147	190p	74LS221	120p	4538	120p
74148	150p	74LS240	175p	4543	180p
74150	130p	74LS241	175p	4553	320p
74151A	70p	74LS242	170p	4556	72p
74153	70p	74LS243	170p	4560	200p
74154	120p	74LS244	150p	4569	250p
74155	90p	74LS245	250p	4572	40p
74156	90p	74LS247	140p	4583	110p
74157	70p	74LS251	140p	4584	90p
74159	190p	74LS253	90p	4585	150p
74160	100p	74LS257	90p	4724	250p
74161	100p	74LS258	160p	40097	90p
74162	100p	74LS259	160p	14411	1100p
74163	100p	74LS266	100p	14412	1100p
74164	120p	74LS273	170p	14433	1100p
74165	130p	74LS279	90p	14500	700p
74166	120p	74LS283	90p	14599	290p
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74177	90p	74LS373	150p	DS8835	250p
74178	160p	74LS374	150p	DS8836	150p
74180	93p	74LS375	120p	DS8838	225p
74181	160p	74LS377	160p	MC1488	75p
74182	90p	74LS378	140p	MC1489	75p
74184A	150p	74LS390	120p	MC3446	300p
74185	150p	74LS393	120p	25S10	350p
74186	500p	74LS399	200p	75107	160p
74188	325p	74LS445	140p	75110	325p
74190	120p	74LS670	400p	75150	175p
74191	120p	**4000 SERIES**		75154	175p
74192	100p	4000	15p	75182	230p
74193	100p	4001	22p	75322	300p
74194	120p	4002	20p	75324	375p
74195	95p	4006	95p	75361	300p
74196	95p	4007	20p	75363	400p
74197	80p	4008	80p	75365	200p
74198	150p	4009	40p	75451/2	72p
74199	150p	4010	50p	75491/2	70p
74221	160p	4011	20p	8T26	160p
74251	140p	4012	25p	8T28	250p
74259	250p	4013	50p	8T95	180p
74278	290p	4014	84p	8T97	180p
74279	110p	4015	84p	81LS95	120p
74283	140p	4016	45p	81LS96	140p
74284	360p	4017	70p	81LS97	120p
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93 SERIES		74S SERIES			
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9310	275p	74S08	75p	74S133	75p
9311	275p	74S10	60p	74S138	225p
9312	160p	74S20	60p	74S139	225p
9314	165p	74S30	60p	74S157	250p
9316	225p	74S32	90p	74S174	250p
9321	225p	74S37	90p	74S175	320p
9322	150p	74S64	60p	74S194	350p
9334	360p	74S74	90p	74S241	450p
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AY5-1317A	775p	ML920	775p
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CA3046	70p	NE555	20p
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CA3086	48p	NE564	420p
CA3089E	225p	NE565	130p
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CA3130E	90p	NE567	140p
CA3140E	50p	NE571	425p
CA3160E	100p	NE5534A	250p
CA3161E	140p	RC4136	80p
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ICM7555	80p	TBA641B11	300p
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12V	7812	60p	7912	65p
15V	7815	60p	7915	70p
18V	7818	60p	7918	70p
24V	7824	60p	7924	70p
100mA	TO 92			
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12V	78L12	30p	79L12	70p
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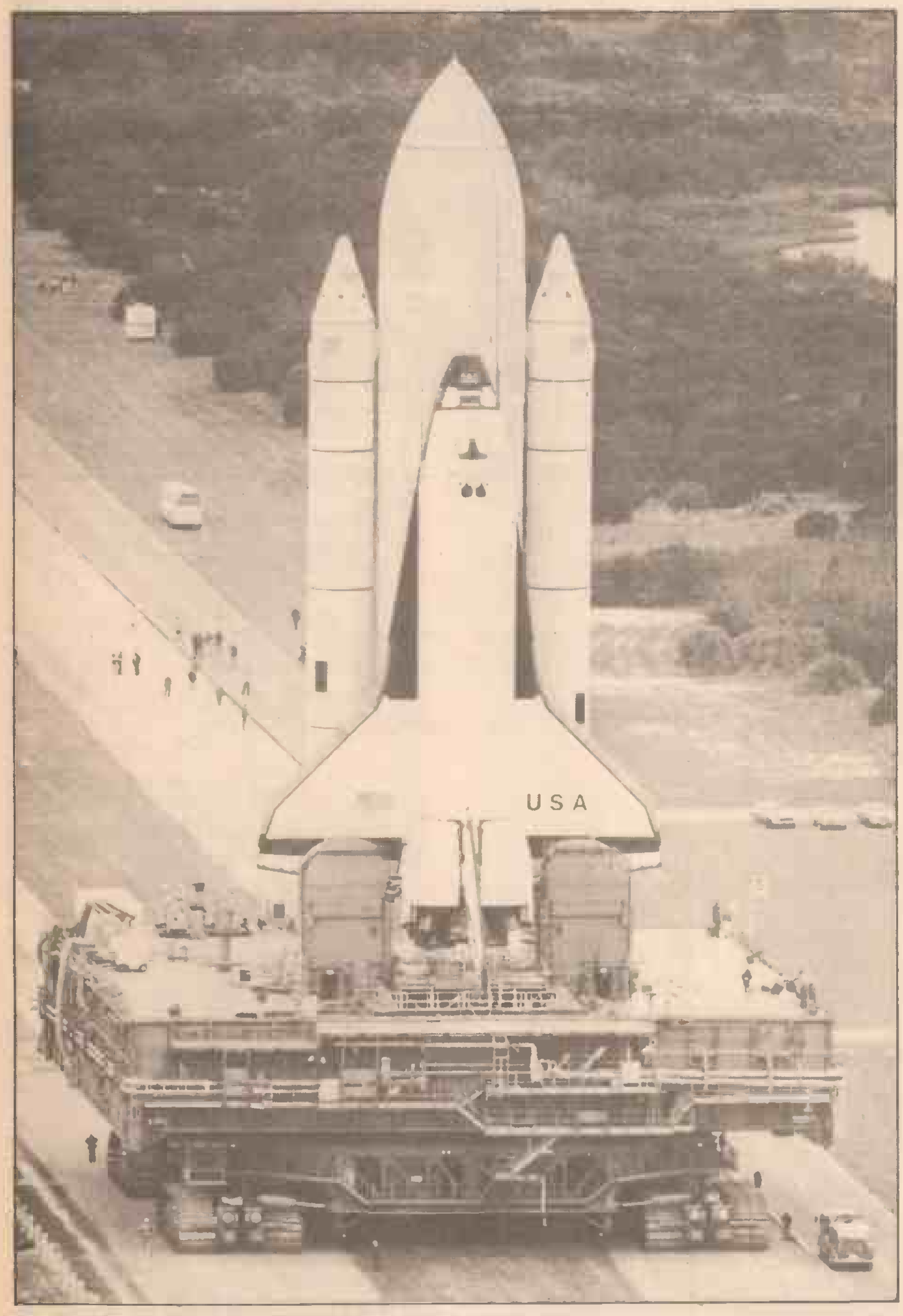
ANATOMY OF A SPACE SHUTTLE

As the dawn of a new Space Age approaches, Ian Graham reports on the fortunes of the first true spacecraft — the Space Shuttle



ONCE UPON A TIME in wartime Germany, a number of brilliant rocket engineers developed the concept of the long-range rocket. Von Braun's V-2 was not an end in itself, but merely the beginning of a series of military rockets. There were plans afoot to upgrade the V-2 and make provision for a pilot. It would have taken off like a rocket and landed like a glider on an air strip. It might have been launched atop a powerful booster rocket. That early idea on a drawing board is no longer a fairy tale.

First Steps To Space

In the early 1950s the Bell Aircraft Corporation, whose X-craft had provided invaluable experience in high speed, high altitude flight in the atmosphere, produced an interesting design — the Bell Bomi. The Bomi was a two stage craft featuring a winged booster and a small piggy-back upper stage. Similar design ideas appeared at about the same time from a number of European aircraft manufacturers and research establishments. One design proposed by the Boeing Corporation and commissioned by the USAF was axed in 1963 before construction could begin.

In the mid-1960s several lifting bodies were flown from B-52 bombers. The lifting body was an attempt to solve the re-entry paradox. Conventional vehicles capable of flying in the atmosphere and coming down to a controlled landing have wings and tailplanes which would burn off during re-entry. However, blunt-nosed vehicles, which can withstand the heat of re-entry are relatively unmanoeuverable in the atmosphere. The stubby wingless wedge-shaped lifting body was a compromise between the two. A series of these vehicles were flown right up to 1975.

Birth Of An Enterprise

The present Space Shuttle project began in 1968 with NASA's official

Enterprise is rolled out onto the tarmac — minus the aerodynamic cover which normally covered its engines for atmospheric test flights

adoption of the programme. The initial design proposal was ambitious and lacked flexibility. By the beginning of the 1970s it was clear that a *completely* re-usable Shuttle system would not be funded by the White House. To bring the project within the cash limits set, the designers proposed that the Space Shuttle Orbiter would be launched with a huge external fuel tank instead of a manned Booster. This also allowed the size of the Orbiter to be reduced, because much of its fuel would be carried externally.

In comparison with the ambitious designs that had come and gone with contracting budgets, the configuration finally adopted may seem to be a relatively low technology solution. In fact, nothing could be further from the truth. The Space Shuttle is undoubtedly the most complex project yet undertaken by NASA and its contractors.

Powerful Problems

The power and re-entry problems called for revolutionary solutions. Power is supplied by three main engines mounted in a cluster immediately beneath the rear tailplane. They burn liquid hydrogen and oxygen at a very high pressure. Their thrust-to weight ratio-is the highest of any engine yet developed, although at just over 4 m tall each is smaller than the F-1 engine used in the Saturn V first stage. The thrust is variable from 65 to 109% of rated power to keep acceleration within comfortable limits for different payloads. They're also responsible for steering the craft. Each engine can swivel 10.5° up and down and 8.5° side to side.

Unlike earlier engines, the fuel is not simply pumped into a combustion chamber and burnt. The Shuttle main engines employ a two stage cycle. The fuel is only partly burnt at low temperature and high pressure and then completely burnt in the main combustion chamber. This is about 99% efficient.

Cost Cutting

It's not an exaggeration to say that the Shuttle main engine has broken new ground in space propulsion. The engine development has been fraught with technical problems from the beginning. To cut costs, NASA departed from its

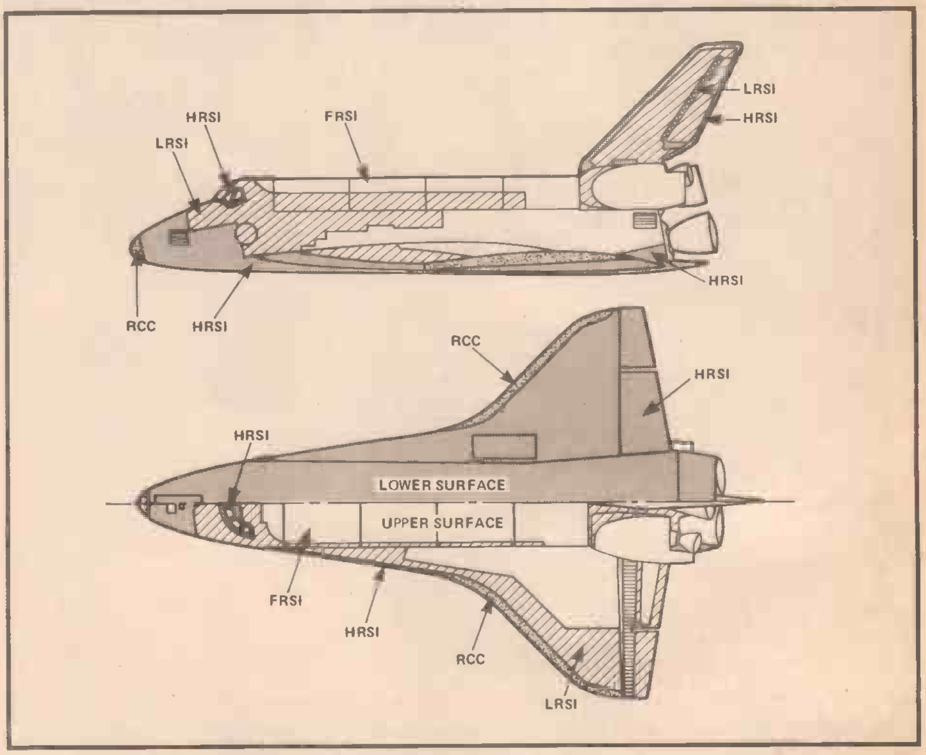


Fig. 1 The Space Shuttle's thermal protection system RCC — re-inforced carbon-carbon; HRSI — high temperature, re-usable surface insulation; LRSI — low temperature, re-usable surface insulation; FRSI — coated Nomex felt, re-usable surface insulation. The carbon nose must withstand a temperature of over 1200°C again and again, flight after flight. The leading edges of the wings reach almost 1400°C

The test craft 'Enterprise' made its first flight from the back of a NASA 747. The aft section was covered by an aerodynamic shroud as this was an unpowered glide test

A Lockheed technician examines some of the odd-shaped silica tiles that will shield the Space Shuttle during re-entry. Each tile is carefully milled on the underside to match the contour of the particular spot it will cover on the Shuttle. For this reason, no two tiles are exactly alike. The tiles are made in two forms — LI-900 (Lockheed Insulation, 9 pounds per cubic foot) and LI-2200 (22 pounds per cubic foot). Lockheed Missiles and Space Company manufactured more that 24,000 tiles for the Shuttle at its plant in Sunnyvale, California

usual practice of proving every individual component on the test bed before building it into the working system. Consequently, when fuel lines split or valves blew, these otherwise minor failures resulted in major (and expensive) engine damage. In short, the engines blew up. There were a number of serious fires. When a simple hydrogen nozzle broke, the interior of one engine was sprayed with burning hydrogen, reducing it to an expensive molten scrap heap.

In the silence of space the Space Shuttle is manoeuvred, not by the main engines, but by two orbital manoeuvring engines (mounted above the main engine cluster) and some 46 small rockets mounted in the nose and tail.

Internal power is provided by two independent electrical and hydraulic systems. Hydraulic power for movement of the control surfaces, landing gear, etc. is provided by hydrazine-powered gas turbines. Electrical power (14 to 36 kW) is supplied by conventional hydrogen/oxygen fuel cells, producing drinking water as a by-product.

A Telling Tile

Once the craft is in orbit, the next problem is to get it back to Earth in one piece. All spacecraft until the Space Shuttle had been fitted with heat shields which could only be used once — obviously unsuitable for use on a reusable spacecraft. The one-shot resin mixture melted and boiled, dissipating 1700° C or so.

The Shuttle's thermal protection system uses a number of different materials ranging from a fire-proof felt on part of the upper surface to the now famous (or infamous?) ceramic tiles. Although there are over 30,000 tiles, no two are identical. They are different shapes and sizes designed to cling to the subtly curved skin of the spacecraft. The main problem here was that they did *not* cling to the skin. In fact, when the Shuttle was carried from the West Coast to Cape Canaveral on the back of a 747 jetplane, a total of 7,500 tiles were damaged, many of them coming away from the skin altogether. It was found that, not only were the tiles themselves mechanically too weak, but also the method used to stick them to the skin was not up to the job. This discovery resulted in round-the-clock work at the Cape to re-treat, re-install and test thousands of tiles before the Shuttle (named Columbia) was rolled out at the beginning of January.

Orbital Trials

Until now, all spacecraft intended for manned operation have undergone unmanned trials to prove the system. However, Columbia's first orbital flight will carry Commander John Young and Co-pilot Robert Crippen, so the system *has* to work first time. The test craft, 'Enterprise' named after the 'Star Trek' starship, has been flown in the atmosphere, but the complex computerised re-entry navigational and control programmes have only been tried in simulation.

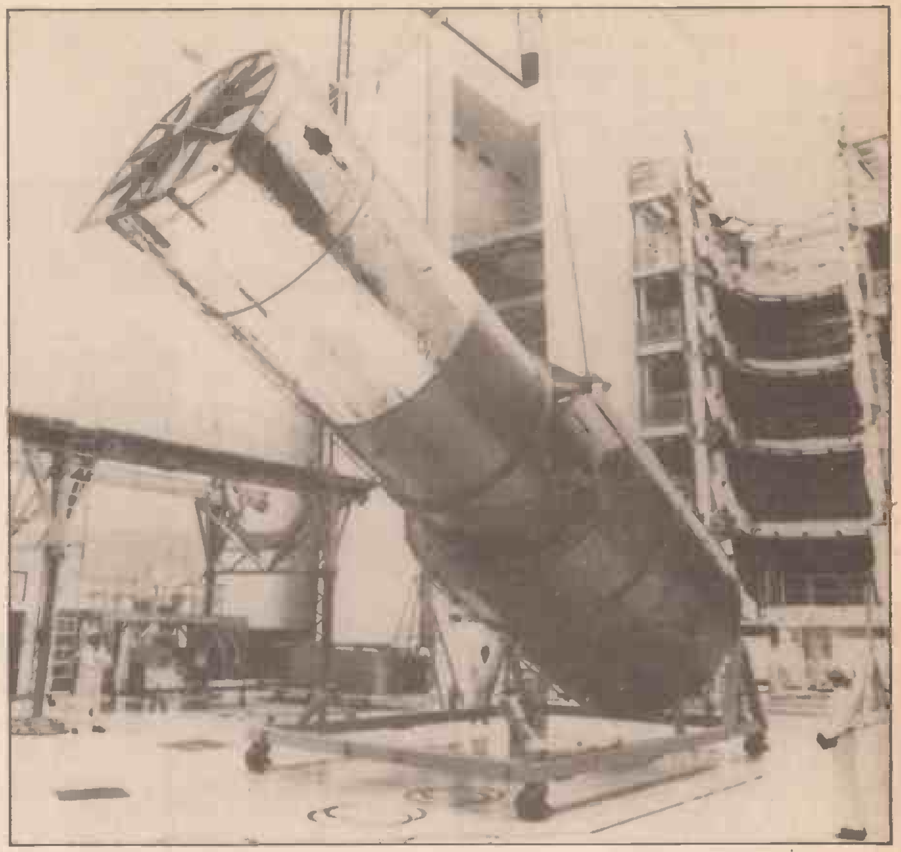
Flight Plan

Before lift-off, the Shuttle is strapped to its external tank and two solid-fuel reusable boosters (SRBs). It is mounted end-on on the launch pad and blasts off in the familiar way. At 44,200 m the SRBs fall away and are recovered from the ocean to be used again for about 20 flights. The Orbiter continues to burn fuel from the external tank until just before it reaches orbit. The tank is then jettisoned and breaks up in the atmosphere.

The first mission will last little more than two days — 54 hours, in fact. Then the Orbiter will head towards Earth again at 14,000 MPH. Once back in the atmosphere, it will glide down to a one-and-only chance for a landing. Earlier plans had called for in-board jet engines for powered landing, but they were axed to save money. The multi-million dollar Space Shuttle will land like an 80-ton glider. Young and Crippen have to get it right first time.

The Last Days

At the time of writing, there are still hurdles to overcome before launch. The external tank has to be fuelled with a total of over half a million gallons of liquid hydrogen and oxygen. It remains to be seen how the structure will react to such low temperatures. The main engines are to be fired before the big day. It will be the first 20-second firing of all three engines together.



NASA's Space Telescope will be placed in orbit by the Space Shuttle in the 1980s. Lockheed Missiles and Space Company are building the basic structure for the gigantic telescope — the Support Systems Module. Operating well above any interference from the Earth's atmosphere, the telescope will be able to look seven times deeper into the heavens than ground-based instruments. It will be able to see objects 50 times fainter and view them with a clarity 10 times better than ever before. Once in space, the telescope will be able to lock onto celestial objects with absolute accuracy for as long as 30 to 40 hours

Clouds On The Horizon?

So, things can still go wrong even at this late stage. It's difficult not to see clouds on the Shuttle horizon. The launch date has been put back time and time again and the project has gone millions of dollars over budget. But now it's on the launch pad on the last lap of its Earth-bound existence. It has been hailed as the first true spacecraft, opening the way for the industrialisation of space. Many of the ambitious suggestions for elaborate space stations built from materials carried up into orbit by the Shuttle are undoubtedly still far in the future — technically possible today but prohibitively expensive. However, when the Shuttle goes operational (planned for 1982) it will have proved its prime function of flying again and again to orbit and back. It will be used as a launch platform for satellites, a research platform (three scientists can be carried in addition to a crew of four) and a repair and maintenance station for craft already in orbit. If it is shown to be cost-effective to the commercial community, its guaranteed flight schedule and flexible operational potential are sure to be exploited. The grander plans, however, will have to remain on the drawing board until there is an upturn in the world economy or until spaceflight again becomes feasible or necessary to national security.

I have no doubt that if the rumoured Soviet Space Shuttle were to be photographed on the launch pad, the flow of money from Washington to NASA would increase. The decisions which determine space project budgets are inevitably influenced by an amalgam of constantly changing factors — general economic trends, the priorities of central government, national prestige, national security, cost-effectiveness: the list is almost as infinite as outer space itself. **HE**

COMPETITION
Project Design for the International Year of Disabled Persons

Could YOU design an electronic aid for a disabled person? If you can then you could win a first prize of £200 cash

1981 has been designated the International Year of Disabled Persons, and HE is running a competition to enable its readers to submit their designs for electronic aids for the disabled.

We place no restrictions on the area of electronics that you wish to use: transistors, integrated circuits, valves (if it is *impossible* for semiconductors to do the job!), electromechanical aids (electronically controlled), computer programmes — 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. We may also make some allowance for the age of the entrant (say for those received from entrants under 18).

First Prize	£200 cash
Second Prize	Kikusui 538A oscilloscope

PLUS Three runners-up prizes

Closing date for the competition is **31 July 1981** — so you have plenty of time to get designing! *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,
145 Charing Cross Road,
LONDON WC2H 0EE

AND include with it the following:

- the completed entry form (see below)
- written details of your design & drawings or black-and-white photographs
- suitable-sized stamped addressed envelope (if you wish to have your material returned)

If your design is 'boxed' or breadboarded, *keep it intact* until 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 (a daytime telephone number would be very helpful).

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 . . . .

The Winner

Here we see Anthony Clarke, of Spondon, Derby, receiving the first prize in our Electronic Games Competition (HE January 1981) from Jim Connell, managing director of Modmags Ltd. The prize was a Rowtron programmable TV game, with an assortment of games cartridges.

SECOND-PRIZE WINNER Jeff Jones, of Risca, Gwent, received a hand-held Jet Fighters game (Computer Games Ltd.) instead of the Space Invader game from Entex. (Our Space Invader game vanished!)

"FRANKLY RAWLINGS – IT'S A BIT TOO UPMARKET FOR US..."

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DEVELOPMENT TIMER	ZD86	Sept. '80	£8.75
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SCRATCH AND RUMBLE FILTER MONO	ZD68	Feb. '79	£22.50
SCRATCH AND RUMBLE FILTER STEREO	ZD69	Feb. '79	£25.00
CAR ALARM	ZD70	Feb. '79	£8.50
FLASH TRIGGER (less flash gun)	ZD65	Jan. '79	£10.50
TOUCH SWITCH	ZD63	Jan. '79	£5.50
VARI-WIPER	ZD64	Jan. '79	£8.00
GRAPHIC EQUALISER	ZD62	Jan. '79	£25.00
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AUDIO MIXER	ZD14	Dec. '78	£20.30
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WAA-WAA PEDAL	ZD60	Nov. '78	£30.00

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

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Callers please ring to check availability of kits.

T. POWELL

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The heart of the circuit is the astable oscillator built around IC1f (see Fig.1). This is a conventional Schmitt trigger design which has been modified by the addition of a diode in the feedback loop so that a short positive pulse is produced when the voltage across C6 falls below the Schmitt threshold level. The frequency of the output is varied by controlling the discharge rate of C6. Electronic control is achieved through the use of a transistor. The modulation is applied via a resistive divider to the base of Q1. Section d of IC1 forms the slow-speed oscillator whose input drives Q1. Both triangle and square-wave signals are available and IC1e may be switched in to blank the oscillator on selected half-cycles. Of course, the rise and fall times of the slow-speed oscillator are independently adjustable.

Ring A Ring Of Noises

Believe it or not we provided all the functions mentioned above from just half the chip, leaving us with three spare gates. These have been connected in a 'ring of three' circuit. That's just like the familiar one gate astable except that each stage now gets its feedback via the other two gates. This results in three square-wave outputs shifted in phase by 120 degrees when equal value resistor-capacitor networks are used.

What does it do? Well with the right component values it makes a noise like a demented canary — keeps your pet budgie happy but it drives the cat wild! Just like the rest of the circuit you can experiment with the values of the resistors and capacitors to obtain special effects. Try connecting diodes in series with resistors R1,3,6 (anode to the IC output, cathode to the resistor) and see how it modifies the output.

Pulse Power

Though the circuit will drive a loudspeaker directly, no fancy amplifiers are used. In fact a glance at the circuit diagram will show that just one odd-looking transistor is used. This is a state-of-the-art VMOS transistor. It works just like the field-effect transistors in the CMOS chip IC1 but its special physical geometry enables large currents to be handled. The volume level and current consumption of the unit will depend on the supply voltage, speaker impedance and width of output pulse. By using a value of 1k0 for R11 short (twenty microsecond) pulses are produced at the output. These may be lengthened by increasing the value of R11. If Q2 gets hot — use a heatsink. It's a very rugged device so don't be afraid to experiment.

Construction

Modular circuit design makes construction a cinch. If you can, we recommend you use our PCB design. It prevents wiring errors (okay — so prove us wrong if you must!) and facilitates testing and circuit modification. There are no special problems so if you're happier with some other method — use it. Present day CMOS chips seem very resistant to damage from static discharge but it's a wise precaution to use an IC socket. If you use our PCB then insert the socket and add the other components working outwards from it . . . . R2,R4,C2,3,4,R1,3,6 etc. It's less fiddly that way.

It would be nice to make a unit where all the resistors were variable but to start you off we've designed the board to accommodate the essential ones. Miniature horizontal pre-sets can be used or wires may be taken to panel-mounted potentiometers for easy operation. Once the unit's working you'll probably want to remove R9 and replace R8 with a 1M0 or 2M0 potentiometer so get it going and try it out before you finalise the panel design. The value of Rx will set the minimum operating frequency of the oscillator so you may want to use a panel-mounted pot for that too!

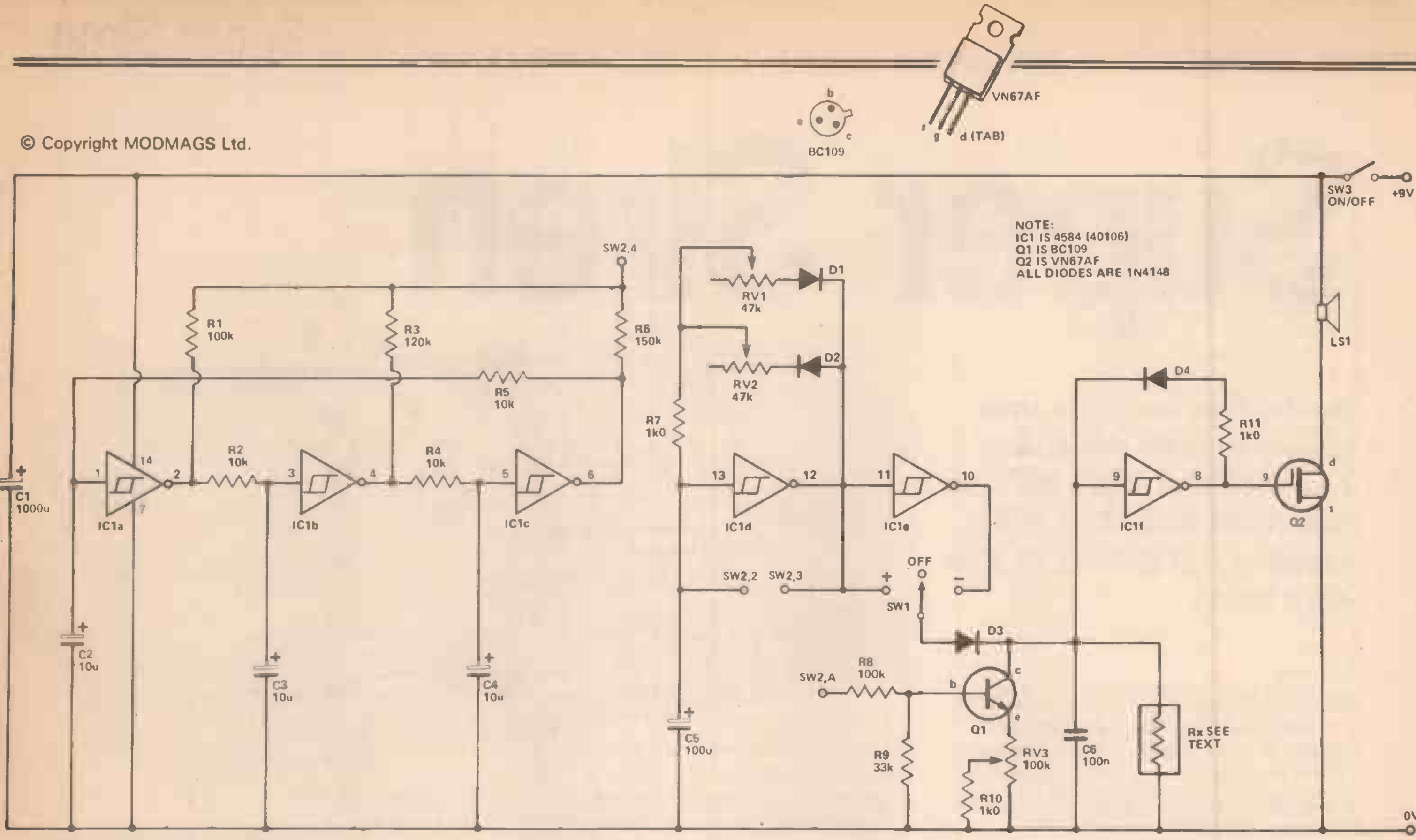


Figure 1. Circuit diagram

Excepting C1 which is electrolytic, we used tantalum types for the polarised capacitors. They cost a little more but they are small, pretty(?) and have very low leakage values — provided you connect them the right way round. Remember that a tantalum cap often fails when subjected to a reverse voltage as low as 3 V so get it right the first time! Diodes, however, will seldom be damaged when accidently reversed but the circuit won't do what you expect.

Take the usual precautions when handling IC1. It's the most expensive single component. The VMOS transistor Q2 is fully protected against static discharge so no problems there. Take care not to overheat any component. Use a small soldering iron of 15 to 25 watts and you should be okay.

Light The Blue Touch-Paper and . . . . . .

When all the components are soldered into place, insert IC1 (the right way round), connect a loudspeaker of 3 ohms impedance up; eight or sixteen ohms is a good value to try, and apply 9 to 12 V to the circuit. With point SW2, A open-circuit, the result will depend on the value of Rx. If you used a pot try varying the resistance. You should be rewarded with a variable-pitch tone. By connecting point SW2, A via the switch SW2, to points SW2,2,3 and 4 in turn you should obtain a twittering sequence of tones, a warbling tone adjustable by RV1, RV2 and a 'two-tone' sound. Switching SW1 to (+) or (−) will blank one of the tones. Note that this still happens when A is modulated by the random modulation. Use RV1, RV2 to adjust the mark-space ratio or switch SW1 to 'centre position' to obtain a continuous output.

If you get no output check Q2. If it's hot switch off and make sure there are no shorts on the board. Check that D4 is connected the right way round. If you still have problems, disconnect D3 and Q1. The circuit will oscillate using only D4,R11,IC1, C6 and about 100k for Rx. If you don't hear any sound from the loudspeaker, check the output of IC1 by connecting a crystal earpiece between pin 8 and ground (0 V).

By connecting two resistors in series across pin 8 and ground you can provide an output for your hi-fi. Choose a ratio to provide the correct signal level. About 100 mV should be right for the 'line' input of your amplifier, and for this voltage use 8k2 and 100R. Select the siren sound of your choice, switch on the afterburner, and give your ears a treat!

Parts List

RESISTORS (All ¼ W, 5%)

R1,8	100k
R2,4,5	10k
R3	120k
R6	150k
R7,10,11	1k0
R9	33k

POTENTIOMETERS

RV1,2	47k miniature horizontal preset or linear potentiometer
RV3	100k miniature horizontal preset or linear potentiometer

CAPACITORS (All 10 V working or greater)

C1	1000n electrolytic
C2,3,4	10n tantalum
C5	100n tantalum
C6	100n polyester

SEMICONDUCTORS

IC1	4584B (40106B, 74C14) hex Schmitt trigger
Q1	BC109, NPN transistor
Q2	VN67AF, VMOS power FET
D1,2,3,4	1N4148, diode

MISCELLANEOUS

SW1	single-pole, double-throw, centre-off toggle switch
LS1	3R or greater, miniature loudspeaker

3 position rotary switch
9 V battery + clip

How It Works

Schmitt inverter IC1f is connected as an audio frequency voltage-controlled oscillator. Output pulse width is set by choice of R11. Frequency varies according to the value of Rx and the base drive into Q1. Electronic control is achieved by modulating the potential divider connected to the base of Q1. A VMOS transistor switched by IC1f output directly drives a loudspeaker.

Modulating voltages are obtained from a slow-speed astable built around IC1d. Rise and fall times are independently adjustable using RV1, RV2 and triangle and squarewave outputs are available. Care should be taken not to load the triangle output excessively or IC1d will be unable to drive C5 past the positive point and oscillations will cease. There are no limitations on the square wave output. Either half cycle may be blanked by connecting D3 anode to IC1 pin 10 or 11 via SW1. With SW1 in 'centre-off' position, continuous output will be obtained.

A pseudo-random output is available from the junction of resistors R1,3,6. These are driven from the outputs of a 'ring of three' oscillator built around IC1a,b,c. Frequency of operation of this section is controlled by choice of C2,3,4 and adjustment of resistors R2,4,5. Change all values equally to maintain identical mark-space ratios or experiment with the effect of altering just one value. Capacitor C1 provides overall decoupling and the circuit should be powered from a 9 to 12 V supply. Take care that the maximum voltage rating of C5 is not exceeded.

Buylines

The VMOS transistor is available from JW Rimmer Ltd. All other components should be readily available from usual suppliers. The total cost of components (excluding case and PCB) should be around £10.

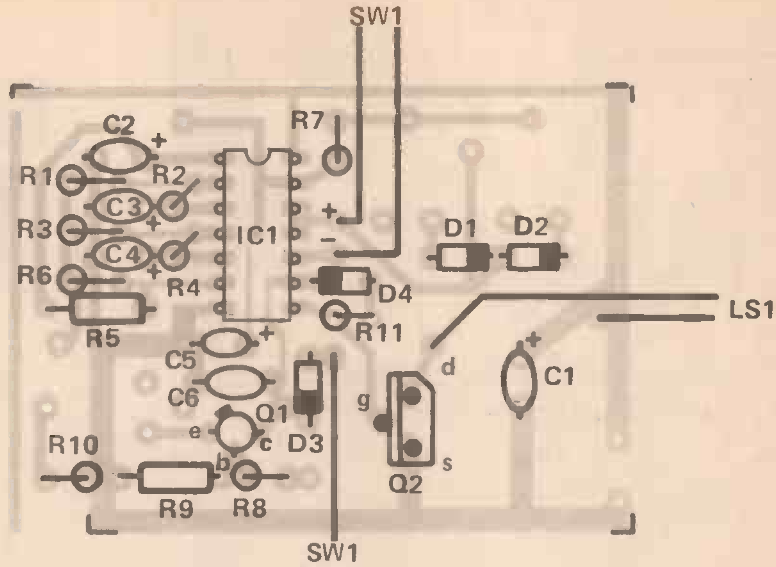


Figure 2. Overlay of the PCB

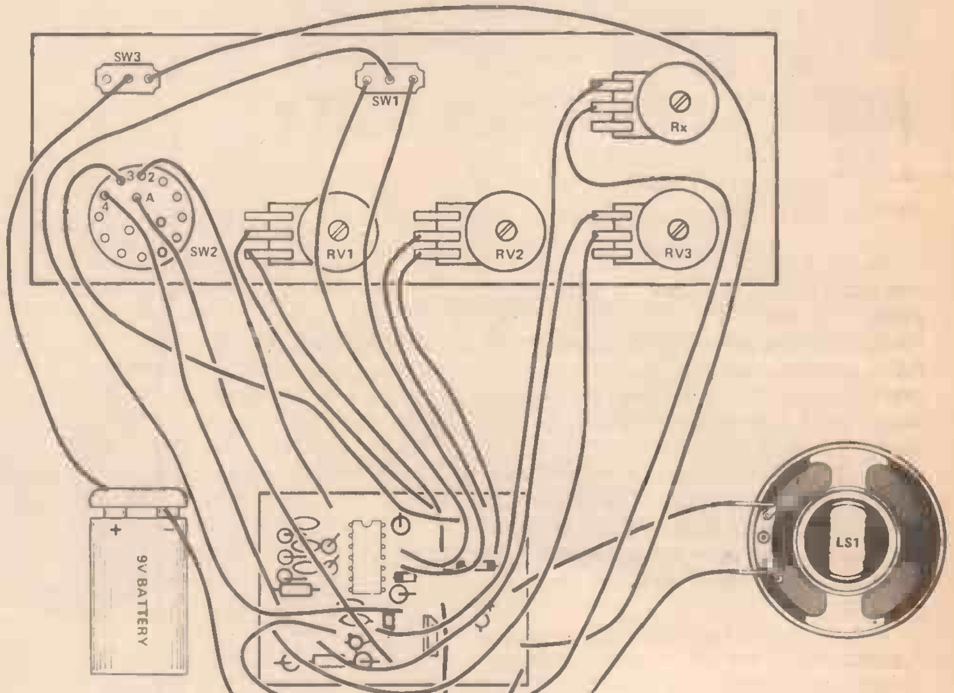
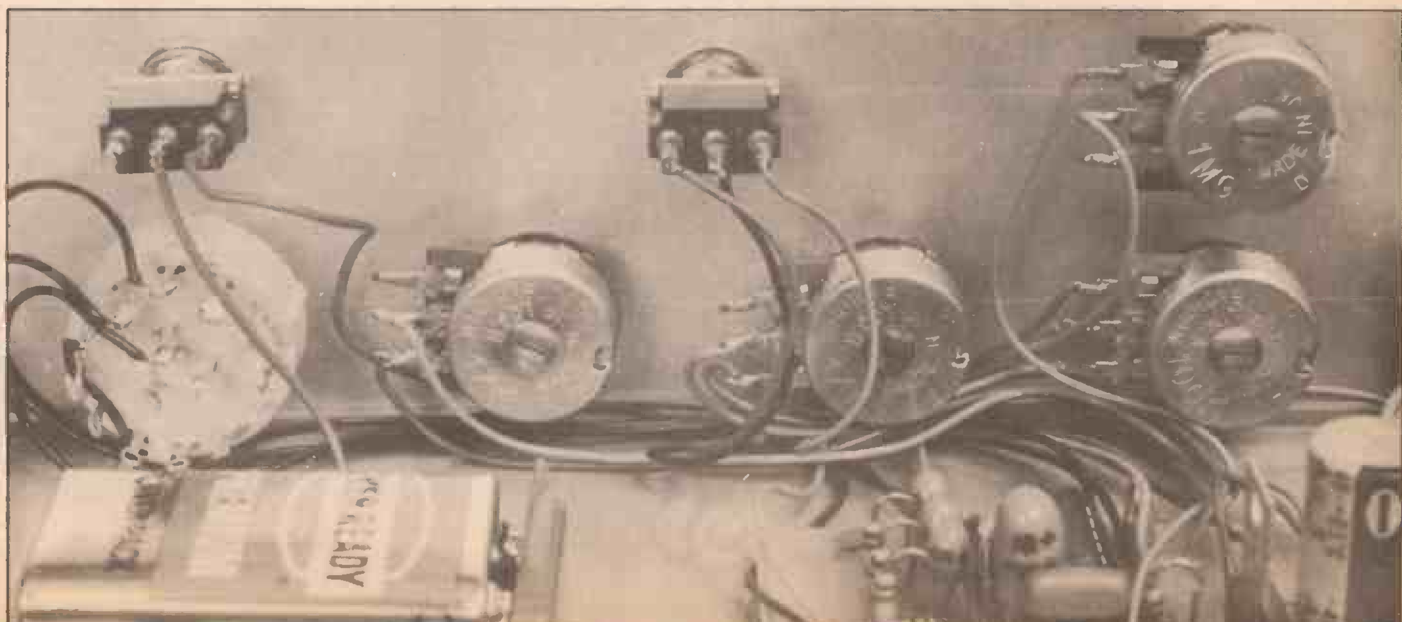


Figure 3. Connection details of the project



Building Site

In this month's episode, Keith Brindley offers some good advice on the tools to buy and use if electronics is your hobby and then shows how easy capacitor codes can be to understand

NO DOUBT, YOU will have heard the old proverb 'A bad workman blames his tools'. Well you'll be pleased to find out that it doesn't apply to electronics. In our field, if you haven't got the tools for the job you will *never* be a good workman — it's as simple as that! Electronics isn't a 'hammer and adjustable spanner' hobby but an art which can be easily mastered if you have the right tools.

Two tools which I'd recommend you buy are a pair of fine, snipe-nosed pliers and a pair of side-cutters. Both are invaluable aids to circuit board work when project building. Remember that the circuit board (either PCB or Veroboard) is the 'heart' of your project and if *it* doesn't work then neither will the whole project.

Buy the best tools you can afford — it's not that the tools are particularly expensive (reasonable pliers and cutters will cost about £6 to £10) but quality is usually in proportion to cost. Those shown in **Fig.1** are high-quality tools for engineers at top-of-the-range prices. They are part of the HE workshop toolkit and we use them every day, so the cost is small compared with the usage.

A good set of such tools, treated reasonably, should last a lifetime. But if you treat them badly they might only last a couple of months — there's nothing more heartbreaking than watching the tip of your prized sidecutters bounce off all four walls of the room, as you attempt to cut 15 amp cable with them. The moral is simple: never use your tools for anything other than what they're made for.

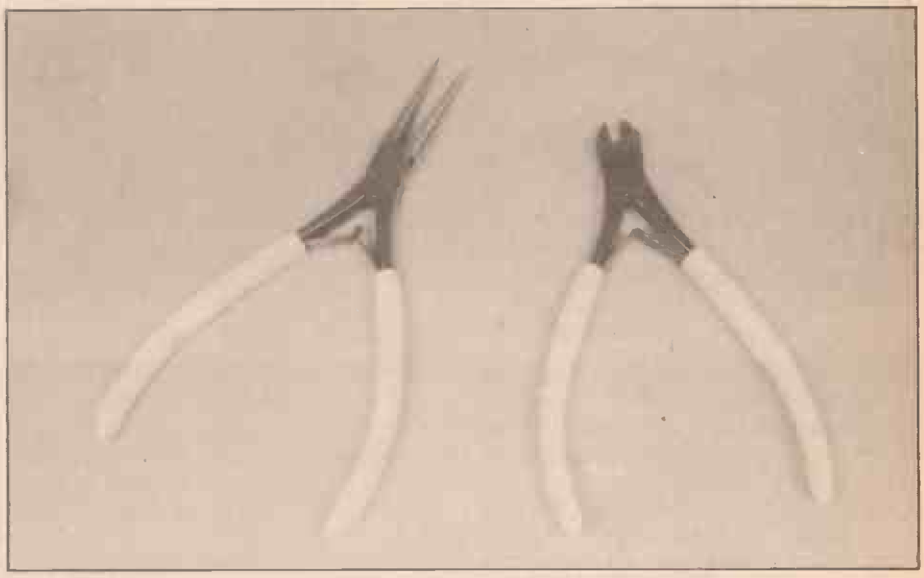


Figure 1. The HE workshop's very own sidecutters and snipe-nosed pliers

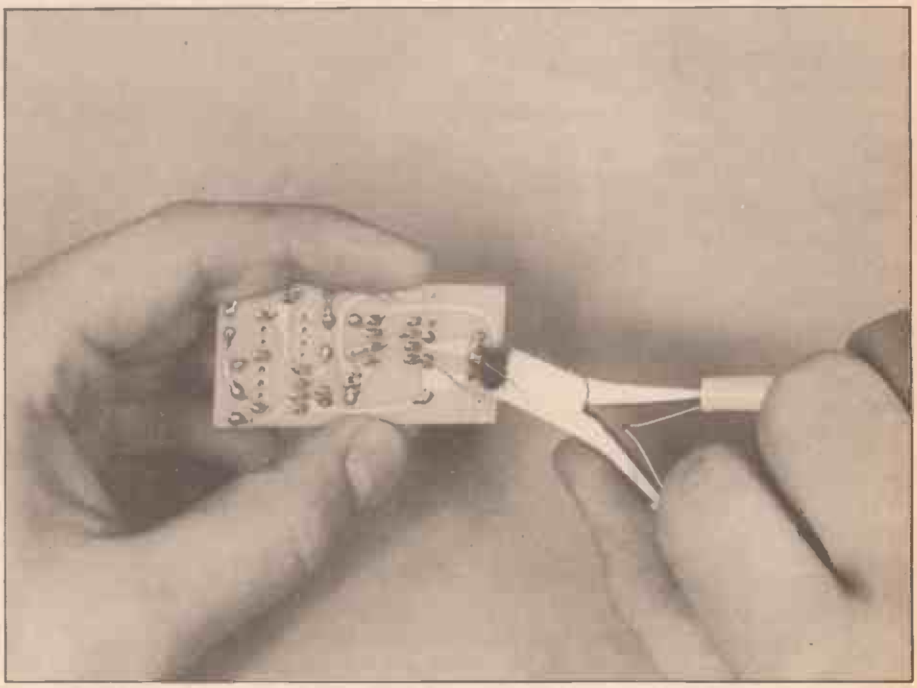


Figure 2. Trimming component leads after soldering. Make sure to cut the lead as close to the soldered joint as you can

Sidecutters

The main use of sidecutters is to cut off excess portions of component leads after a component has been

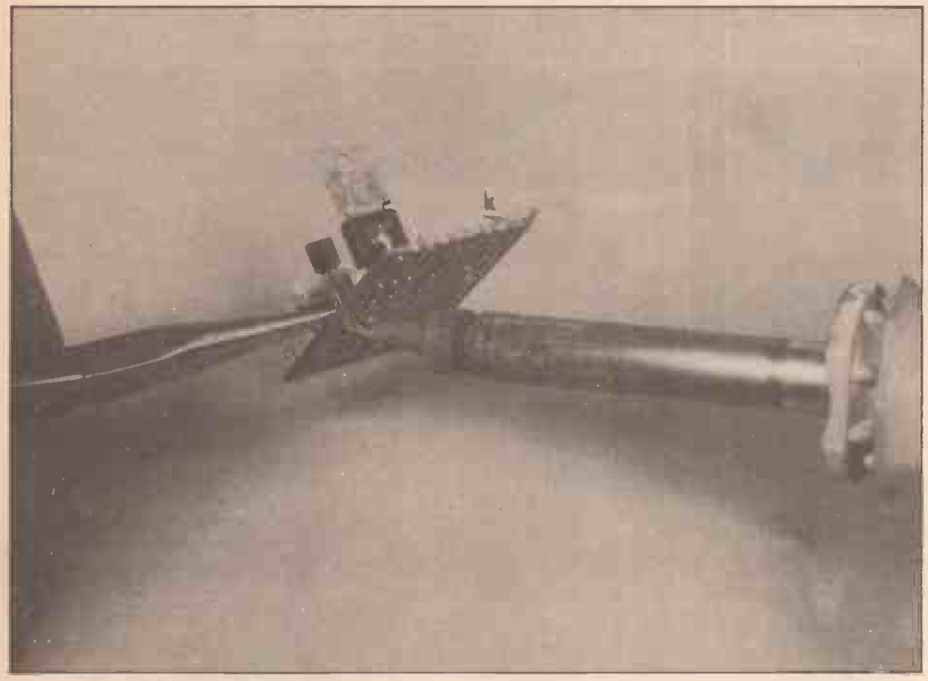


Figure 3. Snipe-nosed pliers can be useful as a heat-shunt to protect heat-damageable components when soldering

soldered into the circuit board. This trimming of leads ensures that short circuits between them cannot occur and that your project has more chance of working.

Incidentally, it's bad practice to insert all (or even just a few) components together before soldering them into place, for the simple reason that once you invert the board to start soldering, inevitably some fall out of position. By the time you have soldered all the leads and turned the board back up again, you will find that half the components are sticking out of the board at all sorts of funny angles and places. Without a doubt, some of the leads will short together. The only simple answer to this problem is to insert and solder each component separately — one at a time.

Other Uses

You can use sidecutters to cut *thin* wire. But make sure that the wire *is thin*. Don't, as we've already said, use your sidecutters to cut thick mains cable. Similarly, you mustn't use your snipe-nosed pliers for tightening or loosening nuts and bolts or for other heavy work. Remember that they are *precision* instruments and can be damaged by rough handling.

Your 'snipes' are mainly used to bend component leads before insertion into the board, or to pre-form wire links. Because they are so fine the lead can be bent, close to the component body, without causing fracture.

Whenever you are soldering components which can be damaged by excess heat (for example, certain semiconductors) into the board, snipe-nosed pliers can come in handy as heat shunts. By holding the component lead with the pliers on the component side of the board, while soldering the lead on the copper side, any heat being conducted up the lead towards the device itself is deflected into the comparitively large mass of the pliers and absorbed. It's an old trick but one well worth remembering.

Capacitors

I receive a number of enquiries regarding the coding of capacitor values so I reckoned that now was a good time to do a bit of brushing up on the topic. In broad terms, capacitors are normally either colour coded or numbered (although the numbers very often don't seem to mean much to our readers).

The colour code (for the first three bands, at least) is the same as the resistor colour code; that is:

black	= 0
brown	= 1
red	= 2
orange	= 3
yellow	= 4
green	= 5
blue	= 6
violet	= 7
grey	= 8
white	= 9

When used for capacitors, the code stands for the number of picafarads ($1pF$ or $1p = 1 \times 10^{-12}F$). Let's have an example (see **Fig.4**).

Figure 4. A typical colour-coded capacitor

Yellow = 4, Violet = 7 and Red = 2 ie 47 followed by two zeros. So the value of the capacitor is 4700pF = 4.7nF or 4n7.

The last two bands of colour on the capacitor body stand for the tolerance:

black	= 20%
white	= 10%
green	= 5%

and the working voltage — the maximum voltage which the capacitor can withstand without damage:

red	= 250 V
yellow	= 400 V

The value of numbered capacitors is just as easy to follow. For example a capacitor of value 27n ($27 \times 10^{-9}F$) will normally be numbered 273. The first two figures stand for the numerical value (27), and the third figure tells you the number of zeros (3):
ie 27000pF = 27n. Simple, isn't it!
See you next month. **HE**

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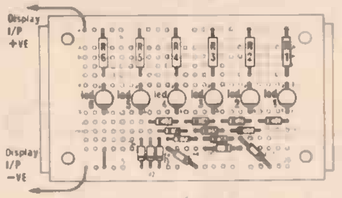

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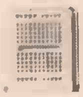

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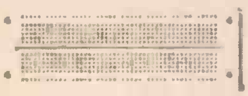

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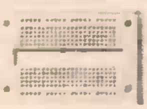

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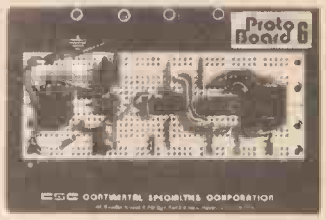

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Doorbell Monitor

A simple-to-build and cheap project for the home, which constantly monitors your doorbell and tells you if you've had a caller whilst you've been out

SOMETIMES IT CAN be helpful to know if there has been a caller while you have been away from the house, and this simple gadget can be used to indicate whether or not the doorbell has been operated. The project uses one of the cheapest and most commonly available ICs around in a novel circuit design which is simplicity itself to build. It has an indicator light which is normally switched off, but turns on and is held in this state if the doorbell is operated.

Construction

A suitable 0.1" matrix Veroboard layout for the circuit is shown in Fig. 2. The board has 11 holes by 12 strips and there are six breaks in the copper strips. These breaks should be made before any components or links are inserted and soldered, by using the standard cutting tool or, alternatively, a hand-held 3 mm drill bit. Hold the cutting edges of the tool or bit against the hole where the break is to be made and twist gently clockwise until a neat circular break in the copper is made. Check that any loose swarf is removed, thus reducing the possibility of unwanted short circuits between adjacent tracks.

Next, insert and solder each wire link, followed by the IC socket if you use one, and finally the other components as shown in Fig. 2. IC1 is a CMOS device and can be damaged by static discharge if handled incorrectly. It should be the last component to be connected into circuit and should be left in its protective packaging until then. If you use an IC socket it only remains to insert the chip into its socket, being careful not to touch the pins of the IC. If you haven't used a socket and you intend to solder the IC directly into the board then you should use a soldering iron with an earthed bit.

Parts List

RESISTORS (All ¼W, 5%)		D1	1N4148 diode
R1	1k0	LED1	0.2" LED
R2	15k		
R3	3k3	MISCELLANEOUS	
		11 hole x 12 strip, 0.1" Veroboard	
CAPACITOR		SW1 single-pole, single-throw toggle switch	
C1	15n polyester		
SEMICONDUCTORS		9 V battery + clip	
IC1	4001 quad, two-input NOR gate	Case to suit	
		IC socket (if used)	

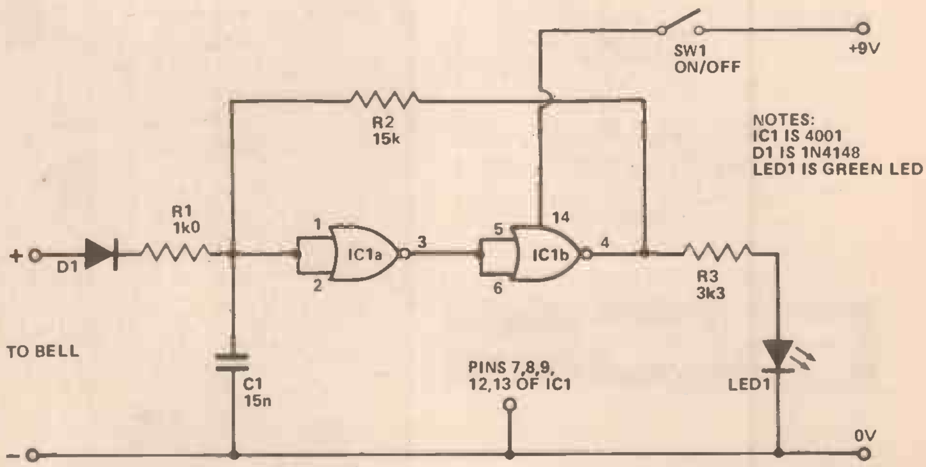
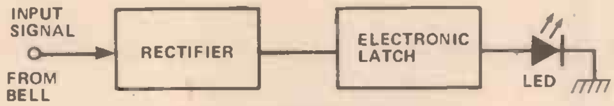


Figure 1. Circuit diagram

How It Works

The incoming signal from the bell is rectified, which provides either a positive signal (bell on) or nothing (bell off) to the electronic latch. Whenever a caller rings the bell, the latch output therefore becomes positive and holds the LED on.

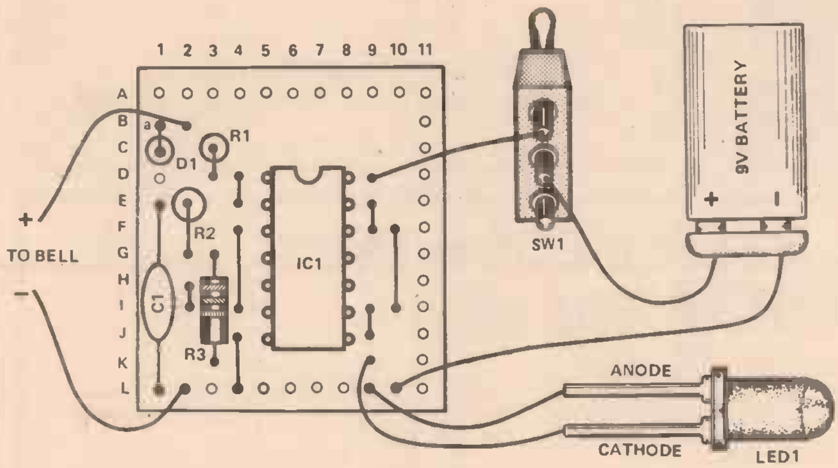


The unit is based on a CMOS 4001 IC which is a quad 2-input NOR gate. Only two of the gates are used, and these both have their inputs connected together so that they act a straightforward inverters. The inputs of the unused gates are connected to earth so that they cannot operate spuriously.

The two inverters are connected in series so tht the output assumes the same logic state as the input. At switch-on C1 will be uncharged, and therefore takes the input to the low logic state. The output assumes the same state, and latches the circuit in this condition because of the feedback through R2. The LED indicator LED 1 is driven from the output via current limiting resistor R3, and will obviously be switched off with the output in the low state.

If the doorbell is operated, a voltage will be fed to the bell, and this will appear across the input of the monitor. In a normal mains-operated bell circuit the bell is powered via a step-down transformer which provides an AC voltage of a few volts to the bell. On positive-going AC half-cycles D1 will conduct, and the input of the circuit will be taken to the high state. The output also goes high and the positive feedback through R2 latches the circuit in this state. D1 does not conduct on the negative-going AC cycles, so the input signal cannot return the circuit to its original state. The indicator light therefore remains switched on until the user resets the unit by momentarily switching off using SW1.

The unit will also work with battery-operated bells having a supply voltage of about 6 V to 9 V, but the input must then be connected with the correct polarity. The circuit has a negligible current consumption in the standby mode, and the consumption is only about 2 mA when the LED is switchod on.



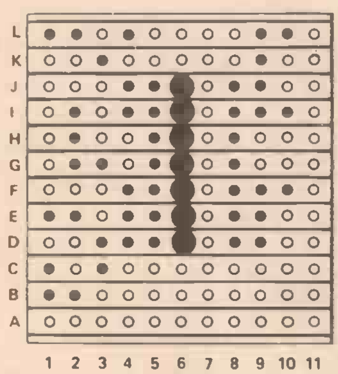


Figure 2. Veroboard layout, connection details and track breaks

Buylines

None of these components are hard to come by and should be found at most component stockists. The approximate price for the parts in this project will be around £3.

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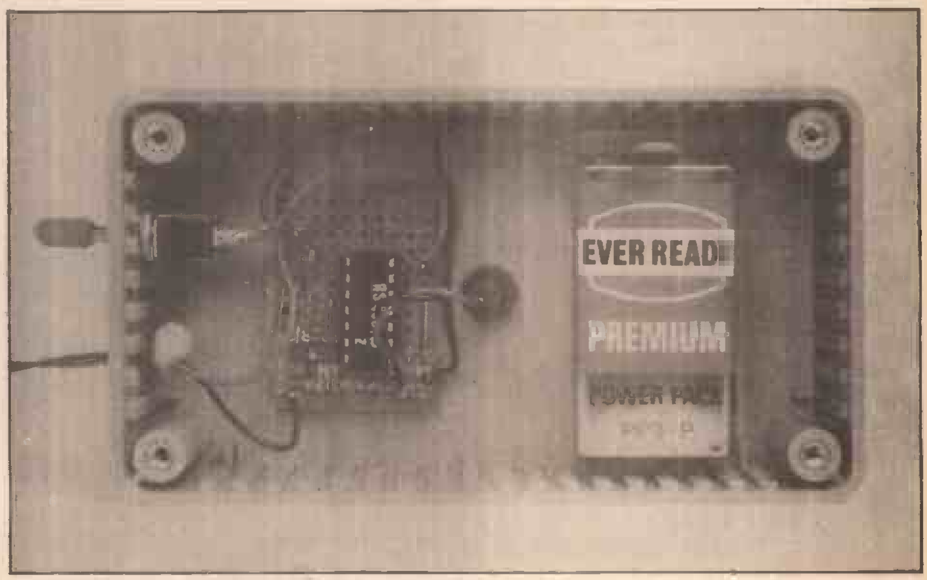

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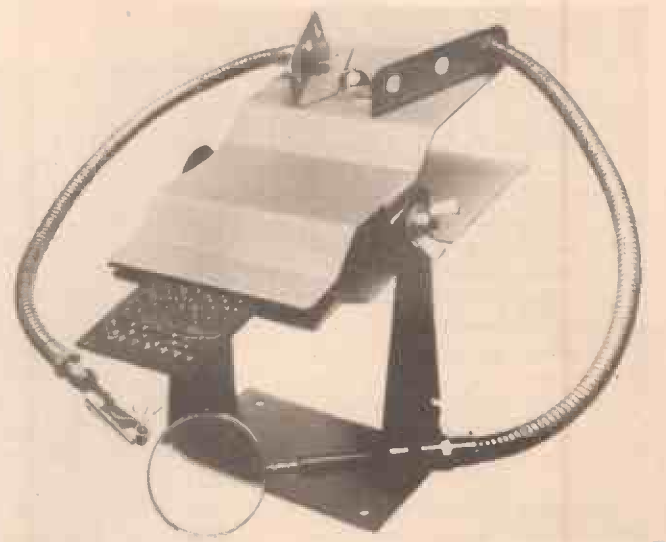

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Famous Names

Michael Faraday

To follow What's In A Name, we present a new series about some of the pioneers of electrical and electronic science. First we look at the lives of some of the famous names associated with the discovery of electricity. Later we look at some of the pioneers of electronics, a science which grew from the understanding of the principles of electricity. We begin with one of the most practical and communicative discoverers: Michael Faraday

EVER FELT TOTALLY baffled by a bit of theory? Ever found that you could learn more with a hot soldering iron in your hand than using a book? Take heart, for your condition is in some respects like that of Michael Faraday, who did more for the progress of electricity than almost anyone else in the history of this subject.

Faraday was born in 1791, at Newington, Surrey, the son of a local blacksmith who must have taught him much about the machines of the day. These, remember, were times of considerable and violent change. The Americans had successfully declared unilateral independence (translation: they threw us out), the French were having a revolution (translation: killing each other), and machines had been invented to do the work of three men and a boy! The results were that there was a huge expansion of trade, a demand for machine-made goods, and jobs for anyone who wanted them. There's nothing new under the sun — the Luddites broke machines because they thought there would be less employment, yet within a few years there was such a scarcity of people to do the jobs that children were working in factories. Our modern Luddites are busy opposing microprocessors right now — with the big difference nowadays that it didn't start here, and no-one is forced to build his factories here in the UK.

In Faraday's youth, the blacksmith was the man who was the machine repairer, because his skills were well fitted to this job. The family moved to North London, to take advantage of this new and lucrative source of income but Michael, at the age of 14, decided that he would not be a blacksmith, and was apprenticed instead to a bookbinder who also had a bookselling business. As he bound the books, Faraday read them and was fascinated by the many books dealing with physical science. Determined to increase his knowledge, he went to hear Humphry Davy lecture at the Royal Institute. This experience convinced him that he should make his career in scientific research, and he wrote to Davy asking for a job, enclosing a complete transcript which he had prepared of the lecture he had attended. Davy was impressed and appointed Faraday, now aged 21, as his assistant at the Royal Institute.

Davy did not regret this step — Faraday proved to be an extraordinarily astute experimenter, able to devise apparatus to prove or disprove any theory which might be put to him.

One early opportunity occurred when the Danish scientist, Oersted, reported that a magnetic field existed around any wire which was carrying an electric current. Faraday at once repeated Oersted's experiments to confirm the principle, and then went on to construct an ingenious piece of apparatus, shown in **Fig. 1**, which demonstrated the shape of the magnetic field. By passing current through the wire and the mercury, Faraday showed that the magnet moved in a circular path around the wire — a path which he concluded must be the shape of the magnetic field round the wire. Davy and Faraday also saw that

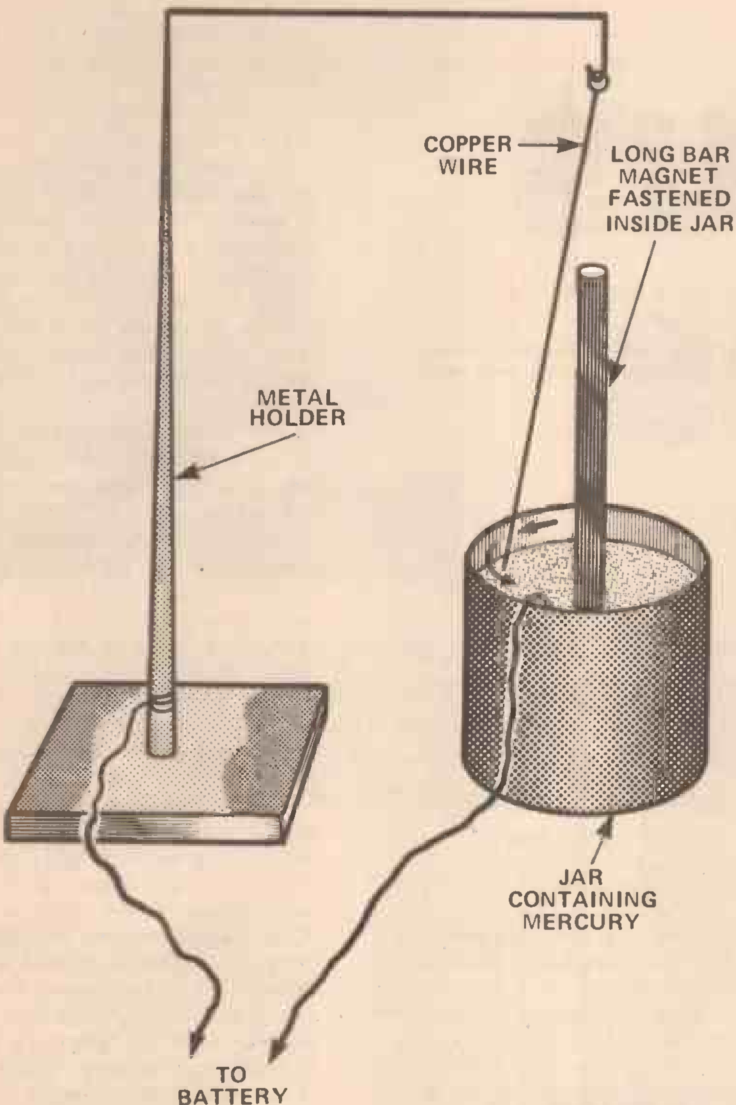


Figure 1. Faraday's motor experiment. A magnet was fastened inside a pot containing mercury. When a wire was dipped into the mercury, and current was allowed to flow through the wire, the wire rotated around the magnet

this device converted electric current into mechanical movement, and so the electric motor was born.

The two men worked as a team, touring Europe with lecture-demonstrations concerned with discoveries which they had jointly made. These tours put them in touch with many of the most famous names in electrical science, in particular Biot and Savart, who were working on a theory of magnetism, and these subjects were to remain the most fascinating of all for Faraday. In 1825, aged 34, he was appointed as Director of Laboratories at the Royal Institute and one of his first actions was to start a series of formal lectures, to be held each Friday, describing new advances in some branch of Science. These Friday lectures have continued ever since, along with the Christmas Lectures to Schools, which Faraday also started. Faraday had a gift for clear and simple language, and his lectures were invariably crowded out. This is one aspect of Faraday's work which is often overlooked, and we may probably never know how many students were set an excellent example both by Faraday's meticulous practical work and by his clear and concise lectures.

In 1831, Faraday published the results of work which was to mark a huge step in our understanding and application of electricity. The experiment was the 'induction ring' — an iron ring (Fig. 2) with two separate windings. One winding was connected through an on/off switch to a battery, and the other winding was connected to a sensitive galvanometer. Faraday was looking for a way to convert magnetism to electric current, and his was the first of many such attempts to succeed. There were two reasons for this. One was that Faraday had built his own apparatus in his usual meticulous way, and the galvanometer in particular was very much more sensitive than most. The other was that Faraday observed and noted everything. On this occasion he observed and noted something which earlier researchers might not have bothered about: that the galvanometer needle flicked each time the switch was made or broken. Everyone expected that the galvanometer would read continually while current was flowing from the battery, and disregarded these transient effects. To Faraday, these were the important results, and he concluded that a current flowed to the galvanometer *only* when the current from the battery was changing. He had, of course, discovered the transformer principle and by doing so, laid the foundation for all our use of electricity. It was only a small step onwards to disconnect the battery and show that a magnet pushed into or out of the iron ring would also cause the galvanometer to deflect. The essential point, which no-one else had grasped, was that *change* was the key, change of current when the arrangement was used as a transformer, or change of position when the arrangement was used with a magnet.

The next step was to produce a continuous current from continuous motion. Faraday realised that a practical generator must use circular motion, and devised the disc dynamo (Fig.3) which we now call a homopolar generator. As shown, it consisted of a copper disc rotated between the poles of a strong magnet. Rubbing connections were made to the shaft and also to the rim of the disc, and a small

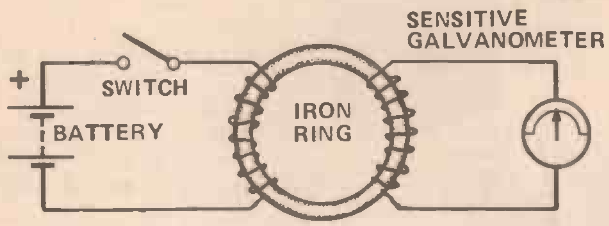


Figure 2. The iron ring experiment. Faraday found that the arrangement, the first transformer, produced a pulse of current indicated on the galvanometer, at the instants when the switch was opened or closed

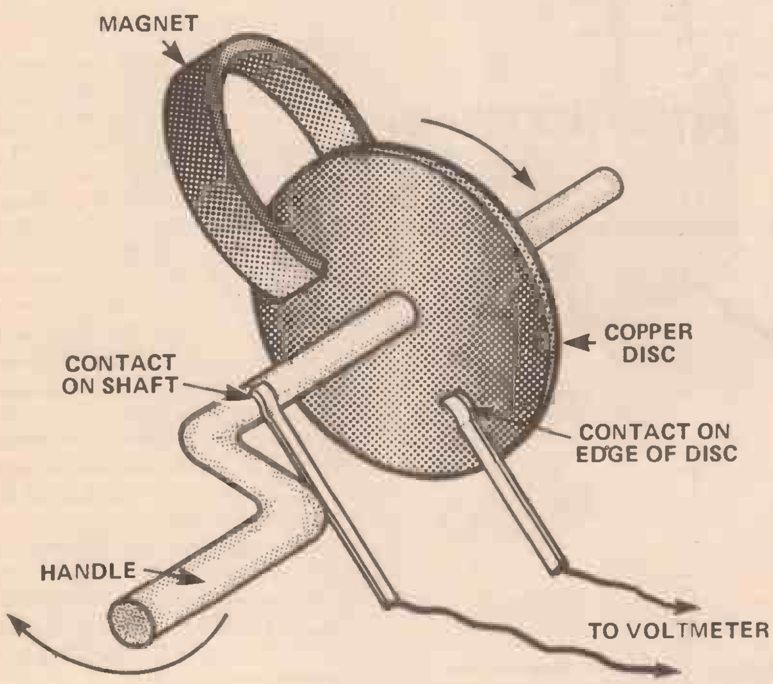


Figure 3. The homopolar generator. The disc revolving between the poles of the magnet generates a small voltage between the contacts, its magnitude depending on the speed of the disc and the strength and size of the magnet

voltage could be detected when the disc was spun round. Oddly enough, this arrangement, which has only ever been a curiosity in the past, is now coming under investigation again. The reason is that though the voltage is very low, the current can be very large, and low-voltage high-current supplies are just what we need for modern semiconductor circuits. Since the output of the homopolar generator is DC, not just a full-wave rectified output such as we get from most dynamos, the homopolar generator is ideal for providing an emergency supply for electronic equipment.

Faraday was content to move on to other topics, and leave the development of the dynamo to others, later, notably Siemens and Edison. His interest was still in the understanding of the mysterious relationship between electricity and magnetism, and he was fascinated by the representation of magnetism in terms of lines of force, an idea which he could express as a drawing. His intuitive feeling was that electrostatics, current electricity, and magnetism must be part of the same thing, but he lacked the mathematical facility to prove what he was sure must be true. The complete proof was left to Clark Maxwell just after Faraday's death.

By 1844, Faraday was busy tying up other aspects of electricity, still pursuing his hunch that electricity was the key to all science. In his early years with Davy, he had made many chemical investigations, some of which had been concerned with glass. Now glass is not a single chemical compound but a mixture, and so thousands of different types of glass can be made. One which Faraday had made and christened 'heavy glass' turned out to be quite remarkable. This particular glass polarised any light which passed through it, acting in the way we all know now from Polaroid sunglasses. What was extraordinary about Faraday's 'heavy glass' was that the polarisation varied when a magnetic field was applied to the glass. To be precise, the plane of polarisation was rotated when a magnetic field was applied. This was a clear indication of a link between light and magnetism, and the 'Faraday rotation' as it is called is an effect which is used nowadays to control laser beams, enabling us to modulate a laser beam directly by an electric current.

Faraday retired in 1858, after a career which had touched on and improved practically every branch of science. We've concentrated here on just a few of his major discoveries, leaving out all his chemical and electrochemical work, which included the discovery of electroplating. He died in 1867, an experimenter of genius with a teacher's gift of clear explanation. He left behind him an extraordinary number of discoveries which still bear his name, an organisation which still delivers lectures in his name, and a new branch of engineering — electrical engineering. Few men have made such an overwhelming contribution to our present century.

HE

PORTABLE RADIO CASE

Size: 11 x 8 x 3¾ ins approx. Made from plywood, pleasingly covered. Suitable for any normal radio circuit. Has studs for mounting 5" speaker and the front is drilled to take a tuning condensor in the centre and normal controls either side. £2.30 + £1.50 post

LAST MONTH'S 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, condensors, multi-turn pots, rectifiers, SCR, etc. 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; ¾" stack £2.50; 7/8" stack £3.00; 1" stack £3.50; 1½" 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 ¼". Don't miss this snip — send your order today.

MAGNETIC LATCH

Low voltage (4 - 8 volt AC/DC operation). Only £1.50 each.

PUNCHED TAPE EQUIPMENT

For controlling machine tools, etc, motorised 8 bit punch with matching tape reader. Ex-computers, believed ingood working order, any not so would be exchanded. £17.50/pair. Post £3.00.

STEREO HEADPHONES

Japanese made so very good quality. 8 ohm impedance, padded, terminating with standard ¼" jack plug. £2.99 Post 60p.

BRIDGE RECIFIER

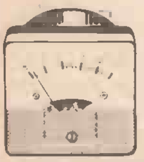
1 amp 400v 30p each. 10 for £2.50. 100 for £20.00

SOLENOID WITH PLUNGER

Mains operated £1.99
10 — 12 volts DC operated £1.50.

MOTORISED 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.



PANEL METERS

Japanese made, full vision front, size 2¼" x 2¼". 0 - 100 uA £2.85. Similar but size 2" x 1½" 100 uA, scaled Vu. Ditto, but scaled 0 - 100. (note: front covers easily removable if you want to rescale these £2.30 each) Ditto but size 1⅜" x 1⅜", scaled Vu, sensitivity 100 uA, £1.50.

MINI-MULTI TESTER

Deluxe pocket size precision moving coilcoil 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 insruction 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 enble you to read DC current from 0 - 10 amps, directly on the 0 - 10 scale. It's free if you purchase quickly, but of you already own a Mini-Tester and would like one, send £2.50.

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.

LOUDSPEAKERS

8" woofer and 4" tweeter, 4 ohms 35 watts power rating £6.90 per pair. Ditto but 8 ohms, £11.50 per pair. Post £2.00.

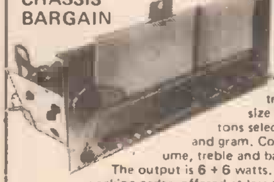
ELECTRONIC VOLT-METER/ SENSITIVE RELAY

Consists of a 4½" square drop through panel volt meter, 0 - 10 fed. Built into the front of the meter are two screw adjusters which move two pointers, up and down the scale, to set a minimum and maximum. A unique "under" and "over" circuit inside the meter operates one of two reed relays to bring an 'under' or 'over' circuit into action. The scale plate is detachable via two screws to be calibrated to your own individual requirements. The 10 transistor 'under' and 'over' circuit is completely separate from the meter movement so does not have to be connected to use this as a standard 0 - 1 meter. Many uses including level controls, light controls, auto battery chargers, alarm units, etc. Manufacturers list price of over £120 each. An unbelievable snip at £9.95 (less than the value of the meter alone.)

THIS MONTH'S SNIP

Vu METER Approximately 1 5/8" square, sensitivity 0 - 500 uA suitable for use also 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, or 10 for £9. post & VAT paid.

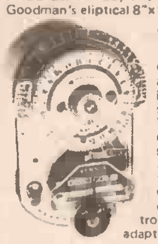
CHASSIS BARGAIN



3 wave band radio with stereo amplifier. Made for incorporation in a high-class radiogram, this has a quality of output which can only be described as superb. It truly hi-fi. The chassis size is approx. 14". Push buttons select long, medium, short and gram. Controls are balance, volume, treble and bass. Mains power supply. The output is 6 + 6 watts. Brand new and in perfect working order, offered at less than value of stereo amp alone, namely £6.90. Post £2.50.

MULLARD UNILEX

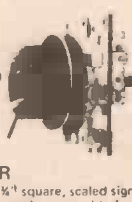
A mains operated 4 + 4 stereo system. Rated one of the finest performers in the stereo field this would make a wonderful gift for almost anyone. In easy to assemble modular form this should sell at about £30 — but due to a special bulk buy and as an incentive for you to buy this month we offer the system complete at only £16.75 including VAT and post. FREE GIFT — buy this month and you will receive a pair of Goodman's eliptical 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/offs 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 2½hrs. 2 contacts suitable to switch 10 amps — second contact opens a few minutes after 1st contact. £1.95.

LEVEL METER

Size approximately ¾" square, scaled signal and power but cover easily removable for rescaling. Sensitivity 200 uA. 75p.

ADVANCE ADVERTISING BARGAINS LIST!

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

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. Comlete 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 headphone, (gives best results) £3.75. Kit includes chassis and front but not case.

RADIO STETHOSCOPE
Easy to fault find — start at the arial 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 5¼in x 3¼in x 1¼in 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 4½v battery and has input, output sockets and on-off volume control, mounted flush on the top. Many other uses include general purpose amp, cueing amp, etc. An absolute bargain at only £1.85. Suitable 80ohm earpiece 69p.

3 CHANNEL SOUND TO LIGHT KIT
Complete kit of parts for a three-channel sound to light unit controlling over 2,000 watts of lighting. Use this at home if you wish, but it is more than 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 ¼" sockets and three panel mounting fuse holders provide thyristor protection. A four-pin plug and socket facilitate ease of connecting lamps. Price £14.95, complete kit and case.

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 BC 107 and 2 type BFY 51 electrolytic condensers. SCR ref 2N 5062, 25 0uf 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.

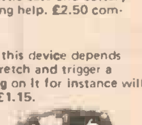
DESOLDERING PUMP
Ideal for removing components from computer boards as well as for service work generally. Price £6.35.

4-CORE FLEX CABLE
White pvc for telephone extensions, disco lights, etc. 10 metres £2, 100 metres £15. Other multicore cable in stock.

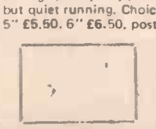
MUGGER DETERRENT
A high-note bleeper, push latching switch, plastic case and battery connector. Will scare away any villain and bring help. £2.50 complete kit.

HUMIDITY SWITCH
American made by Honeywell. The action of this device depends upon the dampness causing a membrane to stretch and trigger a sensitive microswitch. Very sensitive breathing on it for instance will switch it on. Micro 3 amp at 250V a.c. Only £1.15.

EXTRACTOR FANS — Mains Voltage



Ex-Computer, made by Woods of Colchester, ideal also 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.



TIME SWITCH BARGAIN
Large clear mains frequency controlled clock, which will always show you the correct time + start and stop switches with dials. Complete with knobs. £2.50.

J. BULL (Electrical) Ltd.

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Guitar Tremolo

Amplitude-modulate the sound from your guitar with our simple-to-build tremolo

A TREMOLO MAY NOT be the latest electronic musical effect but, like the fuzz effect produced by the HE Fuzzbox (see last month's issue) it has remained popular. Our simple design is primarily intended for use with a guitar, and has both variable frequency and depth controls. It gives excellent results and has a low noise level.

The tremolo effect is very simple in principle, and just consists of an automatic volume control that varies the volume up and down at a typical rate of a few times per second. Obviously this effect could be produced manually, but it is usually far more convenient to have a unit that produces the effect automatically using an oscillator driving a voltage-controlled attenuator (VCA).

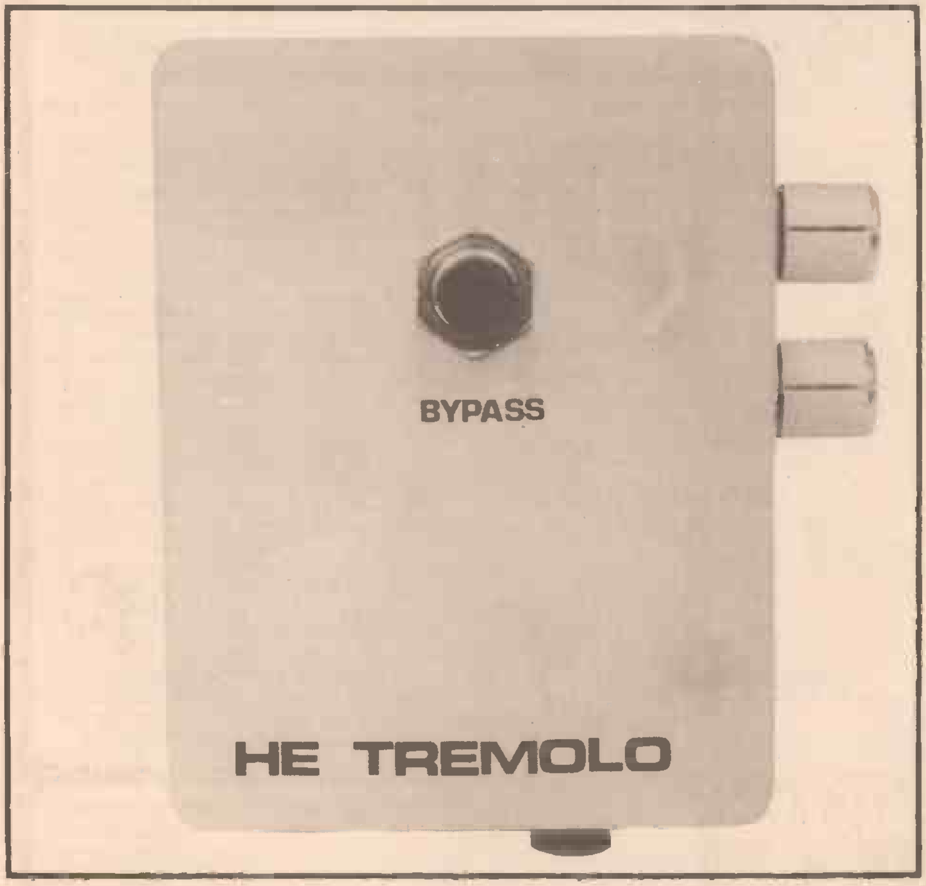
Construction

As this unit is likely to receive a fair amount of rough treatment it is advisable to fit it into a very strong case, and a diecast aluminium box is ideal. However, any strong case of metal construction (to shield the circuitry against interference pick-up) is suitable. Switch SW1 is a heavy duty, successive operation (ie push on/push off) switch, and this is mounted on the top panel of the case so that it can be operated by foot. The other controls and sockets are fitted along two sides of the case. On our unit SW2 is part of input socket SK2, but a separate switch can of course be used here is preferred.

The other components are fitted onto a 0.1" matrix Veroboard, 15 strips by 37 holes, and this is cut down from a board 3.75" wide using a hacksaw. Then the two ⅛" diameter mounting holes are drilled and the breaks in the copper strips are made, after which the board is ready for the components and links to be fitted into place. Integrated circuit IC1 has a MOSFET input stage, and to avoid damage due to high static charges we strongly advise you to use an IC socket with this device. It should be the last component to be fitted to the board and should be left in its protective packaging until that time. Handle the device as little as possible.

Once the board has been wired up to the controls, sockets, and battery clip, as shown in Fig. 2, it can be mounted inside the case using M3 or 6BA fixings.

Once completed, the unit is wired between the guitar and the amplifier (the circuit is automatically switched on when the guitar lead is plugged in, and switched off again when the lead is unplugged from SK2). With RV2 adjusted for zero tremolo, RV3 is adjusted by trial and error to give the same volume with the unit switched in or out of circuit using SW1.



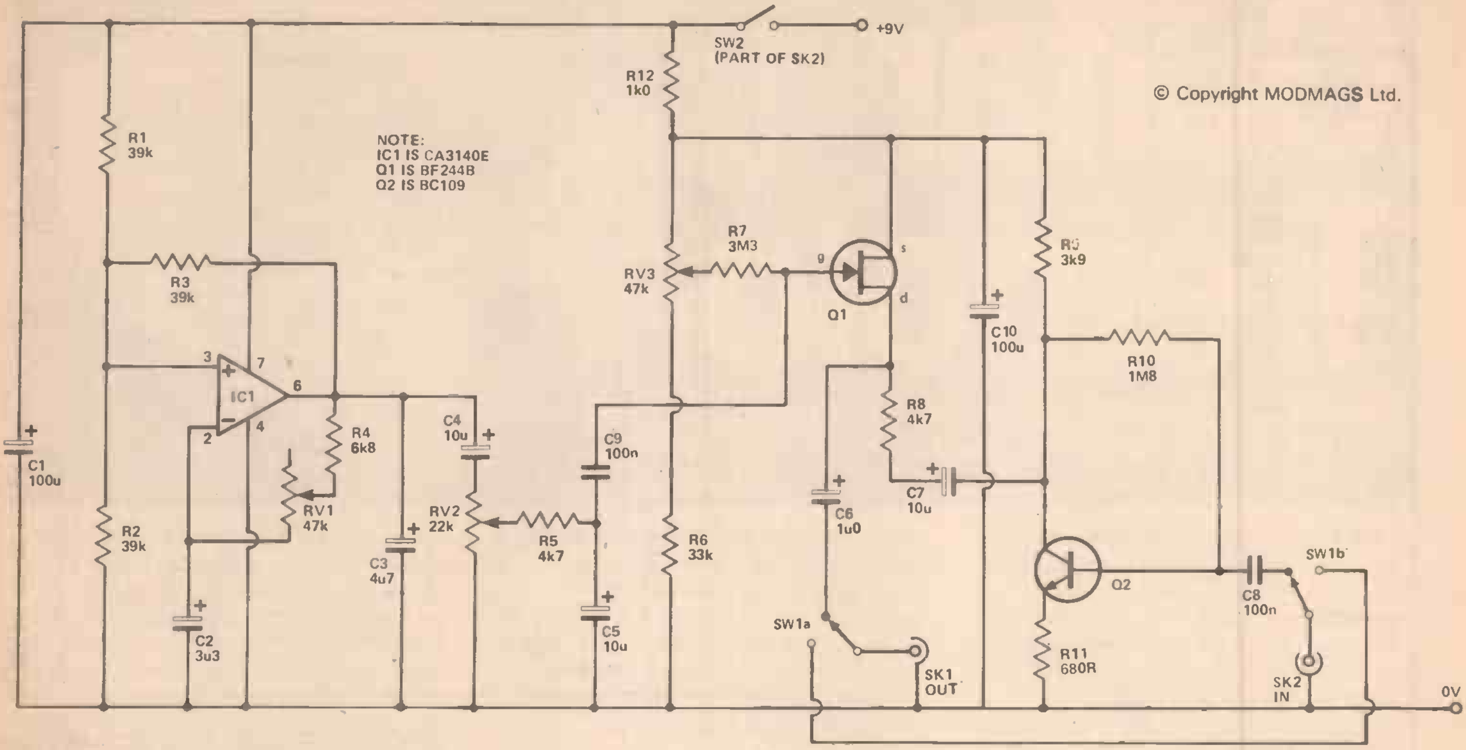


Figure 1. Circuit diagram

How It Works

The HE Tremolo consists of two main parts: a voltage-controlled amplifier and a squarewave oscillator to generate the control voltage. The squarewave is filtered by a resistor/capacitor combination to change it into a close approximation of a triangular wave.

The tremolo effect is produced by changing the amplitude of the guitar signal according to the rise and fall of the triangular wave thus producing the output waveform shown. This combined waveform consists of the original guitar signal amplitude modulated by the triangular wave.

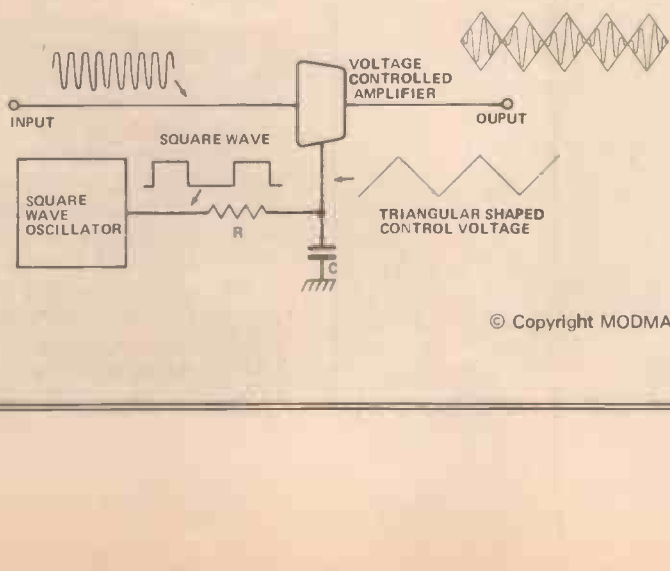
Figure 1 shows the circuit of the tremolo unit, and it consists of three main sections: an oscillator based on IC1, a VCA using Q1, and a pre-amplifier which uses Q2.

The oscillator is a well-known configuration, and this generates a squarewave output at pin 6 of IC1. This is not the ideal waveshape since it would result in the output signal simply being switched between two volume levels, whereas we really require a smooth variation between the two extreme volume levels. The output of the oscillator is therefore coupled via C4 and 'depth' control potentiometer RV2 to a simple RC filter which consisted of R5 and C5. This 'smooths' the squarewave into a much more suitable (sawtooth-like) waveform. Potentiometer RV1 is the tremolo frequency control, and it gives a range of roughly 1.5 to 10 Hz. Capacitor C3 is used to suppress high-frequency harmonics on the output signal of IC1 which could otherwise leak into other parts of the circuitry giving unwanted 'clicks' on the output signal.

Transistor Q2 is used as a common-emitter pre-amplifier stage with unbypassed emitter resistor R11 being used to introduce negative feedback which reduces the voltage gain of the stage to a suitable level (about 6 times). It also boosts the input impedance of the stage to a level that gives a good match for an electric guitar pick-up.

The output of Q2 is coupled by C7 to the VCA formed by R8 and the drain-to-source resistance of Q1. Preset RV3 and resistor R6 are used to give a controlled reverse bias to the gate of Q1 via R7, and this is adjusted to give a drain-to-source resistance in Q1 that gives roughly unity voltage gain through the circuit under quiescent conditions (ie with zero modulation signal). If RV2 is advanced to give a small modulation signal, this is coupled to the gate of Q1 by C9. Here it varies the gate voltage slightly, giving consequent changes in the drain-to-source resistance of Q1 and the gain through the circuit. This gives the tremolo effect. Adjusting RV2 for a larger modulation signal gives larger and more rapid changes in the amplitude of the output signal and a more 'aggressive' tremolo effect.

Switch SW1 enables the tremolo circuitry to be bypassed when the tremolo effect is not required, and SW2 is the ordinary on/off switch. The circuit has a current consumption of only about 2 mA, and a small (PP3 size) 9 V battery is sufficient to give many hours of operation.



Parts List

RESISTORS (All ¼W 5%)

R1,2,3	39k
R4	6k8
R5,8	4k7
R6	33k
R7	3M3
R9	3k9
R10	1M8
R11	680R
R12	1k0

POTENTIOMETERS

RV1	47k linear
RV2	22k linear
RV3	47k miniature horizontal preset

CAPACITORS

C1,10	100u, 10 V electrolytic
C2	3u3, 35 V tantalum
C3	4u7, 10 V electrolytic
C4,5,7	10u, 10 V electrolytic
C6	1u0, 10 V electrolytic
C8,9	100n polyester

SEMICONDUCTORS

IC1	CA3140E operational amplifier
Q1	BF244B N-channel JFET
Q2	BC109 NPN transistor

MISCELLANEOUS

SW1	double-pole, double-throw foot switch
SK1	¼" jack socket
SK2	¼" jack-socket with double-pole, double-throw switch (SW2)

0.1" Veroboard
Case to suit
Knobs
Battery + connector

Buylines

There are two unusual components used in this project; SK2 and SW1. These are both available from Maplin Electronic Supplies.

Approximate price for all parts excluding case is £12.

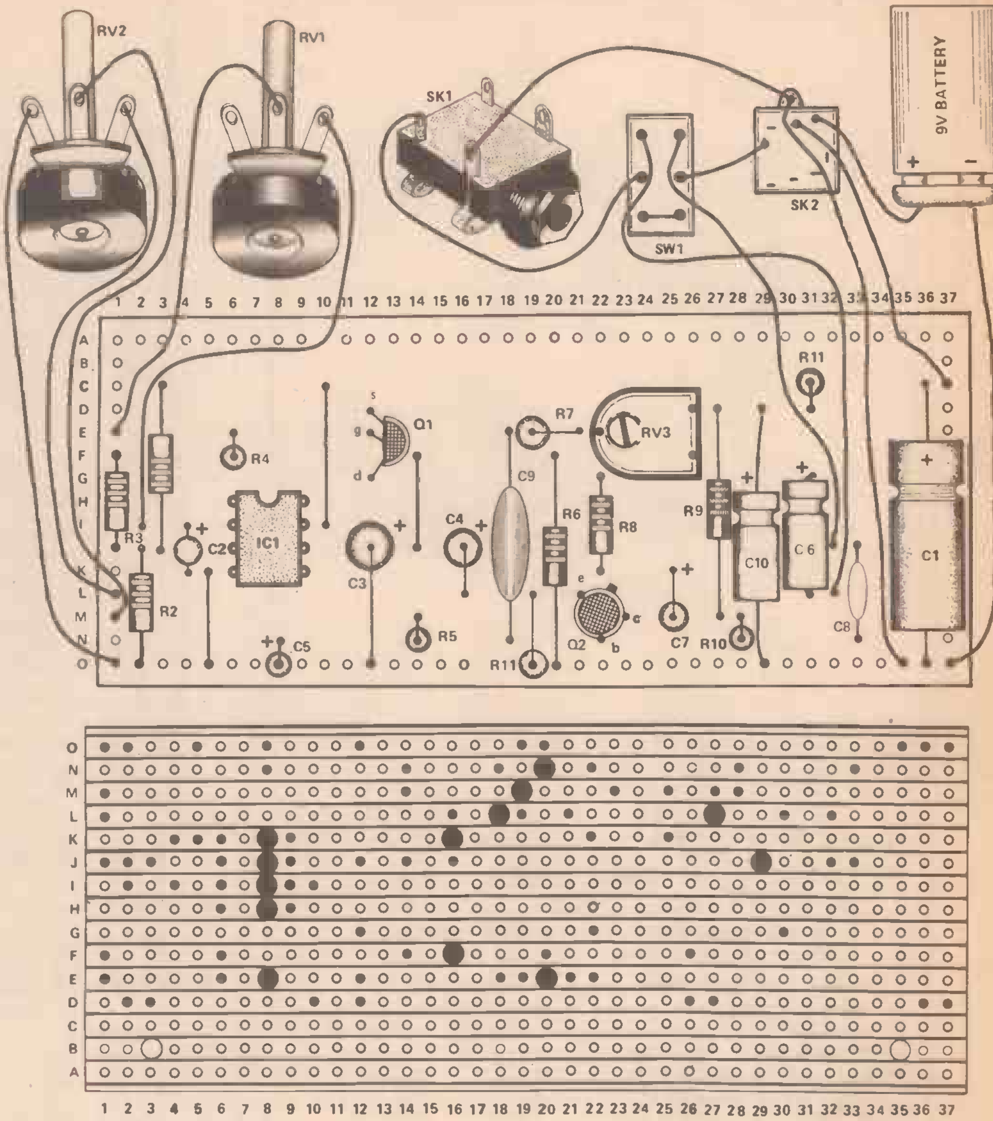
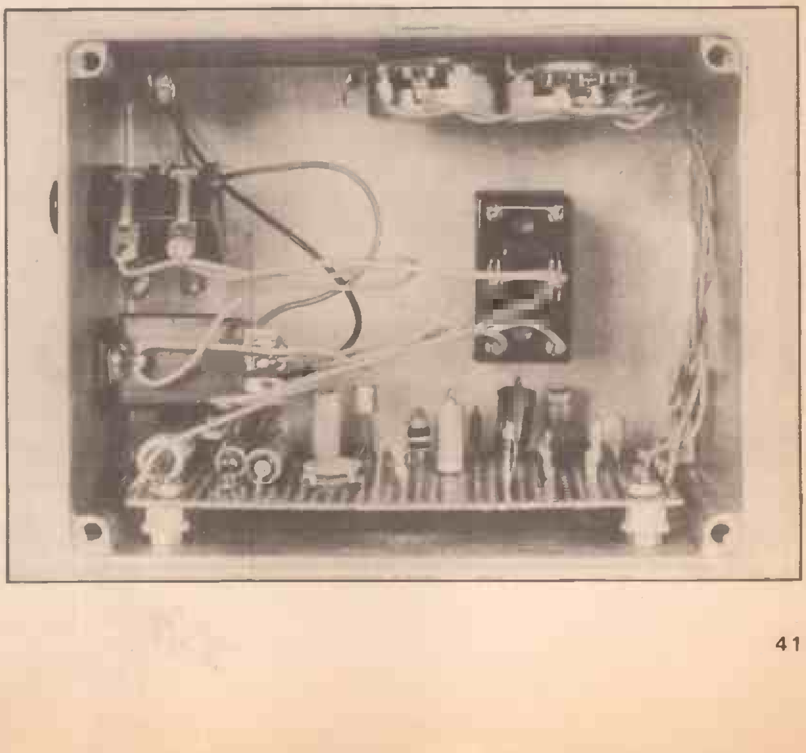


Figure 2. Component positions, underneath track breaks and connection details

HE



OSCILLOSCOPE
EXCLUSIVE OFFER for HE readers

HERE'S a second chance to own the most valuable aid to the electronics hobbyist — AN OSCILLOSCOPE. With a screen size of 75 mm and a bandwidth of DC to 5 MHz the Kikusui 538A will enable you to 'see' how circuits are working *instantly*.

Apart from the CRT, semiconductors are used throughout the circuit: the 'scope is ready to operate in under 20 seconds. It comes complete with operating manual containing full details of operation, maintenance, calibration and circuits.

All-inclusive cost of the 538A, *delivered to your door*, is only **£95**. Each 'scope carries a full one-year guarantee.

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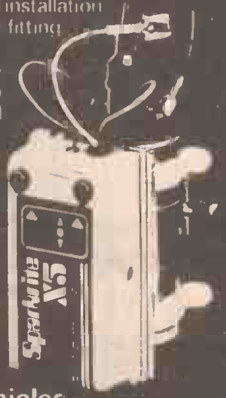

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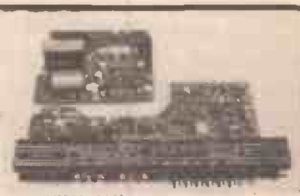

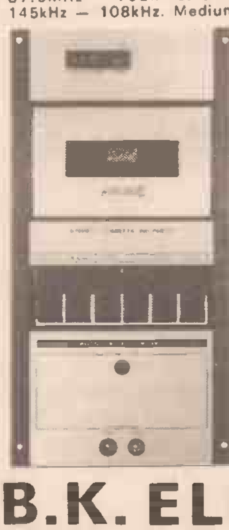

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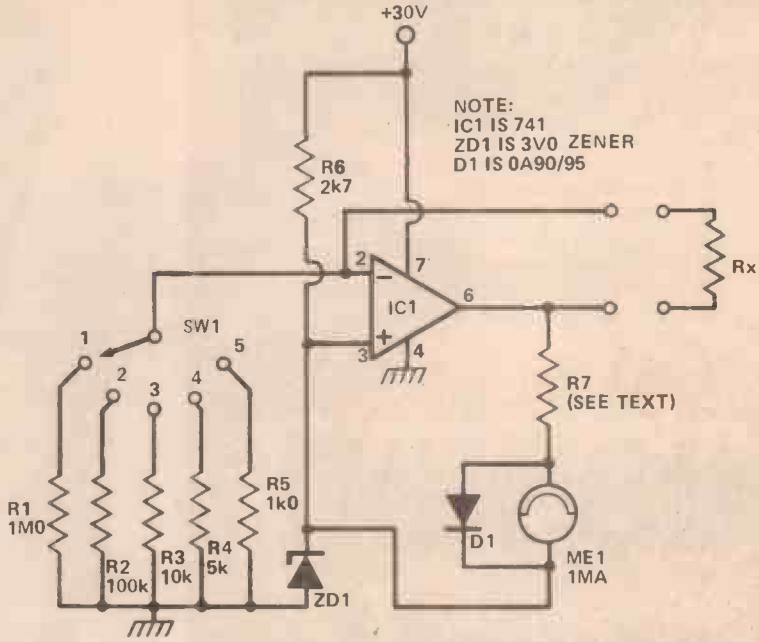
Short Circuit

Direct Reading Ohmmeter

This is a useful piece of equipment for checking unknown resistors, continuity of coils, transformer windings etc. Designed around a 741 operational amplifier it has the advantage that once the meter dial is calibrated, resistance can be read directly from the scale without the usual cramping at the low-resistance end.

The meter can have any internal resistance, but it must be made up to 3k by an external resistor R7. The prototype used a meter with an internal resistance of 100R. It is a good idea to make up the meter resistance to a round value of say, 300R, by a small resistance so that you aren't left with an awkward value for R7.

The complete unit is self-zeroing and is protected against open-circuit or unknown resistance at Rx by diode D1.



All short circuits are offered as suggestions only. To the best of our knowledge they are fully working designs, but we have not tested them. If you have an original design which you would like to see published as a Short Circuit, send it to us — we will pay for all circuits published.

Put the 'bullet' in, spin the chamber and take a chance with HE

Russian Roulette Game

This one will just kill you — a harmless electronic simulation of a dangerous game. Save the expense of redecoration: better still, save your life — with this fun-filled game from HE

RUSSIAN ROULETTE as a game apparently originated in the officers' mess of army posts around the world, where shell-shocked officers would gamble with their own lives merely as a relief to boredom. The idea was to load one bullet in the chamber of a revolver, then to spin the chamber so that nobody would know exactly where the bullet was in relation to the firing pin. One of the men would then hold the gun pointed to his own head, pull the trigger and — if he was lucky (an average of 5 out of 6 times) — click, if not (1 out of 6) — *bang*.

The HE Russian Roulette Game harmlessly imitates the real thing. It uses an integrated circuit to clock in a cycle of six, simulating the six bullet spaces of the chamber. By operating the spin switch the 'bullet' is automatically moved round — the chamber is spun. Each time the 'trigger' switch is pressed, the bullet comes one step closer to the 'firing pin', which is a LED in our game. When the bullet reaches the firing pin the LED lights, 'killing' the last player who pulled the trigger. The winner of the game is the last one left — he buys the next round of drinks.

As you can see, we managed to fit our prototype inside the handle of a full-sized polystyrene model of a gun (a 4" Smith & Wesson 44 Magnum). There is of course, no reason why an

Our prototype fits inside the adapted handle of a 44 Magnum model gun made by L&S Co., Ltd.

Parts List

RESISTORS (All ¼ W, 5%)

R1,2	18k
R3	330k
R4	470R

CAPACITORS

C1,2	100n ceramic

SEMICONDUCTORS

IC1	555 timer
IC2	4017 decade counter/divider
LED1	red LED

MISCELLANEOUS

SW1	single-pole, single-throw miniature toggle switch
SW2	double-pole, double-throw miniature toggle switch
PB1	single-pole, single-throw, momentary action push switch

9 V battery + clip (PP3-size)
Case to suit

Buylines

The parts for this project (excluding the PCB and whatever housing you use) will cost about £6. You should have no difficulty in obtaining components.

Any good model shop should be able to help with a suitable model gun. Be careful to choose one which has enough room inside to house the project.

ordinary plastic potting box can't be used: we chose a gun simply to make it look good. So, we'll leave the choice of casing up to you and deal only with the electronics.

If you are restricted by size, as we were, then you should use our PCB design. The circuit shouldn't be much bigger if you build it on Veroboard but those extra few millimetres might just give you the edge. Begin by inserting the resistors, followed by the two capacitors as shown in the overlay in **Fig.2**.

At this point we normally advise you to use IC sockets but if you are troubled by lack of space then solder the ICs directly into the board. The 4017 is a CMOS chip and as such should be handled carefully. Use an earthed soldering iron and, as with any semiconductor, solder one pin at a time, letting the device cool before soldering the following pin.

Next, connect the switches, LED and battery as shown in **Fig.2** using a good-quality momentary-action push switch for PB1. Then switch on and try it out.

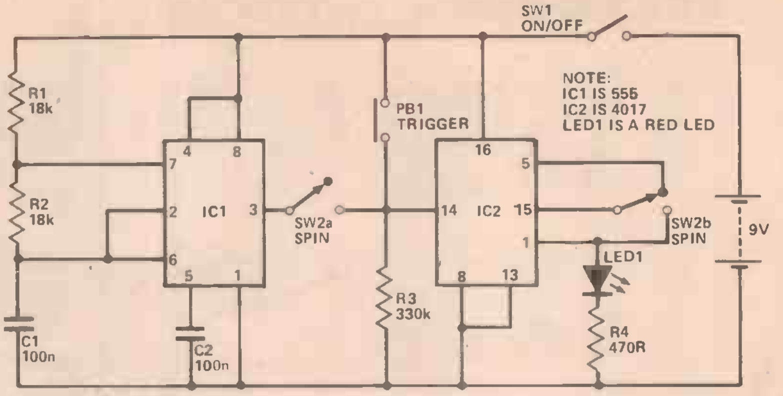
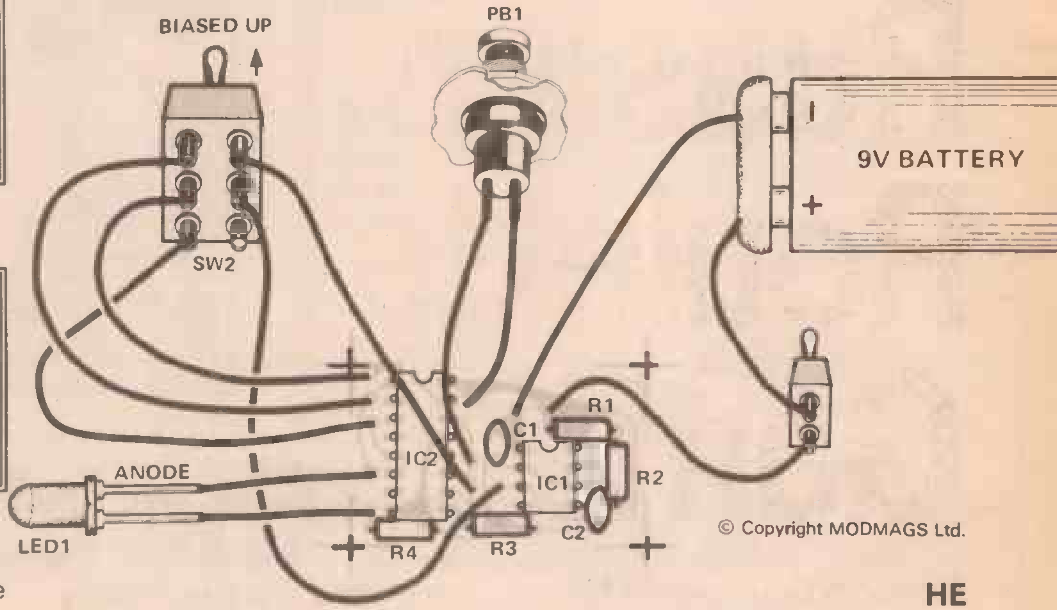


Figure 1. Circuit diagram

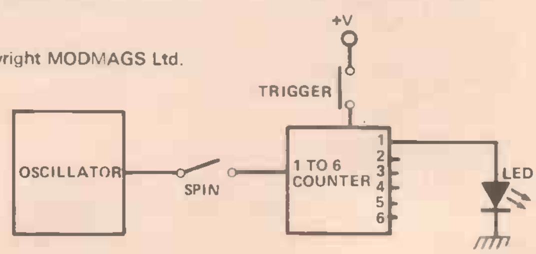
Figure 2. Overlay of the printed circuit board, whose foil pattern is on page 65



HE

How It Works

An oscillator clocks the counter whenever the spin switch is pressed. Upon release the state of the counter is not known. Pressing the trigger switch clocks the counter on, one step. If that is the number one output, the LED lights indicating that the bullet has been fired.



The oscillator is formed around a 555 astable multivibrator circuit operating at about 250 Hz. This frequency is defined by the resistor/capacitor chain R1,2 and C1 according to the formula:

$$f = \frac{1.45}{(R1 + 2R2) \times C1}$$

Switch SW2 is the spin switch, which does two jobs when pressed: it connects the oscillator to pin 14, the clock input of the 4017 counter, and it isolates the LED so that it cannot flash. Releasing SW2 stops the 4017 from clocking. Each press of the trigger switch, PB1, provides one pulse to the clock input and thus moves the 4017 on one step. When the output of the counter corresponds to the LED connection the LED lights up.

O Level Q & A

It's time to talk about transducers. Nick Walton explains what they are, what they do and where you'll find them being used

We have transducers on the bill of fare this month and we will be meeting mike as well — but more of him anon. Whatever is a transducer? Well, I have seen it described as a device which changes one form of energy into another and while that is the basic idea, it is somewhat incomplete. In the same way you could describe your own body as a transducer as it spends a lot of its time changing energy of one sort into another, but as an example it just does not feel right. So we have to settle for a definition something along the lines of a device which receives a signal (or series of waves) in one form and produces a corresponding signal or series of waves in another energetic form. An excellent example of this is the loudspeaker. It spends its time receiving alternating currents from the output of an amplifier and faithfully converting these into movements of a stiff paper cone. These movements in turn cause small changes of air pressure which our ears perceive as sound. So while the energy change bit does take place we can also say that the form of the output is a faithful reproduction (!) of the input.

Hopefully you can see the same idea coming over from the function of a microphone which does the reverse of a loudspeaker: sound vibrations go in and corresponding electrical vibrations come out and are fed usually to the input of an amplifier.

Today there is quite a range of devices all busily transducing, some in an obvious way and others not quite so obviously. Perhaps you can now understand why our syllabus mentions, apart from the speakers and mikes we've already mentioned, the following things as transducers: record player pickups, the thermocouple (a junction of two metals between which there appears a voltage when the junction is heated), various light sensitive devices which conduct better or give rise to a voltage under the influence of light, and our friend the thermistor (pushing it a bit, you might think) which drops its resistance as its temperature goes up.

If you want a really one-up transducer, then how about the photocoupler? This is a combination of light-emitting diode, itself a sort of transducer which emits its light (derived electrically in the first place) and a photo-transistor which changes its conduction according to the level of light incident on it. The two parts of the circuit can be electrically separate from each other. Applications of this transducer are found in oscilloscopes for controlling the grid of the tube and also in the control of thyristors. Surprisingly, this photocoupler can operate at frequencies in the kilohertz range.

Usually, a transducer is what is called 'passive'; that is, its energy output is derived solely from the input energy. If it derives energy for its output from a source other than just the input waves it is referred to as being 'active'.

Left-handed Look At Loudspeakers

Let us now look at our transducers in more detail, and if we first consider the loudspeaker some further basic electromagnetism might not come amiss. A proper understanding of the loudspeaker involves something called Fleming's left-hand rule. (This was named after Sir John Ambrose Fleming: a physicist who lived to the ripe old age of ninety five during which time he invented and developed the thermionic diode for which he coined the name — guess what — the valve.) If you remember back to the December issue, we looked at magnetic field lines or lines of force. Magnetic behaviour can be explained by regarding lines of force wanting to shorten themselves. Thus a north pole of one magnet near a south pole of another can result in the two being drawn together (Fig.1). Suppose we now have, going straight through this field, a current-carrying wire represented by the cross midway between the poles with circular lines of force round it, as shown in Fig.2. There will be a force pushing downwards on the wire and you can think of this as coming about because the north-south field lines want to shorten themselves. It's a bit like a catapult with the wire as the stone and the stretched field lines as the stretched elastic under tension. So we have a right angle between each of the three quantities we are dealing with. That is, the magnet's field (left to right across the page), the conventional current direction (perpendicularly to the page) and the force pushing the wire towards the bottom of the page. Any two you choose will be at ninety degrees to each other.

These directions follow the way your left hand goes if you do a 'thumbs up'. With your hand in this position, point to someone facing you (without, of course, changing the position of

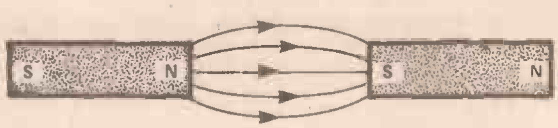


Figure 1. North and south poles of permanent magnets attract each other

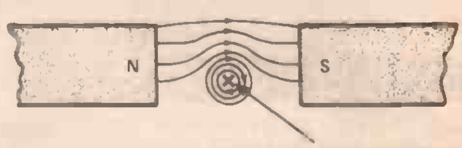


Figure 2. How a current-carrying wire behaves in a magnetic field

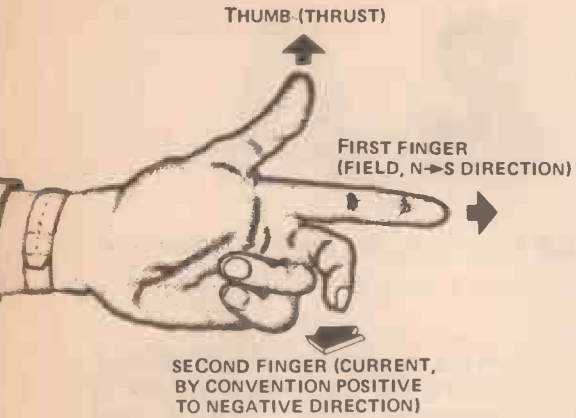


Figure 3. Illustrating Fleming's Left-hand rule

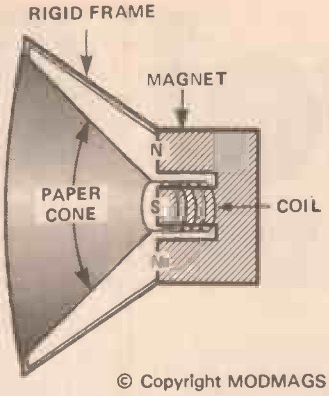


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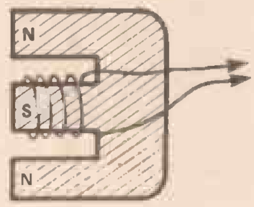
Figure 4. Section through a loudspeaker, perhaps the best-known transducer of all

your thumb) and straighten out your big finger (see Fig. 3). The First finger represents the *field*, the seCond finger represents the *current* (conventional positive-to-negative flow, that is) and the Thumb represents the *thrust* on the wire. You could use the 'm' in thumb to stand for motion of the wire except that it may not *always* move but there is always a thrust or force on it.

And what is the neatest example of Fleming's left-hand rule? You've guessed. It is the loudspeaker, once you realise that the clever bit is the shape of the magnet. A section of the whole speaker is shown in Fig.4, and details of the permanent magnet assembly are shown in Fig.5. While Fig.5a shows a side section of the magnet, Fig.5b shows a view on-axis — in other words, what you would see if you tore out the cone and the speech coil. Actually I am not just being vandalistic. If you can get hold of an old wrecked speaker you can learn a lot by cutting it up as far as possible to look at the coil and the shape of the permanent magnet. The poles are as close together as they can be, leaving just enough of a gap to let the coil slip in as indicated.

Now, looking at the top half of Fig.5a and putting in the x symbol to represent the wire of the coil at that point going away from you, we get to Fig.6. Now give that the Fleming left-hand treatment (first finger downwards from the top of the page to the bottom, second finger down into the page) and you either discover your thumb is pointing to the left side of the page, or that you have dislocated your shoulder. Try turning the magazine round instead of yourself — you'll find it's a bit lighter. So with the current in that direction the coil is pushed to the left. You should also check that the lower half of the coil is also pushed to the left — otherwise you could have

a



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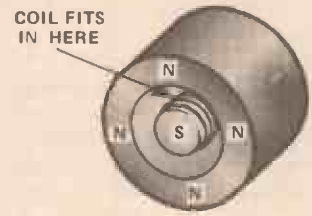

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Figure 5. Loudspeaker permanent magnet: a) side section showing north and south poles and position of speech coil, b) view into centre pole of magnet, from cone side

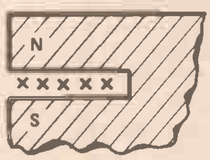

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Figure 6. Current-carrying wire in a magnetic field — this time between the north and south poles of the magnet shown in Fig. 5a

problems! Then, if a split second later the current flows in the other direction, further attempts to dislocate your shoulder (it must still be the left shoulder) should reveal the coil moving further *into* its little gap or towards the right of the page.

Mike The Transducer

Now let's put mike under the microscope as our next transducer. The earliest type of microphone used was the carbon granule type. It did not exactly work as a piece of hi-fi equipment at the turn of the century and it is still used by British Telecom in telephones — and it still does not work very well. It has the great merit, however, of being cheap and simple (you can pick them up in surplus shops for as little as 10 to 20p) and it just works by the sound waves squeezing the granules a bit more tightly together, thus lowering their electrical resistance and so allowing more current to flow. The idea is illustrated in Fig.7. Actually, they do not really do

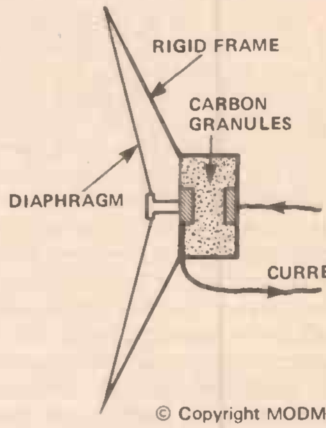

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Figure 7. Side view of typical carbon microphone

such a terrible job when you consider the high expectations we have of microphone behaviour. The mike is expected to respond to air displacements of a ten millionth of a millimetre, which corresponds to an air pressure change of a hundred millionth of atmospheric pressure, all this giving rise to about a million millionth of a watt of power being handled. If that is not sufficiently brain boggling then remember that we expect it to respond over the entire frequency range which our ears can hear, which is usually taken to be from a lower limit of 20 Hz (ie 20 vibrations per second) to 20 kHz (ie 20 kilohertz, which is twenty thousand vibrations per second).

Hertz, incidentally, was a short-lived German physicist who discovered radio waves in 1888 aged 31 and died aged 36. He will be the subject of the new Famous Names series in a few issues' time.

Two mikes we need to consider in detail are the moving-coil and crystal types. The moving-coil bears a striking similarity to the moving-coil speaker. Indeed you can use a speaker as a microphone if you have to. The action is that of a speaker in reverse since the sound waves are producing movements of the diaphragm which moves the coil in the field of the permanent magnet, thus inducing voltages in it.

A not-too-distant relation is the ribbon microphone, which uses just the same induction principle but with a corrugated aluminium alloy ribbon whose movement in the permanent magnet's field does the induction bit.

A condenser microphone (more correctly referred to as a capacitor microphone) gets the electrical fluctuations by a change in capacitor plate separation and hence in capacitance, but the crystal mike uses a different principle altogether, the piezo-electric effect. This is an effect found in some crystals, notably quartz, where small strains imposed on the crystal result in small voltages across it.

Pick Up A Transducer

Indeed the piezo-electric effect is used in the crystal pickup of a record player — yet another type of transducer we have to consider — where the varying strains are transmitted from the stylus moving along the groove. It is a deceptive little path that groove. Did you know that in some highly magnified pictures of the grooves of unplayed records it is possible to see the groove turning through a complete right angle? No wonder they wear out quickly, especially when you consider that early pickups had a tracking weight of up to about two hundred grams whereas today the technology is such that they can manage on a fraction of a gram. Crystal pickups usually give more output than magnetic pickups, though this is not true for the latest type of ceramic crystals that are used. One of the earlier difficulties was that the best piezo-electric crystals were deliquescent (dissolving in water absorbed from the air), so unless the manufacturer took precautions you could have the crystal picking up water from the atmosphere and dissolving itself in a little puddle by the turntable. So how about 'crystal pickup' as a suitable name for your next puppy?

Assuming that the crystal stays undissolved, the output is given in RMS volts for a certain stylus velocity (RMS volts is the 'root mean square' voltage which for our purposes is just a kind of average voltage). For instance, you might meet a pickup with a specification given as one mV/cm/sec. This just means that when the stylus is moving over the record at a speed of one cm/sec the output is 1 mV (millivolt). There can be a slight problem here because if your disc is rotating at a steady 33⅓ RPM, the rim of the disc is travelling twice as fast as a point half way in towards the centre. Since if the speed is halved, the output voltage is also halved, pickup manufacturers have to build in some compensation to their pickups. Without this compensation you would get a progressive diminuendo from the first groove to the last, which might not suit everybody.

Magnetic pickups are the only other sort we have to consider, and yet again we meet our old friend the moving coil. Small wire coils are still used and they still vibrate in the field of a permanent magnet, but the very latest use a printed coil of mass about 150 micrograms (one microgram is one millionth of a gram) on a one millimetre square wafer. The big advantage of this reduction in size and weight is that the magnet can be mounted sitting virtually on top of the stylus and this improves the reproduction even more (see Fig.8).

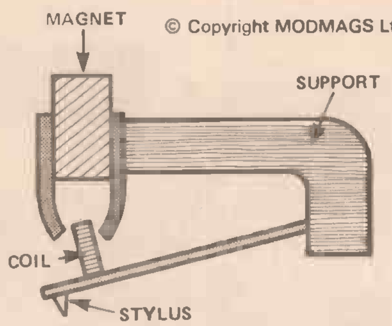

Figure 8. Modern type of moving-coil pickup

Thermocouples, Thermistors & Light-sensitive Cells

If you bend your imagination a bit you might be able to admit thermocouples and thermistors into our crowd of transducers. If you really cannot make that leap, don't worry but you still have to know about them! A thermocouple at its simplest is a couple of different bits of wire (eg copper and iron) twisted together with their free ends connected to a sensitive microammeter. Heat them up and — lo and behold — you see a small current flow. Strictly you should have two junctions, one hot and the other cold, and you'd get a voltage developed between them, as indicated in Fig.9.

In the first example, we were using one of the microammeter or galvanometer terminals as the cold junction. The thermistor, on the other hand, is just a circuit component

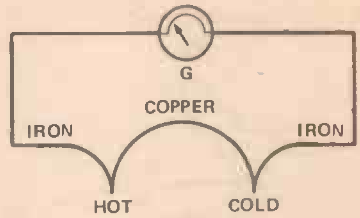

Figure 9. Operation of a thermocouple

whose resistance drops when you heat it, unlike a metal whose resistance increases with temperature. A thermistor can be made of carbon or some metal oxides and can be used as the sensing element in a simple temperature alarm circuit: a thermistor could have been used in the HE Freezer Alarm project described in the October 1980 issue.

Recently I was pulling an old telly apart and found a couple of thermistors whose function was to offer a high resistance when you first switched on, thus keeping current down till things reached their working temperatures.

The last class of transducers to be covered are light-sensitive devices, and these fall naturally into two categories — those that produce a voltage when exposed to light, hence called photovoltaic transducers, and those whose resistance is dramatically altered by light, known as photoconductive cells. Selenium cells and silicon cells fit into the photovoltaic category and probably the best known use of these is in satellites where there is all the sunlight you need to stimulate the cells to produce the electricity required to keep the electrical systems going. I did hear of an American who, in sunny Arizona, built a car whose roof was entirely covered with solar cells . . . .

For photoconductive cells, cadmium sulphide is probably the most common compound used. A strip of it can have a resistance of about a hundred ohms in sunlight but it can rise to ten thousand times that value (over a megohm) in total darkness. The cells can therefore be used as the detector bit of, say, an automatic parking light or in some sort of packet-on-a-production-line counting device.

At this stage my energy output is exhausted, and I hope you consider your energy input was worthwhile and that with all this talk of photosensitivity you are well enlightened and fully transduced. I trust the project and the essay topic are taking shape. Stuck for a topic did you say? Why not something on transducers . . .?! See you next month. Cheers! **HE**

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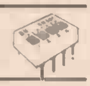

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3300*	150	100 × 65	120p	
4700	75	115 × 35	190p	
11000	25	68 × 50	180p	
15000	16	80 × 35	180p	
15000	40	115 × 35	190p	
22000	16	80 × 50	220p	
22000	25	115 × 35	250p	
28000	25	105 × 70	270p	80p
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0.1"	85	BC	400p
0.15"	12	AC	75p
0.15"	25	BC	120p
0.15"	56	BC	325p
0.156	12	PET	150p
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0.156"	36	BC	200p

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LM723	VAR	–	DIL	35p

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7404	14p	15p	–
7405	18p	–	–
7406	32p	–	–
7407	32p	–	–
7408	17p	22p	–
7409	22p	–	–
7410	15p	19p	–
7411	–	38p	–
7413	30p	–	–
7414	50p	–	–
7416	27p	–	–
7417	28p	–	–
7420	17p	19p	18p
7423	30p	–	–
7427	34p	–	–
7428	35p	–	–
7430	17p	20p	–
7432	28p	30p	–
7437	35p	–	–
7438	30p	35p	–
7439	30p	–	–
7440	17p	19p	–
7441	65p	–	–
7442	55p	–	–
7445	120p	–	–
7447	45p	–	–
7450	17p	–	–
7451	–	22p	–
7454	17p	23p	–
7470	33p	–	–
7472	28p	–	–
7473	34p	–	–
7474	28p	32p	36p
7475	28p	–	–
7476	35p	–	–
7485	90p	–	–
7486	34p	35p	–
7489	200p	–	–
7490	28p	–	–
7492	50p	–	–
7493	28p	–	–
7495	65p	–	–
7496	60p	–	–
7497	175p	–	–
74100	130p	–	–
74104	45p	–	–
74107	32p	–	–
74109	50p	–	–
74111	50p	–	–
74112	–	–	90p
74114	–	–	45p
74116	195p	–	–
74118	75p	–	–
74121	28p	–	–
74122	41p	–	–
74123	45p	60p	–
74125	53p	–	–
74128	72p	–	–
74132	68p	–	–
74133	–	25p	–
74147	180p	–	–
74148	103p	–	–
74150	98p	–	–
74151	60p	100p	–
74153	65p	–	–
74154	98p	–	–
74155	60p	–	–
74157	60p	65p	–
74161	90p	–	–
74163	80p	–	–
74164	120p	110p	–
74166	120p	–	–
74170	235p	–	–
74172	445p	–	–
74173	110p	–	–
74174	85p	–	–
74175	80p	100p	–
74180	92p	–	–
74181	150p	–	–
74182	–	90p	–
74190	85p	–	–
74191	85p	–	–
74193	85p	95p	–
74194	85p	–	–
74197	75p	–	–
74198	140p	–	–
74241	150p	–	–
74266	–	95p	–
74273	265p	–	–
74279	80p	–	–
74283	155p	–	–
74284	400p	–	–
74285	400p	–	–
74298	180p	–	–
74366	95p	–	–
74387	90p	–	–
74390	–	140p	–
74393	195p	–	–

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5.00 MHz	HC18	280p
6.00 MHz	HC18	280p
8.00 MHz	HC18	280p
10.00 MHz	HC18	280p
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LM324N	40p
LM3900	60p
MC1408L8	400p
MC1458R	45p
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NE556	60p
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2652	2200p
6850P	375p
6011	400p
AY-5-1013	400p

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2N2926	7p
2N3053	25p
2N3055H	60p
2N3440	60p
2N3442	120p
2N3702	8p
2N3703	8p
2N3704	8p
2N3771	150p
2N3906	15p
2N4304	20p
2N4351	50p
2N4352	50p
2N5447	10p
2N5449	12p
2N5943	55p
2N6385	125p
ACY19	75p
AD161	40p
AD162	40p
BC108	10p
BC109	10p
BC147	7p
BC148	7p
BC149	7p
BC157	8p
BC159	10p
BC167	10p
BC170	10p
BC170A	11p
BC170C	12p
BC171	10p
BC171A	11p
BC172A	10p
BC172B	10p
BC172C	10p
BC172	10p
BC173C	10p
BC174B	10p
BC182L	10p
BC207B	15p
BC212L	8p
BC213A	8p
BC250A	12p
BC251	14p
BC251A	15p
BC252	16p
BC327	13p
BC337	13p
BC338	14p
BC348	15p
BC547	12p
BC548	8p
BC549	9p
BCY33A	120p
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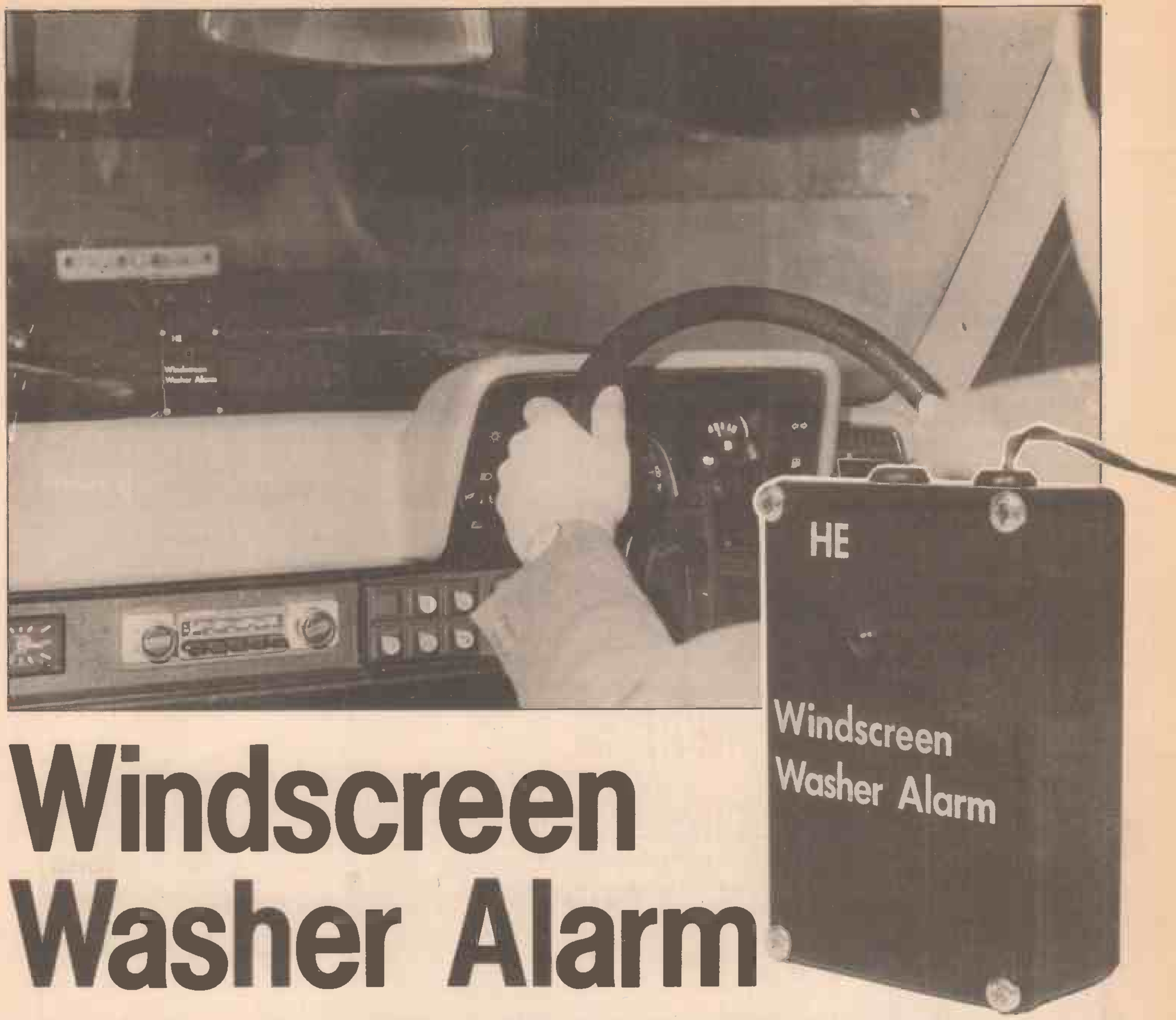


Windscreen Washer Alarm

Fed up with dirty windscreens? The problem can be solved with this all-electronic circuit which gives you an early warning when the fluid in your windscreen-washer bottle is getting low. It's a fun-to-build, simple and cheap project

IT IS REMARKABLE how purpose-built integrated circuits can be made, by modern-day processes, to fulfill functions which, only a few years ago, would require complex transistor (or worse still, valve) circuitry. The IC used in this project is a case in point. Its official title is simply a 'fluid detector' and with only six other readily-available and cheap components it can be used to detect whether the level of fluid in a container is above or below a predetermined height. A similar circuit ten years ago would have used about a dozen separate transistors and twenty or thirty other components.

This project uses one IC, the LM1830, to automatically alert the motorist to the fact that the fluid in his/her windscreen-washer bottle is getting low and shortly will run out. A stop can then be made at the next service station, to refill the bottle before the car in front splatters mud on your windscreen and to your annoyance you find that you can't clean it off because the washer bottle is empty.

A light-emitting diode (LED) comes on whenever the fluid level is low and tells you to refill the bottle as soon as you can.

Construction

Construction of the project couldn't be simpler. There are only seven components to fit onto the Veroboard and only eight track breaks to make underneath. Track breaks can be made with either the correct cutting tool for the job or a small (about 3 mm) hand-held drill bit. Whichever you choose the method is the same: hold the tip onto the hole in question (indicated in **Fig.2**) and gently rotate it clockwise until the copper strip is cleanly broken. Check that no swarf remains lying across adjacent tracks because this might cause a short circuit.

Next, insert and solder all componets and the single link. Use an integrated circuit socket for IC1 to plug into and check that IC1 and C3 are the correct way round. The LED can be used to mount the board into its case (or onto the fascia panel of your car) if you take care.

The probe will vary from car to car and obviously we can't provide details for all applications. However, **Fig. 5** shows one suggestion of how you may construct yours but it all depends on individual washbottles. All that you need to do is make sure that the probes are made of non-rusting material (stainless steel rod is ideal — see Buylines) and that they don't touch each other. Set them to be the required distance from the bottom of the container. Then, when the fluid level gets below the probe height — on goes the LED to warn you.

The circuit draws only 10 to 20 mA so the in-line fuse (which you must use) should have a value of about 100 mA.

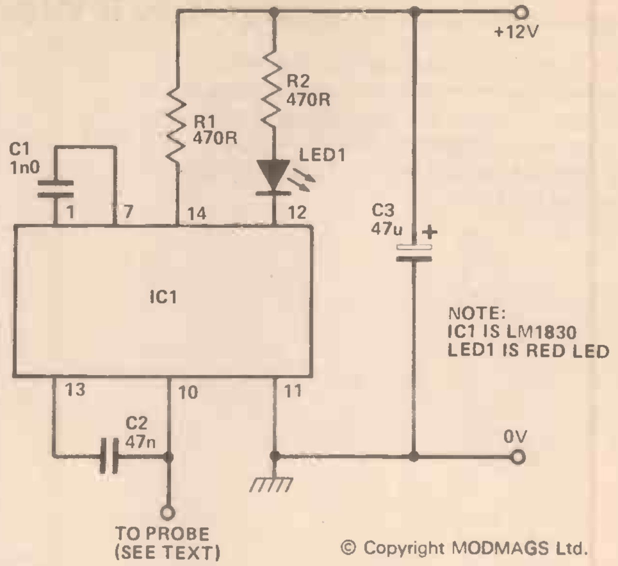
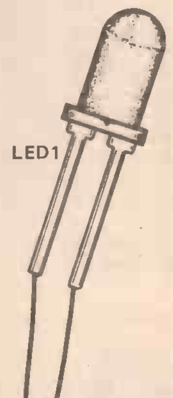


Figure 1. Circuit diagram



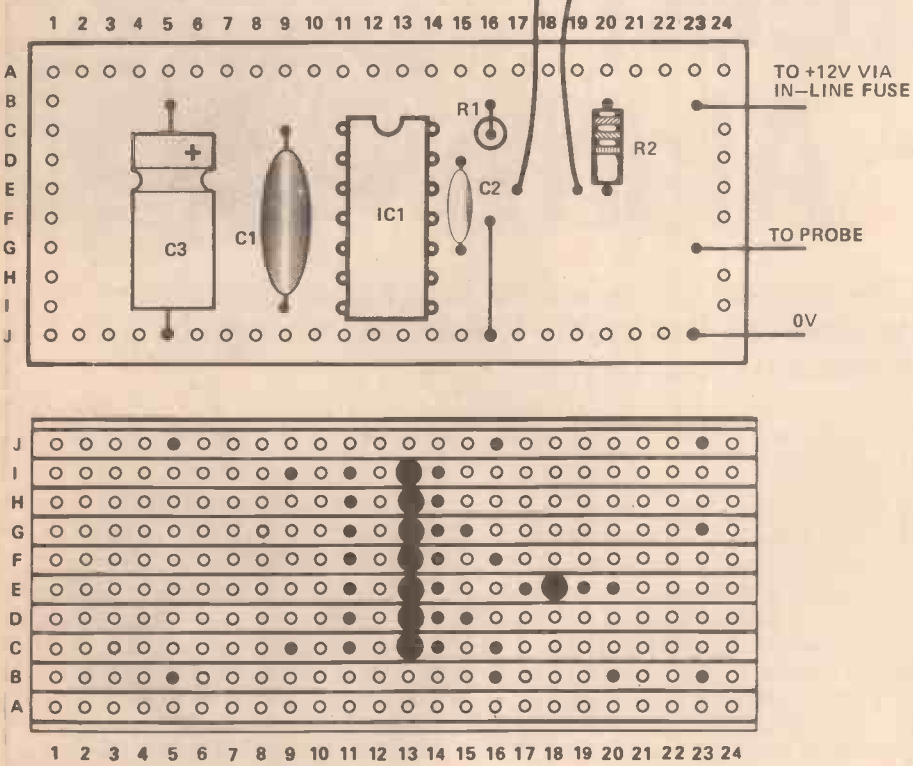


Figure 2. Veroboard overlay, component locations and track breaks underneath

Parts List

RESISTORS (All ¼W, 5%)	
R1,2	470R
CAPACITORS	
C1	1n0 polystyrene
C2	47n ceramic
C3	47u, 16 V electrolytic
SEMICONDUCTORS	
IC1	LM1830 fluid detector
LED1	red LED + mounting clip
MISCELLANEOUS	
10 strip x 24 hole, 0.1" Veroboard	
In-line fuseholder + 100 mA fuse	

Buylines

The components for this project should cost less than £4. If you have any trouble obtaining the LM1830 try TK Electronics, who stock it and advertise in Hobby Electronics.

You can obtain stainless steel rod from:

George King Metals Ltd.
224 Tooting High Street,
London SW17 0SQ.

who will supply two 1ft lengths of ⅛" diameter stainless steel rod for 50p inclusive of VAT and p&p.

How It Works

Integrated circuit IC1 generates a small voltage at its output which is applied via the probes to the fluid (see Fig.3 below). When the resistance of the fluid increases over a pre-determined amount (due to the water level dropping below the height of the probes) the IC turns the LED on.

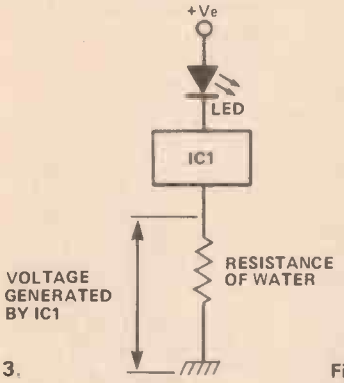
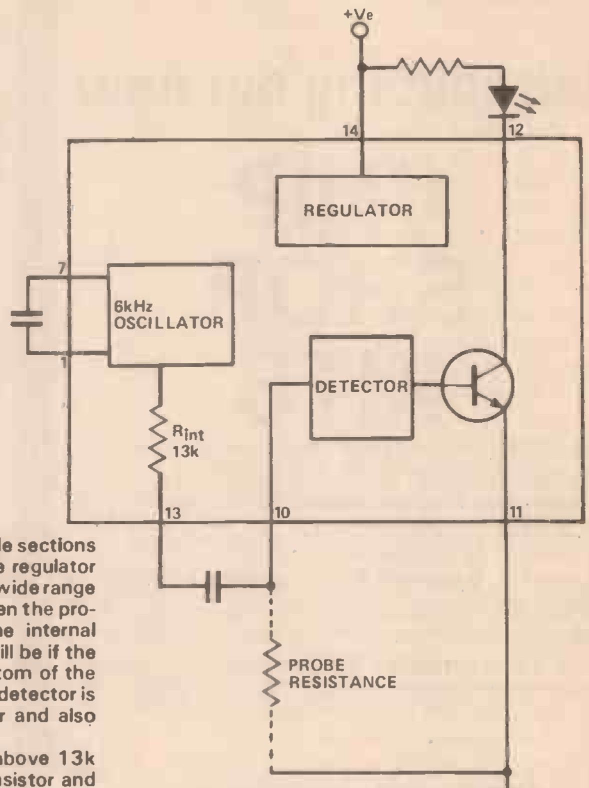


Figure 3.

Figure 4 (right) shows the inside sections of the IC in greater detail. The regulator allows the IC to be used over a wide range of voltages (8 V to 28 V). When the probe resistance is less than the internal resistance (R_{int} — 13k) as it will be if the level of fluid is above the bottom of the probes, then the output of the detector is high, turning on the transistor and also the LED.

If the probe resistance is above 13k the detector turns off the transistor and the LED goes off.



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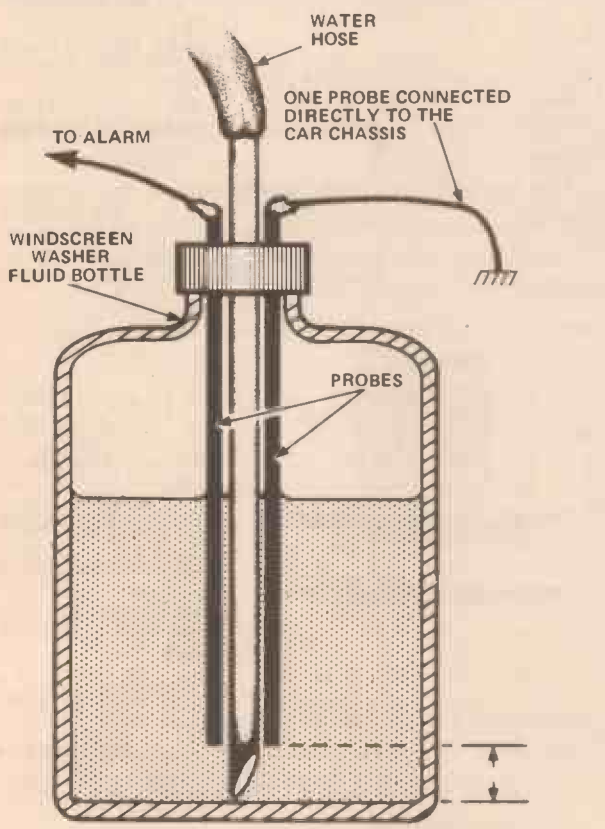
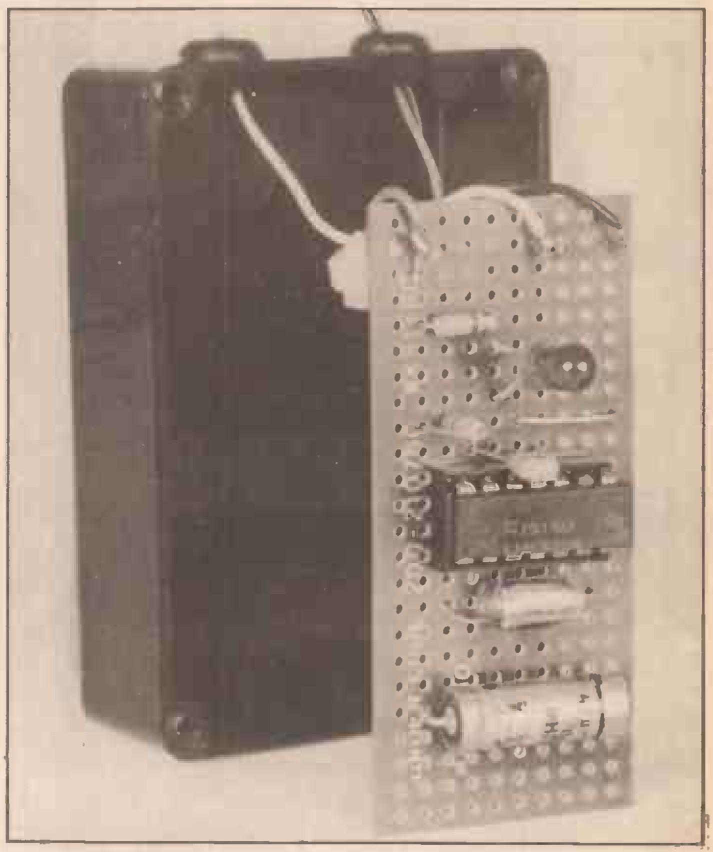


Figure 5. Electrical details of the two probes



Clever Dick

CD names HE's youngest reader and answers a few more queries

BACK IN THE January issue of HE we asked if any of you were younger than Martin Green (he was 13 at the time). Ask a silly question . . . get a lot of answers! We had to open a 'youngest HE reader' file to cope with the volume of letters.

Right then, who *is* the youngest reader? Well, here's one I don't believe.

Dear Educated Richard,

In reply to your request for your youngest reader, so as you can give me a binder, it is possibly me. I am 5 months old + have been reading H.E. for the last 4 months. You may think that your fantastic magazine a little advanced for my tender years, but personally I find you style of writing perfect for my age group.
R. Holland
To whom it may concern:- I certify that this letter has been written by my 5 month old son.
R. Holland
P.S. Isn't his. handwriting remarkably similar to mine.

Sorry — don't believe you — I personally think you're *500* months old. Now for the real winner (determined by all the letters received until the time of going to print): Andrew Bolter, aged 10 years, of Willsbridge, Bristol. He'll be receiving this month's binder. Closest runner-up was Jonathan Wolff, aged 10 years, 9 months, of Boxmoor, Herts.

Now onto some serious business.

Dear Intelligent Richard,

With Reference to the NiCad Battery Charger circuit in your January edition I am a little puzzled about the arrangement of Q1 (TIP41A). Do I take it that the terminals of this transistor are — from Left to Right — B.C.E.?

Also, in your sister mag, E.T.I. there are construction plans for a Differential Temperature Switch, on P.C.B. I have been trying to work out how I could adapt this for vero, but so far without success. Please could you help?
Ta Muchly
A. Harrison
Cramlington, Northumberland

P.S. I am not in the habit of extracting the Michael from people's names!

P.P.S. Martin Green is not H.E.'s youngest reader (Jan. issue), I'm 12 years old. Do I deserve a binder?

In answer to your first query, yes: *looking down* on Q1 (from the board side) the pins are BCE, with the emitter nearest the bottom of page 51, and the heatsink tab of Q1 to the right.

As to converting a PCB design to one on Veroboard, all I can say is that usually the simpler circuits are suitable for Veroboard: those like the Diff Temp Switch can require too much cross-linking.

OK, Martin Green is *not* HEs youngest reader but that doesn't mean that you get a binder!

We received a mixed reaction to the letter from D.S. Nightingale, published in last month's CD. Only one 'nasty' letter was received, from W.H. Biddlecombe of Paisley, Scotland, who started with 'Thank goodness for N.S. Nightingale, Essex. I thought it was just me — now I know better' and ended with 'P.S. You know what you can do with your binder'. Several readers sprang to HE's defence. Cheers to all those who wrote in expressing their loyal support.

Nice short one next.

Dear C.D.,

(1) Could you tell me where I can get hold of ferric chloride and p.c.b. board as I hope to make my own.

(2) I've made the Nicad Charger in the Jan. issue but it makes a loud buzzing sound. What can be done to stop it.

(3) I think H.E.s the best mag out.
D. Young
Ewell, Surrey

One suggestion for ferric chloride and PCB laminate is to order a complete kit: '100 sq ins copper clad board, Ferric chloride, Etch resist pen, abrasive cleaner, two miniature drill bits, etching dish and instructions', cost £4.95 plus 40p p&p, from Greenweld, 443F Millbrook Rd., Southampton S01 0HX (tel. 0703 772501).

Buzzing noises? Either something's shorting and the transformer is 'saturating' (and overheating), or the transformer has loose laminations. If the circuit's OK, check that the transformer is screwed down well to the board. If you're still out of luck, send for a replacement transformer.

Just one more, this time from Spain.

Querido Ricardito el Inteligente,

I'm very interested in construction of the "Phase One", phaser published in HE a few months ago. My problem is more electromechanical than electronic: where can I find a miniature footswitch libe the one in the photos?

"Help me if you can, I'm felling down".

From the city of the Hanging Houses, my best wishes.
J.M.C. Arillo
Cuenca, Espana

Before you fell to your death, you can get the switch for the job (DPDT, 6 amp, heavy-duty push-button switch) from Watford Electronics 35 Cardiff Road, Watford, Herts, England. Cost is £1.72 inc. VAT, plus 50p p&p (to Spain, that is): total cost £2.22 *Sterling*.

I must go back now to my work on the robot editor for HE (a sort of unintelligent HEBOT). Meanwhile, keep those letters short (I print them exactly as they are written, by the way) and remember: I can't answer every query sent in. Look after yourselves.

HE

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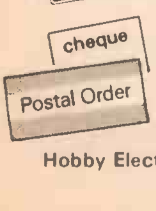

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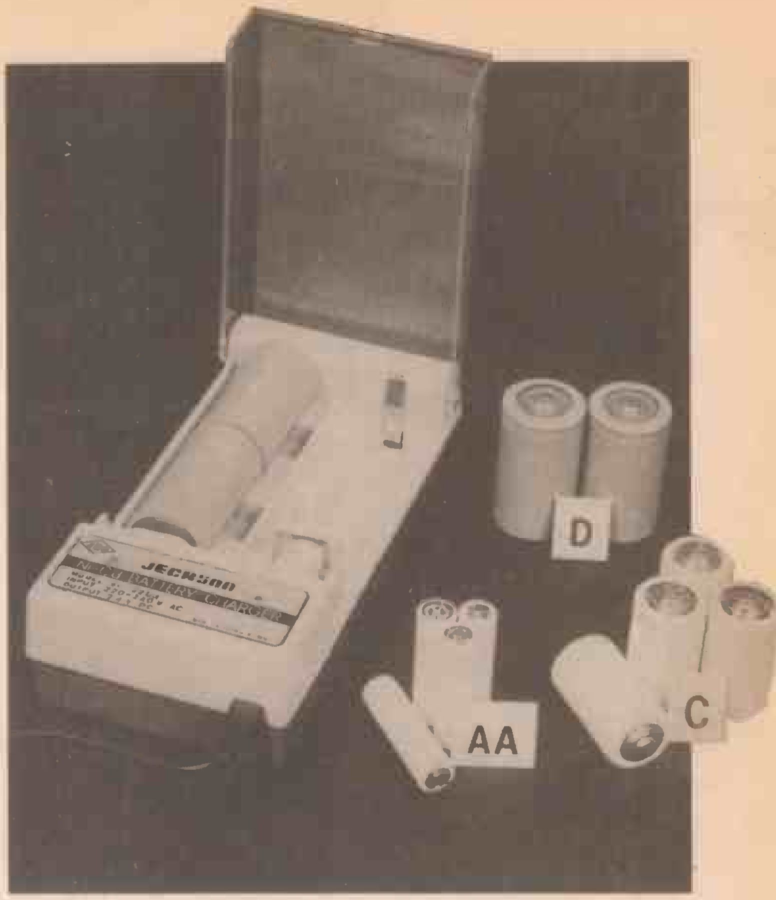

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CB Breaker One Four

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.

Legal CB at last? Rick Maybury looks at some of the preparation required, discusses a few more rumours and names the winner of his DV27 competition

ALTHOUGH, at the time of writing the Home Office has yet to make a public announcement regarding the legalisation of CB there can be few doubts remaining as to the final outcome. If, for one moment, we can assume CB has been legalised — and it may well be by the time you read this, there are a number of things we must consider.

First and foremost must be the setting up of a national organisation to oversee the running of the service. Such an organisation should, to be absolutely effective, be non-governmental. We can, for instance, look to the radio amateur network for guidance. The RSGB (Radio Society of Great Britain), although possibly a little conservative in its outlook for CB, does manage to represent the interests of its members. Hopefully such an organisation could be set up very quickly indeed: perhaps there could be a coalition between the clubs?

Point number two concerns the method by which CB in the UK is administered with regard to emergency channel monitoring. Already THAMES and REACT International have proposals for an emergency service but these must be co-ordinated, particularly in terms of designated channels for emergency use. It may be a good idea to take a note of some of the emergency systems operating on the Continent. Sweden in particular is worth mentioning, because two channels are in use, one for motorists and one for small boats. In both cases the monitoring services have adopted a selective call facility. That means that only calls preceeded by a tone burst generated by the rig will open the squelch of the monitoring services' equipment.

Selective call facilities in general are also worth adopting, particularly for small businesses, where the large capital outlay for a two-way radio system would be prohibitive. The Swedish system allows a number of rigs with a simple modification to be used only when the call is preceeded by a coded tone burst.

My last point, and one that I feel (and hope) will be sorted out before any rigs go on sale concerns type approval. This aspect of CB is often ignored but it is a simple prerequisite of any kind of radio transmission system that the equipment must meet the specifications laid down by the Home Office. Taken a stage further it is logical to assume that rigs that have in some way failed or gone faulty will only be repaired by personnel who have the appropriate qualifications. Being able to give a rig 'a quick twiddle' will not be enough: absolute chaos will ensue if any Tom, Dick or Harry is allowed to repair rigs. One last thought though: what will happen to the half million or so rigs that do not conform to HO type approval; ie, all those that are in use today. I suspect that some kind of amnesty will be announced. This will allow anybody with an old AM rig to hand it in at a Police Station without fear of prosecution. I feel that this will not be too successful, but what are the alternatives?

News Round-up

Back to lighter matters with a quick round up of the month's news. In the past I have tried to give you the names and addresses of all the clubs that write in to the BOF office. I'm

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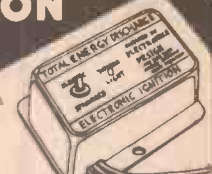

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12A	85p		
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8A isolated tab			65p
Diac			18p

DISCO LIGHTING KITS

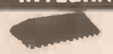
Each unit has 4 channels (rated at 1KW at 240V per channel) which switch lamps to provide sequencing effects, controlled manually or by an optional opto isolated audio input

DL1000K. This kit features a bi-direction sequence, speed of sequence and frequency of direction change being variable by means of potentiometers. Incorporates master dimming control. £14.60

DLZ1000K. A lower cost version of the above, featuring unidirectional channel sequence with speed variable by means of a preset pot. Outputs switched only at mains zero crossing points to reduce radio interference to minimum. £8.00

Optional Opto Input, DLA1 £1.60

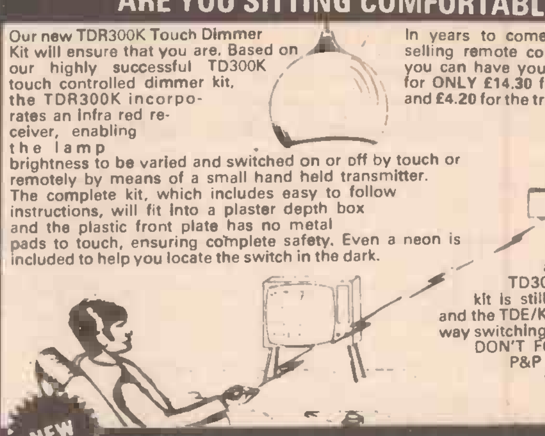
INTEGRATED CIRCUITS



555 Timer	21p
741 Op Amp	19p
AY-5-1224 Clock	£2.60
AY-5-1230/2 Clock/Timer	£4.56
AY-3-1270 Thermometer	£8.20
ICL7106 DVM (LCD drive)	£7.00
LM377 Dual 2 W Amp	£1.45
LM379S Dual 6W Amp	£3.50
LM380 2W Audio Amp	80p
LM382 Dual/low noise Preamp	£1.00
LM386 250mW low voltage Amp	75p
LM1830 Fluid Level Detector	£1.50
LM2907 f-v Converter (8 pin)	£1.40
LM2917 f-v Converter (14 pin)	£1.60
LM3909 LED Flasher Oscillator	60p
LM3911 Thermometer	£1.20
LM3915 — Dot Bar Driver (Log)	£2.20
MM74C911 4 digit display controller	£6.50
MM74C915 7 segment-BCD converter	96p
MM74C915 4 digit ctr with 7 seg o/p	£4.50
S566B Touchdimmer	£2.50
SL440 A.C. Power Control	£1.75
SN76477 Complex Sound Generator	£2.52
TBA800 5W Audio Amp	68p
TBA810AS 7W Audio Amp	£1.00
TDA1024 Zero Voltage Switch	£1.20
TDA2020 20W Audio Amp	£2.85
ZN1034E Timer	£1.80

All ICs supplied with data sheets
Data Sheets only 10p each device.

ARE YOU SITTING COMFORTABLY?



Our new TDR300K Touch Dimmer Kit will ensure that you are. Based on our highly successful TD300K touch controlled dimmer kit, the TDR300K incorporates an Infra red receiver, enabling the lamp brightness to be varied and switched on or off by touch or remotely by means of a small hand held transmitter. The complete kit, which includes easy to follow instructions, will fit into a plaster depth box and the plastic front plate has no metal pads to touch, ensuring complete safety. Even a neon is included to help you locate the switch in the dark.

In years to come everyone will be selling remote control dimmers, but you can have your TDR300K kit now for ONLY £14.30 for the dimmer unit and £4.20 for the transmitter.

For the more athletic of you, the TD300K Touchdimmer kit is still available at £6.50 and the TDE/K Extension Kit for 2-way switching, etc, is £2.
DON'T FORGET to add 50p P&P and 15% VAT to your total purchase.

NEW

REMOTE CONTROL KITS

MK6 – Simple Infra Red TRANSMITTER. A Pulsed infra red source which comes complete with a hand held plastic box. Requires a 9V battery. £4.20
MK7 – Infra Red RECEIVER. Single channel, range approximately 20 ft. Mains powered with a triac output to switch loads up to 500W at 240Vac, but can be modified for use with 5 to 15V dc supplies and transistor or relay outputs. £9.00
* SPECIAL PRICE * MK6 and MK7 together. Order as RC500K. £12.50
MK8 – Coded Infra Red TRANSMITTER. Based on the SL490, the kit includes 2 IR LEDs, measures only 6x2x1.3 cms. and requires a 9V (PP3) battery. £5.90
MK9 – 4 Way KEYBOARD. For use with the MK8 kit, to make a 4-channel remote control transmitter. £1.90
MK10 – 16-Way KEYBOARD. For use with the MK8 kit, to generate 16 different codes for decoding by the ML928 or ML926 receiver (MK12) Kit £5.40
MK11 – 10 On-Off Channel IR RECEIVER with 3 analogue outputs (0-10V) for controlling such functions as lamp brightness, volume, tone, etc. Other functions include an on/standby output and a toggle output, which may be used for sound muting. Based on ML922 decoder IC. Includes its own mains supply £12.00
MK12 – 16 Channel IR RECEIVER. For use with the MK8 kit with 16 on/off outputs which with further interface circuitry, such as relays or triacs, will switch up to 16 items of equipment on or off remotely. Outputs may be latched or momentary, depending on whether the ML926 or ML928 is specified. Includes its own mains supply. Size 9x4x2 cms, excluding transformer. £11.95
MK13 – 11-Way KEYBOARD. For use with MK8 and MK11 kits. Transmits programme step + and –, analogue + and – (3), mute, normalise analogue outputs, an on/standby £4.35

ALL COMPONENTS ARE BRAND NEW AND TO SPECIFICATION. ADD 50p P&P and 15% VAT TO TOTAL. OVERSEAS CUSTOMERS ADD £1.50 (Europe), £4 (elsewhere) for P&P. Send sae for price list and with all enquiries. Callers welcome 9.30-5.00 (Mon-Fri) 10.00-4.00 (Sat).

TK Electronics
(H.E.). 11 Boston Road, London, W7 3SJ
Tel: 01-579 9794

sorry to say that shortage of page space now precludes this particular service. I now have over 200 clubs on my files so you'll have to look at a copy of 'Citizens Band' for the latest information. (Sorry Mr Editor but you can't begrudge me the odd plug.*)

Video fans will be interested to know that Convoy, the film and record that started this whole business, is now available from EMI. Both of the popular formats (VHS and Betamax) are available and the code numbers to look for are: EVH 20231 and EVX 40231.

Rumours have been flying about right, left and centre about the issue of CB licences. One of our informants told us that a company often called upon to print official documents was actually printing the licences. A phone call to the company concerned revealed absolutely nothing, however. Our informant went on to give details about the form and even promised to try and obtain a sample. Although we haven't yet seen this form (nor am I too hopeful) the details we have do sound feasible and are in keeping with what we do already know. It will be interesting to know who will get licence 00001: how about *us* Mr. Home Secretary — ?

Still with the rumours, I keep hearing about rigs that have been confiscated by the Customs & Excise and being returned in plastic bags with seals that read something like 'Don't Open Till Christmas' or some such similar message. I haven't seen one myself, nor have I met or spoken to anyone that has: just a lot of people who know someone, etc. A genuine HE Binder to the sender of one of these elusive wrappings to the BOF office.

*Rick's main occupation now is to edit Citizens' Band — Ed

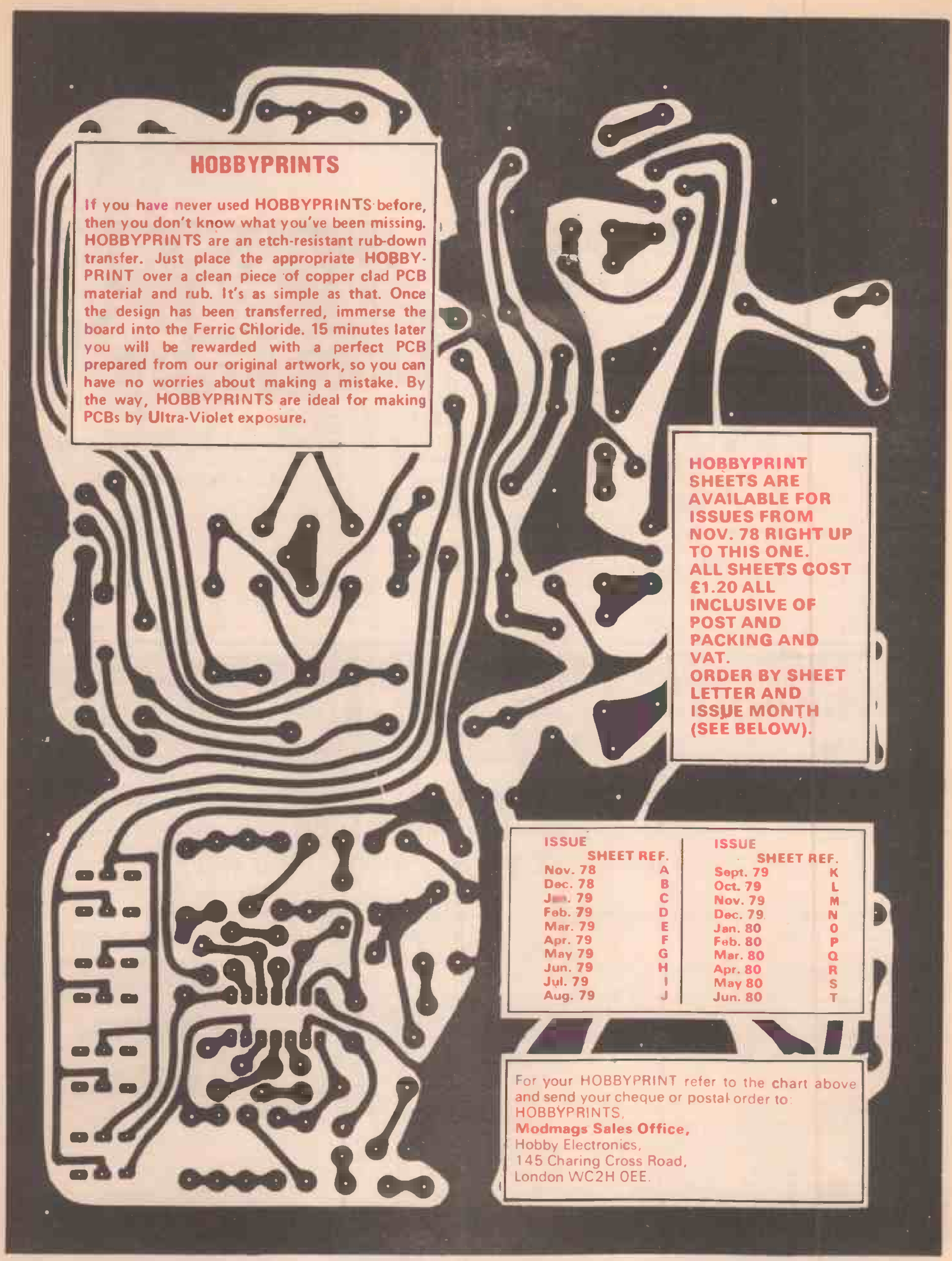
DV27 Competition

And finally, I have collated the results of my little competition last month to find the vendor of the cheapest DV27. A number of you have told us about Midland Telecom, 113 Flaxey Road, Milton Keynes, which sells the redoubtable DV27 for an incredible £3.90.

First letter out of the BOF hat with this information came from 'Little Hitler'. Congratulations — and your Tee-Shirt is on the way.

Time's up for another month. Stay Lucky out there in CEEBEELAND and see you all next month, hopefully with some very good news.

HE



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Mar. 79	E	Jan. 80	O
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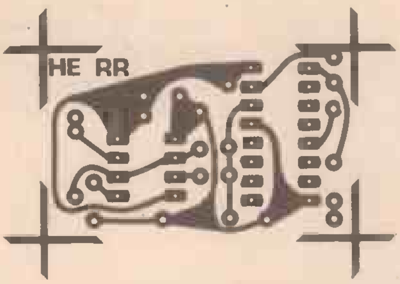
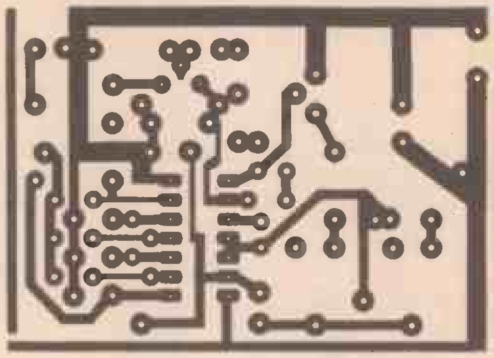


HE Russian Roulette foil pattern



The foil pattern of HE Super Siren

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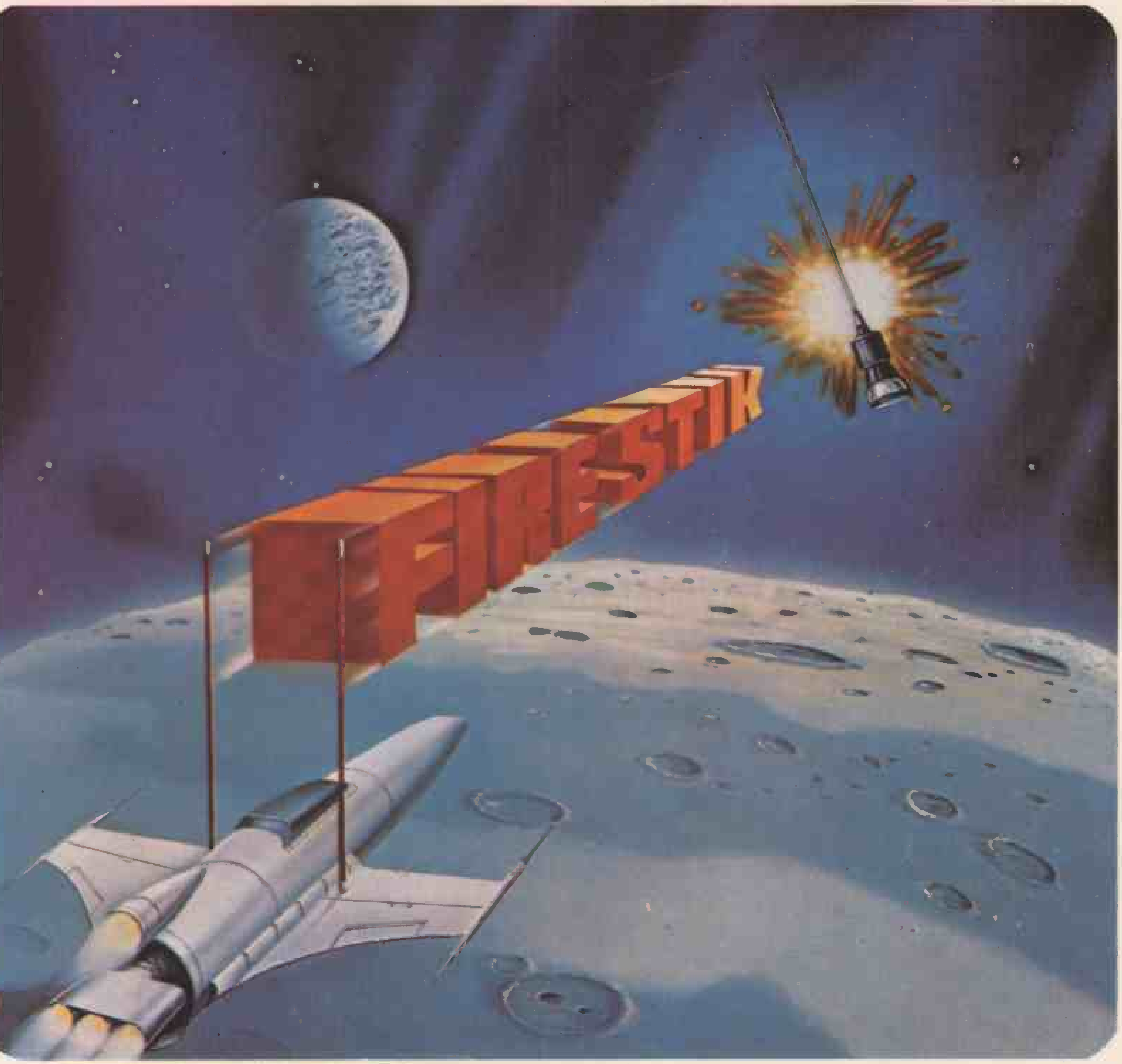

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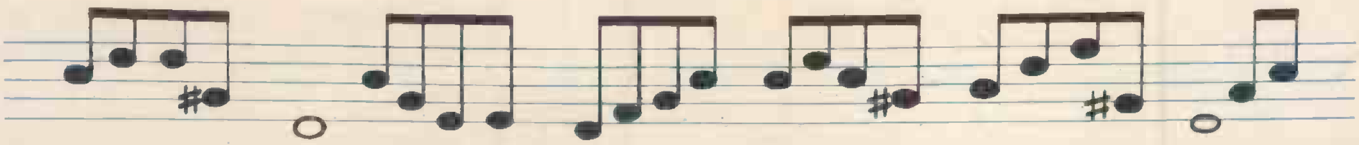

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