

TELETEXT ~ WE SCREEN THE FACTS

Hobby Electronics

September '80

ISSN 0142-6192

55p

GET IT RIGHT FIRST TIME!

With our inexpensive
development
timer

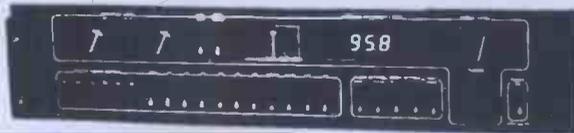


**WITH THIS ISSUE
YOU CAN BUILD:**

- A Simple Audio Signal Mixer
- A Reaction Timer With Digital Readout
- A Full Spec. Phaser For Under £12!
- A Versatile Touch Operated Switch
- An Inexpensive Bench Power Supply

**GREAT NEW BEGINNER SERIES:
INTO DIGITAL
ELECTRONICS
FROM BASICS TO
MICROCOMPUTERS
THE EASY WAY**

Complete Audio/Tuner Kits



Mk III FM Tuner series

Carriage for Mk III tuner £3 inc

The Mark III series FM tuner has been updated, and now includes a centre zero tuning meter as standard. The instruction manual has been meticulously revised, enabling easy assembly by constructors of various levels of experience - a preview copy may be purchased for £1.00.

Mark III A series 'Reference series' tuner modules£171.35 inc.
Mark III B series 'Hyperfi' modules, with switched IF, BW, pilot cancel decoder£198.95 inc.

A matching synthesiser unit will be made available later this year, and can be retrofitted to either version. All versions include digital frequency readout/clock, VU deviation meters, 6 preset stations, 10 turn pot manual tuning, toroidal PSU, output level adjustment, 110/240v AC input. Full alignment service available.

Power Amplifier

Style and performance - with a real 'belt and braces' PSU design.

After a couple of preview comments, it seems that many of you are waiting to hear about the matching HMOSEFET power amplifier for the Mk III tuner. Well, it's out at last - complete with twin toroidal PSUs for comfortable 80W RMS per channel, over 100W peak, but limited by thermal shutdown of the HMOs. 10W-100W log LED output peak indicator, DC offset protection and switch-on pause relay. AC or DC input coupling, direct or relay protected output terminals. The works.
Only one version of this item: Complete kit£178.25 inc. Carr. £5.

Preamplifier

More features and facilities, thanks to DC switching and control design

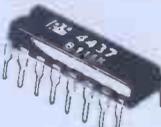
Previewing the most comprehensive audio preamplifier yet..... DC switching of 7 inputs, plus two tape in/outs. 2 low pass, 2 high pass active filters, genuine volume 'rated loudness', 1dB channel matching, with DC volume, balance, bass and treble controls. Suitable for bus/remote control, tape dubbing, switched monitor etc. 80dB S/N, THD 75dB or better. Pluggable PU equalization boards, tone control override. Price for complete unit about £149 ex VAT.

Semiconductors

Radio/Communications ICs

FOR COMPLETE LISTINGS - SEE OUR NEW PRICELIST

CA3089E	2.11	HA1197	1.61	SD6000	4.31
CA3189E	2.53	CA3123E	1.61	TDA4420	2.59
HA1137W	1.95	TDA1072	3.09	MC1330P	1.38
HA11225	2.47	TBA651	2.53	MC1350P	1.38
HA12412	2.81	TDA1090	3.51	KB4412	2.24
KB4420	1.95	TDA1220	1.61	KB4413	2.24
TBA120S	1.15	TDA1083	2.24	KB4417	2.53
KB4406	0.80	TDA1062	2.24	MC3357P	3.16



SL1610	1.84	SL1626	2.80
SL1611	1.84	SL1630	1.86
SL1612	1.84	SL1640	2.17
SL1613	2.17	SL1641	2.17
SL1620	2.50	SL6600	4.31
SL1623	2.80	SL6640	3.16
SL1624	3.77	SL6690	3.68
SL1625	2.50	MC1496	1.44

VARICAP DIODES.....

A section from our PL:

BA102	0.35	16:1 ratio AM tuning	
BB204	0.41	KV1215 9v triple	2.93
BB105	0.41	KV1211 9v dual	2.01
BB109	0.31	KV1225 25v triple	3.16
MVAM2	1.93	BB212 9v dual	2.25



POWER MOSFETS

100W PA's made simple

Since pioneering the 100W complementary MOSFET technique - Hitachi have developed a range of output devices and drivers that ought to revolutionise opinions and attitudes towards the design of all LF amplification systems. We have a new 48 page application note (£1.50 inc) and complete sets of parts, modules and now the new complete PA system (see above).

2SK133 120v N-ch 100W MOSFET £6.33 2SJ48 Pch complement £6.33
2SK135 160v N-ch 100W MOSFET £7.29 2SJ50 Pch complement £7.39
PA101B Kit for 100W MOSFET PA less heatsink £16.10 (£23 inc heatsink/bkt)

ULTRA LOW NOISE PU PREAMPLIFIER

The HA12017 is the last word in PU preamps, and general low noise audio design. It is an SIL IC, with 86dB S/N in RIAA configuration, 10v RMS output capability, 0.002% typ THD at 10v RMS output (imagine the overload margin !!). It comfortably supercedes discrete circuit designs in terms of price/performance, and takes the art beyond the TDA1042's capabilities. (Replaces HA1457) £1.80 each - or an RIAA applications PCB with two ICs for £5.75. Complete with R&C's £9.95.

Radio Control ICs

We have various RC ICs, including NE544 NE5044, and two new ones from OKI

KB4445 4 channel dig.prop. FM TX IC. 30mW out (amplifiable) £2.30 inc
KB4446 4/5 ch. dig. prop FM RX IC. Suits KB4445 or RCME syst. £2.65.
KB4445/6 pair: £4.75. New 8 page data-sheet 35p + SAE. More RC ICs in list

CMOS, LPSNTTL, TTL, MPU:

Most CMOS is available in low volume - also LPSN, Standard libraries and TTL OK.

Listings in the new pricelist.

Things like ICM7216B, ICL8038, 8080A, 6800P, 2708, NE555, NE556, etc

Coming Soon..... Contain yourselves, RF fans! Not yet ready for a full launch until autumn, but previewed here..

SSB transceiver system : 10kHz to 1000MHz !!

A modular VLF to UHF SSB TX/RX system at last. With the correct first mixer, the basic PCB covers 10kHz to 1000MHz - using LO fed from ext. source (Our 2 IC Mullard synth for instance) and RF PA for TX. OP. 0.2uV basic sensitivity in HF. Typ cost for HF synth SSB RX will be less than £200. Add an RF PA for full TRX for another £50. See one in our foyer, and marvel.

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Radio/Audio/Communications Modules

LW-MW-SW-SW DC tuned and switched

91072: All switching of bands by a single pin to gnd. Varicap tuned, with LO output for synth. MW/LW version or MW/LW plus 1 or 2 SW bands
MW/LW: £15.58 +1SW £16.73



VHF Tunerheads

Europe's largest stock range for broadcast and communications. Probably also the world's - details in the catalogues and PL. Specials are also supplied in the region 30-220MHz.

Pilot Cancel PLL Stereo decoders

Again, Europe's widest range of stereo decoders including pilot cancel PLL types. The pic shows the 944378 - pilot cancel including post decoder 26/38kHz filtering and muting preamp output

944378-2
£26.45



Switched bandwidth FM IF strips

Broadcast FM IF strips for all occasions, including the new 911225 - with diode switched narrow filter option, ultra linear phase ceramic filters, 84dB S/N, and 0.04% THD (40kHz deviation). Plus usual things like AGC, AFC, dev. mute, level meter drive. £23.95 (supplied in screen can with 0.1 edge connection system) Also the 7230 hyperfi series - as the 911225, but with slope controlled AFC that operates in conjunction with signal level - and an extra IF amp stage for DXing.

Various digital frequency displays

The World's largest range of receiver DFM's is now joined by the DFM7 (shown) - and L shaped version of the DFM3 with remote display mount connector possibility. 1kHz SW resolution with 455kHz or 10.7MHz offsets, 100Hz res up to 3.9999MHz, and VHF to 299.99 MHz in 10kHz steps : £41.75



Components

Crystal Filters

Most popular types are available ex-stock, and in quantity.

10.7MHz	25kHz Channel spacing 8pole	£16.67
	12½kHz	£17.82
	2.4kHz SSB	£19.78
	Monolithic dual roofing filter	£2.30
34.5MHz	1.3dB loss, 80dB stopband HF	
	first filter in synth. RX	£36.80
RC XTALS	FM pairs (no splits)	£3.74
	AM pairs	£3.57
USB/LSB	Xtals for 10.7SSB filter	£2.88 ea



Piezo Sounders

The most efficient warning sounders yet

The latest thing in electro-acoustic efficiency. 1mA of drive from CMOS will give an SPL of 83dB - 10v RMS drive from CMOS uses 3mA for 100dB SPL at 4.8kHz (88dB at 1.65kHz)
The data sheets shows various drive circuits, and give full specifications with regard to broadband responses and power consumption etc. 1 off 44p inc. 100 off 28.75p (25p ex vat)



Keyboard switches and caps

From the world's most widely used switch manufacturers - ALPS - come the biggest and best range of keyswitches, and data entry keyboard switches. The SCMB1101 is shown here, with the KT5 2-part cap (with clear top, to enable easy fitting of your chosen legend. Other types are available with built in LED, 90° mounting etc.
SCMB1101 : 17p, KT5 : 16p - or 29p/pair



LCD CLOCKS

Clocks use 1.5v at 15uA only.

LCD DVM

DVM 9v/1mA

CM161:	7mm LCD 12/24hr, alarms etc	£11.44 each
CM172:	13mm, 12hr, alarms, timer etc	£14.32 each
CM174:	13mm, 12hr, min/sec stopwatch	£14.32 ea
DVM 176:	ICM7106 based LCD 3½digit	£22.36 each



WHAT'S NEW at AMBIT

NEW PRICELIST/SHORTFORM:- 28 pages, FOC with A5 SAE pse

Bigger print than our recent one page list and vastly extended

If you still need convincing to invest £1.60 in the cats, be mean and get this first.

POWER MOSFET APPLICATIONS HANDBOOK by HITACHI :

£1.50 each - nr free with pairs of HMOs and the PA101B.

Everything you should know about HMOSEFET devices theory and applications.

CWO PLEASE Commercial ATA items an application Goods are offered subject to availability, prices subject to change - so please phone and check if in doubt

Parts 1-3
AMBIT catalogues
60p ea, or
£1.60 the lot.

SEPTEMBER 1980

Vol. 2 No. 11

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Hobby Electronics



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Advertisement Department: Group
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NEWS & INFO

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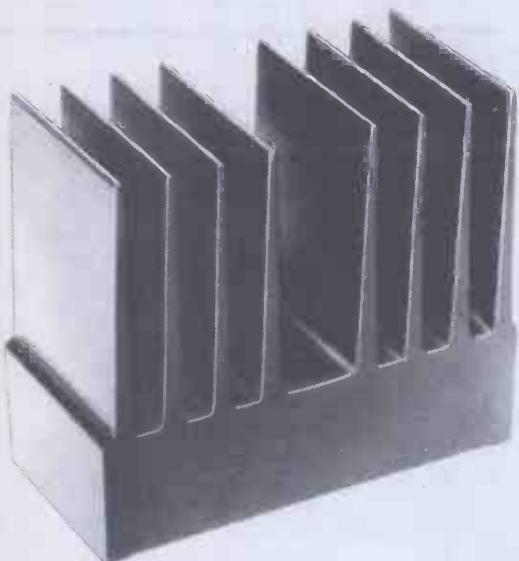
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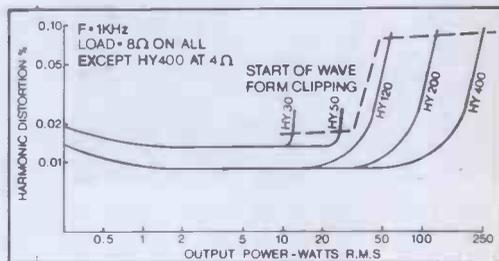
Simply ahead...



ILP PRE-AMPS ARE
COMPATIBLE WITH ALL
ILP POWER AMPS AND PSUs

POWER AMPLIFIERS

ILP Power Amplifiers are encapsulated within heatsinks designed to meet total heat dissipation needs. They are rugged and made to last a lifetime. Advanced circuitry ensures their suitability for use with the finest loudspeakers, pickups, tuners, etc. using digital or analogue sound sources.



Model	Output Power R.M.S.	Distortion Typical at 1KHz	Minimum Signal/Noise Ratio	Power Supply Voltage	Size in mm	Weight in gms	Price + V.A.T.
HY30	15 W into 8 Ω	0.02%	100dB	-20 -0 +20	105x50x25	155	£6.34 + 95p
HY50	30 W into 8 Ω	0.02%	100dB	-25 -0 +25	105x50x25	155	£7.24 + £1.09
HY120	60 W into 8 Ω	0.01%	100 dB	-35 -0 +35	114x50x85	575	£15.20 + £2.28
HY200	120 W into 8 Ω	0.01%	100 dB	-45 -0 +45	114x50x85	575	£18.44 + £2.77
HY400	240 W into 4 Ω	0.01%	100 dB	-45 -0 +45	114x100x85	1 15K g	£27.68 + £4.15

Load impedance - all models 4Ω - ∞
Input sensitivity - all models 500 mV
Input impedance - all models 100K Ω
Frequency response - all models 10Hz - 45 KHz - 3dB

POWER SUPPLY UNITS



ILP Power Supply Units with transformers made in our own factory are designed specifically for use with ILP power amplifiers and are in two basic forms — one with circuit panel mounted on conventionally styled laminated transformer, for PSU 30 and 36 — in the other, for larger PSUs, ILP toroidal transformers are used which are half the size and weight of laminated equivalents, are more efficient and have greatly reduced radiation.

PSU 30 ± 15V at 100mA to drive up to 12xHY6 or 6xHY66 £4.50 + £0.68 VAT

THE FOLLOWING WILL ALSO DRIVE ILP PRE-AMPS

PSU 36 for 1 or 2 HY30s £8.10 + £1.22 VAT

PSU 50 with toroidal transformer for 1 or 2 HY50s £9.75 + £1.46 VAT

PSU 60 with toroidal transformer for 1 HY120 £9.75 + £1.46 VAT

PSU 70 with toroidal transformer for 1 or 2 HY120s £13.61 + £2.04 VAT

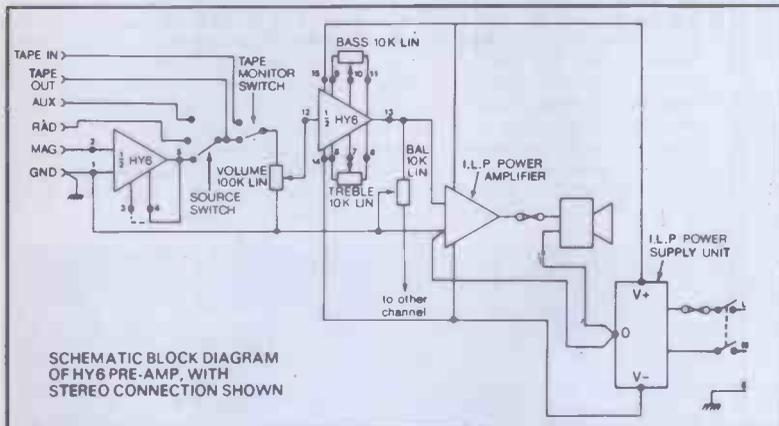
PSU 90 with toroidal transformer for 1 HY200 £13.61 + £2.04 VAT

PSU 180 with toroidal transformer for 1 HY400 or 2xHY200 £23.02 + £3.45 VAT

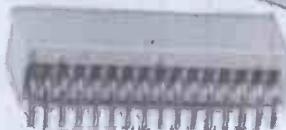


AVAILABLE ALSO FROM WATFORD ELECTRONICS, MARSHALLS AND CERTAIN OTHER SELECTED STOCKISTS.

this time with two new pre-amps



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



HY6 mono HY66 stereo

When ILP add a new design to their audio-module range, there have to be very special reasons for doing so. You expect even better results. We have achieved this with two new pre-amplifiers – HY6 for mono operation, HY66 for stereo. We have simplified connections, and improved performance figures all round. Our new pre-amps are short-circuit and polarity protected; mounting boards are available to simplify construction.

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



HY6 mono

£5.60
+ VAT 84p

HY66 stereo

£10.60
+ VAT £1.59

Connectors included

B6 Mounting Board
78p + 12p VAT

B66 Mounting Board
99p + 15p VAT

- LOW DISTORTION - Typically 0.005%
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- HIGH OVERLOAD FACTOR - 38 dB on Mag. P.U.
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The Game Column

At last, and not to put too fine a point on it, about time too! Squark, squeek and flashing light fans everywhere pay attention now, we would like to introduce you to Fabulous Fred. Fred is a ten game (nine button) hand-held or desk top machine. Most of the games are fairly conventional, Memory Tune, Mindbender etc, all of these have been around for some time now under various guises. However, we can now add 'Catch The Comet', 'Space Attack' and 'Baseball' to the list, all good fun, should keep the peace for a few hours or until the batteries run out.

Fabulous Fred and his jolly repertoire of noises and flashing lights should be available for around £25 (or less if you shop around or wait a few weeks).

Optim Toys Ltd are the people to speak to, they live at: 45 South Street, Bishop's Stortford, Herts.

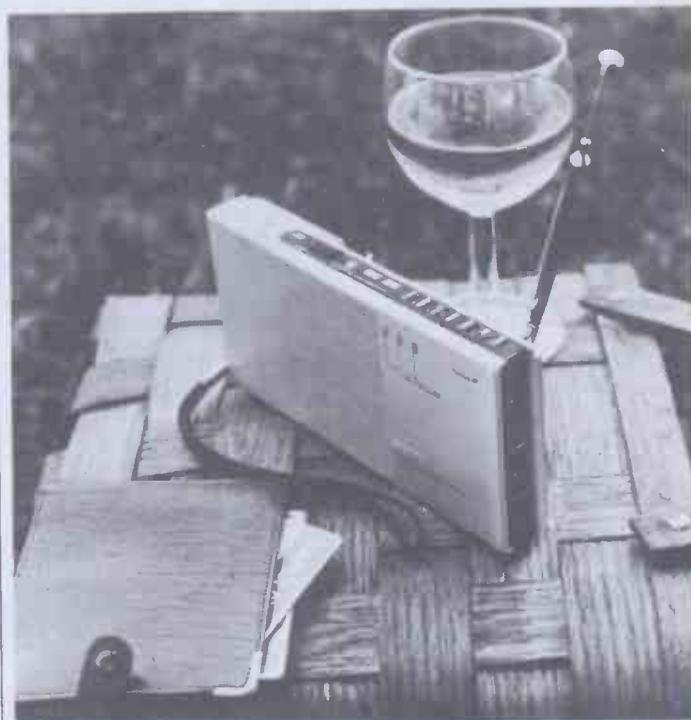
Atari have announced another cartridge for their video computer system, it's called Adventure and goes something like this: The scene is a medieval kingdom somewhere inside the back of your telly. This is a particularly nasty place, infested by hungry, multi-coloured dragons and evil magicians. You, the player has the unenviable task of finding the golden chalice and returning it to the Enchanted castle. Of course the dragons, magicians and not forgetting the wicked Black Bat all do their best to prevent you carrying out this task. You too can enter fantasy land for around £29, NIC in Tottenham has his shelves groaning under the weight of games, why not pop round sometime.

Touch Tranny

Full marks to Sony for their latest portable radio. The ICF-M20L has been designed with the blind and partially sighted in mind. The radio can be operated without any kind of visual reference, all the controls are 'touch buttons' and have a 'pip tone' to tell the user that it is being operated correctly. The tuning is taken care of by IC scanning techniques, up to 14 stations can be stored in the radio's memory on all of its three bands (7 on VHF and 7 on MW/LW). To aid control iden-

tification all of the touch-buttons have raised dots and the radio can be easily be operated with just one finger, making it ideal for people with handicaps that limit movement.

The ICF-M20L weighs in at just 380 grammes and measures 179 x 85 x 26mm, making it small enough to fit into a hand-bag or coat pocket. Price is expected to be around £55. For further details contact Sony (UK) Ltd, Pyrene House, Sunbury Cross, Sunbury-on-Thames.



Sonic Surveys

Forgotten your tape measure? Not to worry, for just £189 (plus VAT) you can dispense with that cumbersome yard-stick and get into the wonderful world of ultrasonic range finding.

This system from Survey and General Instruments Ltd is actually quite clever. The slave



unit (left) is placed on whatever you wish to measure and the master unit sited at the appropriate distance. The master unit emits a 25 kHz signal which is picked up by the slave and re-transmitted as a 40 kHz signal. This effectively cancels out any spurious reflections which might otherwise affect the accuracy of the reading. The Ultraset, as its known to its friends, has an effective range of 40 metres and an accuracy of $\pm 0.2\%$ (up to 30 metres) and 0.3% (up to 40 metres). The readout shows the distance in centimetres, this is derived by calculating the time taken for the beam to travel the distance between the two units. SGI Ltd are to be found at: Fircroft Way, Edenbridge, Kent TN8 6HA.

Vintage Wireless

That's the name of a catalogue from the Vintage Wireless Company. This really unusual publication is just full of obsolete valves, restored vintage wireless apparatus and large wooden and metal things with coils wound round them. Real connoisseur stuff this, they've even got those loud-speakers that look like ear-trumpets. If you are a collector or need any spare parts, data sheets etc then this is one publication you cannot afford to miss. It costs £1.00 and can be obtained from: The Vintage Wireless Company, 64 Broad Street, Staple Hill, Bristol, BS16 5NL.

WATFORD ELECTRONICS

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We stock thousands more items. It pays to visit us. We are situated behind Watford Football Ground. Nearest Underground/BR Station: Watford High Street. Open Monday to Saturday. Ample Free Car Parking space available.

POLYESTER CAPACITORS: Axial lead type. 100V: 1nF, 1n5, 2n2, 3n3, 4n7, 6n8, 10n, 15n 9p; 18n 10p; 22n, 33n 11p; 47n, 68n 14p; 100n 17p; 150n, 220n 24p; 330n, 470n 41p; 680n 52p; 1µF 64p; 2µ 82p; 4µ 85p.
160V: 39pF, 100n, 220n 11p; 330n, 470n 19p; 680n, 1µF 22p; 1µ 5, 2µ 2 32p; 4µ 7 36p.
200V: 10nF, 15n 20p; 22n 22p; 47n 28p; 100n 39p; 470n 53p; 1µF 175p.

POLYESTER RADIAL LEAD CAPACITORS: 250V: 10n, 15n, 22n, 27n 8p; 33n, 47n, 68n, 100n 7p; 150n 10p; 220n, 330n 13p; 470n 17p; 680n 19p; 1µF 22p; 1µ 5 30p; 2µ 2 34p; 4µ 7 50p.

ELECTROLYTIC CAPACITORS: Axial lead type (Values are in µF). 500V: 10 50p; 47 78p; 250V: 100 85p; 63V: 0.47, 1.0, 1.5, 2.2, 2.5, 3.3, 4.7, 6.8, 8, 10, 8p; 15, 22, 47, 32, 50 12p; 63, 100, 27p; 50V: 50, 100, 220, 25p; 470, 32p 1000, 60p; 40V: 22, 33, 10p; 100, 12p; 2200, 3300, 85p; 4700, 98p; 35V: 33, 10p; 330, 470, 32p; 25V: 10, 22, 47, 100, 8p; 160, 220, 250, 15p; 470, 25p; 640, 1000, 35p; 1500, 40p; 2200, 45p; 3300, 77p; 4700 85p; 16V: 10, 47, 68, 7p; 100, 125, 8p; 220, 330, 14p; 470, 20p; 1000, 1500, 30p; 2200, 36p.

TANTALUM BEAD CAPACITORS 35V: 0.1µ, 0.22, 0.33, 0.47, 0.6p; 1.0µ, 2.2µ, 3.3µ, 4.7, 25V: 10, 20V: 6µ, 18V: 2µ, 2µ, 4.7, 10, 20p; 16V: 22p; 30p; 47, 100, 50p; 220, 80p; 10V: 15p, 22p, 33, 22p; 100, 100p; 6V: 47µ; 68, 100 32p; 3V: 100 23p.

MYLAR FILM CAPACITORS 100V: 0.001, 0.002, 0.005, 0.01µF 7p 0.015, 0.02, 0.04, 0.05, 0.056µF 8p 0.1µF, 50V: 0.47µF 12p

MINIATURE TYPE TRIMMERS 2.5-6pF, 3-10pF: 10-40pF 28p 5-25pF, 5-45pF: 60pF 35p

COMPRESSION TRIMMERS 3-40pF: 10-80pF; 25-190pF 33p 100-500pF 45p 1250pF 58p

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

SILVER MICA (Values in pF) 3-3, 4.7, 6.8, 10, 12, 18, 22, 33, 47, 50, 68, 75, 82, 85, 100, 120, 150, 180, 11p each; 220, 250, 270, 300, 330, 360, 390, 600, 820, 160p each; 1000, 1200, 1800, 2200 26p each.

CERAMIC CAPACITORS 50V: 0.5pF to 10nF 4p; 22n to 47n 6p, 100n, 7p.

EURO BREADBOARD ES.20.

VOLTAGE REGULATORS
1A 7805 +ve 7905 -ve 220p
5V 7803 145p 7912 220p
12V 7812 145p 7912 220p
15V 7815 145p
18V 7818 145p
24V 7824 145p

100mA TO22 Plastic Casing
5V 7805 80p 7905 85p
5V 7803 80p 7912 85p
12V 7812 80p 7912 85p
15V 7815 80p 7915 85p
18V 7818 80p 7918 85p
24V 7824 80p 7924 85p

100mA TO92 Plastic Casing
5V 7805 30p 7905 85p
6V 7806 30p
8V 7808 30p
12V 7812 30p 7912 85p
15V 7815 30p 7915 85p

JACKSONS VARIABLE CAPACITORS
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451/0AF 145p slow
Dial Drive 4103 410p motion drive
6.1/36.1: C8045pF: 10: 15: 20: 25: 30: 35: 40: 45: 50: 55: 60: 65: 70: 75: 80: 85: 90: 95: 100: 110: 120: 130: 140: 150: 160: 170: 180: 190: 200: 210: 220: 230: 240: 250: 260: 270: 280: 290: 300: 310: 320: 330: 340: 350: 360: 370: 380: 390: 400: 410: 420: 430: 440: 450: 460: 470: 480: 490: 500: 510: 520: 530: 540: 550: 560: 570: 580: 590: 600: 610: 620: 630: 640: 650: 660: 670: 680: 690: 700: 710: 720: 730: 740: 750: 760: 770: 780: 790: 800: 810: 820: 830: 840: 850: 860: 870: 880: 890: 900: 910: 920: 930: 940: 950: 960: 970: 980: 990: 1000: 1100: 1200: 1300: 1400: 1500: 1600: 1700: 1800: 1900: 2000: 2100: 2200: 2300: 2400: 2500: 2600: 2700: 2800: 2900: 3000: 3100: 3200: 3300: 3400: 3500: 3600: 3700: 3800: 3900: 4000: 4100: 4200: 4300: 4400: 4500: 4600: 4700: 4800: 4900: 5000: 5100: 5200: 5300: 5400: 5500: 5600: 5700: 5800: 5900: 6000: 6100: 6200: 6300: 6400: 6500: 6600: 6700: 6800: 6900: 7000: 7100: 7200: 7300: 7400: 7500: 7600: 7700: 7800: 7900: 8000: 8100: 8200: 8300: 8400: 8500: 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The pack contains all the electronic components to build the radio, you supply only the wire and solder as featured in the Practical Electronics March issue. The P.E. Traveller features pre-set tuning with five push button options, black illuminated tuning scale, with matching rotary control knobs, one, combining on/off volume and tone-control, the other for manual tuning, each set on wood simulated fascia. The P.E. Traveller has a 6 watts output, negative ground and incorporates an integrated circuit output stage, a Mullard IF module LP1181 ceramic filter type, pre-aligned and assembled and a Bird pre-aligned push button tuning unit. The P.E. Traveller fits easily in or under dashboards. Complete with instructions.

£10.50 p&p £1.75

CONSTRUCTORS PACK 7A Suitable stainless steel fully retractable locking aerial and speaker (approx 6" x 4") is available as a kit complete. **£1.95** Per Pack, p & p £1.00. Pack 7A may only be purchased at the same time as Pack 7. **NOTE:** Constructor's pack 7A sold complete with radio kit **£15.20** including p&p.

A FEATURED PROJECT IN PRACTICAL ELECTRONICS



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21H HIGH STREET, ACTON W3 6NG. Mail Order Only. No Callers. Closed Thursday

NEW 12+12 AMPLIFIER KIT



An opportunity to build your own 12 watts per channel stereo amplifier with up-to-the-minute features. To complete you just supply screws, connecting wire and solder. Features include din input sockets for ceramic cartridge, microphone, tape or tuner. Outputs—tape, speakers and headphones. By the press of a button it transforms into a 24 watt mono disco amplifier with twin deck mixing. The kit incorporates a Mullard LP1183 pre-amp module, plus 2 power amplifier assembly kits. Also featured 4 slider level controls, rotary bass and treble controls and 6 push button switches. Silver finish fascia panel with matching knobs. Easy to assemble teak simulate cabinet and ready made metal work. For further information instructions are available price 50p. Free Size 9 1/4" x 8 1/4" x 4" approx. with kit. **£13.95** p&p £2.55

TWO WAY SPEAKER KIT To suit above amp. Comprising 2, 8" approx Phillips base unit, and 2, 3 1/2" approx tweeters with 2 crossover capacitors **£4.95** p&p **£1.65**. Available only to first time purchasers of the 12 + 12 kit.

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ACCESSORIES Suitable mains power supply parts, consisting of mains transformer, bridge rectifier, smoothing capacitor and set of rotary stereo controls for treble, bass, volume and balance. **£3.00** plus p&p **£1.80**

Two Way Speaker Kit Comprising of two 8" x 5" approx. 4 ohm bass and two 3 1/2" 15 ohm mid-range tweeter with two cross-over capacitors. Per stereo pair plus p&p **£4.05**

£76.00 p&p £4.00

100 WATT MONO DISCO AMP Brushed aluminium fascia and rotary controls. Size approx. 14" x 4" x 10 1/4" Five vertical slide controls, master volume, tape level, mic level, deck level. **PLUS INTER DECK FADER** for perfect graduated change from record deck No. 1 to No. 2, or vice versa. Pre fade level control (PFL) lets YOU hear next disc before fading it in. VU meter monitors output level. Output 100 watts RMS 200 watts peak.



EMI SPEAKER BARGAIN

Stereo pair 350 kit. System consists of 13" x 8" approx woofer with rolled surround, 3 1/2" Goodman tweeter crossover components and circuit diagram. Frequency response 20 Hz to 20 KHz. Power handling 15 watts RMS 20 watts max. 8 ohm impedance. **£18.25** Per stereo pair p&p £4.20



BSR P200 £25.50 Belt drive chassis turntable unit semi-automatic, cueing device. p&p £3.00

Shure M75 6 Magnetic Cartridge to suit. **£7.95**



BSR Manual single play record deck with auto return and cueing lever fitted with stereo ceramic cartridge 2 speeds with 45 rpm spindle adaptor ideally suited for home or disco use. p&p **OUR PRICE £12.25** £2.75

50 WATT MONO DISCO AMP £30.60 p&p £3.20



Size approx 13 1/2" x 5 1/4" x 6 1/4" 50 watts rms, 100 watts peak output. Big features include two disc inputs, both for ceramic cartridges, tape input and microphone input. Level mixing controls fitted with integral push-pull switches. Independent bass and treble controls and master volume.

NOW AVAILABLE



30 + 30 WATT STEREO AMPLIFIER Viscount IV unit in teak simulate cabinet. Silver finish rotary controls and pushbuttons with matching fascia, red mains indicator and stereo jack socket. Functions switch for mc magnetic and crystal pickups, tape tuner and auxiliary. Rear panel features fuse holder, DIN speaker and input socket. 30 + 30 watts RMS 60 + 60 watts peak for use with 4 to 8 ohm speakers. Size 14 1/2" x 3" x 10" approx. **BUILT AND READY TO PLAY** p&p **£32.90**



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PHILLIPS RECORD PLAYER DECK GC037 HiFi record player deck, belt drive complete with GP401 magnetic cartridge—LIMITED STOCK. **£27.50** complete. UNBEATABLE OFFER AT BUYER COLLECT ONLY.



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Risk Watch

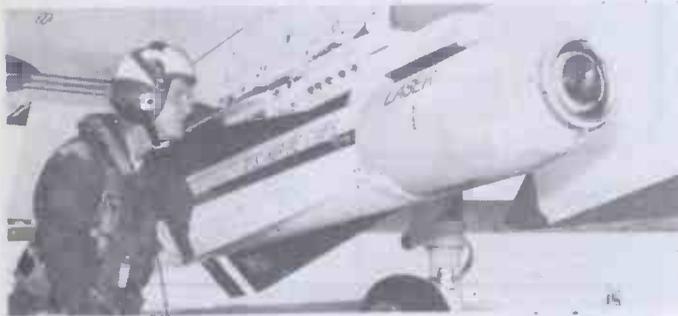
This rather bulky looking watch conceals a miniature radio transmitter with a range of around 100 metres. Now before

you start jumping to conclusions, it has absolutely nothing to do with secret agents. The idea is that an elderly or infirm person can quickly summon help in emergencies. The radio

receiver has a built-in alarm, mains powered with battery back-up, and can be sited in a next-door neighbour's house or outside where it will attract the attention of passers-by.

The Sigtron comes in three styles, a basic wriststrap transmitter for £120, the same model but with a 17 jewel mechanical movement for £140 and the deluxe model with electronic quartz movement for £160. All these prices are exclusive of VAT. Emerald Electronics are

taking orders right now, they can be contacted at: Willowburn Trading Estate, Alnwick, Northumberland NE66 2PQ. By the way, just in case you're wondering, they are Home Office approved though a small licence fee may be levied.



Laser Liquidator

It's a constant source of worry to us, the way electronics is being used to make deadly weapons even deadlier. Here we have a Maverick Air-to-ground missile. The Maverick employs a laser guidance system developed by the Hughes Aircraft Company in the USA. So far, three low-level, long-range tests have all resulted in direct hits. No, we won't be presenting it as a project in HE!

Video Confusion

Strange, isn't it? With something like five different video cassette systems all trying to become accepted as a standard and yet another system coming in the autumn the video industry is now trying to convince us that we need Video Discs.

Now, for everyone who is trying to keep up with all this, you'll soon be able to spend your money on a disc system from the Victor Company of Japan (JVC to their friends) aided and abetted by our own Thorn EMI (bless 'em) who will try to extract the maximum number of pound notes from your wallet and at the same time convince you this will become the accepted standard and not a useless piece of junk should some other system triumph. You've got to admire their nerve.

Actually, this one does look good, the player accepts a 10 inch plastic, grooveless disc neatly sheathed in a sort of case that stops you getting your grubby fingerprints all over it. Each disc will play for 2 hours (1



hour per side), in full sparkling technicolour, don't forget though you can't record on videodisc.

The basic player has a diamond or sapphire stylus with an electrode that senses variations in capacitance between the

stylus and the disc. Microscopic pits are moulded into the disc in much the same way as grooves are pressed onto conventional audio discs. The plastic is actually electroconductive so the depth of the pit will vary the capacitance between the sur-

Errata

We're definitely getting better, only three very small ones this month. First, the Equitone, the layout diagram on page 22 shows the Earth and Input connections transposed. On the left hand side of the diagram the input leads are the top two connections and the bottom connection is Earth. Still on the subject of overlay diagrams, the one on page 43, Pass The Loop suffered from an attack of wrong IC numbering. IC 1 is actually IC 2 and vice-versa. Last but not least, you guessed it the overlay diagram on page 58, Gas Detector shows two IC 1s, in fact the IC on the bottom left hand side of the diagram is IC 2.

Anyone want a job as an overlay checker, pays not too good but we're fun to work with.

Books

Babani Books Ltd have just produced a very comprehensive catalogue for their range of books. The good news is that it's free, just send an SAE to ; Bernard Babani Publishing Ltd, The Grampians, Shepherds Bush Road, London W6 7NF and they'll send you one by return.

face and the stylus. The clever stuff starts with another excursion into the wallet when you purchase the Random Access unit. This will enable you to replay your disc at fast and slow motion speeds or even still frames. You'll also be able to programme in a variety of different sequences so you can skip the boring bits.

The last trick concerns the possibility of this system being used for audio-only recordings. Because the information on the disc is digitally encoded the quality is super-high, this, however, is still at the experimental stage.

If all goes well the VHD/AHD (Video/Audio High Density) system should be on sale around the end of next year. Thorn and JVC are naturally confident this system will become the global standard, we shall see. If you just can't wait then Thorn may be able to help you out with further information. Their address is: Thorn House, Upper St Martins Lane, London WC2 9ED.

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If you do not have the Issue of H.E. which includes the project — you will need to order the Instruction reprint as an extra. **45p each.**

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Magenta's Catalogue has been carefully designed for Electronics Constructors. Product data and illustrations make the Magenta Catalogue an indispensable guide for the constructor. Catalogue includes ELECTRONIC COMPONENTS, HARDWARE, TOOLS, CASES, TEST EQUIPMENT. Details of advertised items and CIRCUIT IDEAS for you to build.

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ADVENTURES WITH ELECTRONICS by Tom Duncan

An easy to follow book suitable for all ages, ideal for beginners. No Soldering. Uses an 'S Dec' breadboard. Gives clear instructions with lots of pictures. 16 projects — including three radios, siren, metronome, organ, intercom, timer, etc. Helps you learn about electronic components and how circuits work. Component pack includes an S Dec and the components for the projects.

Adventures With Electronics. £1.75.

Component Pack £16.72 less battery.

ADVENTURES WITH MICROELECTRONICS

Same style as above book; 11 projects based on integrated circuits — includes: dice, two-tone doorbell, electronic organ, MW/LW radio, reaction timer, etc. Component pack includes a Bimboard 1 plug-in breadboard and the components for the projects.

Adventures with Microelectronics £2.35.

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Temperature Controlled Soldering Iron

If we've tempted you into building any of these projects then you should know about our Temperature Controlled Soldering Iron project next month. You'll be able to build all of the projects without worrying about burnt out bits anymore.

Home Electronics

To round it all off we will be taking a look at some of the benefits electronics has brought to the home. The homely Tina Boylan looks at some of the gadgets on sale today and some of the labour saving devices we can expect in the next few years.

The items mentioned here are those planned but unforeseen circumstances may affect the actual contents.

Inside Teletext

Most of us have seen Teletext at some time, you may even have a receiver equipped with a decoder. So for all of you that have ever wondered how it works, Gwyn Morgan, head of Engineering Promotions of the BBC looks at the present system and reveals, exclusively for HE, some of the developments taking place

FOR MANY TECHNOCRATS and engineers some of the fun has gone out of Teletext. With the first stages of teletext development over, production firmly in the hands of the big semiconductor companies and receiver manufacturers, a market in Britain that will take teletext ownership to around 200,000 sets by the end of 1980 and with the editorial teams leading the current stage of development, there seems to be little novelty for the technocrats to get to grips with. Well, if like me you are fascinated by electronic ingenuities come with us as we take a look behind the doors of the research labs and committee rooms, there we will find some very interesting developments.

Teletext today is well established as a technical standard and looks set for market success — probably catching up and passing the video-recorder market in Britain this year or next. Teletext tomorrow needs thinking about and there are plenty of people doing just that.

The key to extending Britain's teletext system lies in anticipating the ever reducing costs of digital storage. Almost without exception today's teletext decoders store just one page of CEEFAX or ORACLE. That means a page store of some 7 kbits (7 thousand bits). If predictions of the falling costs of storage are correct then before the end of the 80s we will be able to afford enough storage for one super quality full colour still picture or a thousand teletext pages or various combinations of the two.

But before we launch off into the future we should get the past and the present into perspective to get a better idea of just how these developments are likely to come about.

Early Days

The rumblings of teletext began in the second half of the sixties in the BBC Designs Department, without any publicity. Work was concentrated on developing a simple kind of printer that would be acceptable in the home



The CEEFAX editing room at the BBC, copy for each page is written on typewriter type keyboards.

— small, quiet and without the need for ink or inky ribbons. The method of sending the signals posed no problems. Ways of sending digital signals in the field blanking period were already being developed jointly in the European Broadcasting Union. That system, called ICE (Insertion Communication Equipment), has been in use with the BBC for many years.

The real breakthrough to the kind of teletext we know today came about in 1968 when Peter Rainger, then at the BBC Designs Department, and now Deputy Director of Engineering at the BBC, realised that the Character Generator ROMs (Read Only Memories) that were being developed for computer terminals could be used in domestic receivers, so that instead of printing the words on paper they could be printed on the screen of an ordinary television set.

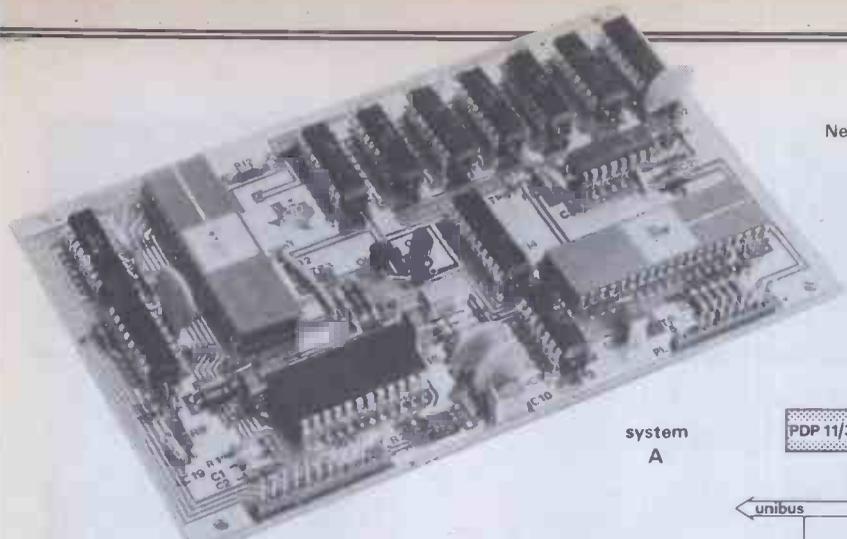
From that point the development work got well underway with investigations of potential data rates and ways of sending the data. One idea that was investigated was to use an extra subcarrier in the television signal but that was thrown out in

favour of sending the data in short, fast bursts on some of the unused lines in the television field blanking period, just as with ICE.

At first the BBC worked on two separate systems, "Teledata", for ordinary pages of text, and "Teletitles" on a different television line carrying subtitles for the deaf. It soon became obvious that the two ideas could be amalgamated and the same decoder could be used for both services. This passed all the benefits of mass production onto a decoder for subtitling that might otherwise have only a limited market. It's ironic that in the USA where much of the semiconductor technology used in teletext was developed they are still to get teletext under; however they have instituted "Deafax", a service that carries only subtitles and at a relatively slow data rate.

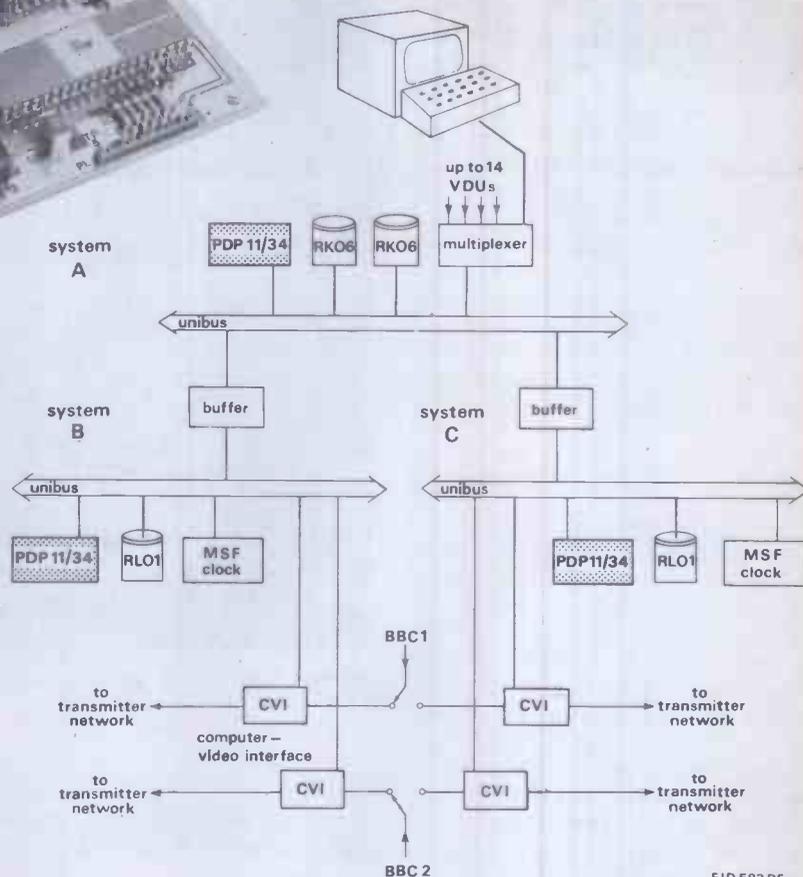
Teletext Grows Up

Teledata and Teletitles together became CEEFAX and the first public announcements were made in 1972. The IBA announced their ideas for ORACLE soon after and the BBC, the



Above: A Texas Tifax Teletext decoder. This single board is all that is needed to decode teletext signals.
 Right: Block diagram of the present CEE-FAX system. Three PDP11 computers are used.

New Ceefax Computer System



EID 583 DF

IBA and the British Receiver Industry got together in what must be one of the most effective committees that has ever been formed. In little more than a year the group hammered out the specification that is now the cornerstone of teletext. A great deal of development work was squeezed into that year. The BBC's mobile laboratory was packed full of test equipment and a great many transmission variations were tried out — different numbers of characters in a row, different numbers of rows, addressing alternatives and, above all, the effect of increasing the data rate.

The test transmission started with a data rate of around 3.5 Mbits/sec during each data line. The data rate was pushed up to 4.5 Mbits/sec with no measurable reduction in the teletext service area and finally increased to more than 6 Mbits/sec, again with little reduction in the extent of the teletext service area. The receiver industry representatives on the teletext committee were most insistent that the teletext standard would not be determined by the performance of the television receivers of the day. Everyone involved was keen to push the data rate up as far as possible and the manufacturers' opinion was that future receivers would provide much improved IF performance. They were right and though the IF boards for the first teletext receivers had to be handpicked, teletext has moved on to become an ordinary part of the production line. Yet another step towards reliable and stable performance has been the introduction of surface acoustic wave filters (SAWFs) which drastically reduce the number of adjustments

that need to be made during alignment and promise more stable performance during the life of the receiver.

The first teletext specification (or the 'White Book' as it became generally known in the trade) was published in May 1974. It was in 1974 too, that the system first left the hands of the engineers and the world's first teletext journalist got his hands on the keyboard of a teletext Visual Display Unit. That was Colin McIntyre, appointed as Editor of CEE-FAX. In order to get in the maximum amount of practice at writing in the teletext format of 24 rows of 40 characters he even typed all his notes and letters in that shape for a year or so.

Scope for Development

The first teletext specifications laid down some very important ground rules for the service while at the same time giving it enormous scope for development and expansion. The most important aspect of all is the way that Britain's teletext system is said to have a fixed format. What it means in

this context is that the blocks of data come in a well defined, regular order, that is repeated on each television data-line. The data for a single row of a teletext page is always carried on one complete television line. This direct correspondance between the position on the data waveform and the position and location within a teletext page imparts considerable 'ruggedness' to the system.

This technique is particularly valuable when applied to the address codes that 'label' every data line to indicate where the decoded text belongs. The addresses are broadcast with a special error correcting code called a Hamming code (after its inventor). It is very important that the addresses are correctly recognised because even if a viewer would put up with occasional errors in the display under poor reception conditions then it is very important that all information is correctly identified for the pages it belong to.

Furthermore, thanks to this synchronous characteristic the decoder is more easily able to find the

framing code that identifies the start of the data signals. If the system were not synchronous then the data signals for rows of text would begin and end anywhere on a television line and the decoder would have a much more complex and difficult job in deciding where the start and finish of a page was and where each began and ended. With Britain's synchronous teletext system it is very much easier to build a decoder that will give a continuously up-dated clock in the top right-hand corner of the pages as well as provide other "user-friendlies" (as the Americans call them), such as numbers that rotate to tell you when to expect the new page to arrive.

Graphics

From the outset teletext has had a system of graphics which takes up no more space in the decoder memory than an ordinary page of text. The graphics system uses the same digital codes as those that are used for letters and numerals, but to trigger off the start of a graphic section after an ordinary section of alpha-numeric, needs a control character. The control characters are not seen on the screen but because of the synchronous format, in the present system, they have to take up a place in the display. They usually appear as a blank space. The decoder will recognise particular 8 bit codes as control characters and will trigger off the appropriate form of display.

With alpha-numeric the image on the screen of each letter, numeral or sign is generated by the character generator ROM. With graphics the image that appears on the screen is generated directly by the bits in each character code byte.

Graphics images are made up by taking the space that would normally be occupied by a letter or numeral and dividing it into six rectangles, three high and two wide. The individual rectangles are 'switched on' by one of the six bits in a character code so that each character code has two meanings. One of the meanings produces an alpha-numeric character on the screen and the other produces a simple graphic image. The decoder knows which to produce because the control characters switch-in a particular mode of operation until either the end of a row or until the next control character appears and changes the operation. Every control character has a different job. There are different control characters for each of the



Above: An example of the enhanced teletext system capable of transmitting still pictures in full colour.

different colours that can be displayed in either the graphics mode or on the alpha-numeric mode.

Enhancements

In 1976 a second specification was published for teletext and this introduced some enhancements to the 1974 teletext transmission that was put on trial for two years. The new specification made it easy to draw a colourful map of Britain against a background of blue sea, and it made it possible to join areas of different colour together as well as providing some further options.

Previously, a control character that changed the colour of the graphics display would leave a blank space on the screen but by using the new 'hold graphics' control character, the blank space could be 'painted-over' to join up the two coloured areas.

That is the situation today and that 1976 specification will set the standard for teletext for many years to come. But it is possible to provide more sophisticated options than are available on today's teletext receivers and some of these enhancements can be introduced without making any change at all in the specification of the transmission. For example, one section of the address codes was originally known as the 'time code'. This time code address is totally indepen-

dent of the alpha-numeric time that appears in the top right of every page.

The original idea was that by labelling each page with a regular time address as well as the ordinary page number, a single page number could carry different information, perhaps every minute of the day. This would multiply the number of pages available enormously. But it is not necessary to think of the time-code as a time. Instead, think of it simply as a number and it means that every one of the 800 different page numbers that could be specified in teletext can also be given 3,200 more sub-numbers or 'sub-codes' as they are now called.

One of the applications for this is to classify pages so that, for example, any pages about football might carry a sub-code 2000 while all pages about horse racing might carry the sub-code 2100 and all pages about the weather might have the sub-code 3000. Put that advantage together with the option of a 'don't care button' (available with the General Instrument Microelectronics decoder) and you have a way of automatically sifting through the pages you want to see.

If you wanted to see all the pages that were in the transmission on the subject of football you would press the don't care button three times instead of specifying a specific page number but then you would instruct

P198 CEEFAX 198 Wed 18 Jun 11 31/50

BBC CEEFAX

NEWS HEADLINES 101	FOR THE DEAF 169
NEWS IN DETAIL 102-119	TV/RADIO 171-4
NEWS FLASH 150	TV CHOICE 177
NEWS INDEX 190	TOMORROW 178
NEWSREEL 199	WEATHER/TRAVEL INDEX 180
FINANCE HEADLINES . 120	FULL INDEX
FINANCIAL NEWS 121-139	A-F 193
SPORT HEADLINES . . . 140	G-O 194
SPORT PAGES 141-159	P-Z 195
FOOD GUIDE 161	TRANSATLANTIC YACHT RACE LEADERS . 191
FARMING 168	

The contents page of the current teletext system, all tastes are catered for.

the decoder to look for all pages that had the sub-code 2000. The decoder would recognise this in the transmission and display them rapidly one after another as they passed by. This is the electronic equivalent of flicking through the pages of a book, but selectively.

Telesoftware

There is another development of teletext that also requires no changes in specification. This is called 'telesoftware' and it was originally devised by mathematician W. G. Overington. Since then it has been enthusiastically followed by John Hedger of ORACLE and engineers in Mullard. There are some telesoftware pages on the air at this moment and if you dial up one of them you would find, not a readable teletext page, but a page full of an apparently meaningless jumble of letters, figures and symbols. But this would not be meaningless at all to a 'more intelligent' teletext receiver.

An intelligent teletext receiver has a more or less conventional teletext decoder but in addition has a microprocessor and some extra memory. Microprocessors need a computer program or software before they will produce any answers and the apparently meaningless teletext

pages are, in fact, the software commands for a microprocessor. Once the program has been loaded into a telesoftware decoder, the receiver becomes interactive. No longer do you just read the page and then perhaps dial another one but you can use the receiver to make calculations or play games or follow a programmed learning exercise.

A telesoftware page displayed on a telesoftware decoder might ask you questions. Using the ordinary remote control key pad you would insert numerical answers so it will calculate just what it ought to ask you next or once it has received all the information it needs from your answers, it will calculate the final answer to your problem — your mortgage repayments if ever the interest rate goes down!

Telesoftware decoders could make the programmable television games that are available now seem very old fashioned because using telesoftware the broadcasters will be able to think up new games perhaps as often as they think up new versions of the 'Little and Large Show'.

Just as there are creative script writers for comedies and dramas so there will have to be creative programmers for telesoftware. But instead of using a typewriter they will be using a keyboard of a VDU and in-

stead of writing in English they will be writing in a computer language. An experimental trial of telesoftware is about to get under way under the auspices of the Department of Education and with the joint efforts of some decoder makers like Mullard, Educationalists at Brighton Polytechnic and of course, ITV ORACLE and BBC CEEFAX.

W. G. Overington's original ideas for telesoftware had in mind a special microprocessor that would receive a programme in the form of a machine code. More recent opinion seems to be leaning towards the use of a high level language. The telesoftware field trial that is being carried out with the aid of the Department of Education, will use a form of the computer language 'BASIC'. This means that the telesoftware decoder will not only need additional memory and, of course, a microprocessor, but will also need a device called an 'interpreter'. The interpreter will convert the commands in whatever language is finally chosen, into the specific commands that operate the microprocessor chosen by whichever company happens to be manufacturing that particular telesoftware decoder.

Mega-Memory

Telesoftware is one development of teletext that will certainly demand more memory but as the price of digital memory tumbles then teletext will be able to provide yet more sophisticated services. Imagine a television set with a memory of say 7 million bits. This would be able to store a complete still picture with an extremely high definition. It could be used, for example, to store the goal kick in a football match under the control of the viewer but it could do more than that, it could be used with teletext to provide instant access to perhaps a thousand teletext pages of the kind we have today or again, using teletext, it could be used to receive still pictures.

The still-pictures might be just part of a frame so that around a small still-picture in the corner of the page, there could be a text of a story. The still-picture could be used in all sorts of ways — to illustrate a news story or advertise a product or provide a Snoopy cartoon-strip or carry animated jokes. The data for these special still-pictures would be broadcast along with the conventional teletext signal. A small portion of the still picture would be transmitted

every time the teletext magazine turned around. Because there would be an enormous amount of detail in each still-picture and because only a small amount of the picture could be transmitted every few seconds, then the image would take quite a long time to build up, perhaps even a few minutes, but that need not be a particularly important drawback as the main purpose of teletext would remain the same — broadcasting words and figures.

The still pictures could have excellent definition. The quality would be as good as the RGB output from a studio TV camera: they could even have a full grey scale as well as fully saturated colours and there would be complete freedom from cross colour patterns.

But still-pictures represent the extreme possibilities. Between that and the kind of teletext pages we see today, there would be a whole hierarchy of developments. High among the list of needs would be improved definition for graphics incorporated into the existing transmission.

Yet another important contribution, that would come from the freedom to use more memory in a teletext decoder, would be the ability to underline words, to change the colour of letters within a single word, the provision of an extended alphabet that allowed for accents as in French, German and the Nordic languages. It would be possible to display the words with proportional spacing. Instead of the present typewriter style of display where each character takes up the same space, whether it be a thin letter like an 'i' or a wide letter like an 'm', then with proportional spacing each letter could take up the space it needed to make a good display on the page.

The key to operating the teletext enhancements is the use of the presently unused address codes. There are only 24 rows in a single teletext page but the addresses can specify up to 32 row numbers. Row numbers 24-32 are free for new applications. One application of these extra rows would be a way of providing improvements to the basic appearance of a teletext page. The page would be transmitted in the conventional way as now and could be received on the kind of decoder that receives teletext today, but a more advanced decoder would be able to recognise the other rows as commands that actually applied to earlier parts of the page. For example, say it was necessary to underline three



An example of a 'rolling page'. The number in the top right hand corner beneath the clock denotes this is the third of four pages.

words in one particular teletext row. The commands for the enhanced facilities would be broadcast on a row numbered somewhere between 24-32 but that row would follow immediately after the row that needed underlining and the extra command row would only need to be recognised by the more advanced decoder.

Linked Pages

The potential is really enormous. One of the ideas that has been proposed by John Chambers of the BBC Research Department is a system of linked-pages. It would rely on the decoder being able to store several pages (with 7 megabits of memory — 'several' could mean up to 1000!) and it would give the viewer instant access to these pages at the touch of a button on a keypad. Once the viewer has chosen any particular page the decoder would automatically file away a set of related pages as they appeared in the transmission by obeying commands hidden in the transmission of the first page. When the viewer was ready to read one of the pages that was related or 'linked' to the first there need to be no waiting time because the page would already be stored in another part of the decoder's memory.

One other refinement that Chambers described is a page-check-word. This is a very short digital message that enables the decoder to check positively and automatically whether a page has been completely and correctly received. This would have applications beyond the domes-

tic decoder to business computer systems where perhaps several hundred pictures are to be stored automatically.

The Future

So teletext is by no means standing still. Just as we had television in black-and-white and later in colour, so we can extend the teletext service without making present day decoders redundant. The potential reduction in the cost of storage is very considerable.

Engineers at the BBC Research Department are investigating storage by laser holograms. One day soon we may well be using holographic video storage, they make present day video recorders with all their whirring wheels and delicate mechanics seem like medieval carts. It is theoretically possible that a single 1 cm crystal cube could store some 3½ hours of television programmes. The storage would be by "volume holograms", laid layer upon layer within the cube. Each hologram would provide a digitally coded message to a replay machine. But we are very many years away from achieving that potential. Much sooner, perhaps 1988 or 1990, it may be possible for us all to afford at least 7 million bits of storage in our television receivers. As that day comes nearer so we can look forward to some exciting extensions to the teletext service we have at present, but do not let it put you off enjoying today's teletext service today. **HE**

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Micromix

A simple to build, cheap and versatile mixer which can be easily adapted into a multi-input device. A superb project for the beginner.



WELL, they said it couldn't be done! It was impossible to make a mixer to combine music and microphone signals with only one active component and costing only £2.50 for the bits. So we did it — and proved them wrong.

The majority of currently available cassette recorders and decks do not incorporate any facilities for mixing. They are primarily intended for direct recordings from tuner or record deck preamplifier. This makes it difficult to produce a recording on which speech via a microphone is to be recorded together with background music from, say, a second recorder, tuner or similar, such as when making a tape to accompany a slide or cine show.

This simple mixer overcomes the problem as it can mix the output from a high impedance (50k) microphone with a high level signal from a tape deck, tuner etc. The output of the mixer is fed to the high level of the recorder (tuner, aux, etc.).

The circuit revolves around IC1, an operational amplifier used in what is known as a summing mode i.e. it adds together the two input signals. In order that different microphone sensitivities can be used with different levels of music signal, to get just the mixture of voice with music which you require, both inputs are fully adjusted with the use of pots.

The circuit really couldn't be simpler, yet it gives an equivalent performance to, and the same versatility as expensive commercial mixers.

The result is a truly professional recording. You can combine voices with recorded music, or guitar solos with radio broadcasts — you name it, the Micromix'll do it.

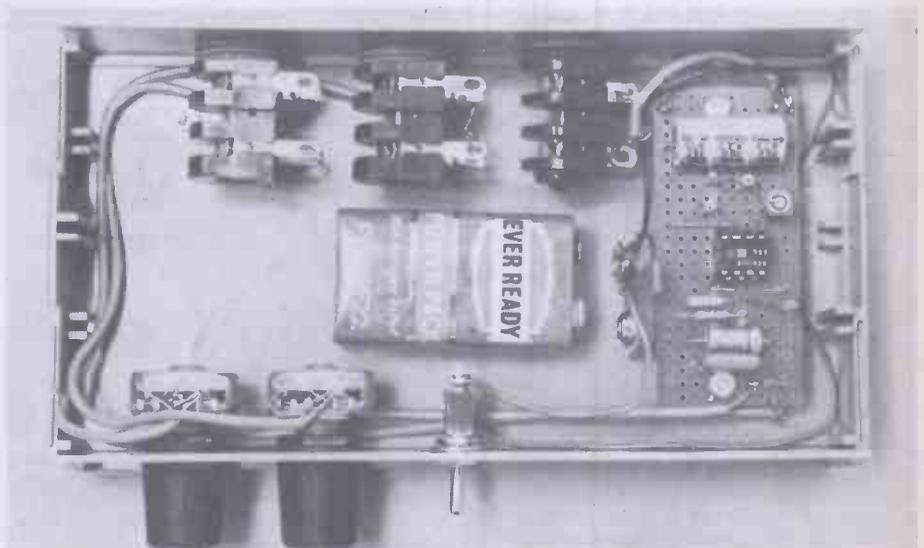
Construction

Our layout for the mixer circuit is shown in figure 2. As you will see,

we have used our usual sized, 10 x 24 hole, piece of 0.1" matrix vero board. So the usual techniques apply.

Remember to break the track where indicated, in the diagram of the underside of the board, prior to insertion of components. Then solder in the wire links where necessary, and then the components, leaving IC1 till last. As usual, the IC socket is not absolutely necessary but it makes things easier if used.

Now, although we mounted our 



Above. The insides of Micromix — neat and tidy as all good projects should be.

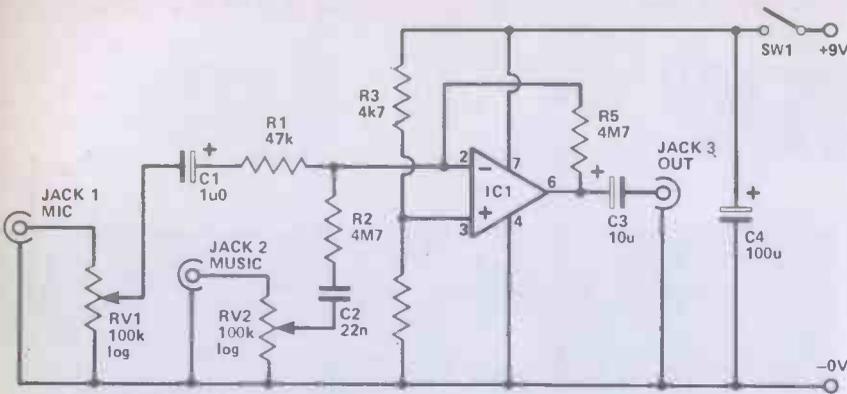


Figure 1. Micromix's circuit diagram.

Parts List

RESISTORS (All 1/4 W 5%)

R1	47k
R2, 5	4M7
R3, 4	4k7

POTENTIOMETERS

RV1, 2	100k log
--------	----------

CAPACITORS

C1	1u0 10 V electrolytic
C2	10u 10 V electrolytic
C3	100u 10 V electrolytic
C4	22n polyester

SEMICONDUCTORS

IC1	LF351
-----	-------

MISCELLANEOUS

SW1	single-pole, double-throw toggle
-----	----------------------------------

3 x 1/4" Jack sockets
2 x knobs

Battery & clip, case to suit, screened cable

whole circuit into a plastic case, you may find it better to put yours into a suitable metal one to help screen the circuit from mains hum and other electrical interference. Ours works quite well as it is, but if positioned too close to other electrical machinery or mains wiring a level of mains hum is encountered.

For the same reason, interwiring between the board, the potentiometer and the input and output sockets should be screened cable, the screen taken to 0V.

If you are adventurous you may wish to add further inputs to the mixer simply by adding more resistor/capacitor/potentiometer arrangements to pin 2 (the input) of IC1. So if you require another microphone input, add a 47k resistor, a 1uF capacitor and a 100k log pot. Likewise, if you require another music input add a 4M7 resistor, a 22nF capacitor and a 100k log pot. The number of inputs can, in theory at least, be extended indefinitely but above more than half a dozen or so, mains hum and noise may become a serious problem.

Obviously, for a stereo unit two mixer circuits are required, one for each channel but the on/off switch and battery can be common to both channels. **HE**

How it Works

The circuit diagram of the mixer is shown in Figure 1, and is a conventional amplifier based design. IC1 is used as a form of inverting amplifier, but it has two input signals. The voltage gain of the amplifier is equal to the value of R5 divided by the value of the input resistor. The signal applied to the "music" input is fed to R2 via level control VR2 and DC blocking capacitor C4. The value of R2 gives only unity voltage gain here ($4M7 \div 4M7 = 1$). The situation is rather different at the "mic" input, where the signal is applied to R1 via level control VR1 and DC blocking capacitor C1. The lower value of R1 results in a voltage gain of some 100 times ($4M7 \div 47k = 100$). This imbalance in the input sensitivities is necessary merely because the microphone signal will normally be about 100 times smaller than the music signal, and the higher amplification at the "mic" input is needed to boost this signal to an acceptable level.

R3 and R4 are used to bias the non-inverting input of IC1 and C2 provides DC blocking at the output. SW1 is a straight-forward on/off switch. The current consumption of the circuit is about 3mA so battery operation is ideal for this project.

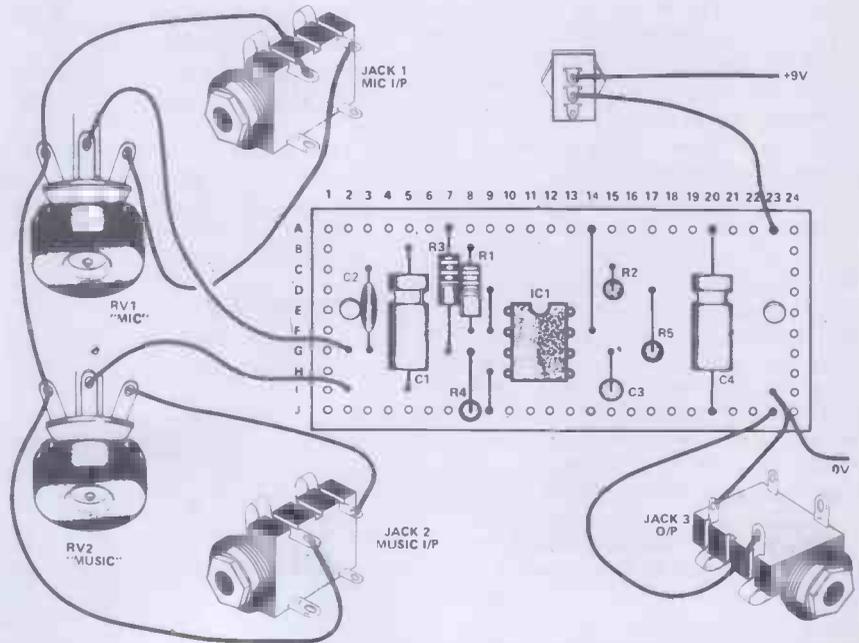
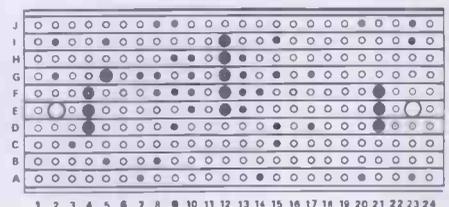


Figure 2. Overlay of the veroboard along with necessary connections. Below — the underside of the board showing track breaks.

Buylines

The builder should have no trouble in obtaining any component in this project. If you do then we tentatively suggest that you are going to the wrong supplier. The parts are all commonly available!

Component cost (i.e. excluding the case and hardware) is around £2.50.



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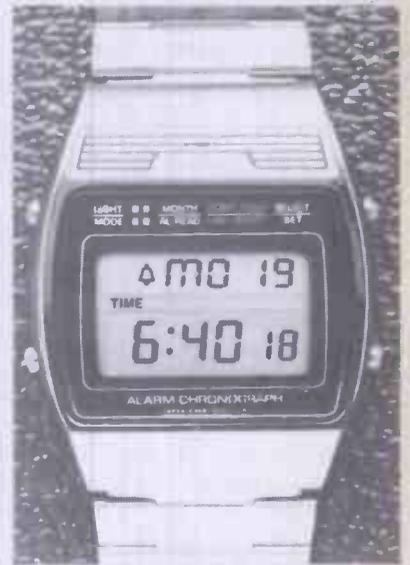
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Time 1. 24 hour alarm.	✓
Time 1. Day of week in English.	✓
Time 1. Day of week in French and German as well.	✓/✓
Hourly chimes.	
Time 2. Hours, mins, secs, day and date.	✓/✓/✓/✓
Time 2. Automatic viewing of time, day and date.	✓
Time 2. 12 24 hour AM/PM display.	✓
Time 2. 24 hour alarm.	✓
Time 2. Day of week in English, French and German.	✓/✓/✓
Chronograph. Measuring up to 12 hours in / sec.	✓
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Chronograph. Split lap timing modes.	✓
Count-down timer up to 100 minutes.	✓
Count-down timer up to 23 hours 59 mins.	✓
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Battery availability.	most battery retailers
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Quartz mineral crystal lens.	✓
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Seiko alarm chrono. **£42.95**
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Time 1. Hours, mins, secs, day and date.	✓/✓/✓/✓
Time 1. Automatic viewing of time, day and date.	✓
Time 1. 12 24 hour AM/PM display.	
Time 1. 24 hour alarm.	✓
Time 1. Day of week in English.	
Time 1. Day of week in French and German as well.	
Hourly chimes.	
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Time 2. Day of week in English, French and German.	
Chronograph. Measuring up to 12 hours in / sec.	✓
Chronograph. Measuring up to 24 hours in / sec.	
Chronograph. Split lap timing modes.	✓
Count-down timer up to 100 minutes.	✓
Count-down timer up to 23 hours 59 mins.	
Number of digits.	10
Number of symbols.	7
Slimness.	8mm
Battery life.	2 years
Battery availability.	Seiko dealer only
Stainless steel construction.	✓
Quartz mineral crystal lens.	✓
Water-resistant to a depth of.	Yes, but not specified

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47 High Street, Daventry, Northants.
Please send me Buler watches at £24.95 plus
75p&p. I enclose cheque/PO for £

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HE9

O Level Q & A

If you're taking the AO-level exams next year you'll be interested to know that we're starting a new series to cover the syllabus. Nick Walton, head of Physics at a London school, will be with us for the next few months, hopefully making those exams a little easier.

OBVIOUSLY you have an interest in electronics or you would not be reading this now; but has it occurred to you that if you have been an avid reader of HE for the past 18 months — or any of the many other electronics magazines that struggle to follow where we lead (*we're pretty broad-minded at HE and now you have your hands on the best we won't hold the others against you!*) then you may well know enough about the subject to be able to get yourself an exam qualification in electronics, without a huge amount of effort or extra knowledge.

Sadly, we live in a world dominated by a need for qualification, often gained by sitting an exam. So if you can't beat 'em why not join 'em? Most O-level and CSE Physics courses these days contain a little electronics together with delights like calorimeters, black bodies (cor!) and streaking by Archimedes that you would sooner bury in the past.

Electronic Examinations

Electronics used to be regarded as a branch of electricity which itself was (and still is) regarded as a branch of Physics. But with the arrival of the micro-electronics revolution (it has already started with calculators and digital watches, home computers — but boy, you ain't seen nothing yet compared with what's to come) electronics is now regarded as a subject in its own right. This is reflected in the exam scene right across the board from courses offered at Universities involving electronics, down to ordinary level for ordinary people like you and me. Did you know you can take A-level these days in Electronics Systems (if you can find somewhere or someone that will teach it to you?) This is set by the Associated Examining Board and they have also just brought out an O-level Electronics, as have the Oxford Board. One course which is now quite well established is the London University Exam Board's Electricity and Electronics at A-O-level (that's Alternative

Ordinary level with the status of O-level if not a little better).

We've thought for some time now it would be worth looking at the course in some detail — and if you happen to think it is child's play then why not try to find a school or college that is a centre for the exam and would let you sit it as an external candidate? Or, if you are still at school and have a friendly science department you might be able to persuade them to take you through the course. (Be prepared though to be told details of cuts and other rather nasty realities, though I did hear of one school in North London where a physics teacher took a group of pupils through the A-level Electronics Systems course entirely in break times and lunch hours).

Incidentally, your approach would be very much in line with one of the stated aims of the course which is "to allow the pupil to see his studies as a personal expression of his interests . . ." which in plain language can be taken to mean he can use what he has picked up on the way to get him an AO-level pass. Oh, and while we're talking about *him* there is absolutely no reason why that need not embrace *her* as well — why on earth shouldn't girls enjoy it just as much? Electronics I mean.

The Right Course

So let's have a quick glance at what it all involves. The scheme is organised into seven parts with 1-5 being the syllabus proper, part six a practical project and part seven a case study in which you have to find out and write about a topic of your own choice relevant to your studies.

If you are still undaunted by all that and not itching to see what the next lot of Beasties are up to or whether that super bird that played Pass The Loop is featured again, we might look a little closer at the way the syllabus is organised into its five parts. Part one deals with energy since you cannot really start anything without a bit of that. You have to know the relative

merits of fossil fuels (coal and oil), nuclear, solar, geothermal, wave and tidal, and of course how these convert to electricity and how the National Grid helps it on its way to the sockets in our houses. You can't really make much progress without some basic electrical concepts, so the second part looks at what voltage really is (did you know that a volt is actually a . . . No? Well then . . .), it looks at resistors, capacitors, inductors and finishes up with the theory of resonance. With that under your belt, a section (number three) on transducers follows. A transducer is a device which changes one form of energy into another, like a microphone which receives energy as sound waves and converts it into little pulses of electrical energy. Other transducers considered are loudspeakers, record pickups, the thermocouple and light sensitive devices.

Active Components

Moving on towards the real stuff, section four looks at active components (though it does seem something of a matter of opinion what you think of as active; they include, for instance, as active a PN junction diode). Also considered are the Zener diode, the light emitting diode (LED), the NPN transistor and the transistor as a switch. There is simple logic and you have to know about various gates like the NOT gate and its friends the AND, OR, NOR and NAND gates. The section finishes with the old chestnuts the multivibrators (both bistable and astable). So many projects involve these that it would be a good investment to understand them properly. The fifth and last section is the real nitty-grotty and is entitled 'Electronic Systems.' You have to know about meters (who doesn't?), the oscilloscope (principles, not circuit details), the amplifier likewise and its close relation the operational amplifier (Op Amp). The principles of feedback are encountered here, a theory by no means confined to elec-

tronics. By this time you should be able to devise simple circuits to perform useful functions and to round it all off you have to know how information can be stored on tape and disc.

The practical project is something you have to understand properly and could well be the sort of gadgets you see in HE. By the time you have built the little beast you will almost certainly know what every component does. On the other hand you may be able to get it going without having a clue what anything does but that would not really be good enough.

Close Study

Your final task would be a case study extending to about a thousand words — somewhat less than the length of this article — on any electronic or electrical topic you choose. A list can be supplied and titles can range from Citizen Band Radio, Digital Techniques, or even for sheer jargon generation "The Use of Myoelectricity as a proportional control signal for upper limb prostheses" which out jargons Rick Maybury's jargon

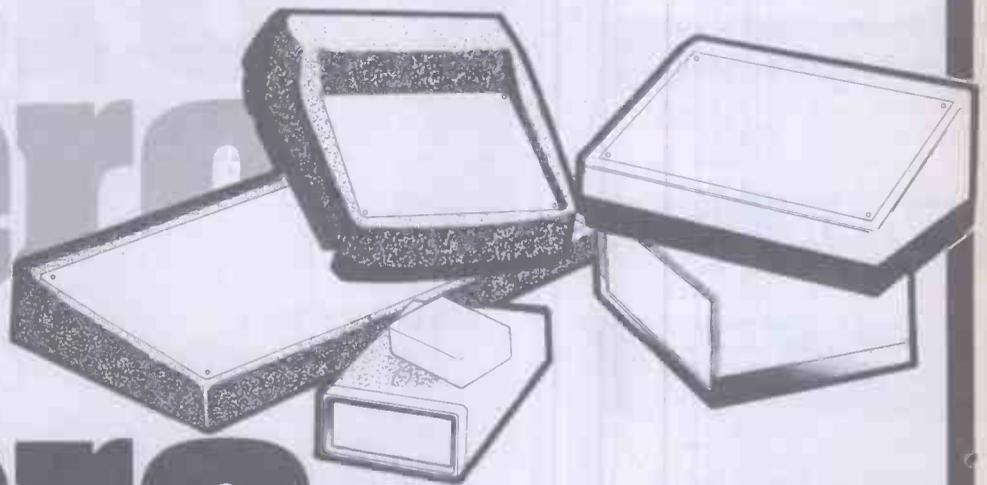
generator for its total transitional capability (!!) The exam board does expect much of the material of the course to be developed through individual practical work and it also suggests that for each group of four students there should be available a cathode ray oscilloscope, a signal generator, a power pack, a multimeter and electronic logic components (either discrete components, integrated circuits or commercial modules). Additionally they say that it would be desirable to have access to a double beam oscilloscope, an electronic voltmeter and an RF signal generator — all of which may suggest that the enthusiast who does it all in his bedroom might need to find ways of moving his bed elsewhere.

Further Reading

Even in a series of articles you cannot expect everything you need to be covered in the fullest necessary details. The board itself recommends a couple of books: Using Semiconductors by J. Hughes and T. M. Johnston and published by Heinemann, and Basic Electronics Books 1-5 published

by Hodder and Stoughton. To these two I would add a recent and excellent addition to Ian Sinclair's collection, called Electronics for the Service Engineer (Technical Press); or indeed any relevant title you can find by Ian Sinclair in the HE Book Service, e.g. Introducing Amateur Electronics. Other good books recently published that I would recommend are Electronics for Technicians 2 by S. A. Knight (slightly mathematical but beautifully explained) published by Newnes Butterworth, also Practical Electronics by Barry Woollard (McGraw Hill) again clearly written and with emphasis on a practical approach, and finally Basic Electronics Circuits by P. M. Buckley and A. H. Hoskyns which teaches you by getting you to build up circuits and which also has a useful section on exam questions. Having said all that, you have to realise that books are pretty personal things, and an author I think is great might be the biggest pain of all time for you — and vice versa. Like HE constructional projects, exam courses or anything else, I guess you just have to suck it and see. **HE**

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Reaction Timer

At long last, the ultimate reaction testing machine — get your finger on the button and check out just exactly how fast you really are.

YES, we've all seen them, those silly little games with a line of LEDs, and the player has to stop them before the light reaches the end of the line. Well, as usual we thought we'd go one step better to produce a device to give a digital readout of reaction time — much, much more accurate and much, much more entertaining. So here it is — our superb, hand-held reaction timer, complete with four-digit accuracy, battery operation and push button controls.

To keep things easy we've done away with the rather more conventional seven segment displays and their associated counter and driver ICs and used one, four-digit multiplexed display (see How it Works for a detailed discussion of the term multiplex) along with a single

four-digit counter and driver IC from GI Microelectronics.

The four-digit display comes ready mounted onto its own PCB with all connections on one edge. This of course makes it ridiculously simple to use and easy to mount, as either on a front panel or on to a PCB (as we have done in this project).

IC1, the General Instruments Microelectronics chip AY-5-4007D is a remarkable device and must have many more uses, such as frequency counters, voltmeters etc. In fact, its use in the Reaction Timer must merit as one of its simplest applications. However, it does the job well and we have no grumbles.

A simple voltage regulator, two common chips and a handful of transistors, resistors and capacitors make up the rest of the circuit which keeps the display and its counter/driver chip running. It includes a pseudo-random time delay before the display lights up to



indicate the start condition. This means that the individual whose reactions are under test does not know when the device is to commence timing and he is therefore always taken unawares.

Parts List

RESISTORS (All 1/4W, 5%)

R1	4k7
R2,5,6	100k
R3,4	10M
R7	10k
R8,9,10,11, 12,13,14,15	330R

CAPACITORS

C1	100n polyester
C2	1u0 polycarbonate
C3	100n ceramic

SEMICONDUCTORS

IC1	AY-5-4007D four digit counter/display driver
IC2,3	4001 quad 2-input NOR gate
IC4	7905 —5 V regulator
Q1-5	BC212L PNP transistor
D1,2	IN4148 diode
DISPLAY	NSB 5881 multiplexed, 4-digit, 7-segment display

MISCELLANEOUS

PB1,2	push-to-make switches
SW1	single-pole, single-throw, miniature toggle switch

Case (see Buylines)
2 x PP3 battery connectors

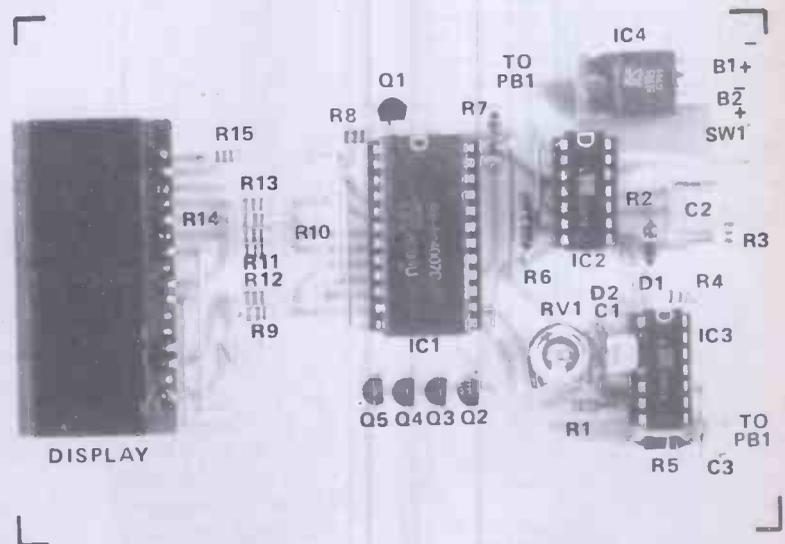
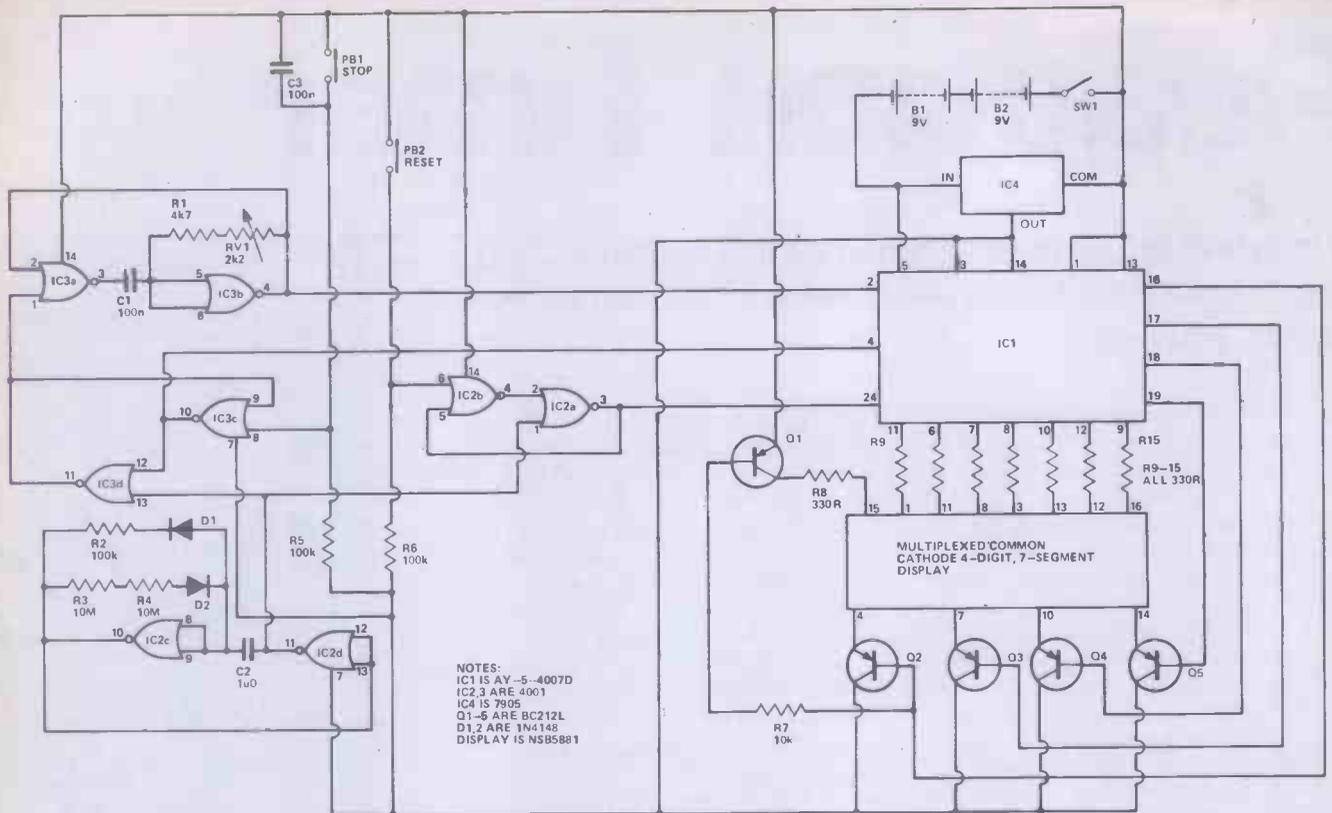


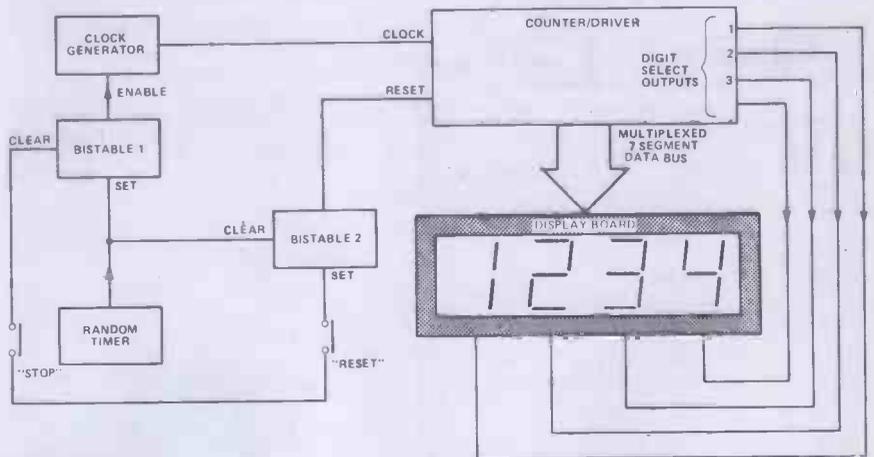
Figure 1. PCB overlay of the project. Make sure that all ICs are inserted correctly. The 4-digit display board is mounted onto the main PCB — Fig. 4 overleaf gives greater detail.



NOTES:
 IC1 IS AY-5-4007D
 IC2,3 ARE 4001
 IC4 IS 7905
 Q1-5 ARE BC212L
 D1,2 ARE 1N4148
 DISPLAY IS NS85881

Figure 2. The circuit diagram. From this you can see how IC1 is basically the heart of the project.

Figure 3. The Reaction Timer in block form showing the display board as a separate entity within the circuit.



CONSTRUCTION

The PCB layout is neat, uncluttered and makes construction fairly easy so we do advise that you use our design. Make all links first, using short lengths of stiff wire or old resistor/capacitor leads that you have cut from previous projects. It is most convenient to solder in the links first as this way you can make sure they are flush to the board and perfectly straight, reducing the risk of short circuits. Use a fine pair of long nosed pliers (if you have them) to

bend the leads at right angles, to make the links fit perfectly.

Next, all resistors should be fitted, followed by capacitors, diodes and transistors. Mount IC4 flush to the board with its pins at right angles through the correct holes. Make sure that all semiconductors are the correct way round! We advise the use of IC sockets for IC1, 2 and 3.

The four-digit display board mounts flat on the PCB and is connected to the underside of the PCB via short wire links as in figure 4.

How it Works

The block diagram of figure 3 shows the main function of the various sections of the circuit. We shall first assume that the display section ie the counter/driver and multi-plexed display board needs only two inputs for correct function — a clock or pulse input to be counted and a RESET input to zero the four digits as well as blanking them (ie turn them off).

The action of the reset button is as follows. Pressing the switch sets bistable 2, consisting of IC2a and b, which holds the display in its reset position. A bistable is simply a switch with two inputs, whose output remains on when a pulse is received on the set input. It will not turn off until a second pulse is received by its clear input. After a length of time determined by the pseudo-random timer (IC2c and d and associated components R2, 3, 4, D1 and 2, and C2), bistable 2 is cleared enabling the display section to start counting. As well as clearing bistable 2, the timer sets bistable 1 (IC3c and d) which enables the clock generator, thereby sending pulses to the counter. The clock generator consists of R1, RV1, C1, IC3a and b. RV1 allows the clock frequency to be fine tuned.

When the player presses the "stop" button, bistable 1 is cleared which disables the clock generator. There are no more pulses to be counted by the counter so it appears stationary. Pressing the "reset" button clears the display ready for the next cycle.

Transistors Q2-5 switch each digit on in turn as IC1 transmits along the "seven-segment data bus" the information to that corresponding digit. This reduces the number of interconnections necessary between the counter/driver and the display. The standard term for this method of interfacing is "multiplexing" — quite a common idea in the field of computing.

Reaction Timer

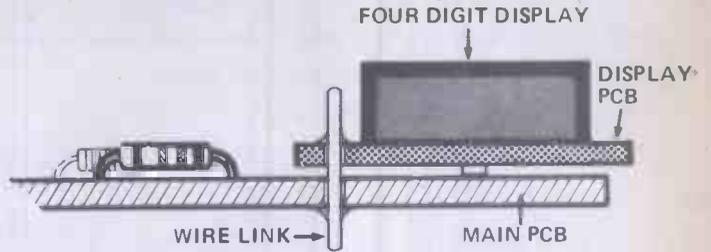


Figure 4 (above), showing details of the method of mounting the display board to the main circuit board. By soldering the wire links in the appropriate places, under the main and above the display board, adequate connections are made.

One of the lovely girls on the HE staff, Sue, timing her reactions with the completed prototype.



Solder the links to the underside of the main PCB and the topside of the display board.

Connect SW1, PB1 and 2, and the two batteries, then switch on and try it. It should work with no

problems, although nothing may seem to happen for 10-15 seconds if the display is blanked. When the display lights up it should start from zero and continue until you press the stop button.

HE

Buylines

The multiplexed display type NSB 5881 and IC1, the AY-5-4007D will be the only two devices which may cause you trouble but any of the mail order companies, eg Marshall's, Technomatic, who advertise in HE should be able to help you. All other components are common and should cause no problems.

We have used our adding machines and abaci (plural of abacus?) to work out an approximate price (for components only) at £18 for this project. Obviously the cost of the PCB and case will depend on where and what you buy. The case is type BOC 708 from West Hyde.



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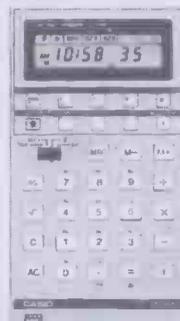
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Intellivision

All work in the HE office stopped for a couple of days, nothing unusual you might say, but wait until you hear the reason. Rick Maybury, playful as ever, explains.

THE TV GAMES SCENE has been pretty quiet over the past year or so, Atari have introduced new game cartridges with admirable regularity but there has been an almost complete lack of new machines. Now all this has changed with this exclusive review of the long-awaited machine from Mattel. We're actually feeling quite smug. This will be the first review of the Intellivision you'll see, simply because we've managed to get hold of one of only a handful of machines in the country, so remember, you saw it here first.

Pricey??

The Intellivision is due to be launched around September, the selling price is expected to be around £200. Before you get too incensed, we can fairly say that it's worth it. Anyway, given a few months it'll certainly come down to a more respectable level. If that sort of money still daunts you then we can reveal that the Intellivision is going to be the first games machine offered on a rental basis and extensive credit facilities will be available too.

So let's take a look at where your £200 (or around £6 monthly if you rent) will go. The games console or 'Master Component' as Mattel prefer to call it contains a 16 bit microprocessor, most games have only a four bit device, one or two have an 8 bit micro. In simple terms this means that the graphics will be as good, if not better, than some of the 'Pub and Arcade' games.

Play The Game

The controllers are a good example of ergonomic design, comfortable to use for prolonged periods, provided you remember that button pushing is not a matter of applied pressure but timing. People were walking around for a couple of days complaining of sore fingers. Rather than provide a selection of controllers for different games, Mattel have designed an all-in-one controller that has a joystick type action, numeric keypad and side buttons for 'rapid fire'. The main directional control consists of a small disc, pivoted in the centre, so just by pressing it on one edge any one of 16 positions can be selected. This type of action is much smoother than a con-



ventional joystick, especially noticeable on fast games like Space War and Football. The side buttons came in for some criticism, doubts were expressed as to their life-span. I'm happy to report that over a dozen butch and burly Modmags employees did their utmost to destroy the controllers, particularly during tense moments in the Armour Battle game, the controllers survived intact save for some rather deep scratches on the fire buttons. We still can't explain these.

Amazing Space

Initially, only a dozen or so game 'Carts' will be available; the soccer game comes with the Master Component. The most popular game in the office was undoubtedly the 'Armour Battle', similar in many respects to a conventional Tanks game but with the added advantage of around 240 'battlefields' and a 3D perspective view. This game lent itself to rather good tactical play, invisible mines could be dropped for the unwary to run onto. Not a game to tire of.

The football game came a close second. At the start of play the players emerge from the tunnel to the cheers, hoots and whistles of the crowd. You can only control one man at a time but the other men in the team are under computer control and will always be in the best positions for passing and tackling. Best feature of the soccer game comes with throw-ins. If a ball should be kicked off the pitch a little man from the appropriate team automatically crosses the pitch and throws the ball back into play —

amazing stuff. The pitch is actually only ever seen in part. The area where the action is 'pans up and down the pitch. Its rather like watching Match of the Day!

Keyboard Add-On

The story isn't over yet, the Mattel Intellivision has one more trick up its microprocessor sleeve and that's an add-on keyboard unit just bristling with microprocessors and various other multi-legged ICs. Having spent in the region of £300 for the keyboard and plugged in your Master Component you'll now have a microcomputer with 16k of memory capable of decoding and supplying information in the Teletext/Prestel format, running software in Microsoft Basic and of course playing some pretty mean games that you can now write yourself. The computer comes with a four track cassette deck built in, using an audio track in conjunction with the programme data.

The Intellivision is without doubt the best TV game yet. It is destined to become the market standard for a few years to come. The keyboard option makes it a serious contender for the microprocessor market, so start saving now!

The author would like to thank Bob Denton at Advance Consumer Electronics, Unit 3, Fulton Road, Wembley, Middlesex for the loan of his Intellivision. Maybe he'll get it back one day. Thanks too, to Tony Dean at Silica Shop for helping us track one down.

HE

Into Digital Electronics

BY IAN SINCLAIR

Ian Sinclair returns with a new series aimed exclusively at the newcomer to Digital Electronics. In part one we look at some of the ways electronics are helping us to count. In the coming months Ian Sinclair will deal with all of the most important aspects of this most important branch of electronics.

WHAT IS IT THAT frightens so many people away from digital electronics? Does the word digital conjure up pictures of advanced mathematics, or do you just wonder what possible use you could make of these circuits? Perhaps you've browsed through descriptions, and wondered if you were reading the same language as they were written in. Your worries are at an end, for the usual HE service is here, to provide you with a clear and right-from-the-beginning guide to the new electronics where everything is happening so quickly.

Finger Trouble?

The word digital sounds as if it might have something to do with fingers and there is indeed a connection. When we're very young (and sometimes when we're a bit older, too) we count on our fingers. Later on, we usually get out of that habit, but it's not a bad description of how computers do their counting. The difference is the number of fingers and how fast they can be used. Our standard allocation of fingers and thumbs totals ten, so it's not very surprising that we count in tens, and place figures in columns to show how many units, tens, tens of tens (hundreds) and so on, each figure represents.

When we come to try to do something similar in electronics, though, there's no obvious way of using ten of anything. We could, of course, imagine a transistor working from a 10 V supply, with its bias adjustable (Fig. 1.1) so that the collector voltage could be changed in 1 V steps from zero to ten. Now from what you know

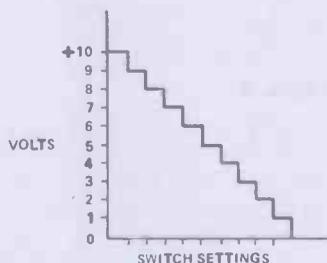
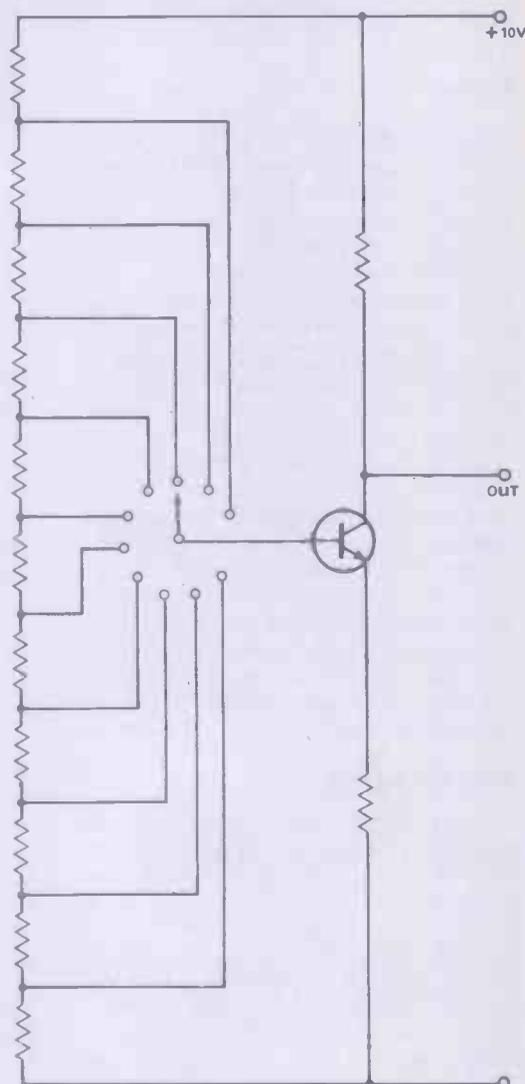


Fig. 1.1 Yes, you could use a transistor to count in a scale of ten — but it's a fearsome method, and the reliability would be poor. The step diagram above shows how we can use a voltage gradient to count from 1 to 10 in one volt steps. This method is not, however, very practical.

(don't you?) about transistor bias, what do you think would be the chances of things staying that way? Quite right, pretty low! As the transistor warmed up, the bias would change, and the collector voltage would alter. Not a promising start.



Two's Company

No, the really natural counting system for electronics is a scale of two. It's pretty easy to set an electronics system to be either fully on or cut-off, two states, as they're called, which can be set quite definitely. A transistor which

is fully on, or bottomed, has a collector voltage of nearly zero (Fig. 1.2), and it's not difficult to make this state stable, meaning that it's not easily upset by changes of temperature or anything else. For example, the transistor in Fig. 1.2 is bottomed, and will stay that way because of the resistor which connects the base to the supply voltage. Provided that the resistor is not of too high a value, there will be more than enough current flowing into the base to keep the transistor collector voltage bottomed no matter what happens in the way of temperature changes, ageing of components and all the other things that can beset transistor circuits.

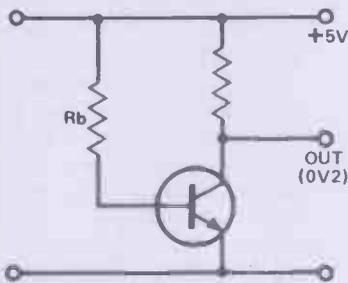


Fig. 1.2 Saturating or bottoming the collector voltage of a transistor. Connecting the base to the positive supply voltage makes sure that the transistor is passing as much current as the resistors permit.

The cut-off state is equally stable. As long as you keep the base voltage of a transistor below 0.5 V, there will be no collector current flowing unless the transistor is quite hopelessly leaky. These two conditions can be used in several ways. Two of the most important of these uses are in digital logic circuits and in digital counting circuits. We're going to start with digital logic circuits for the very good reason that they're simpler, and we'll move on to look at the counting circuits later.

Easy as Falling off a Log (ic)

Now you've probably come across the word logic many times before in articles dealing with digital circuits, but you've probably never seen it explained. Logic means a system for arriving at a conclusion starting from facts. If a cricket ball suddenly thumps through your window (fact), you start looking for someone with a cricket bat (logical conclusion). If you thump the first guy you meet who's carrying a tennis racquet, you've been illogical! Logic is about thinking clearly, as mathematics is, but the language of logic is ordinary English (or close to it), and it doesn't *have* to

be expressed in symbols. Like mathematics, though, logic is a lot tidier and shorter if we do use symbols to express what we mean.

No, No, Yes, Yes, No

Now logic has been studied for a long, long time, several thousand years, and yet it took centuries for people to realise that each step in a logical argument could be simplified so that it consisted of a question which could have only two possible answers — yes or no. Logic, remember, is about getting conclusions from facts, and 'maybe' answers aren't much use for that purpose. Fig. 1.3 shows a simple logic process (is the kettle heating?) broken down into a set of these YES/NO steps just to illustrate what is needed. What's that? You don't need to use transistors to put the kettle on? Of course you don't, but the fact that *any* logical process can be broken down into a set of questions, each of which must have a YES or NO answer, does have a lot of uses. YES and NO are two *states*, and we can use the two stable states of a transistor to represent them. We can, for example, decide that a cut-off transistor, collector at supply, represents YES and a bottomed transistor, collector at 0 V, represents NO; which opens the way to using transistors for any sort of logic operation.

Now this way of looking at logic problems was invented a long time ago by a self-taught genius called George Boole, and he worked out a system for writing down logic problems in a kind of mathematical shorthand, and of solving the problems using what is now called Boolean Algebra. Boolean Algebra was at that time just a curiosity, a fascinating sideline for people with nothing more urgent to do, until much later it gradually dawned on engineers that

telephone switching circuit problems could be solved by using Boolean Algebra. It didn't take engineers very long after that to find that Boolean Algebra was almost indispensable in computer design — and it's been a top-priority topic ever since. Moral is that no piece of truly *scientific* research (as distinct from a lot of so-called 'social science') is ever really wasted.

Do IC Digits?

We're not here to do a course on the theory of Boolean Algebra, though, our task is to show how digital ICs can be used. Digital ICs, like any digital circuits, use signals which are either zero volts (transistor bottomed) or supply volts (transistor cut-off). We could, of course, call these NO and YES signals, but we usually shorten the description a bit more by referring to zero volts as 0 and supply volts as 1. The input or output of any digital circuit will consist of just these voltages, perhaps a signal which changes between 0 and 1 at intervals. We can forget about waveshapes, amplitudes, phase shifts and all these problems of linear circuits; all we're interested in is the two levels 0 and 1. That, incidentally, can make digital circuits a lot simpler than most linear circuits.

Long before digital transistor circuits were invented, logic circuits were built using switches. A switch is another device which is either off or on, and that's why the first use of Boolean Algebra was in switching circuits. The great advantage of the transistor is that its switching action doesn't rely on any mechanical contacts making or breaking. The switching of a transistor can therefore be much faster, with none of the bouncing, sparking and contact-wear problems which plague mechanical switches.

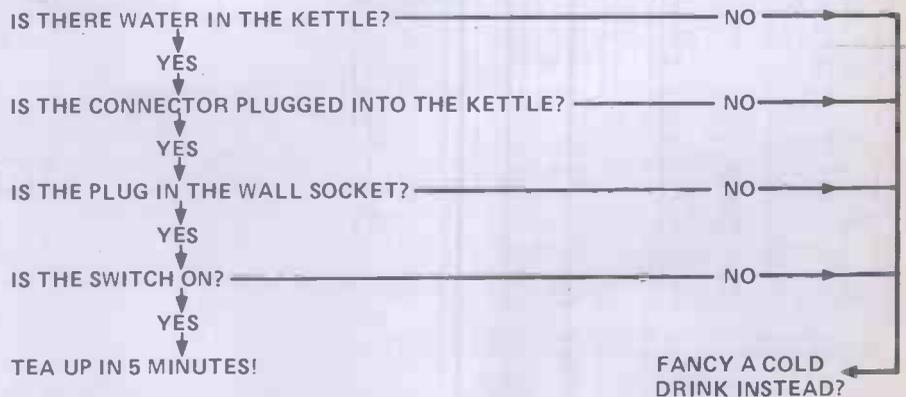


Fig. 1.3 YES/NO decisions for the kettle problem.

How are we going to learn about all this, then? The easiest way, of course, which is the HE practical way. We'll knock up circuits which make use of digital ICs, show what they do, and what they could do. We're not going to build our own computer, nor gadgets for playing the National Anthem every time a tap is turned on, but we are going to understand how these things *can* be done. What we will do is to put signals into digital ICs, using switches (mainly), and see what comes out (using LEDs). Once you understand what each of these circuits does, the way is clear to understand more complicated circuits, and that's what it's all about.

If Euronovice . . .

Now if you've followed the Linear ICs articles, you'll have met the Eurobreadboard before. If you're new to this style of circuit construction, then the Eurobreadboard is a system for building circuits without the use of soldering. The Eurobreadboard (Fig. 1.4) is a plastic block which is perforated with holes at 0.1" spacings. Under the holes are metal clips, so that a component leadout wire which is pushed through a hole is held by the clip underneath, and makes electrical contact to the clip. The clips aren't separate, but are grouped in fives, so that any one of a line of five can be used. These lines are indicated by letters A-D and numbers 1-25, so that 22A is a group of five contact points and 16B is another group. The lines are spaced so that normal sized ICs,

such as the ones we're going to use will fit with one lot of pins on column A and another on B or one lot on C and the other on D. Big ICs like microprocessors can be fitted on these same columns or on the larger space between columns B and C.

Using these lettered and numbered lines, we can connect up circuits very quickly, test them, take them apart and then move on to the next bit of work without needing to wait for a soldering-iron to heat up. How do you build the circuits? Simple, when we make use of the letters and numbers. For each bit of work on digital ICs, we'll plug in one or more ICs into the board. They don't go in just anywhere — they have to be plugged into lines which are indicated in the text. Connections can then be shown by printing the line number and letter for each connection. If it sounds complicated, that's just because we haven't started yet — it's a lot easier to do when you have a Eurobreadboard, with the IC, all ready in front of you. Having said that — let's start.

Preparing the Board

Before we can start, we need to prepare the board with the switches for putting in voltage signals and the LEDs for reading them off. The switch is a quad changeover, meaning that there are four sections of switch and the output of each section can be switched between two contacts. These switches are available from RS Components, Watford, or Maplin, and work out a lot more convenient

than any other switch arrangement. The switch unit has 16 pins, four for each block, and is plugged into the Eurobreadboard in the position shown in Fig. 1.5. To make the connections to the switch, wire links then have to be added. These links should use insulated 0.5mm single-core wire, because stranded wire is useless for breadboards, and Maplin sell a suitable wire as Bell wire. So long as it's about 0.5mm diameter, insulated and single strand, it'll do fine. Each link will need about 8 mm of insulation stripped off — I use a little Bib stripper and cutter which has served me well for more years than I care to remember. Measure out the length of wire you need for each link (roughly — there's no need to do a Rolls-Royce job on it) and just plug the ends of the wires into the lines on the board which are indicated by the numbers and letters. For example, if you have to connect 8D with Y2, then one end of the wire goes into any hole in line 8D and the other end goes into *any* hole along the edge line which is marked Y2. The two long links connect the X1 lines to the X2 line and the Y1 line to the Y2 line. These four lines are going to be used for battery (or power supply) connections, with the + connections to X1 and X2 and — connections to Y1 and Y2.

Now add the LEDs and their 1kΩ resistors as shown in Fig. 1.7. When we use the board, the LEDs will glow to indicate a voltage across them, so that a glowing LED indicates a logic 1 (+5 V in this case) and a LED which is

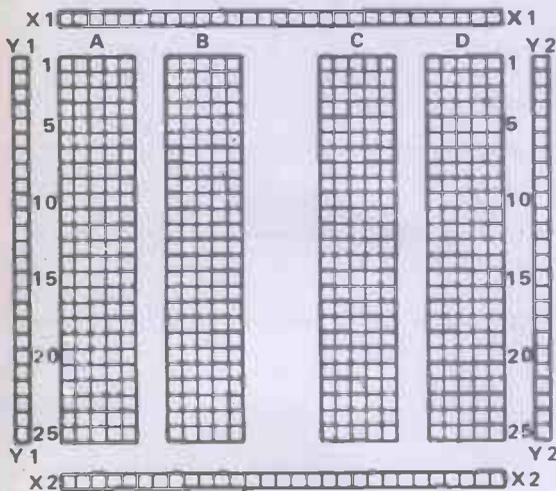


Fig. 1.4 The EUROBREADBOARD, on which all the circuits are constructed.

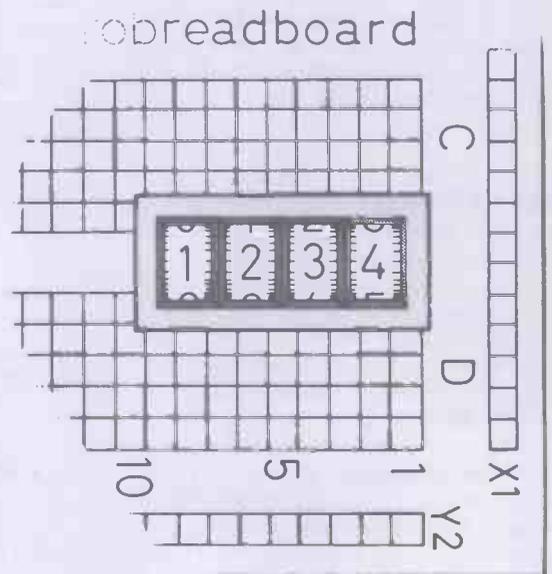


Fig. 1.5 Position of the Quad DIL switch on the Eurobreadboard.

SWITCH LAMP

1C TO 2C	1D TO Y2	Y1 TO Y2 (NEGATIVE)
3C TO 4C	2D TO X1	X1 TO X2 (POSITIVE)
5C TO 6C	3D TO Y2	
7C TO 8C	4D TO X1	
	5D TO Y2	
	6D TO X1	
	7D TO Y2	
	8D TO X1	

LED'S:

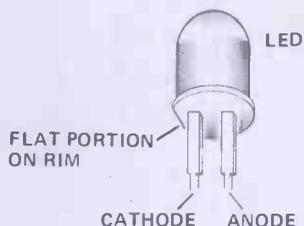
LED1 ANODE ON A7	CATHODE ON Y1
LED2 ANODE ON A5	CATHODE ON Y1
LED3 ANODE ON A3	CATHODE ON Y1
LED4 ANODE ON A1	CATHODE ON Y1

4 x 1k0 RESISTORS:

A7 TO B7
A5 TO B5
A3 TO B3
A1 TO B1

Fig. 1.6 Wire links for the switches. These ensure that the switches operate correctly (UP for 1, DOWN for 0). Leave these connections in place.

Fig. 1.7 The LED connections. No wire links are needed, because the components themselves bridge the gaps. Note which end of the LED is the cathode.



not glowing indicates a logic 0. We don't use all of them each time, but it's handy to have four of them ready on the board. The resistors prevent too much current from flowing through each LED, and our connections from the ICs are made to the resistors each time.

LED, Kindly Light

LEDs have to be connected the right way round if they are to be of any use and the Maplin LEDs have a particularly simple identification. There's a small flat segment on the plastic case of the LED, and the nearest metal lead to that end is the cathode lead, the one which plugs into line Y1. The anode wires plug into the lines A7 to A1 as shown — the spacing is because of the width of each LED. The resistors then connect across to the lines in column B, and our connections are made there. The switches are numbered already, and the LEDs follow the same pattern, with LED 1 on the left when the Eurobreadboard label is right way up.

Now at this point it's advisable to test the switches and LEDs to make sure that everything's working as it ought to — that way, you don't get any silly holdups later when you're using the ICs. The simplest way of testing is to use each switch to control one LED by linking B1 to C1, B3 to C3, D5 to C5 and B7 to C7. Now connect up a 4½ V battery to provide some power.

The type 1289 is useful — it has a fairly long life when used with the type of ICs we shall be investigating, and its + and — are clearly marked. For making the battery connections, I

bought a pack of car-type LUCAR connections in Halford's. These are a tight slide-fit on to the battery tags, and they can also be clamped onto single-strand wire. Use a **red** insulated wire for + and **black** for —ve — it saves a lot of time when you are trying to get things going. The + (red) wire plugs into any hole along X1 or X2 and the — (black) wire plugs into any hole along Y1 or Y2. With the battery in place, and the board right way up, so that the Eurobreadboard label reads right way up, try each switch. Moving the slider of a switch up should cause its LED above it to light, moving the slider down should extinguish the LED. Try each switch in turn, making sure that it switches on and off correctly. If there's a rogue, check that the LED is the right way round and that the switch pins are connected into the correct places.

LEDs don't take kindly to being connected wrong way round, and there's a chance (not inevitable) that one which has been A for T will not work when you put it the right way round. If that happens, you're out of

luck and you'll need another LED some time — no hurry because we don't use all four right away. With the 1k0 resistors specified here, though, there should be no damage to LEDs even if they are wrongly connected.

Next month then, it's down to work on the first IC, a 74LS132. The ICs we're using are all of the type called TTL Low Power Shottky. That's rather a mouthful, so we'll just refer to them as the 74LS types, because each type number starts with 74LS. They have several advantages over other types, one of which is that you can't damage them by handling the pins. Unlike CMOS ICs, TTL ICs can't be ruined by the electrostatic voltages you get from sitting on nylon seat-covers or walking along woollen carpets. The main drawback of the 74 family was that they needed a lot of current and a 5 V supply, but the 74LS types need very little current, and are quite happy at 4½ V, so we can use a battery supply.

If you do make use of a mains supply, make sure that it's set at 5 V, no higher. Don't trust any switch or dial readings for this, take a voltmeter reading, because higher voltages can damage these ICs.

Meanwhile, if you want to get your orders in ready for next month, here's a buying list for this month, next month and for the rest of the series (if you're rich!)

HE

Parts List

Starter Pack:

- 1 Eurobreadboard
- 4 x LED, standard size (5 mm diameter)
- 4 x 1k0 ¼ W resistors. All obtainable from Watford Electronics
- 1 x Quad DIL switch
- Single-strand wire
- Power supply (5V) or No. 1289 battery and Lucar Connectors.

Remaining Items:

- ICs—
- 1 x 74LS132
- 1 x 74LS75
- 2 x 74LS76
- 1 x 74LS90
- 1 x 74LS47 (may be difficult — substitute 7447 if necessary)
- 1 x 74LS82
- 1 x 7-segment display such as DL707

Other components—

- 1 x 560R ¼ W resistors
- 1 x 470 µF (1000 µF also useful to interchange) capacitors
- 7 x 47R ¼ W resistors

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SN7447AN	EO.48	SN74165N	EO.80
SN7448N	EO.45	SN74167N	EO.70
SN7450N	EO.15	SN74174N	EO.80
SN7451N	EO.15	SN74175N	EO.63
SN7453N	EO.15	SN74176N	EO.74
SN7454N	EO.15	SN74177N	EO.73
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SN7474N	EO.25	SN74185AN	EO.10
SN7475N	EO.31	SN74186N	EO.35
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SN7481N	EO.71	SN74190N	EO.74
SN7482N	EO.65	SN74191N	EO.79
SN7483N	EO.60	SN74192N	EO.79
SN7484N	EO.95	SN74193N	EO.79
SN7485N	EO.70	SN74196N	EO.74
SN7486N	EO.25	SN74197N	EO.74
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What's In a Name

This month's What's In A Name has absolutely nothing to do with part-time bus conductors. Our word this month is Semiconductor, the keystone of modern electronic technology as Rick Maybury explains.

IT'S NO ACCIDENT THAT ENGLISH has become the language of science. English is the only language that has the capacity to form compound words with such precision. This makes life relatively easy for us, almost without exception the words and phrases we'll be looking at in this series are made up from two or more familiar words. Our word this month falls neatly into this category, it's 'Semiconductor', the word most readily associated with modern electronic technology.

One hundred years ago you could say with some degree of authority that a material was either a conductor (it would conduct electricity) or an insulator (it wouldn't conduct electricity). Today, as we have come to expect, things aren't so clear-cut. The word Semiconductor implies that the material so named is neither one nor the other, yet for reasons that should become obvious later we cannot use the term resistor.

Two substances have become synonymous with the word semiconductor, both are elements, the first is called Germanium, a greyish metal, not really used much outside electronics, the second is Silicon, famous for chips and sand, not to be confused (as it often is) with Silicone.

Germanium was the first material to be used in any quantity for semiconductor manufacture, today it has been largely superseded by silicon although the basic manufacturing process is the same.

Current Affairs

The difference between conductors and insulators is actually quite subtle, it's all down to the presence (or absence) of free electrons. These are loose electrons that run around inside conductors; by adding certain impurities to silicon or germanium in a process known as 'doping' you can either cause an excess of free electrons (this we call 'N' type) or conversely deprive the material of free electrons, leaving 'holes' which are effec-

tively positively charged particles (this is known as 'P' type). In either case the material is now known as a semiconductor.

Up the Junction

Now the story really gets interesting, by fusing two pieces of semiconductor material (P and N type) together we get what is known as a junction at the point where they meet. It's to be expected that we should now have a PN junction. This is the basic unit in semiconductor electronics. At the junction strange things happen, the free electrons and the hole tend to 'migrate' across the junction forming an area called the depletion layer.

Now try to imagine a battery connected across this junction, the positive side connected to the N type and the negative side of the battery to the P type, under these conditions no current will flow, this we call 'reverse bias'. In simple terms the positive side of the battery has drawn all the elec-

trons from the depletion layer and the negative side has removed all the holes, the movement is caused by simple electrostatic attraction — unlike polarities attract. If we now connect the battery the other way round the opposite happens, the positive side now pulls the electrons through the P layer, the negative side of the battery attracts the holes, current now flows quite happily. We have here the semiconductor diode, the electronic one way street, clever isn't it?

As you might expect the story doesn't end here. By varying the proportions of the impurities you can make the basic semiconductor diode do quite strange things. Adding successive layers of semiconductor material to our basic PN junction will produce transistors (three layers, two junctions), thyristors (four layers, three junctions) and ultimately Integrated Circuits which incidentally is the subject of next month's 'What's In A Name'. See you then. **HE**

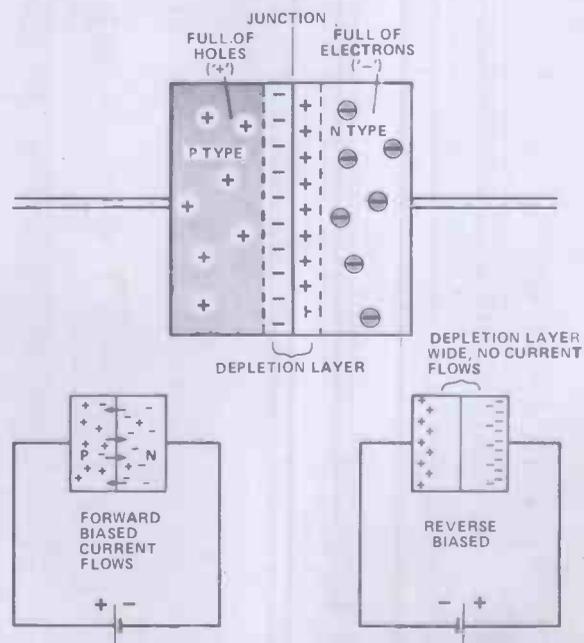
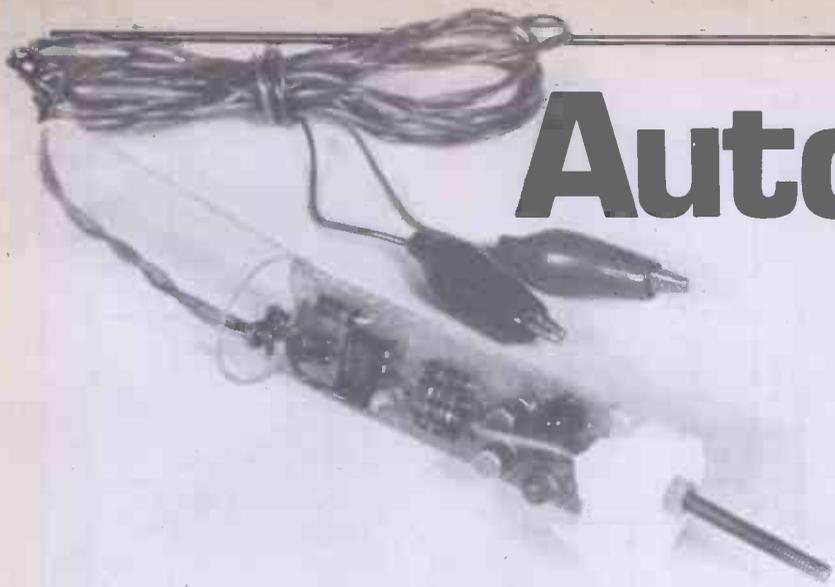


Figure 1. A typical PN Junction in each of its three possible states. Top: The Junction in its dormant state. Bottom left: In the forward biased condition. Bottom right: A PN Junction reverse biased.

TTLs by TEXAS 7400 11p 74290 18p 4020 100p 7401 6p 74293 15p 4021 100p 7402 12p 74365 100p 4022 100p 7403 14p 74366 100p 4023 27p 7404 14p 74367 100p 4024 50p 7405 18p 74368 100p 4025 130p 7406 36p 74369 200p 4026 130p 7407 36p 74490 225p 4027 84p 7408 17p 74492 225p 4028 84p 7409 19p 74493 225p 4029 100p 7410 15p 74494 225p 4030 55p 7411 24p 74495 225p 4031 200p 7412 20p 74496 225p 4032 180p 7413 20p 74497 225p 4033 180p 7414 40p 74498 225p 4034 200p 7415 40p 74499 225p 4035 110p 7416 27p 74500 225p 4036 295p 7417 27p 74501 225p 4037 115p 7418 27p 74502 225p 4038 120p 7419 27p 74503 225p 4039 340p 7420 17p 74504 225p 4040 100p 7421 17p 74505 225p 4041 80p 7422 22p 74506 225p 4042 80p 7423 34p 74507 225p 4043 90p 7424 34p 74508 225p 4044 90p 7425 34p 74509 225p 4045 110p 7426 40p 74510 225p 4046 110p 7427 34p 74511 225p 4047 100p 7428 36p 74512 225p 4048 55p 7429 36p 74513 225p 4049 50p 7430 17p 74514 225p 4050 48p 7431 36p 74515 225p 4051 80p 7432 36p 74516 225p 4052 80p 7433 40p 74517 225p 4053 80p 7434 36p 74518 225p 4054 80p 7435 36p 74519 225p 4055 125p 7436 36p 74520 225p 4056 135p 7437 36p 74521 225p 4057 140p 7438 36p 74522 225p 4058 140p 7439 36p 74523 225p 4059 140p 7440 36p 74524 225p 4060 140p 7441 36p 74525 225p 4061 140p 7442 36p 74526 225p 4062 140p 7443 36p 74527 225p 4063 140p 7444 36p 74528 225p 4064 140p 7445 36p 74529 225p 4065 140p 7446 36p 74530 225p 4066 140p 7447 36p 74531 225p 4067 140p 7448 36p 74532 225p 4068 140p 7449 36p 74533 225p 4069 140p 7450 36p 74534 225p 4070 140p 7451 17p 74535 225p 4071 25p 7452 17p 74536 225p 4072 25p 7453 17p 74537 225p 4073 25p 7454 17p 74538 225p 4074 25p 7455 17p 74539 225p 4075 25p 7456 17p 74540 225p 4076 107p 7457 17p 74541 225p 4077 107p 7458 17p 74542 225p 4078 27p 7459 17p 74543 225p 4079 27p 7460 17p 74544 225p 4080 27p 7461 17p 74545 225p 4081 27p 7462 17p 74546 225p 4082 27p 7463 17p 74547 225p 4083 27p 7464 17p 74548 225p 4084 27p 7465 17p 74549 225p 4085 27p 7466 17p 74550 225p 4086 27p 7467 17p 74551 225p 4087 27p 7468 17p 74552 225p 4088 27p 7469 17p 74553 225p 4089 27p 7470 17p 74554 225p 4090 27p 7471 17p 74555 225p 4091 27p 7472 17p 74556 225p 4092 27p 7473 17p 74557 225p 4093 27p 7474 17p 74558 225p 4094 27p 7475 17p 74559 225p 4095 27p 7476 17p 74560 225p 4096 27p 7477 17p 74561 225p 4097 27p 7478 17p 74562 225p 4098 27p 7479 17p 74563 225p 4099 27p 7480 17p 74564 225p 4100 27p 7481 100p 74565 225p 4101 22p 7482 84p 74566 225p 4102 180p 7483 84p 74567 225p 4103 180p 7484 84p 74568 225p 4104 95p 7485 84p 74569 225p 4105 95p 7486 34p 74570 225p 4106 90p 7487 34p 74571 225p 4107 47p 7488 34p 74572 225p 4108 47p 7489 21p 74573 225p 4109 47p 7490 36p 74574 225p 4110 30p 7491 36p 74575 225p 4111 25p 7492 36p 74576 225p 4112 25p 7493 36p 74577 225p 4113 25p 7494 36p 74578 225p 4114 25p 7495 36p 74579 225p 4115 25p 7496 36p 74580 225p 4116 25p 7497 180p 74581 225p 4117 25p 7498 180p 74582 225p 4118 25p 7499 180p 74583 225p 4119 25p 7500 180p 74584 225p 4120 25p 7501 180p 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10p BFY90 90p TIP41C 78p 2N3892 700p BC159 11p BRY39 45p TIP42A 78p 2N3903/4 18p BC169C 12p BSX19/20 20p TIP42C 82p 2N3905/6 20p BC172 12p BU104 225p TIP54 160p 2N4037 65p BC177/8 17p BU105 190p TIP120 120p 2N4058/9 12p BC179 18p BU108 250p TIP122 130p 2N4080 12p BC182/3 16p BU109 225p TIP142 130p 2N4061/2 12p BC184 11p BU205 200p TIP147 130p 2N4123/4 27p BC187 30p BU208 200p TIP285 78p 2N4125/6 27p BC212/3 11p BU406 145p TIP405 70p 2N4401/3 27p BC214 12p E300 50p TIS43 34p 2N4427 90p BC237 15p E308 50p TIS93 30p 2N4871 60p BC327 16p E310 50p TZK300 12p 2N5027 27p BC337 16p MJ2501 225p TZK500 15p 2N5089 27p BC338 16p MJ2955 90p TZK502 18p 2N5172 27p BC461 36p MJ3001 225p TZK504 30p 2N5179 90p BC477/8 30p MJ340 50p 2N5194 90p 2N5197 90p BC516/7 50p MJ2955 100p 2N5245 40p 2N5198 90p BC517 50p MJ3001 225p 2N5246 40p 2N5247 40p BC548C 9p MPF102 45p 2N5248 40p 2N5249 40p BC549C 18p MPF103/4 40p 2N706A 20p 2N5457/8 40p BC557 18p MPF105/6 40p 2N708A 20p 2N5459 40p BC559C 18p MPF5531 50p 2N918 45p 2N5460 60p BCY70 18p MJE6534 50p 2N930 18p 2N5485 64p BCZ1/2 22p MSA506 32p 2N1131/2 20p 2N5488 64p BO131/2 50p MPSA12 50p 2N1613 25p 2N6027 48p BD135/6 54p MPSA13 50p 2N1711 25p 2N6107 25p BD446 1/4 54p MPSA20 50p 2N12102 70p 2N6247 180p BD140 60p MPSA42 50p 2N12160 350p 2N6254 130p BD189 60p MPSA43 50p 2N219A 60p 2N6290 65p BD232 95p MPSA66 32p 2N2222A 30p 3N204 100p BD233 75p MPSA70 50p 2N2369A 25p 25C1172 150p BD235 85p MPSU06 63p 2N2484 30p 3N128 120p BD241 70p MPSU07 90p 2N2646 45p 3N140 120p BD242 70p MPSU45 90p 2N2904/5 30p 3N141 110p BDY58 32p MPSU65 78p 2N2906A 30p 3N201 110p BF300 32p OC28 130p 2N2974 30p 3N204 100p BF448 35p OC35 130p 2N2926 9p 4Q290 250p BF256/8 70p TIP29A 40p 2N3053 30p 4Q360 40p BF257/8 32p TIP29C 55p 2N3054 65p 4Q361/2 75p BF259 35p TIP30A 48p 2N3055 48p 4Q364 120p BFR39 25p TIP30C 60p 2N3442 140p 4Q408 70p			DIODES BY127 12p BY36-300 20p OA47 8p OA81 15p OA85 9p OA90 9p OA91 9p OA95 9p OA200 10p 1N914 4p 1N918 4p 1N4148 4p 1N4007/2 5p 1N4003/4 6p 1N4005 7p 1N4006/7 6p 1A 50V 40p 1A 400V 22p 1A 50V 75p 1A 400V 85p 1A 500V 85p 1A 400V 110p 1A 500V 110p 1A 500V 130p 1A 50V 160p 1A 400V 180p 1A 500V 220p BT106 110p C1061 45p CMR100 36p 2N3525 130p 2N4444 140p 2N5000 34p 2N5064 40p			TRIACS 3A 400V 60p 3A 500V 75p 6A 400V 60p 6A 500V 85p 8A 400V 75p 8A 500V 95p 12A 400V 85p 12A 500V 105p 16A 400V 110p 16A 500V 110p T2800D 130p			THYRISTORS 1A 50V 40p 1A 400V 22p 3A 400V 90p 8A 600V 140p 12A 400V 160p 16A 400V 180p 16A 500V 220p BT106 110p CMR100 36p 2N3525 130p 2N4444 140p 2N5000 34p 2N5064 40p			HEAT SINKS For TO20 TO-18 on-edge Regs and Transistors 22p For TOs 12p			BRIDGE RECTIFIERS 1A 50V 18p 1A 100V 20p 1A 400V 25p 1A 600V 30p 2A 100V 30p 2A 400V 45p 3A 600V 45p 4A 100V 95p 4A 50V 100p 6A 50V 100p 6A 100V 100p 6A 100V 120p			LOW PROFILE DIL SOCKETS BY TEXAS 8 pin 9p 18 pin 16p 24 pin 24p 14 pin 9p 20 pin 20p 28 pin 30p 16 pin 11p 22 pin 22p 40 pin 40p			WIRE WRAP SOCKETS BY TEXAS 8 pin 25p 18 pin 50p 24 pin 70p 14 pin 35p 20 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Auto-Probe

When it comes to probing faults or otherwise in a vehicle's electrical system, a multimeter has distinct disadvantages. This highly convenient probe is very useful in those awkward places so often encountered; it's also simple to build and inexpensive.

THE DIFFICULTIES of tracing a fault in a vehicle's electrical system using a multimeter are probably familiar to most readers. As that accursed Murphy's law generally has it, you have to contort yourself into an awkward position before you can see where to put the test prod, or prods, and having done that, find that you can't twist yourself sufficiently to see the multimeter face.

Damned annoying isn't it!

Then again, a multimeter can give you a false indication. No, not possible, you cry. It sure is though. If, for some reason, you're measuring the voltage at a particular point and it happens to be connected to the battery via a low, but significant, resistance how do you detect the presence of that low resistance?

A voltmeter measurement won't show it. If that low resistance is the fault, an ohmmeter measurement may well be impossible.

Sorting out the wiring can be a nightmare — especially on motorcycles.

This project gives clear indication of the six conditions one usually finds in an automotive electrical system. These are:

- Short to +ve supply
- Short to -ve supply
- Open circuit
- Connection to +ve supply via an intermediate impedance
- Grounded via an intermediate impedance
- Connection to a fixed, intermediate (low) voltage level

The Auto-probe is smaller, cheaper, easier to interpret and easier to use and read than a multimeter. It is the sort of device that can be left in the tool kit in the

boot of your car or stored in the glove box. It is a worthwhile addition to any mechanically-minded handyman's array of gadgets.

The Auto-probe can be used on 6 volt or 12 volt systems, with minor changes to the circuit values.

To get an idea of how it can be used, and how useful it is, let's take a look at a few typical problems encountered in vehicle electrical systems.

The Problem

Let us consider the case of a car radio that has 'stopped working'.

Looking at the panel lights, you observe that they aren't lit up when the set's turned on. Obviously, it would seem to be a supply problem. Wriggling, upside down, under the dashboard, you check the fuse and find it intact. Taking the Auto-probe, you attach its supply leads to the rear connection of the cigarette lighter or the ignition switch. Both lights should blink on and off. If they don't then you'd have to reverse the connections and mentally castigate yourself for being a twit. No worries though, it's protected against twits.

Touching the probe on the radio's B+ connection, the red LED glows steadily. 'Aha! This shows the probe tip is connected to the supply. Touching the probe onto the radio's ground lead results in a blinking red LED. Hmm, it's connected to supply via an impedance. It seems the ground connection isn't grounded.

Some jiggling and scraping at the radio's ground lead earthing point results in a steady green LED and a burst of music . . . well, more likely, commercials.

Suppose you wish to know if your car has an ignition ballast resistor. This is a resistance inserted in series

with the ignition coil primary during normal running, but is shorted out when the starter is operated so that the coil receives a voltage 'boost'. The resistor may be a heavy wirewound type mounted somewhere in the engine compartment or (as is common in many late-model vehicles) a resistance lead is used — they're hard to spot.

In this case, the probe tip is touched on the coil primary terminal that is not connected to the contact breaker points. With the ignition on, (engine not running) no light will show on the probe, indicating it is connected via an intermediate impedance. When you touch the starter, the red LED should burst into lusty life, indicating the resistor is shorted, as you would expect.

Tracing wiring and switch operation can be a real hassle. Does this motorbike operate its horn by supplying power or a ground connection via the horn switch? If touching the two switch contacts in turn shows first a steady green LED then a blinking red LED, the first contact is grounded and the second is clearly connected to the positive supply via an intermediate impedance, ie: the horn. If the green LED lights and then both LEDs blink when the probe is touched to the other switch contact, this would indicate that the horn is open circuit.

The circuit will cause both LEDs to blink when the probe tip is connected to an open circuit or to either side of the supply via an impedance greater than about 1,000 ohms. In an automotive environment 1,000 ohms is a high impedance!

Simple, and easy to use, isn't it?

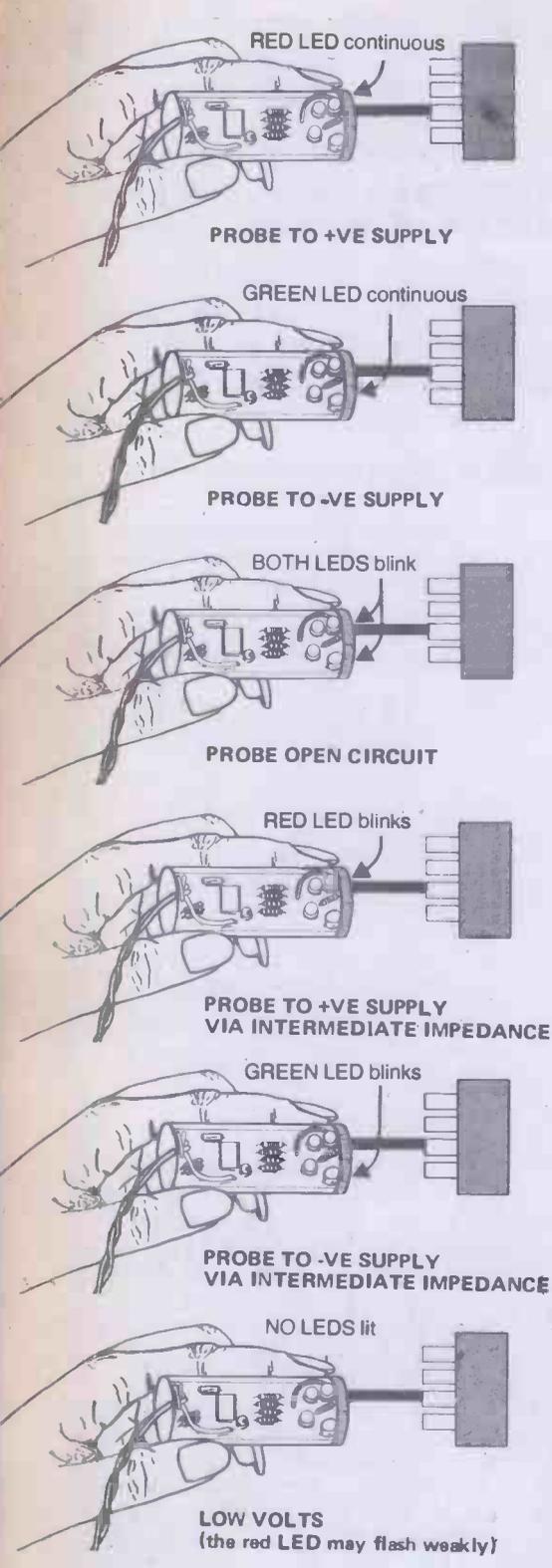


Figure 1 showing in visual form the wide variety of electrical conditions which may be encountered in automobile electric systems and how the HE Autoprobe detects them.

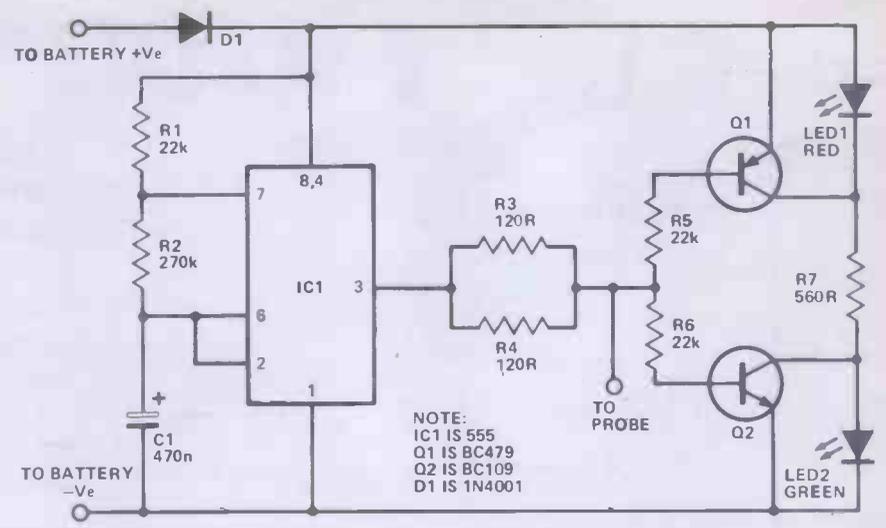


Figure 2 (above), the circuit diagram — yet another ingenious use of the 555 integrated circuit.

How it Works

Consider first the 'idle' state of the device — ie: with the probe open circuit. Diode D1 protects the whole circuit against accidental reversal of supply polarity. When the battery is connected correctly, the battery voltage (less about 0.7 volts dropped across D1) is applied to the electronics.

IC1 is the familiar 555 timer IC, connected as an astable multivibrator. When C1 charges up to 2/3 of the supply voltage, via R1 and R2, the 'high' level comparator (pin 6) detects this and sends the output high, which also shorts pin 7 to near ground. C1 thus commences to discharge via R2. When it reaches 1/3 of the supply voltage, the 'low' level comparator trips (pin 2) and C1 is allowed to recommence charging as before, since the output is sent low. This cycle repeats indefinitely, with a frequency of

$$F = 1 / (0.692 \times C1 \times (R1 + 2R2))$$

With the values chosen, this is about 4 Hz. This may be varied by changing C1 or R2. The output on pin 3 of IC1 oscillates between nearly 0 V and V+ (less 0.7 volts). It can source about 200 mA.

Consider now the circuitry surrounding the LEDs. Assume at first that the voltage on the junction of R5 and R6 is about half the supply potential. Current will flow through the bases of both transistors via R5 and R6, hence both of these transistors will conduct. Each transistor will short out the LED connected in parallel. Thus neither LED will glow. If the voltage on the resistor junction (the probe connection) were to fall below 0.6 volts, or thereabouts, Q2 would be biased off and would no longer bypass the current flowing through R7 away from the green LED. Thus the green LED would light. Similarly, if the voltage on the probe were to rise to within 0.6 volts of the unit's supply rail (ie: within 1.3 volts of the battery supply, due to the action of D1) Q1 would be biased off and the red LED would light.

Now let us put the picture together and see what happens in practice. The output of IC1 is connected to the probe and the resistor junction of the LED driver circuit via a 60 ohm resistance made up of two 120 ohm resistors in parallel. There are two resistors rather than one 1W or larger resistor for reasons of physical size.

With no connection made to the probe, the 555 drives the probe alternately to the +ve and -ve rails, with the result that the LEDs flash alternately.

Shorting the probe to either rail of course forces the appropriate LED to stay on continuously. If a resistance is placed between the probe and ground, say, three possibilities occur:

- 1) The current flowing from pin 3 of the 555, via R3/R4, is insufficient to develop 0.6 volts across the resistance — this looks like a short and the green LED stays on.
- 2) The current develops sufficient voltage to turn Q2 on and the LED extinguishes on that part of IC1's cycle when its output is high. This allows the appropriate LED (green) to blink.
- 3) If the resistance is high enough (over 1k? both LEDs blink, giving the open-circuit response.

However, if the resistance is not high enough to allow the junction of R5/R6 to go far enough positive the red LED will not turn on. This gives green only blinking.

The same argument applies 'upside down' for a resistance to the positive rail, but the voltage across it must be 1.3 V due to D1 being in the emitter circuit of Q1. If the voltage is fixed midway, neither LED can glow, as first assumed.

Resistor R7 fixes the LED current and R3/R4 limits the 555 output current to a safe level and defines the voltage 'turnover' points.

Parts List

RESISTORS (All ¼ W, 5% unless specified)
R1, 5, 6 22k
R2 270k
R3, 4 120 R ½ W (See text)

CAPACITORS
C1 470n 16 V tantalum

SEMICONDUCTORS
IC1 555
Q1 BC470
Q2 BC109
D1 1N4001
LED 1, 2 0.2" red, green, LEDs

MISCELLANEOUS
 Lengths of red and black wire
 Crocodile clips
 Pill container
 4 BA nut and bolt (for probe)

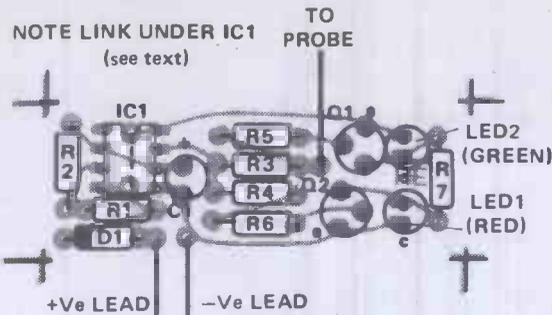


Figure 3. Printed circuit board overlay. Once completed the project will, no doubt, pay for itself very quickly by savings on costly repair bills.

Buylines

It is a distinct possibility that our readers will have problems obtaining the case for this project (i.e. the pill container) from their usual electronic hardware suppliers.

You could always try the National Health. The grand total for all components in this project shouldn't be much more than around £3.

Construction

Constructing the project on a PCB is simple. First thing to do is locate the position of IC1. A link is inserted between two pads located between the two rows of holes for the IC pins. Having done that, insert the IC. Take care that you have it correctly oriented. All the other components may now be assembled and soldered into the board. Watch the orientation of Q1 and Q2, the two LEDs and C1. Refer to the overlay picture.

Now comes the testing. You will need either a 12 V battery or a power supply that can deliver around 12 V to 14 V DC. Temporarily solder battery leads and a probe lead to the board. Connect the battery leads to the 12 V supply. The two LEDs should flash. Shorting the probe lead to the negative of the supply should cause the green LED to flash.

If you cannot obtain the correct indications at this stage, look for incorrect connections or components round the wrong way. To check that IC1 is working, connect a multimeter — set to, say, the 30 V range — between the supply negative and pin 3 of IC1 (positive meter lead to the latter). The meter needle should rise and fall at about four times per second.

The pill bottle used to house this project measured 61 mm overall length (with the cap on) by 21 mm outside diameter. A 25 mm long 6 BA bolt was used for the probe. This was bolted through a hole made in the cap somewhat off-centre. The

photograph shows roughly where this needs to be. Just keep it out of the way of the board. A small solder lug under the bolt head is used to attach the probe lead from the board. The battery leads should be colour-coded to avoid confusion. The convention is: red for positive, black for negative. Twist together about one metre of each colour hookup wire.

Connect the appropriate leads to the board and tie a knot close to the board (see photograph).

Drill a hole in the end of the pill bottle, near the edge, and pass the battery leads through it. The knot

prevents the leads being pulled out of the board. Attach alligator clips to the ends of the battery leads.

Two small cutouts will have to be made in the lip of the pill bottle's cap so that the LEDs may be seen easily. All these details are clearly shown in the photograph of the completed project.

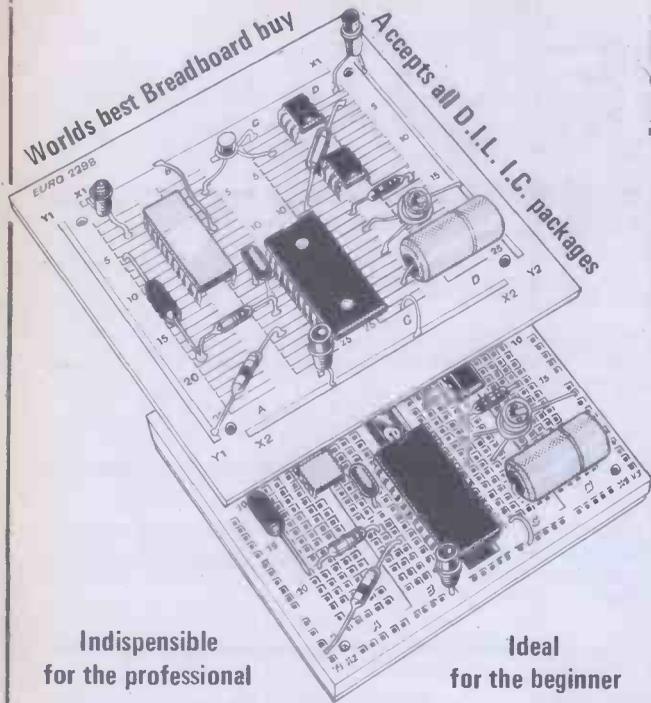
When the unit is assembled, give it a thorough work out.

Once you have this little project working for you, you'll be amazed how quickly electrical problems in your vehicle are sorted out. **HE**



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Talking Design

Month by month we'll be looking at the various ways electronic circuits are designed.

THE MOST USED transistor configuration is the common emitter stage. The reasons are not hard to find since it offers a reasonably high voltage gain combined with a medium input impedance.

Just how to design such a stage and what to expect from it is the subject of this month's 'Talking design'.

Figure 1 shows the outline circuit of a common emitter stage with all the important currents and voltages. Before any design work can start certain parameters must be fixed. The most important of these are the supply voltage and the gain of the transistor to be used.

For the sake of our example we will assume a gain of 100 and a supply of 9 V. The gain of a transistor is usually found in semiconductor data sheets under H_{fe} . A range of values will usually be quoted, transistor gain varies considerably from device to device and all that one can be sure of is that the sample to hand will lie somewhere within the specified band.

Under these circumstances it is advisable to assume the lowest value and calculate accordingly. At least that way you will be certain that the circuit will function satisfactory with any device sample.

The circuit of Figure 1 shows an NPN transistor although these methods are equally applicable to PNP types, the only different being the polarity of the supply rails.

Transistor Amplifier

The circuit as it stands is intended to amplify low level analogue AC voltages, ie audio signals, and so these

are coupled into the base of the transistor via C1. This has to be chosen so that its impedance at the lowest frequency to be amplified is at least ten times less than the input impedance of the stage. The input impedance of the stage will be calculated later but first attention must be directed towards the output section. In order that the circuit can deliver the maximum output swing to the next circuit the collector must be held at half the supply voltage, in our case 4.5 V. In order to define the value of R3 a collector current must be chosen.

This is dependent upon the input impedance of the following stage. The output of the stage 'sees' the following stage as a resistance in parallel with R3. That is to say it is loaded by it. The golden rule of matching stages together is to ensure that the output impedance of your stage is at least five to ten times smaller than the impedance into which you are feeding signals. Since a transistor acts as a current source it is safe to assume that the output impedance of the stage is defined by, and is the same value as, R3.

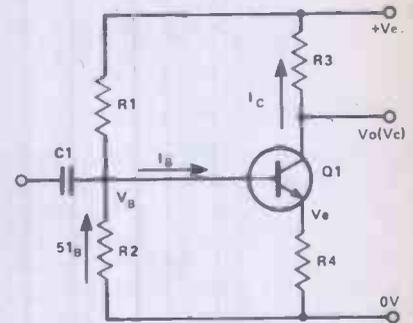
The situation changes somewhat when feedback techniques are employed, the output impedance is then less than the value of R3. How much less is dependent upon the amount of feedback employed.

As this is a small signal stage a convenient value for this current is 1mA. R3 can now be found from Ohm's law to have a value of $4.5V / 1mA = 4.5k$. The nearest preferred value is 4.7k and this should be used.

Base Bias

Because transistors are current operated devices a certain amount of base bias-current must be provided.

This current is nominally the collector current divided by the gain of the transistor. As already described, this varies considerably from device to device. A further complication is that the transistor base has to be held at 0.65 V above the emitter to operate in the linear region. These factors determine the values of R1 and R2 in the bias chain.



$$R3 = \frac{+V \times I_c}{2}$$

$$R4 = \frac{R3}{\text{GAIN}}$$

$$V_e = R3 \times I_c$$

$$V_b = V_e + 0.65$$

$$I_b = \frac{I_c}{H_{fe}}$$

$$R2 = \frac{V_b}{5I_b}$$

$$R1 = \frac{(+V - V_b)}{5I_b}$$

$$C1 = \frac{5I_b}{2\pi f Z}$$

WHERE:

$$\frac{1}{Z} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{H_{fe}(r_e + R4)}$$

and $V_e = \frac{26}{I_c}$ Ohms

Figure 2. Calculating the values of the resistors and capacitor.

As we have a gain of 100 the base current will be $1mA / 100 = 10\mu A$. A useful rule of thumb is to have five to ten times this current flowing through the bias chain. This will swamp any variations in calculated base current but reduces the input impedance. In electronics, as in anything else in this world, you don't get owt for nowt and so, if a stable circuit is to be produced, the penalty must be paid. The other requirement is to hold the base at 0.65 V. Five times our calculated base current is $50\mu A$ and since the voltage on the base is 0.65 V the value of R2 must be, again from Ohm's law, $0.65V / 5 \times 10^{-5}A = 13k$. The nearest value is 12k. R1 is found by subtracting the voltage drop across R3 from the supply voltage and dividing by $5 \times 10^{-5}A$, ie $8.35V / 5 \times 10^{-5}A = 167k$. The nearest value here is either 150k or 180k. Since the bias current must also flow through R1 the lower value should be chosen.

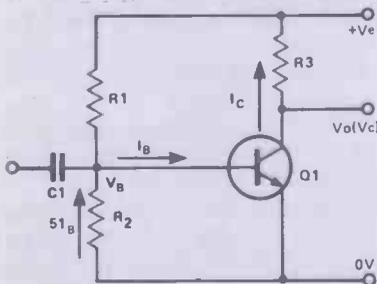


Figure 1. Bias conditions for an NPN transistor.

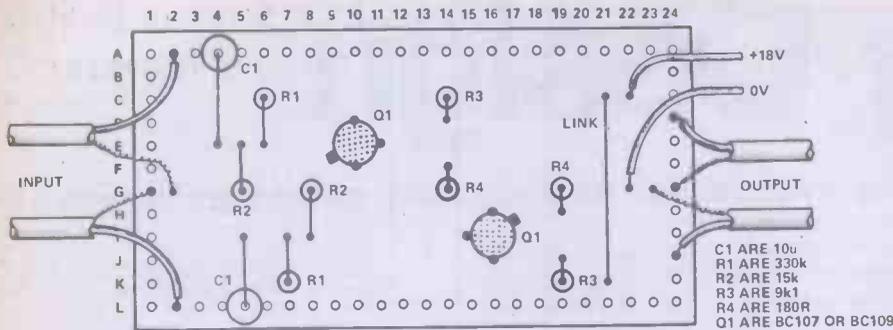


Figure 3. Simple stripboard layout for the Fig. 2 circuit diagram. This is a stereo version.

The gain of the stage depends on a hidden resistance in the emitter of the transistor. This resistance, hereinafter called r_e , the emitter resistance, is determined by the collector current. Its value, for silicon transistors, is $26/I_c$ Ohms, where I_c is the collector current expressed in milliamps. The voltage gain is $R3/r_e$.

For practical purposes the gain of any common emitter stage without negative feedback is twenty times the supply voltage, 180X in our example.

The input impedance is the parallel combination of R1, R2 and $H_{fe}Xr_e$. Putting these figures into the case in point we find that the input impedance Z, can be found by evaluating the following expression,

$$\frac{1}{Z} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{(H_{fe}XV_e)} =$$

$$\frac{1}{167,000\Omega} = \frac{1}{15,000\Omega} + \frac{1}{2,600\Omega} +$$

will reveal the answer, 1790R, 1.79k.

A few minutes work on a calculator, will reveal the answer, 1790R, 1.79k.

Having established this the value of C1 can be calculated. As you know the impedance of a capacitor is dependent upon frequency. The higher the input frequency the lower the impedance. At DC any decent capacitor will be, for all practical intents and purposes, an open circuit. The size of C1 is dependent on the lowest frequency to be amplified. For audio work this is 20Hz. The correct size capacitor, to give us a -3db point at that frequency, will have an impedance that is equal to the input impedance of our stage at 20Hz.

The required capacitance can be found from the expression,

$$C = \frac{1}{2\pi fZ}$$

by substituting all our known values

into this equation we find that the required value is;

$$\frac{1}{3.14 \times 2 \times 20 \times 1.79 \times 10^3}$$

$$= 4.4 \times 10^{-6}F, 4.7\mu f.$$

It is wise to choose a value ten times that obtained from this calculation. In order to understand why consider what would happen if two circuits, both with a -3db point at 20Hz were to be connected together. With this situation the response of both amplifiers together will be -6db down at 20Hz, hardly hi-fi!

By making the input capacitor several times larger than necessary this is avoided.

Fixed Gain

Of course it is not always desirable to use the circuit without feedback an amplifier with a known voltage gain is often required. Under these circumstances the circuit in figure 1 can be modified as shown in figure 2. The only obvious difference between figure 1 and 2 is the inclusion of an extra resistance, R4, between the emitter and ground. This has the effect of defining the gain to any required value, increasing the input impedance and lowering the output impedance.

To illustrate this I will outline the design of a simple microphone amplifier with a gain of 50 running from a supply voltage of 18 V and using our transistor of gain 100.

First we find the value of R3 by letting the collector voltage equal half the supply voltage, 9V. Again choosing 1mA quiescent current for the stage gives us a value for R3 of $9V/10^{-3}A = 9k$. 9k1 is the nearest value.

To get the required gain from the circuit R4 must be chosen to be R3/gain. In our case the required gain is 50 so R4 becomes $9k/50 = 180R$. Now because the current that flows

through R3 also flows through R4 there will be a voltage drop across it of $10^{-3}A \times 180 = 0.18V$. To this must be added our 0.65 V base emitter voltage to find the voltage drop across R2. This is 0.83 V. Because our transistor has a gain of 100 the bias current is the same as the previous case, $50\mu A$. The value of R2 is therefore $0.83V/5 \times 10^{-5}A = 16k6$, the nearest value is 15k. R1's value is $(18V - 0.83V)/5 \times 10^{-5}A = 343k$ nearest value 330k.

The input impedance looking into the circuit is gain the parallel combination of R1, R2 and the impedance looking into the base. This time however the impedance is equal to the gain of the transistor multiplied by r_e plus R4. Since R4 is much larger than r_e the latter can normally be ignored. For completeness however,

$$\frac{1}{Z} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{H_{fe}(r_e + R4)}$$

$$= \frac{1}{1.5 \times 10^4} + \frac{1}{3.3 \times 10^5} + \frac{1}{2.06 \times 10^4}$$

$$= 1.18 \times 10^{-4}$$

Hence $\frac{1}{2} = 1.18 \times 10^{-4}$, and $Z =$

$$\frac{1}{1.18 \times 10^4} = 8K45.$$

C1 is calculated from, $C1 =$

$$\frac{10}{2\pi fZ} = \frac{10}{2 \times 3.14 \times 20 \times 8.45 \times 10^3}$$

As it stands the stage we have just designed is suitable for amplifying low level, low impedance microphone signals sufficiently to be fed into the high impedance auxiliary input of any power amplifier.

Low Power

Of course there are many uses for the common emitter stage apart from simple audio amplifiers. In fact you will find them in nearly all types of transistor equipment often in the disguises of oscillators, RF amps, DC amps, level shifters, the list could be extended indefinitely but whatever the disguise the basic design principles remain the same.

Since the circuit is so simple a PCB would be a little extravagant so the stripboard layout of figure 3 is used. A stereo version is shown and the circuit can conveniently be run from a pair of PP3's in series. Because of the low current drain the batteries can be expected to last for several months even if an on-off switch is not fitted.

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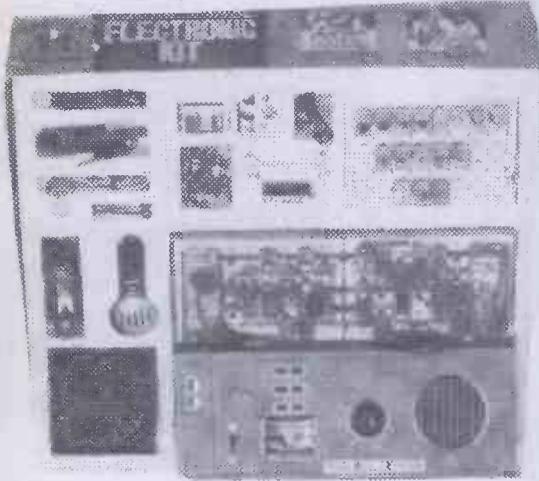
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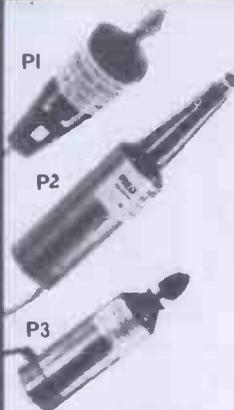
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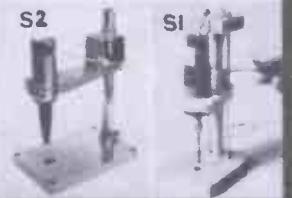
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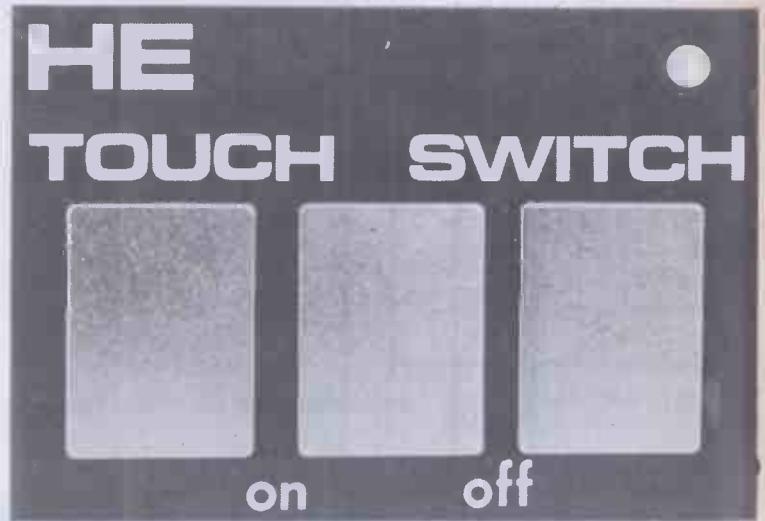
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Touch Switch

A unique new design for a popular project. The HE Touch Switch uses VMOS Field Effect Transistors to turn your offs back on again. A cheap and easy to build circuit.



WOULD YOU LIKE to turn your radio, your stereo system or virtually any electrical equipment on and off merely by *touching* it? This simple touch switch can be adapted to do the job.

This unique device uses ordinary skin resistance to trigger a VMOS power transistor into conduction by touching the "ON" metal plates on the front panel. Once it has been touch-triggered, the transistor remains in this state (and so your electrical equipment remains on) until the device is turned off by touching the "OFF" plates.

Obviously the absence of any moving parts to wear out means that a touch switch has the advantage over mechanical switches of an almost unlimited operating life. The HE VMOS Touch Switch is primarily intended to suit 9 volt battery operated equipment, drawing up to a couple of hundred milliamps or so. However, there is nothing to stop the ambitious reader from connecting a relay at the touch switch output and using the relay contacts to switch mains type equipment. The sky's the limit.

Construction

No breaks in the track of the 10x24 hole, 0.1" matrix veroboard are required so the components can be soldered in immediately, following the board layout of figure 1.

Although Q2 is a MOS device, its

internal protection diode withstands higher voltages than those which can occur on human skin so special handling precautions are absolutely unnecessary.

Suitable touch contacts can be made from small bits of printed circuit board but the ones which we used are commercially available and a suitable source is quoted in Buylines.

The circuit can be cased if required, or left as ours, on a panel therefore enabling its easy insertion into equipment. It really is up to you and the use to which the Touch Switch is to be put.

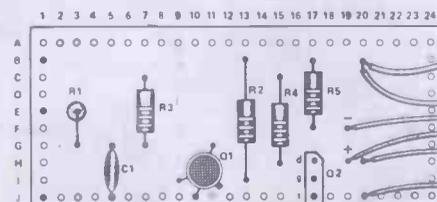
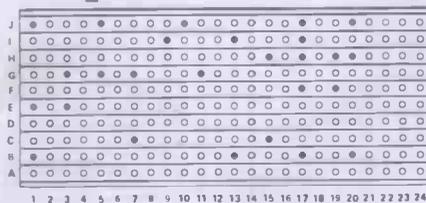


Figure 1. The veroboard layout and (above) the underside of the board. The three connections from points B1, E1 and J1 go straight to the off, central and on touch plates.

Buylines

To our knowledge, the only mail order stockist of the VMOS powerfets is J. W. Rimmer, who advertises in "Hobby Electronics".

Watford Electronics stock the touch contacts which we used.

All other components should be readily available and the approximate price of the components is around £3.00.

Parts List

RESISTORS (All 1/4W, 5%)

R1	3k3
R2	1M0
R3, 4	10M
R5	270R

CAPACITORS

C1	47n polyester
----	---------------

SEMICONDUCTORS

Q1	BC109 N-P-N
Q2	VN66AF or VN67AF N-channel power VMOS (see Buylines)

LED1	0.2" Red LED
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MISCELLANEOUS

3 x	touch contacts (see buylines)
10 x	24 holes 0.1" matrix veroboard
1 x	battery and clip

How it Works

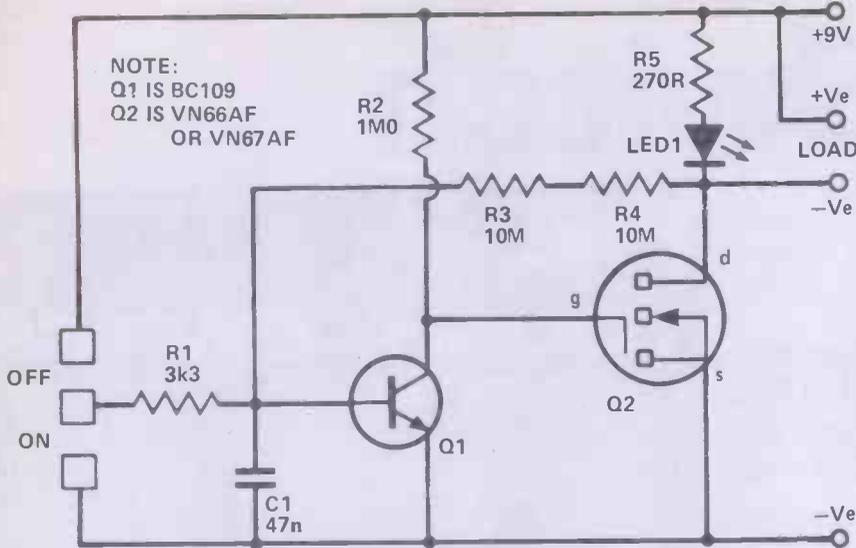


Figure 2. The HE Touch Switch circuit diagram. Q2 is a VMOS FET and needs no special handling precautions.

Fig. 2 shows the circuit diagram of the touch switch, which is a form of bistable multivibrator.

When power is first applied to the circuit it goes into the "ON" state, with Q2 being biased into conduction by R2. The voltage at the drain of Q2 is then at virtually the negative supply potential, and so no base current is supplied via R3 and R4 to Q1, and the latter remains switched off. Many readers may be unfamiliar with VMOS devices, such as the one used in the Q2 position. In practical terms, these differ from ordinary power transistors in that they have an extremely high input impedance, and consume no significant input current. In fact they are voltage rather than current operated devices, requiring a gate potential of about 1 to 2 volts before they start to conduct, and just a very few volts more than this to bias them into saturation. Thus, despite its high value, R2 is quite capable of switching Q2 hard on.

If the two "OFF" touch contacts are operated, a base current for Q1 flows from the positive supply, through the user's skin and R1 into Q1, causing Q1 to switch on. Q2 then switches off as its gate potential falls to virtually zero, and power is cut off from the load. Q1 then obtains an extremely small base current via the load, R4, and R3, but this current is sufficient to keep the device switched on when the operator's finger is removed from the touch contacts. The circuit therefore latches in the "OFF" state.

The unit can be returned to the "ON" state by touching the "ON" touch contacts. This diverts the base current for Q1, causing the device to switch off so that Q2 is biased into conduction once more.

R1 ensures that an excessive base current cannot flow into Q1 if an accidental short circuit across the "OFF" contacts should occur. C1 prevents electrical noise from producing spurious operation of the unit. The current drain of the unit is an insignificant 9uA when it is in the "OFF" state, and practically zero when it is in the "ON" state.



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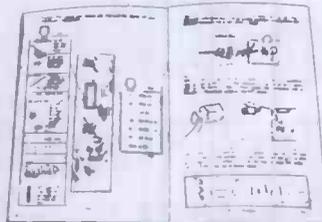
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Hobby Electronics, September 1980

ETI NEXT MONTH

October issue on sale September 6th - Don't miss out order your copy today.

FM Radio Control

In the course of the past year you've seen all the others produce radio control projects. You've also seen them make a right mess of the idea!

Next month ETI presents the definitive FM, easy-to-build, every-home-should-have-one, radio control. We won't spin it out over 10000 issues either, our circuit is sufficiently refined for us to be able to present full details in one issue!

If you're at all intrigued by controlling things at a distance ETI October is the place to be.

Einstein Relatives

Yep. The feature you said we would never do. A clear easily understood explanation of the Special Theory of Relativity. This is the topic that those smug little physicists are always telling us humans we can never hope to comprehend. Well we can. Just read ETI next month and see for yourself.

Also Appearing

Taking part in next month's production we also have: a Bench Amp for the experimenter; a review for the HP-41C alpha-numeric calculator; an audio signal generator; a flash trigger for quick-off-the-mark photographers plus, of course, all our usual brilliant regulars. It's got to be worth the mere 60p we ask in exchange!

Articles mentioned herein are in an advanced state of preparation. However, circumstances may dictate changes to the final contents.

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Guitar Phaser

Build this easily constructed, cheap, compact and versatile phaser. An ideal project for the professional or amateur guitarist.

MANY MUSICIANS WILL know the electronic effect known as phasing. The sound produced by such a unit gives a pleasant, rhythmic, modulation of the source to which it is connected and can often, with a bit of imagination, create the illusion of flight. For this reason the effect has been referred to in the past as "sky-riding". With this unit the speed of the effect is continually variable over a wide range.

Of the many designs for phasers, featured in various magazines, noise has been an over-riding disadvantage for serious work by musicians.

The HE Phase 1 overcomes this and other problems by the use of some of the latest technology from Texas Instruments (TI). Recently, TI introduced a new family of operational amplifiers known as BI-FETS. For the technically minded, the abbreviation BI-FET means that the op amp has a high impedance, JFET input stage combined with a low-distortion bipolar output stage. They also feature further improvements such as low noise and

low power, both vital for a professional phasing unit — low noise for a high quality sound and low power for a long battery life!

Phase 1 uses a particular IC from this family of BI-FETs having four op amps in the one 14-pin body (known as a quad device). The use of this chip, the TL 064, obviously keeps the size of the complete phaser to a minimum, enabling its construction in an extremely small and neat case.

Automatic switching

An override footswitch is provided so that the musician can bypass the phasing effect when it is not required. Another important feature is the lack of an on/off switch. We have used a stereo input socket to switch the unit on whenever a jack plug is inserted into the socket. The circuit is automatically switched off when the plug is removed.

Construction

The method of construction of the unit is entirely up to the individual, but if you want to build the unit as illustrated, the full description follows. Although a PCB is recommended the unit could be successfully built on veroboard, though we give no details. When designing the unit the primary concern was to produce a low noise, low power, high performance phaser, at a reasonable cost. With this in mind we then considered the use to which the unit would be put, eg. stage use, with all the abuse which that entails. The case chosen to fulfil these requirements was a strong alloy enclosure, of small physical size yet easy to work with.

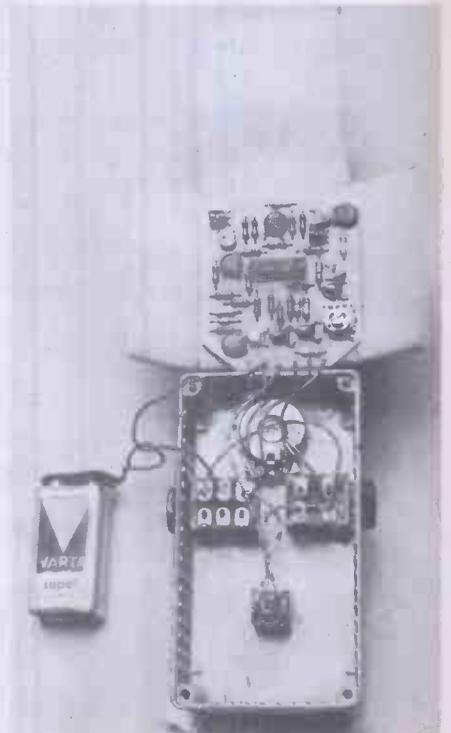
Due to the limitations of size, we used jack sockets that are smaller than usual, along with a slightly unusual method of PCB construction. A PP3 battery is used to power the unit, being the smallest of the 9 V range.

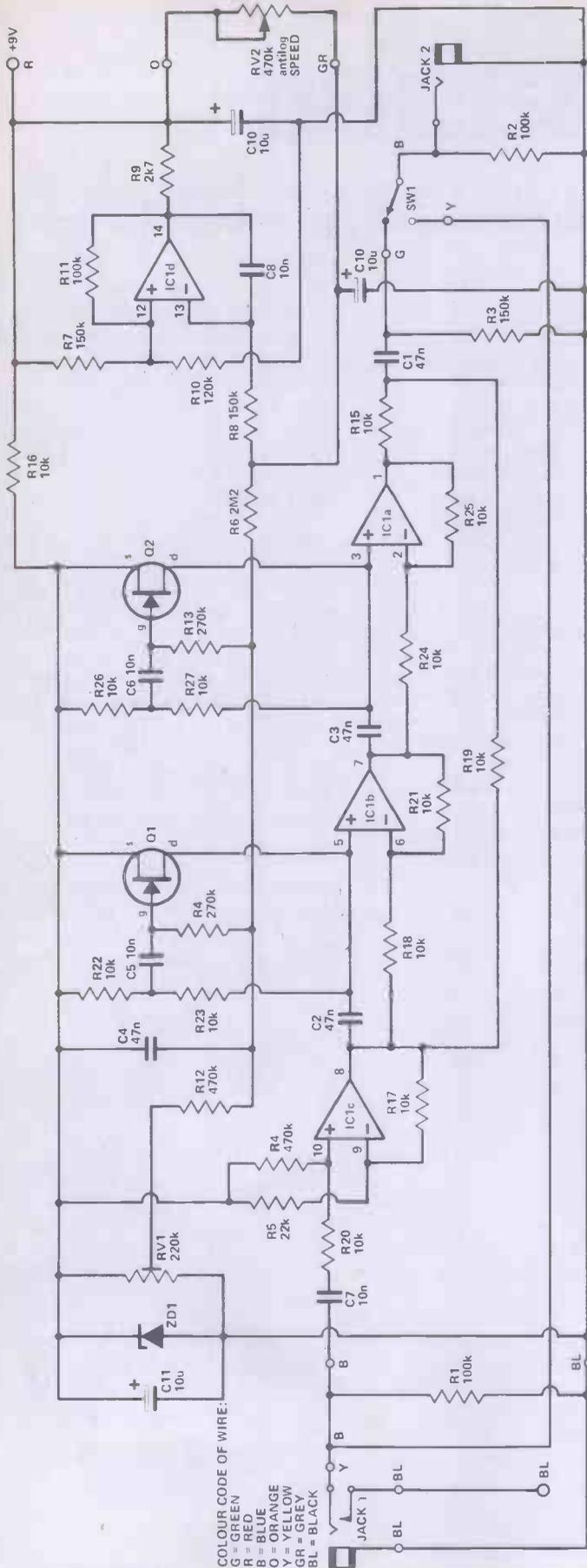
The PCB is constructed as follows. The overlay shows the location of the components with special attention drawn to the FETs, which are mounted with the flats facing the board, and the capacitors, as shown in Fig 3.

Take care

No special precautions are required for IC1 except that it should be inserted the correct way round as should the tantalum capacitors and FETs. Although we normally advocate the use of IC sockets, in this particular case, space requirements mean that the IC must be inserted directly into the PCB. You must, therefore, be careful not to overheat the device when soldering it in — likewise the FETs! When the board is completed, attention can be turned to the case.

The alloy box is easily drilled with normal drills, alternatively the larger holes may be punched with a Q-max type of punch. When the machining





NOTE:
 IC1 IS TL064
 O1 & 2 ARE TIS88A
 ZD1 IS 5V1 ZENER 400mW

COLOUR CODE OF WIRE:
 G = GREEN
 R = RED
 B = BLUE
 O = ORANGE
 Y = YELLOW
 GR = GREY
 BL = BLACK



Figure 1 (above). The complete circuit diagram of the HE Phase 1 phaser. Note the use of colour coded interconnections.

How it Works

The unit was designed around the TL 064, a BI-FET quad operational amplifier. Three of the amplifiers are used in the audio chain and the fourth is used in a multivibrator circuit, to give the low frequency modulated phase sound. The audio processing chain is split into four distinct sections, these are an input buffer, two active phase shift networks and a summing mixer. The circuit diagram is shown in Fig. 1.

The input buffer is formed around the operational amplifier, IC1c and has a gain of 1. The gain of the two phase shift networks is also 1 and so the unit as a whole has a unity gain. The phase shift networks consist of, respectively C2-Q1 and C3-Q2. At some frequency, say, f_0 , each network causes a 90° phase shift, thus 2 90° phase shifts in series give an anti-phase signal i.e. 180° out of phase (see Fig. 2). R19 feeds a portion of the buffered input signal direct to the output and if this is mixed at the output in a 1-1 proportion with the anti-phase signal the effect is to cancel out the signal at the frequency f_0 .

IC1d forms a simple triangle waveform generator whose frequency is variable over the range approximately 0.1 Hz-10 Hz. This waveform is fed to the FET gates via resistors R6, 13 and 14. It is this varying voltage that modulates the FET gates and so gives the well-known phasing effect. SW1 is a single pole changeover switch to bypass the unit when not required. A stereo socket is used on the input of the unit to eliminate the on/off switch by connecting the negative battery lead to the earth tag, and the negative circuit wire to the ring tag. Inserting a mono-plug will connect the earth and ring tags and perform the switching action.

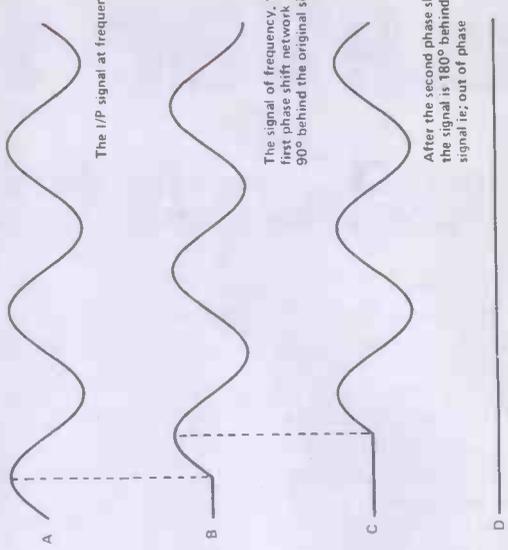


Figure 2. Waveforms within the circuit.

is complete it can be rubbed down with fine wet and dry paper to provide a good surface for a primary coat and then finally a top coat of good, hard paint.

When the top coat is dry, the sockets, pot and switch can be fitted in their respective places. The board is wired up as shown in Fig. 3, remembering to make the earth connection to the back of the pot by scraping off the plating and soldering the wire to this point.

Due to the fact that the wiring connections in the phaser are quite complex, we have tried a new technique to make things easier for you in construction — the colour coding of connecting wires. The use of colour coding is self-explanatory, really, and will present no problems

to the builder — on the contrary you should find it much easier to construct a project in this way.

The tags on the sockets will have to be bent inwards to clear the PCB when the lid is screwed down. When the wiring is complete a thorough visual inspection should be made, especially of the PCB. The unit is now ready for setting up. With the preset at its centre position, fit a battery and

plug a connecting lead from an amplifier into the O/P socket. Turn the unit on by plugging a lead from a guitar or similar instrument into the I/P socket. If the sound you hear has no modulation present, press the foot switch. There should be some sort of phasing though it may be irregular. Now adjust the preset for a smooth phasing sound with no discontinuity at the end of the sweep. It will now be found that the speed of the phasing can be controlled by the pot

on the front. This completes the construction, except for the cutting of a piece of foam plastic to protect the board from short circuits. **HE**

Buylines

We are not quoting an approximate price for components in this project because Watford Electronics are offering a complete kit of parts, including the case and PCB for the remarkably low price of £12.

If you prefer to buy the components separately, the only problems may be with the antilog pot RV2, (try Electrovalue) and the jack sockets.

Parts List

RESISTORS (All 1/4W, 5%)

R1, 2, 11 100k
R3, 7, 8 150k
R4, 12 470k
R5 22k
R6 2M2
R9 2k7
R10 120k
R13, 14 270k
R15-27 10k

POTENTIOMETERS

RV1 220k miniature horizontal preset
RV2 47k antilog

CAPACITORS

C1, 2, 3, 4 47n miniature ceramic
C5, 6, 7, 8 10n miniature ceramic
C9, 10, 11 10u 16V tantalum

SEMICONDUCTORS

IC1 TL 064 quad op amp
O1, 2 TIS 88 FET
ZD1 5V1 400 mW zener diode

MISCELLANEOUS

SW1 double-pole, double-throw foot switch
SK1 Stereo 1/4" jack socket, Cliff Products ref S3
SK2 mono 1/4" jack socket, Cliff Products ref S1
Case to suit, PF3-type battery connector, knob, foam plastic.

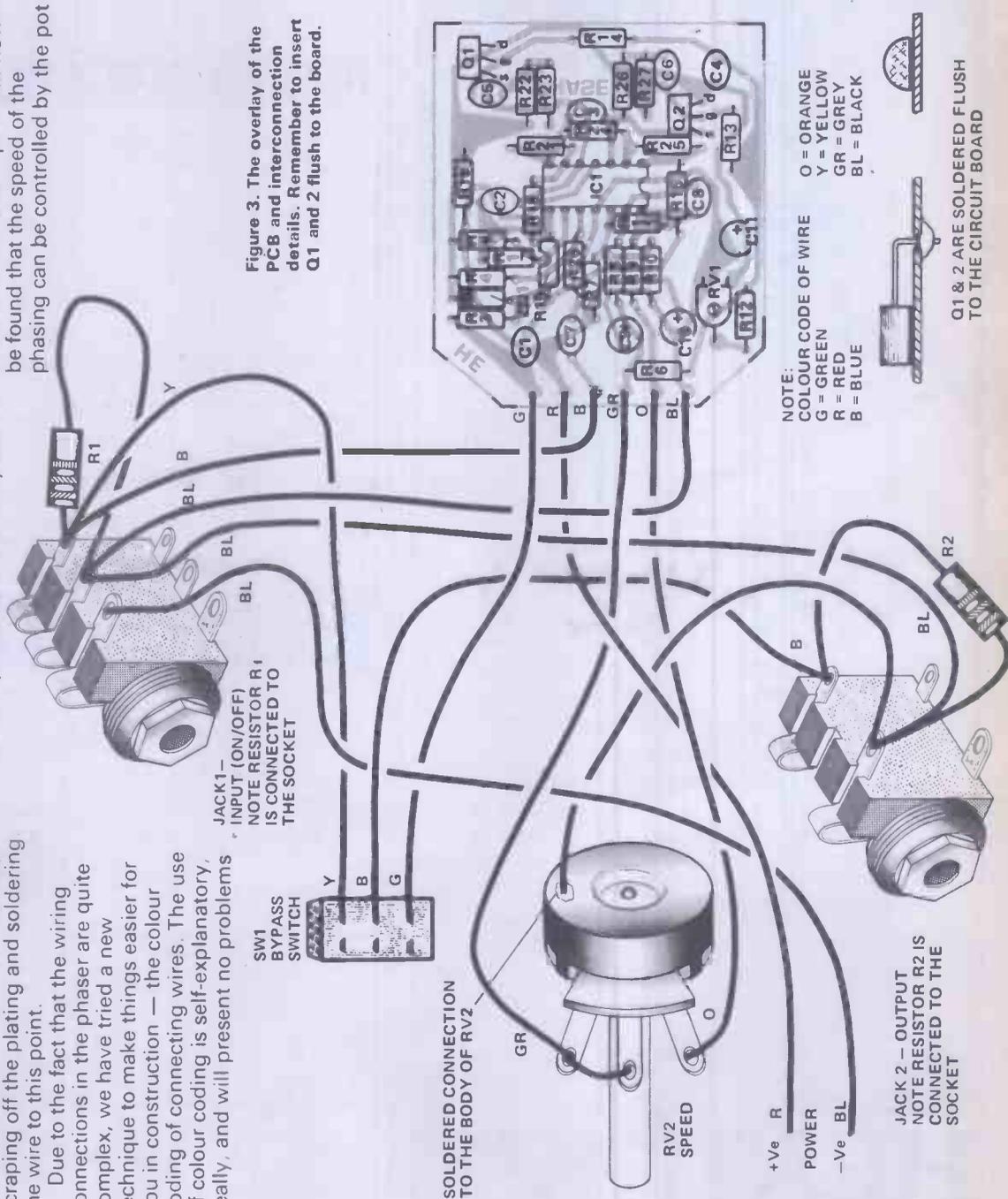


Figure 3. The overlay of the PCB and interconnection details. Remember to insert O1 and 2 flush to the board.

NOTE:
COLOUR CODE OF WIRE
O = ORANGE
Y = YELLOW
GR = GREY
R = RED
B = BLUE



O1 & 2 ARE SOLDERED FLUSH TO THE CIRCUIT BOARD

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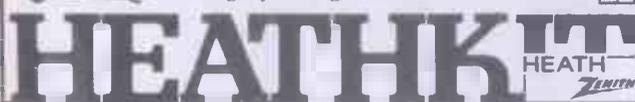
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HEF4002	22	HEF4067	109	HEF4517	476	CA3130E	99	IN4002	5	BC184L	12		
HEF4006	119	HEF4068	57	HEF4518	69	CA3140E	48	IN4004	7	BC212	11		
HEF4007	22	HEF4050	57	HEF4519	69	CA3189E	293	IN4007	9	BC212L	12		
HEF4008	100	HEF4051	87	HEF4520	118	LM301AN	34	IN4148	4	BC214	11		
HEF4011	22	HEF4052	90	HEF4521	225	LM339N	78	IN5402	15	BC214L	12		
HEF4012	22	HEF4053	90	HEF4526	124	LM339N	104	2N239	21	BC547	13		
HEF4013	37	HEF4054	62	HEF4532	150	LM381AN	198	2N2646	46	BC548	11		
HEF4014	105	HEF4067	475	HEF4534	638	LM3900N	75	2N2926G	13	BC549	12		
HEF4015	100	HEF4068	22	HEF4539	138	MC3403P	156	2N3053	19	BC557	15		
HEF4016	57	HEF4069	22	HEF4545	122	NE531	131	2N3054	55	BC558	15		
HEF4017	100	HEF4070	22	HEF4571	214	NE536T	259	2N3055	55	BCY70	15		
HEF4018	100	HEF4071	23	HEF40097	113	NE555N	28	2N3202	9	BCY71	15		
HEF4019	58	HEF4072	23	HEF40098	92	NE556N	66	2N3704	9	BD131	39		
HEF4020	112	HEF4073	23	HEF40106	78	NE568N	171	2N3705	10	BD132	39		
HEF4021	107	HEF4075	23	HEF40192	149	NE570N	465	2N3773	257	BD139	39		
HEF4022	103	HEF4076	130	HEF40196	149	NE571N	505	2N3819	22	RD140	39		
HEF4023	22	HEF4077	22	Voltage Regulators				RC4136	146	2N3820	39	8FR90	333
HEF4024	76	HEF4078	23					TBA1205	88	2N3904	9	8FX85	28
HEF4025	57	HEF4081	23	TOA1022	713	2N5457	39	8FY50	17				
HEF4026	244	HEF4082	23	TDA1034B	239	2N5459	35	8FY51	17				
HEF4027	57	HEF4085	80	LM309DA(K) 119	42	TL081CP	84	40673	88	8FY39	50		
HEF4028	89	HEF4086	80	UA723CN	42	TL084CN	156	8C107	14	8SX20	21		
HEF4029	113	HEF4093	63	UA7815CU	78	UA741CN	20	8C108	14	CL8960	2850		
HEF4030	58	HEF4094	219	UA7812CU	78	UA741CT	47	8C108C	18	8FY51	17		
HEF4031	130	HEF4104	206	UA7815CU	78	Zener		8C109	14	TIP32	54		
HEF4035	256	HEF4502	114	UA7912CU	97	Diods		8C109B	19	TIP41C	76		
HEF4040	107	HEF4505	214	UA7915CU	97			8C109C	20	TIP42C	76		
HEF4041	94	HEF4506	230	UA78105CS	38	400W CAY7-C33		8C148	10	TIP2955	75		
HEF4042	83	HEF4510	135	UA7812CS	38	8ZY88/BZX79		8C158	10	TIP355	60		
HEF4043	100	HEF4511	157	UA7815CS	38	+ Voltage	9	8C177	17	T1543	36		

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CAPACITORS				Polyester Radial Leads				Electrolytic Radial Leads			
Electrolytic Axial -10% to +50% Tol.				Dipped Type, C280/352 Style				Cap 352			
Order Code	Cap 016	µF	±	Order Code	Cap 352	µF	±	Order Code	Cap 034	µF	±
1.0	16	26	40	352	360	47	83	1.0	10	16	26
1.5	8	10	15	001	1	1	7	1.5	7	10	15
2.2	9	10	15	0015	7	15	8	2.2	9	11	15
4.7	9	10	15	0022	6	7	11	4.7	9	11	15
8.2	8	10	15	0033	6	7	11	8.2	9	11	15
10	8	10	15	0047	6	7	14	10	8	10	15
15	8	10	15	0066	6	7	17	15	8	10	15
22	8	10	15	01	6	8	21	22	8	10	15
23	8	10	15	015	6	8	30	23	8	10	15
47	8	11	13	022	6	8	35	47	8	10	15
68	9	13	18	033	6	8	35	68	9	11	15
100	9	13	18	047	6	8	35	100	9	11	15
150	9	10	31	068	7	8	35	150	9	11	15
220	13	26	36								
330	—	32	47								
470	—	33	47								
560	21	30	39								
1000	26	30	59								
1500	35	39	—								
2200	42	—	—								

RESISTORS				D.I.L. Sockets				P.C.B. Components			
Carbon Film, Fixed				8 Pin Low Profile Socket Tin				Diode Pan, Blue Ink, Slow Drying			
0.25W, E24 Values, 10R-10M, 5% Tol. 2 each Res RD%				14 Pin Low Profile Socket Tin							
0.5W, E12 Values, 10R-4M7, 10% Tol. 3 each Res RD%				16 Pin Low Profile Socket Tin							
Metal Film, Fixed											
0.5W, E24 Values, SR1-M, 2% Tol. 8 each Res MR30											
2.5W, E12 Values, 10R-27K, 5% Tol. 16 each Res PR52											
Metal Glaze, Fixed											
0.5W, E24 Values, 1M-33M, 5% Tol. 16 each Res VR37											

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0.12V, 0.12V				L180 W110 D60 223 Case BIM2006 OR			
0.15V, 0.15V							
0.20V, 0.20V							
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0.12V, 0.12V				ABS Base, C/W Brass Bushes, In Grey			
0.15V, 0.15V				Trim Aluminium Top Panels, Finish as Oiled			
0.20V, 0.20V							
Diodes							
L85 W56 D29 112 Case BIM4003 OR							
L111 W71 D42 150 Case BIM4004 OR							
L161 W96 D53 208 Case BIM4005 OR							

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2.5" x 1" 1" pitch Veroboard 85/Pack 200-21076C				SPDT C/OH			
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Verovox Combs (26) 109/Pack 200-21339F							
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The Watkins Factor method of development is little known and at present almost unused — is this due to the lack of a proper timer?



Development Timer

IN 1893, a photographer called Alfred Watkins noticed that the time taken for an image to appear during the development of a photographic plate was a fixed fraction of the total development time.

The Watkins Factor

The phenomenon that Watkins noticed was that the total development time was a fixed number (called the Watkins Factor) times the period taken for the plate to be seen to darken initially. Now, whereas development time varies with temperature, concentration and 'age' of the developer, the Watkins Factor does not. If you develop a film for a *fixed* period, you *must* keep these three factors constant. If, however, you develop it using the Watkins Factor you can (within reasonable limits) *forget* the age, concentration and temperature.

This is all very well, but you would have to be able to see the film as it develops. This is not feasible with modern high-speed panchromatic film, which has to be developed in complete darkness. For this reason the Watkins Factor has been all but forgotten, hardly rating a mention in modern textbooks.

Theory

In the process of developing a print, developer slowly diffuses into the paper, reacting as soon as it reaches the photosensitized areas. The reaction is *diffusion controlled*. The reason why nothing appears for the first few seconds of development (called the 'induction period') is that the developer is still working its way into the paper.

With film you can't watch it develop, with paper you can so the Watkins method of development timing should be extremely useful to the amateur who can't afford a constant-temperature bath for his developer.

The Timer

It works like this: you set the appropriate Watkins Factor (which is specific to a particular developer and paper) on the front panel control. When you put the paper into the developer, you push the switch to 'START'. As soon as the first image starts to appear, you flick it back to 'TIME'. At the end of the development period the buzzer will sound. Then pull the paper out of the dish, wash it and fix it... voila! beautiful prints.

It may take a bit of experiment to find the correct Watkins Factor. Once you have it, though, you need not bother too much about developer temperature and (within limits) its age and concentration.

Construction

Construction should begin with the PCB. Make sure all of the capacitors, diodes, transistors and ICs are inserted the right way round. RV2 and RV3 are 'upright' preset pots bent over to fit flat against the PCB.

Mount C4 directly onto the back of the front panel using conventional double sided adhesive pads. The buzzer mounts on the end of the case. Note that the red lead goes to the '+' buzzer connection on the board.

Make sure that you use the correct tags of RV1. Refer to the wiring diagram. It is a log characteristic pot.

A linear one will not have the same calibration scale.

Setting Up

After finishing the unit, disconnect the 'TIME' and 'START' wires from SW2. Solder them together and put the most sensitive current meter you have between this joint and 0V (most medium-priced multimeters will do). Disconnect the wire which goes to the middle contact of SW2 and connect it to the + end of C4. Set RV1 to '2'. Switch on and adjust RV2 for a zero meter reading.

Current Resistance

What you have just done is to ensure that when the resistance of RV1 is at the '2' value, the current through Q1 is the same as that through Q2 (see 'How It Works'). This is to correct for differences between the two FETs which seldom have the same characteristic.

Now adjust RV3. Turn it fully clockwise and then slowly rotate it until the buzzer sounds (if it doesn't — there's something wrong). After this happens, turn it back about one-eighth turn. The timer is now fully set up.

Sound Thinking

Re-connect the unit as shown in the diagrams. Switch on and set SW2 to 'TIME'. Short out C1 temporarily to remove the charge put on it during the setting-up. With RV1 set to 2, switch SW2 to 'START' for five seconds and then push it back to 'TIME'. Five seconds later, the buzzer should sound. This device will make an interesting addition to any darkroom.

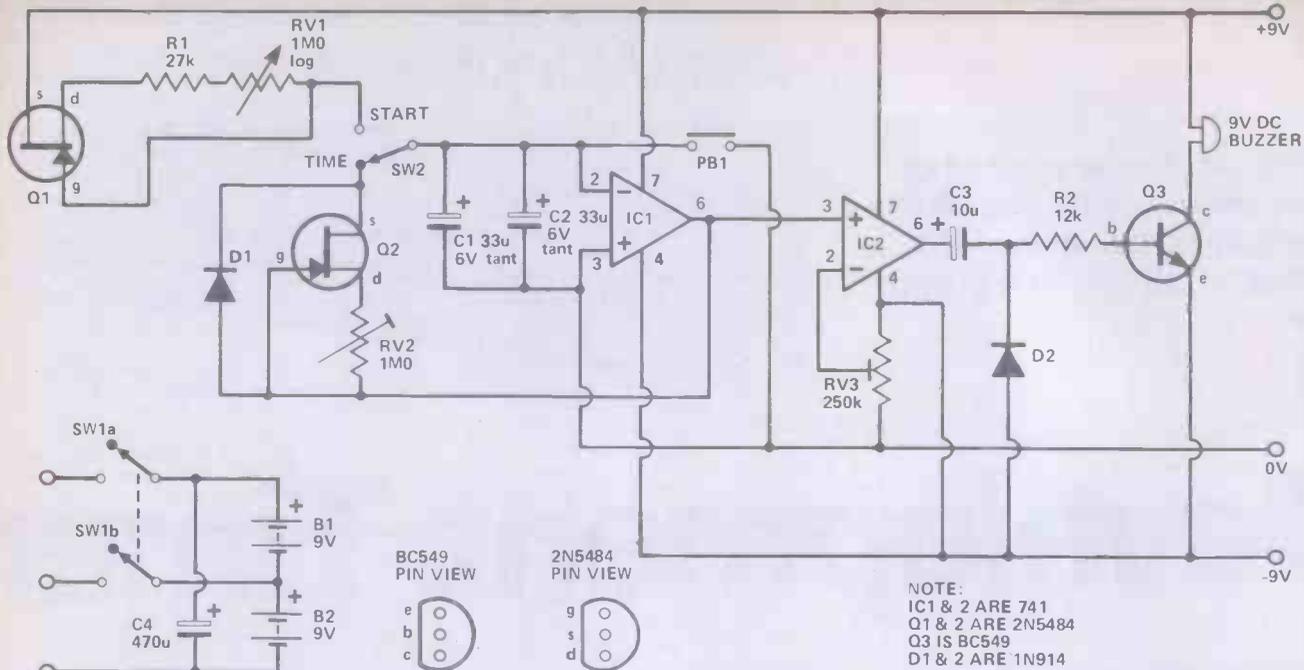


Figure 1. The circuit diagram of the Development Timer.

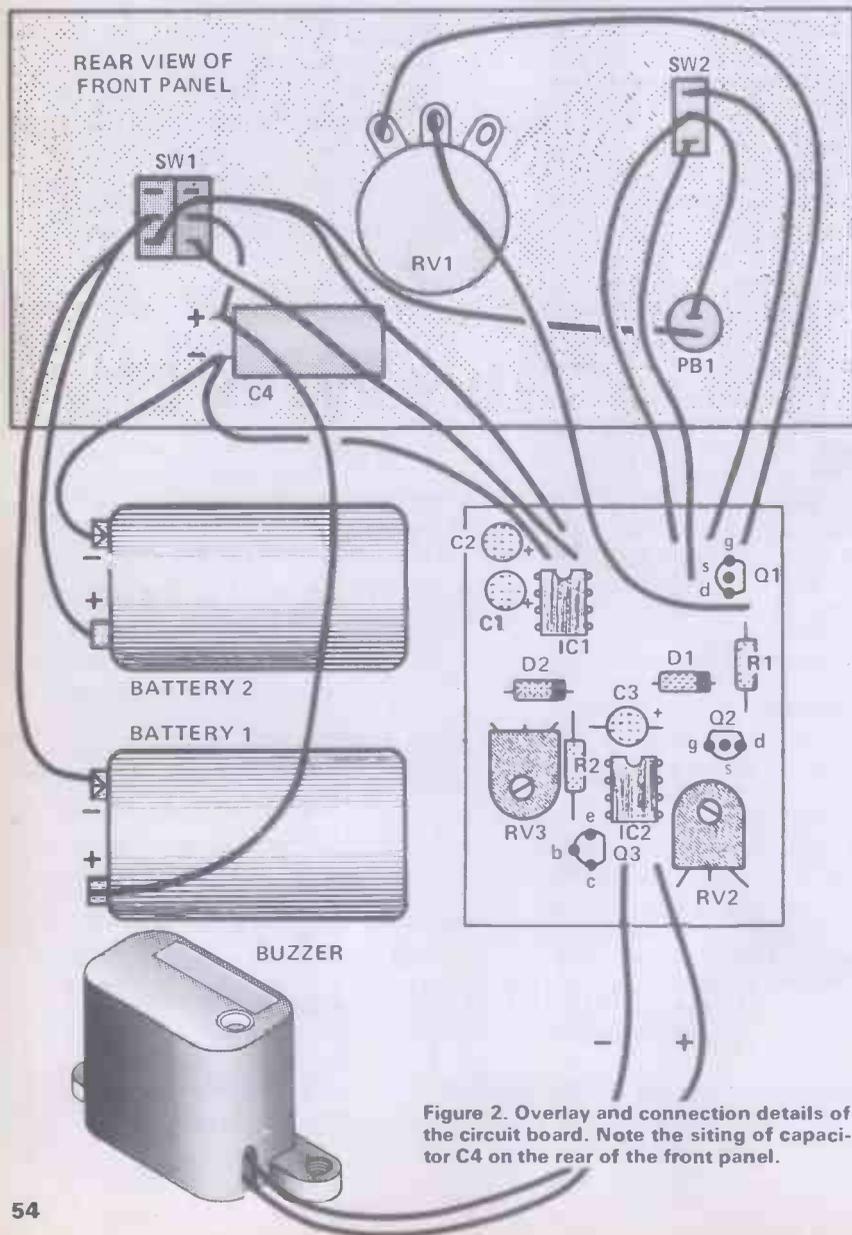


Figure 2. Overlay and connection details of the circuit board. Note the siting of capacitor C4 on the rear of the front panel.

Parts List

RESISTORS (All 1/4 W, 5%)
 R1 27k
 R2 12k

POTENTIOMETERS
 RV1 1M0 log
 RV2 1M0 miniature vertical preset
 RV3 220k miniature vertical preset

CAPACITORS
 C1, 2 33u 10 V tantalum
 C3 10u 25 V electrolytic
 C4 470u 25 V electrolytic

SEMICONDUCTORS
 IC1, 2 741 Op-Amp
 Q1, 2 2N5484 FET
 Q3 BC109 N-P-N transistor
 D1, 2 1N4148 Diode

MISCELLANEOUS
 SW1 miniature double-pole, double-throw toggle
 SW2 miniature single-pole, double-throw toggle

9 VDC buzzer, case to suit, knob with pointer, batteries and clips.

Buylines

You should be able to obtain all parts locally with no trouble and the components (excluding case and PCB) should come to no more than about £6.

How it Works

The Watkins Factor is the ratio of two time periods. A timing circuit having one variable period, which you set, and one fixed period is arranged to indicate when the correct ratio of time periods has been reached.

This is achieved by charging and then discharging a capacitor. The time taken to charge the capacitor is varied while the discharge time is fixed. The control used to vary the charging time is calibrated in terms of the Watkins Factor.

When a capacitor is charged at a constant current, the voltage across it will rise linearly with time — or 'ramp' upwards. Similarly, when it is discharged at a constant current, the voltage across it will 'ramp' downwards. This technique allows good accuracy to be obtained in timing applications.

In this circuit, the current at which the timing capacitance is charged is varied by means of a potentiometer control.

Q1 is connected as a 'constant current' source; that is, it will only allow a constant current to pass, the amount being determined by R1 and RV1. The potentiometer RV1 sets the Watkins Factor.

When SW2 is set to START, C1/C2 will charge via Q1/R1/RV1, the voltage across it ramping upwards at a linear rate. The lower the resistance of RV1, the higher the charging current causing C1/C2 to charge at a faster rate. The converse is also true.

Q2 is connected as a 'constant current' sink — when SW2 is set to TIME, C1/C2 will discharge via Q2/RV2, these components 'sinking' the current. The discharge current will be constant and the voltage across C1/C2 will ramp down at a linear rate.

A Watkins Factor of '2' requires equal charge/discharge times for C1/C2. So that the currents through Q1 and Q2 will be equal when RV1 is set for a Watkins Factor of 2, RV2 (a trimpot) is provided to set the current through Q2. This is used to calibrate the timer.

When the timer is switched on initially, with SW2 in the TIME position, any positive voltage on C1/C2 will cause the output of IC1 to go negative, drawing current through Q2/RV2, discharging the capacitors. Any negative voltage that may appear on C1/C2 will cause the output of IC1 to go positive. This will forward-bias D1 and 'pull up' the voltage across the capacitors. The combined action of these processes ensures that the voltage across C1/C2 stabilises at zero volts.

When the timing period is commenced at the start of developing a print, SW2 is set to START. As C1/C2 charge, the output of IC1 will go negative. When the image first appears on the paper, SW2 is set to TIME. C1/C2 will then discharge, as previously explained, and the voltage across the capacitors will go to zero. At this time, the buzzer will sound.

IC2 is arranged as a 'trigger'. When C1/C2 first begin to charge, the output of IC1 goes negative. When this negative voltage passes the value of the negative voltage applied to the inverting input of IC2, set by RV3, the output of IC2 will go very rapidly to about -7V. At the end of the timing period, the output of IC1 goes to zero volts. As this drives the non-inverting input of IC2, the output will swing rapidly from about -7V to +7V.

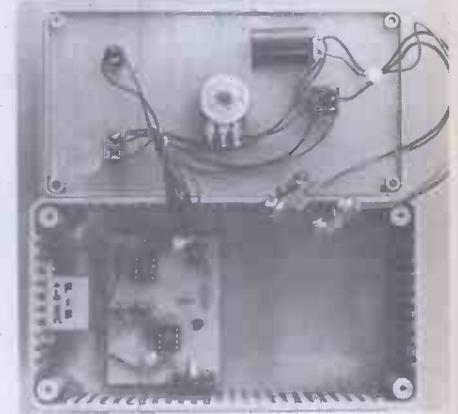
This will force a pulse of current through C3/R2, forward-biasing the base of Q3. When Q3 turns on the buzzer will sound.

C3 will take about one second to charge, Q3 will not receive sufficient base current and the buzzer will cease its cacophony. It sounds not unlike the wheeze from expiring bagpipes!

D2 discharges C3 when the output of IC2 goes low when next you turn SW2 to START.

A pushbutton, PB1, allows you to abort a timing sequence by shorting C1/C2.

Note that the buzzer will sound whenever the unit is turned on. IC2 will trigger as the output of IC1 will initially be zero and the output of IC2 will thus jump to about +7V, setting off the buzzer.



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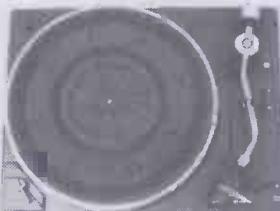
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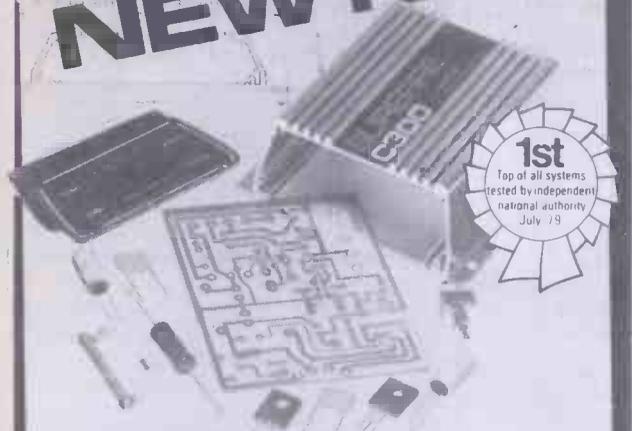
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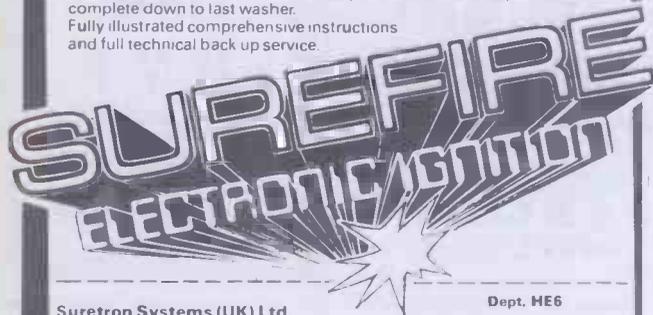
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Building Site

Back again with more constructional problems, this month Keith Brindley tackles the serious aspect of handling CMOS (but maybe it's not quite as serious as you think).

RATHER THAN TALKING about all of the seven projects featured in HE this month, I am going to pinpoint just two. This gives me a chance to muse in depth about the slightly unusual aspects of these projects and still have room later to discuss some more salient problems — those encountered with CMOS integrated circuits and the necessary handling precautions involved in their use.

But first things first, and back to the projects. The most noteworthy is undoubtedly the HE Phase 1 phaser. It's rugged, easy to build and outperforms many commercial units, costing several times as much! The area I want to cover concerns the phaser's construction. By way of an experiment we have used a new system of colour-coded interconnection wires to ease what could well be a difficult task. Of course, it's not a unique method of construction, used for some time in the electrical and electronics industry but it *is* new to HE and probably most of our readers. So, if you think it works and *is* helpful during construction of a project why not let us know — you may see it become commonplace in the months ahead.

The Reaction Timer merits consideration due to its slightly unusual 4-digit, 7-segment LED display. Usually projects employ four, separate 7-segment, single-digit displays mounted individually on the PCB. However, the convenience of the 4-digit module made it an easy choice and it has the added bonus that if you shop around you may find it cheaper than the equivalent separate devices.

Mounting the module is easy — just line it up on the PCB with the connection holes of the board and solder in the wire links. The module is double-sided, ie it has track on both sides, with plated through holes so one soldered joint on the top of the module will automatically join to all the necessary connections underneath.

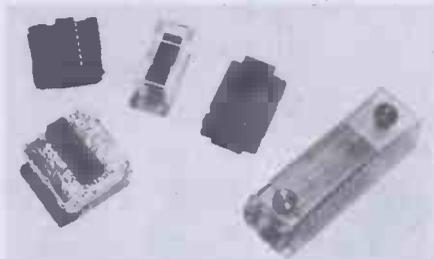


Photo 1. A collection of packaging methods for CMOS.



Photo 2. Bending IC pins manually to fit a holder.

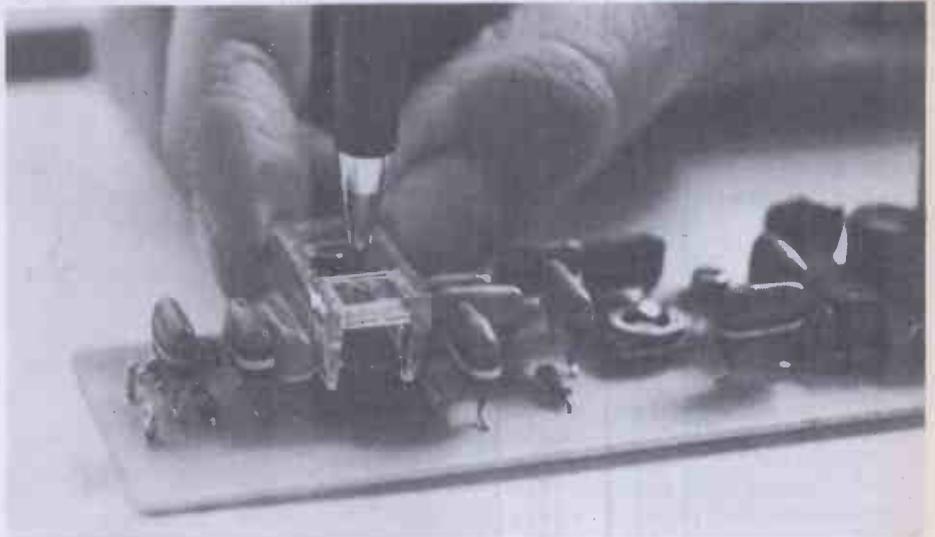


Photo 3. Using a plastic packaging holder as a hybrid insertion tool.

CMOS — With Care!

It occurred to me this month that we use CMOS integrated circuits in many of our designs, usually without too much explanation concerning the precautions which should be taken when handling them. Occasionally, somewhere underneath the Construction heading some rather blasé phrases crop up such as "be careful

— CMOS are easily damaged by static" or "take care not to touch any of the pins" but overall we tend to neglect some of the important points.

Of course, that is not to say that they need any earth-shattering handling precautions. I *have* read elsewhere that unless you work on an earthed metal tray, using an earthed soldering iron and with an earthed wrist strap, you stand a good chance of exterminating your precious chips. Oh yes, I almost forgot, you mustn't wear nylon underwear (unless earthed) or any other such apparel! If you go in for these fanatical precautions then fair enough, but I think you are probably being slightly over-cautious if you do.

The reason for CMOS susceptibility to damage by static is inherent in their internal circuits. Input protection diodes within the device prevent

damage except when the voltage across them exceeds about 4 kV. Static voltages of over 10 kV can be quite common on the human body so in this respect, it's understandable that damage *can* happen although to be fair, it's worth mentioning that I have never "killed" a chip in this manner myself (incorrect insertion, standing on them, accidentally bending the pins outwards whilst

trying to get them in their circuit — yes!).

So how do you go about handling CMOS? Well — the answer is really just to take things easy and not to overhandle the animal. They normally arrive inserted into conductive foam, or ordinary polystyrene foam wrapped with aluminium foil, or alternatively in a plastic holder of some description or another. Photo 1 shows these main methods of packaging CMOS. Incidentally, if an integrated circuit which you know to be of the CMOS family, reaches you in an unprotected manner, there's a good chance that it will not function correctly upon insertion into circuit. Your first course of action is to complain vociferously to the supplier.

The conductive foam and aluminium foil methods of packaging are usually the most convenient for amateur and hobbyist use — the foam or the foil short the pins together and to their surroundings, thereby preventing any pin of the IC having a different voltage from another pin — hence the chip can't be damaged. By holding the foam in your hand before removing the IC, all parts are automatically at the same potential.

The next step is to earth the circuit board — laying your hand flat on the work surface should do that, also hold the PCB for a few seconds. Remember that the whole procedure is simply an attempt to maintain all parts at the same potential — nominally earth.

Insertion

Most ICs come with their pins slightly splayed — this means that to insert them into their holders (and holders are normally advised) they need to be bent somewhat closer together. Theoretically, of course, (with all potentials equal) you should be able to bend the pins to your heart's content to get them into circuit but it is probably worth while still taking one or two precautions. Hold the chip by the ends between thumb and forefinger (see photo 2) and lay it edgewise onto your work surface — do this singlehanded, holding your other hand flat on the surface. Then carefully bend the body of the IC so that it is perpendicular to the surface after which turn it over and do the other side. You should find that the IC will now fit neatly into its holder. Well done — OK, you can breathe again now!

The type of IC packaging which uses a small plastic holder for each chip, seen in photo 1, can be used to



Photo 4. An IC insertion tool.

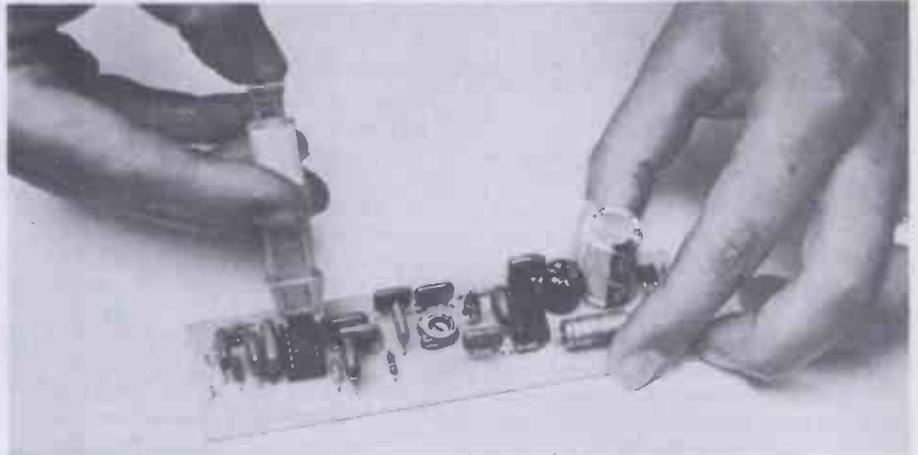


Photo 5 showing the insertion tool in use.

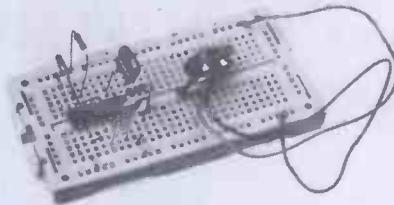


Photo 6. Our tested CMOS IC still functioning healthily.

advantage in overcoming this last difficulty by using it as a hybrid insertion tool. These holders automatically keep the pins of the IC at exactly the right angle which ensures a simple insertion into their PCB holder as in photo 3. Life just couldn't be easier!

Next, we come to one of the best methods for insertion of ICs be they of the CMOS variety or any other type of standard DIL (Dual In Line) integrated circuits — the IC insertion tool. Photo 4 shows such a tool and photo 5 shows it being used to insert an IC into circuit — the chip is inside the tool and by pushing down the centre rod the chip is "syringed" out of the tool into its holder. The particular tool in the

photograph is manufactured by Vero and retails at around £2.00 not an extortionate price to pay considering its advantages in inserting all kinds of ICs — not just CMOS. A larger size for 24 pin ICs is also available.

I suppose there are many people who would query the use of CMOS in the first place — can't some less volatile components be used in their place? Well, the answer to this is yes and no! Yes, because there *are* alternative devices and, no because of CMOS versatility and power requirements. No other ICs have the same capabilities as the CMOS range coupled with the wide voltage supply

(about 3-15 V) and low current requirements which they offer (not to mention low cost), meaning that the majority of circuits can be battery operated. So, you see, CMOS are a necessary evil and they will be around for a while yet.

Finally, if any of our readers are still hesitant regarding the use of CMOS just consider this: to prove the point that CMOS ICs are not quite as fragile as people tend to think, a team of intrepid explorers from the HE office ventured forth into worlds anew to destruction test a 4001 — quad nand gate. The IC was built into a breadboarded test circuit to check that all was OK. It was then removed and all, literally all, was tried to damage the device by static discharge from human beings (if you can call the HE staff human beings!) After half an hour of rigorous walking up and down on nylon carpets, touching the pins, discharging through the device to earth etc etc, the IC was inserted back into circuit and lo and behold it still worked perfectly — a happy ending — so we all had a cup of tea and went back to sleep.

See you next month.

HE

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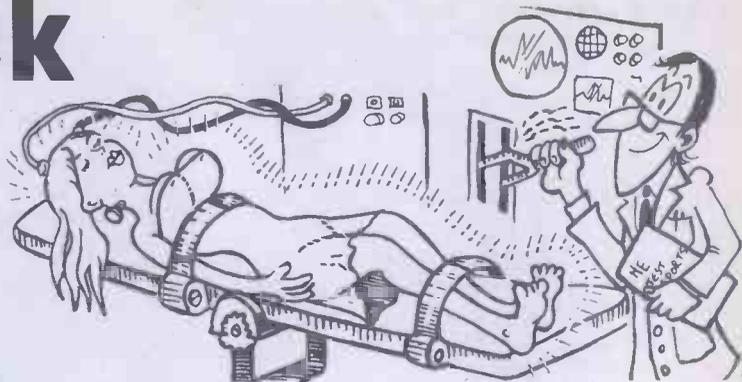
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BLOCK LETTERS PLEASE

Clever Dick

Who on earth needs an electronic Wolf Whistle? Who is Clever Dick? We've some nose and lecherous letters this month as you'll see!



LECHERY! From the depraved depths of Aldershot Derek Conchie has this smutty suggestion for our Project Team. Can we oblige?

Dear CD,

Firstly I must congratulate HE for producing such a brilliant mag. As a newcomer to electronics your publication shone out among the rows of magazines with your great covers. Well done HE!

Now some questions; How about an electronic "Wolf Whistle" project for us female-admiring motorists? I've only seen crude mechanical whistles, mostly rubbish. Secondly, I'm crazy about Space Invaders games, know anyone with a circuit diagram for such a project. What about you CD, anything in the pipeline?

Keep up the great, humorous HE mag, ideal for us newcomers with just a little knowledge.

Derek Conchie
Aldershot

A free Binder to that man. Now about this unhealthy obsession for whistling at members of the opposite sex, what a great idea! It's down on our projects list now, hopefully it'll be coming out in the coming months.

Your question about the Space Invaders brings us to the rather tricky problem of "Dedicated" TV games, machines that play just one game. Two or three years ago we would have been justified in designing such a circuit, providing of course someone had done all the donkey work by producing a "chip" like the old AY-3-8500 "ball and paddle game". These days dedicated chips are almost non-existent, the market has moved over to the programmable

game with a vengeance. It would be almost impossible to design such a game without going the microprocessor route, indeed, the Space Invader programme for the PET computer is as good as any we've seen and it even has the "Tromp Tromp" sound effects. However, all is not lost, Atari have an Invaders cartridge for their excellent system. NIC Ltd sell a handheld version of Space Invaders for around £25 and if you are lucky (?) enough to own a PET the software will cost you £5. Don't despair though, you never know!

Back in the late 'sixties, before the IC was unleashed onto the amateur market, there was a spate of unusual semiconductor devices coming out of American research labs. Most of them disappeared without trace but one in particular, a device known as the "Esaki" or "Tunnel Diode" crops up every once in a while. Michael Morris has a problem with Tunnel Diodes or rather, a lack of Tunnel Diodes.

Dear Dick,

I would be most grateful if you could tell me of a company that stock Tunnel Diodes. It seems that they are unobtainable in this country, although they feature regularly in American publications.

Michael Morris
Letchworth

Tunnel Diodes, for the uninitiated, are basically the same as conventional semiconductor diodes except that during manufacture a large amount of impurity is added to the silicon. This has the effect of producing a high speed charge movement and a

negative-resistance region above a minimum level of applied voltage. (If you understood all that then please explain it to us sometime). Anyhow, the upshot of all this trickery is that the Tunnel Diode can be used to make a very simple oscillator or amplifier with the addition of just one or two components. It has the added advantage of being able to operate at extremely high frequencies, well into the Gigahertz region. Now to answer your question Michael, Tunnel Diodes are available in this country, a morning spent phoning around semiconductor manufacturers turned up this address: International General Electric Co of New York, Park Lorne, 111 Park Road, London NW8 7JL.

Unlike most hobbies electronics is a pretty solitary pastime, so it was with interest we read this letter from George Edwards.

Dear Dick,

I would be grateful if you could enlighten me on the following: I have not seen any mention in HE of the activities of electronics clubs. Having left school nearly 60 years ago I'm lacking somewhat in the maths and calculations department, but understand the practical and constructional side of electronics. So, I would like to join, help or form any club where discussions and exchanges of ideas, etc, are fostered, any information would be greatly appreciated.

My last question concerns two ICs that I'm having difficulty in identifying. They are both 8 pin and bear the numbers QPHB 849 and PJUZ 267N, any ideas?

George Edwards
Abercynon
(Mid Glamorgan)

Your first question is relatively easy to answer, there are very few clubs about, the only national organisation we know of is the British Amateur Electronics Club (BAEC) they can be found at "Dickens", 26 Forrest Road, Penarth, South Glamorgan, which, judging by the address, must be pretty close to you. Incidentally, the man you need is Cyril Bogod. He should be able to put you in touch with someone nearby. We will be only too happy to give a mention to any other electronics clubs if they would like to write to us at our usual address.

The IC mystery isn't so easy to solve, none of our reference books could shed any light on these devices, can anyone help?

Please try to keep your letters as short and to the point as possible and remember we can't make personal replies unless it's a matter of life or death. Letters in this category should be clearly marked "Matter of life or death" and enclose an SAE.

What a nosey person William Leung is, why? Well read on and find out.

Dear Car Ignition, (See HE April '80)

I would like to congratulate everyone at Hilarious Electronics for making us open our eyes and laugh at the jokes you lot produce.

Since I am writing this letter to you, who are you? I know you are Clever Dick but who is the person that sits at his (or her) desk reading our letters and calls her (or him) self CD? Could it be the Editor?, the Managing Director?, OR a ghost from the deep blue yonder?!

Anyway, how about giving your project team a day off so they may sleep and dream up a project like some kind of audio signal Encoder/Decoder. In other easy to understand words, a gadget to encode audio signals from a microphone to a tape recorder to prevent the odd spy listening to our cassettes, since he or she will probably not have a decoder to decode the encoded audio signal!

One last word, HE seems to lack speed in arriving at our newsagent at the Towncentre, I feel like a Hebot walking in and out each day waiting for HE. Another last word, does HE's Managing Director have any relations

working at a school in Harlow?

William Leung
Harlow

PS It's LEUNG, not as some Electronics Suppliers & people put it!!

Since you ask I'm none of these people, you'll have to keep guessing.

Not sure exactly what you mean by the Audio Signal encoder/decoder. If, you've got problems with spies then I may suggest you read our feature on Electronic Espionage in the July issue.

Sorry about the problems in getting hold of HE, we do have a procedure for this kind of thing, let us know the name and address of your local stockist and we'll make sure he has a regular supply in future.

Lastly, a word from our Managing Director, he assures me (between beatings) that he has absolutely no relations working in any schools anywhere near Harlow, a couple in Wormwood Scrubbs perhaps —
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... Argggggg ... see you ...
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4017	80p	4048	60p	4518	90p
4018	90p	4049	50p	4520	110p
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7410	18p	7476	40p	74150	120p
7413	35p	7483	90p	74154	110p
7414	56p	7485	80p	74157	80p
7420	16p	7486	35p	74164	120p
7427	30p	7490	45p	74165	120p
7430	30p	7492	55p	74174	100p
7432	35p	7493	45p	74175	95p
		7494	70p	74190	100p
		7495	70p	74191	100p
		7496	70p	74192	100p
		74121	45p	74196	100p

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Bench PSU



Designed with the beginner in mind, this mains bench power supply unit combines high performance and quality and yet is simple to build.

TEST AND EXPERIMENTAL equipment remains perhaps one of the most popular project areas in electronic hobbyist magazines. Rightly so, of course — the home constructor would find it difficult to build and test his projects without test gear — and the most fundamental piece of equipment (bar a test meter) is arguably a power supply. The beginner naturally uses dry cells as a power supply for his first few projects, but eventually there comes a time when his requirements are for a voltage which is impossible to obtain with batteries (eg 20 V) or a higher current than batteries can supply (e.g. 1 amp).

Bear in mind that a good power supply unit is worth its weight in gold, consider this, you would only have to purchase 20 x 9 V cells at today's prices and the power supply would be paid for!

And so the scene is set! Enter from the wings to rapturous applause the HE PSU, a mains operated mains power supply with six switched output voltages (although you can adapt to a fully variable 1V5 to 20V supply if you wish). One simple, three terminal integrated circuit, (the LM317K) does all the hard work and it features a maximum output current of 1.5 amps, more than adequate for 99% of projects. The IC is called a voltage regulator and this particular variety has been around for three or four years now, that must say something for its quality and reliability in these days of rapidly changing technology. The alternative is a voltage regulator, using relatively expensive discrete transistors. However, of necessity these discrete component voltage regulators are complicated if they are to be as efficient as their IC counterparts. Because of this, there are more things to go wrong (as we all know,

the well-known 'Murphy's Law' states what can go wrong — will!)

Given that all connections are correct, the HE PSU is virtually indestructible. Even a direct short circuit on the output will do no damage an internal current limiter keeps things in order. In this way, of course, there is less likelihood of a circuit under test being damaged if, say, it has a short circuit due to a solder bridge between tracks. A simple dry cell battery would continue to pass current at its highest rate until removed, by which time damage may have been done. The LM 317K continually monitors its own output current and if it is too high it "folds back" ie it switches the O/P current off. When the short circuit is removed or repaired the regulator automatically switches the current back on.

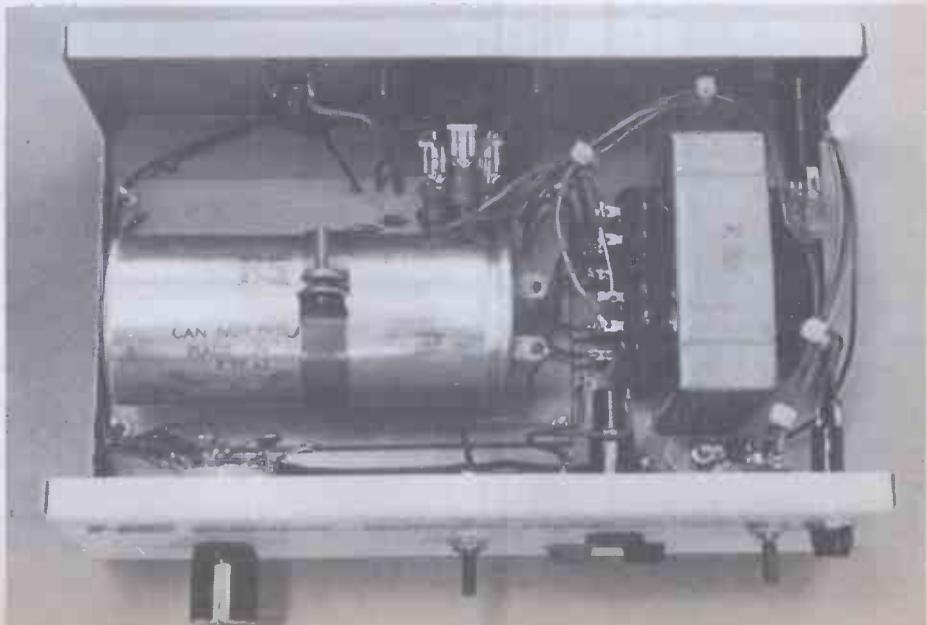
Construction

Care must be taken with the mains part of the circuitry ie everything up to and including the mains transformer T1 (the left hand side of the circuit diagram of figure 1. To aid clarity and safety we are giving two connection diagrams, one for the

mains side of the supply and one for the relatively safe low voltage side. These are figures 3 and 4 respectively.

The first constructional step is the marking and drilling of the case. Ideally, a mild steel case should be used, in order to reduce electrical interference with other equipment which may be positioned close to the power supply. Mount the transformer on the base, leaving enough room for the PCB, bearing in mind the size of the capacitor C1. Bolt the fuse holders, mains on/off and DC on/off switches, mains neon (with integral resistor), output sockets and IC1 to the case, leaving only the six-way rotary switch and the PCB out.

Insert a grommet in the cable hole, push through the mains cable so that enough cable is inside the case to complete all of the mains side wiring (figure 3). We have shown all wires to be loose in the figure but when wiring up your supply, form all wires around the edge and keep them together using cable grips, lacing cord or ordinary string — whatever you have at hand. Fasten the cable as it comes through the case wall using a bolt-on cable clip or



Once the mains voltage side has been wired in, the PCB can be completed. Mount C1 on the board using a capacitor clip and solder the tags to the board making sure it is polarized correctly ie the tag close to the red dot or positive marking on the capacitor goes to the positive connection on the PCB. Then SW2 (the rotary switch and resistors) can be mounted. Note how the resistors are mounted on SW2 and make sure you get them in the correct order. You won't do any damage if they are in the wrong order but the output voltages will not be correct.

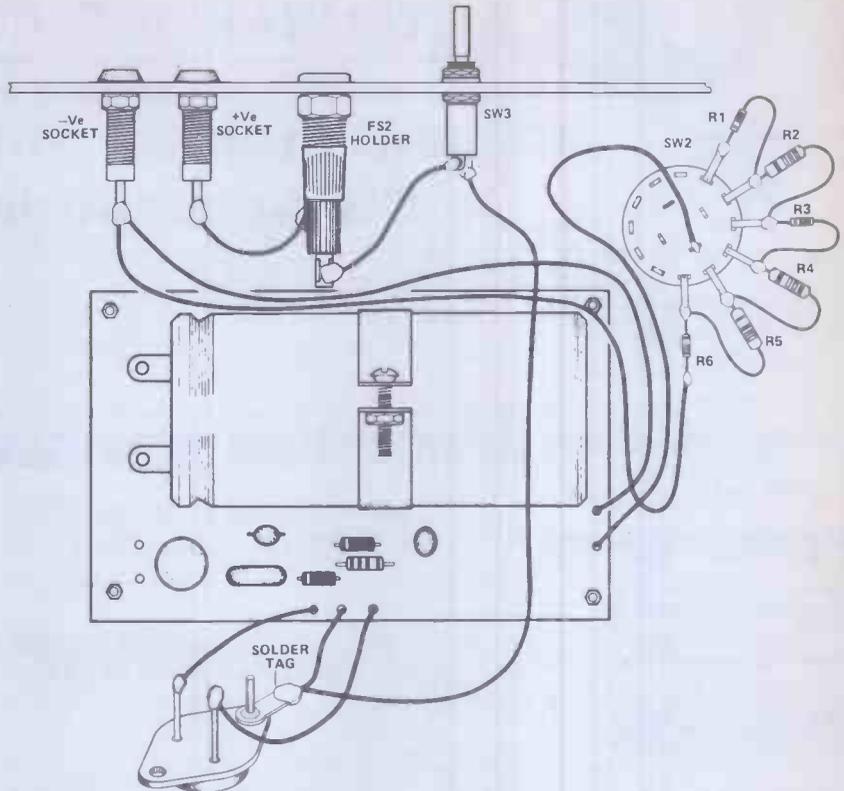
Next, wire up the PCB, the two switches and the output sockets as in the connection diagram, again taking all leads neatly around the outside of the case and tying them together. Finally, wire in IC1 to the PCB.

At this stage, the PSU is complete and should work first time. Measure the DC output using a meter and check that all the settings are correct. If you possess a 25 V or a 30 V panel meter, an alternative suggestion is to insert a 4K7 linear potentiometer in the front panel instead of the SW2-resistor combination, with the meter across the output and use it to give a reading of the now fully variable output voltage.

HE

Figure 3 (above) shows connection details of the mains circuitry. Care is needed as mains voltage can be dangerous.

Figure 4. The low voltage side of the Bench PSU project.



Buylines

A rough approximation of the cost of components for this project comes to around £15. This does not, of course, include the case or the PCB.

IC1 should be obtainable from the main National Semiconductor distributor (Marshall's) or the usual mail order companies.

C1 may be a problem. If you experience difficulty then it is possible to use a lower value capacitor eg 2200uF or 4700uF but the working voltage of 40 V must be maintained.

Parts List

RESISTORS (All 1/4W, 5%)

R1	820R
R2,4,5	510R
R3	560R
R6	330R
R7	220R

CAPACITORS

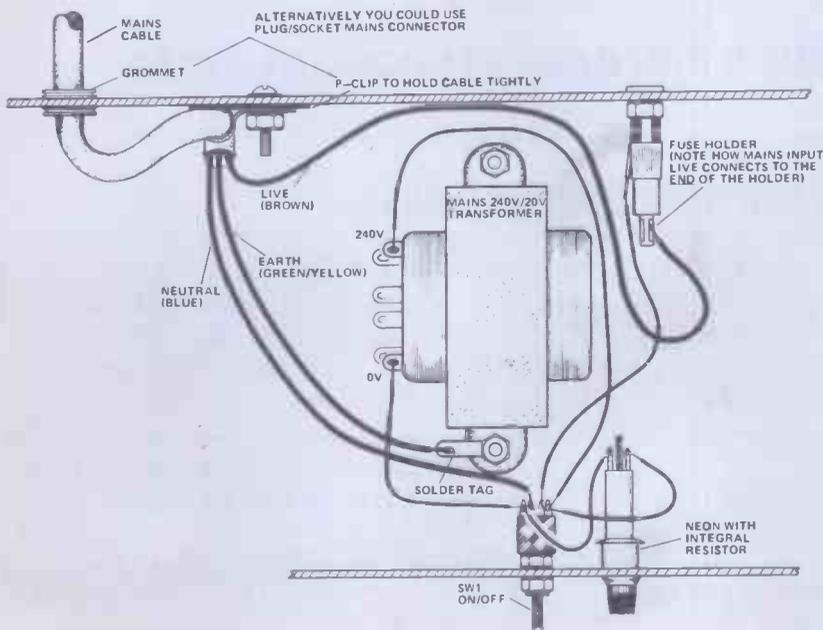
C1	10,000u 40 V electrolytic, single ended
C2	100n polyester
C3	10u 35 V tantalum

SEMICONDUCTORS

IC1	LM317K voltage regulator
BR1	1A, 50 V bridge rectifier
D1,2	1N4002 diode

MISCELLANEOUS

SW1	Double-pole, double-throw toggle switch
SW2	6-way rotary switch
SW3	Single-pole, double throw toggle switch
FS1,2	Panel mounting fuse-holders and 1 Amp quick-blow fuses.
Neon	Panel-mounting with integral resistor
T1	20 V, 20 VA mains transformer
Grommet, cable clip, knob, 2 x 4mm O/P sockets, case to suit, mounting clip for C1.	



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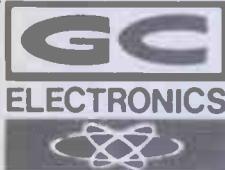
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Rick Maybury reports from the Trafalgar Square Rally plus a run-down of the suggested frequencies for Open Channel.

THE STORY SO FAR: The UBA and several other 'user groups' are still pushing for legalisation on 27MHz, 'they're pretty determined as we saw at the Trafalgar Square rally, but more of that later.

NATCOLCIBAR (National Committee for the Legalisation of CB Radio), comprising CBA, GLC, (Greater London Council) (Citizens Band Association), manufacturers and CB Clubs up and down the country are pushing for 41 to 49 MHz, (405 line TV frequencies).

Meanwhile Her Majesty's Government, in the shape of the Home Office are almost certainly going for 900 MHz, a strange choice, best summed up by Richard Town of NATCOLCIBAR who said at the last meeting of the technical sub-committee:

"900 MHz acts like light and you can't see round corners".

Trafalgar Square

So there you have it, two campaigns and one government standpoint, all this came to a dramatic head at the Trafalgar Square rally on July the 6th.

The rally was organised by NATCOLCIBAR as the finalé to a six month campaign of demonstrations, petitions and meetings up and down the country. In retrospect this campaign has done more to highlight the absurdities of British law and bring the campaign to the attention of the public than any previous campaign.

The rally was designed to bring these achievements to the attention of the media and the government, and to thank the hard-working campaigners who have done so much. Approximately 5,000 people also thought it was worth turning up. Proceedings got underway around noon, the programme was laid down well in advance. We heard from Ivan Francis of REACT, (see last month's BOF). MPs Austin Mitchell, John Butcher and Patrick Wall gave a rousing speech apiece, liberally punctuated with: "Whadda ya want" and returned equally en-

thusiastically from the throng with a loud "CB".

All went fairly well until members of the UBA (United Breakers Association) were denied access (rightly or wrongly we'll never know) to the microphone. From then on events took a nasty turn for the worse. Things got completely out of hand and physical violence was threatened to members of the platform (MPs included) on at least two occasions.



Trafalgar Square — full to capacity.

Lucky!!

One thing became abundantly clear at that meeting; whether you want CB on 27 MHz, VHF or UHF all you will get is two tin cans and a piece of string if the various groups can't get together and thrash out a common policy. Threatening violence and forming multitudes of splinter groups is counter-productive. Everyone should consider themselves extremely lucky the media were

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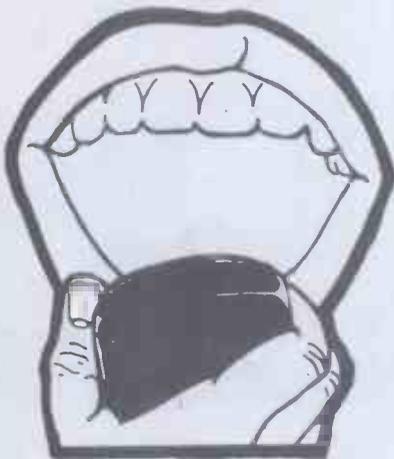


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Austin Mitchell, John Butcher, Patrick Wall, Richard Town, Theo Yard and Hobby Electronics!

kind enough to ignore the in-fighting, it could have put back the campaign five years.

The Choices

For those of you still confused by the various suggestions here is a run-down of the proposed frequencies with some notes on advantages and disadvantages.

27 MHz This is the traditional CB frequency currently used by over 20 countries worldwide.

Advantages: Equipment cheaply and freely available, range good, technology well established.

Disadvantages: Massive interference problems both locally-Radio Control, (Soon to be allocated another frequency on 35 MHz) Radio Paging, TV etc Long distance 'Skip' from overseas. Quality is generally poor but acceptable.

41-49 MHz

A VHF system, used in the states for low power walkie-talkie equipment and some radio modelling.

Advantages: Equipment cheaply and freely available, range good, (within certain limits of power output), technology well established, quality can be excellent.

Disadvantages: Only one really, these frequencies are at present the 'property' of 405 line TV transmissions by the BBC and IBA. Note — TVs for 405 lines haven't been made for around 15 years.

230 MHz The original 'New frequency' proposed by the CBA some years ago.

Advantages: Virtually interference free, a good opportunity for British manufacturers as no mass production facilities exist for equipment on these frequencies.

Disadvantages: A non-starter really, the band is the province of the MOD (Ministry of Defence), who, although they probably don't use it, are nonetheless reluctant to hand it over.

900 MHz The most likely frequency to be legalised for 'Open Channel'.

Advantages: Interference free, another opportunity for British Industry, possibility of other EEC countries adopting this frequency.

Disadvantages: Reliable studies show range could be under a half mile in urban environments (power output is not significant at these frequencies as it follows the inverse square law). RF absorption by concrete and foilage is high. Some evidence to suggest that cataracts in the eye can be aggravated by high frequency RF though we would not consider this a major drawback until these studies are confirmed. No equipment available in any quantity.

Your Opinion?

Coming down to case histories it's clear that there are only two viable frequencies, namely 27 MHz and 41-49 MHz. We estimate there are something like 150,000 illegal CB rigs in the country, problems do exist with radio modellers but they are soon to be allocated another frequency. TVI can be cured very easily at the manufacturing stage, adding pence to the cost of TVs and rigs. Radio pagers can be upset, although 27 MHz pagers are somewhat old fashioned these days, very few new systems are being installed operating on these frequencies. On the whole the illegal CB network exists without any real inconvenience to the general public and can be said to be successful within its limitations.

41-49 MHz is our favourite. Equipment exists, it has been used in the States for some time now, the problems, such as they are, are well known and have been largely dealt with. In this country something like half a million 405 line TVs are being served by powerful transmitters on this frequency. The old 405 line transmitters were switched off in Ireland some time ago, complaints were few and no-one really missed it. One authority now suggests that the cost of running and maintaining these transmitters is greater than the cost of replacing all the sets that still operate on this frequency that would seem to be a logical answer.

We would like to see CB, Open Channel, call it what you will on or around 41-49 MHz, actually we would only need around one megahertz, what do you think?

Club Corner

No shortage of clubs this month but first a couple of points regarding our previous lists.

We've managed to get the name of the chairman of the CBRAG wrong on a couple of occasions, despite frantic letters from the gentleman concerned. So sorry to Bill Gittings who is most definitely the chairman and promise we won't do it again. Lastly we're sorry to hear that Keith Townsend has resigned from the MCBRC, all correspondence should now be addressed to the new chairman whose address appears below.

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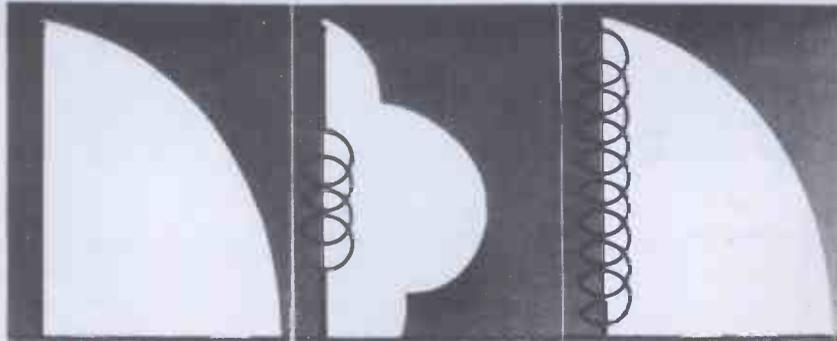
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The telephone number for the Northern Ireland CB Information Centre is 0232 58291, sorry to Margaret McCulloch for the confusion.

National Directory

We promised to bring you details of the National Directory this month; unfortunately production pro-

blems look like holding it up for a couple of weeks. (Have you any idea how much work is involved in sorting 15,000 names alphabetically?) The publication date is still mid September so no worries on that score. Cover price has also been decided but we're sure we'll know by next month — watch this space.

The Trafalgar Square Rally promoted a lot of comment, much of it unprintable, we think the best and most

CB VIP

BERNIE MURRAY



Firstly, a few points about myself. I am 40 years old. Among my hobbies are photography, rifle shooting, tape-sponding, radio controlled model making, and of course, campaigning for the legislation of Citizens Band Radio.

I was first introduced to CB in West Germany 10 years ago whilst on a camping holiday. We found the little walkie-talkies very useful for keeping contact if one of us strayed too far from base. Whilst in Germany, I helped form two CB clubs and one in Luxembourg. Of course, CB proved invaluable in driving across Europe (sometimes my navigation isn't too good). I have actually assisted in the saving of three lives thanks to CB. Two French people trapped in an overturned car, and a lorry driver in Germany stranded in the snow having gone off the road.

In 1976, myself and a few similarly minded people decided to form a campaign, hence UKCBC. We cam-

paign for the legislation of CB on any frequency and any power but do not condone the use of illegal equipment. A lot of hard work and dedication has gone into the campaign, and we have at last had a statement from Mr. Whitelaw saying that the Government agrees in principle to CB radio. We have asked our members to send letters to Mr. Whitelaw to show just how much public support there is throughout the British Isles, and hopefully you, the readers of Hobby Electronics, will assist us and do your bit even if you do not belong to any CB clubs or campaigns.

We here at UKCBC have to date produced 10,000 letters which have been sent out to our members for signature and forwarding to Mr. Whitelaw. We have collected over 5,000 signatures for the GLC petition which was duly handed in, and about 30,000 signatures on a nationwide petition, with the help of other CB clubs. These are yet to be handed in, and we hope to do this after the publication of the Green Paper.

Before closing I would like to publicly thank the following people:- Mr. Patrick Wall, MP, and all the members of his Parliamentary Committee, Mr. Theo Yard, Chairman of the National Steering Committee, Richard Town, John Sanderson of UKCBC Yorkshire, and his helpers, Les Carroll of CB North East, Steve Bishop from UKCBC Doncaster, Chuck & Trixie of UKCBC North Wales, Ray Withers and Paul Thompson from Birmingham, Bill Gittins, Chairman of CBRAF without whose help the Lewisham CB Road Show would not have got off the ground, and the loyal and dedicated few, including very patient wives, who have helped in the running of UKCBC and without whose help we couldn't keep going.

Final thanks go to Hobby Electronics for allowing me space in their excellent publication.

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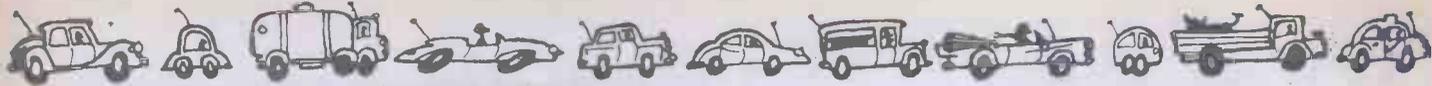
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Austin Mitchell MP addresses the crowd.

constructive criticism came from Theo Yard, chairman of NATCOLCIBAR. Here are his views.

Sir,
The policy of the National Committee is to press for the legalisation of CB in this country. The Government will decide frequency, and although the Committee has an opinion on this matter, our philosophy has consistently been that any CB is better than no CB at all.

We are well aware that CB could be legalised immediately on the FCC 27MHz system, and would provide a service. Indeed, if that was the only option, I, and the members of my Committee would be delighted. However, that is not the case, and it is worth stating why we do not press for this to be done.

The Government has on three occasions publicly stated that it will not licence 27MHz therefore, it seems stupid to antagonise the very people who will ultimately make the political decision, particularly as we now know that we are pushing at an open door. Secondly, imagine if you will, 40 telephone lines stretched across London, to which upwards of a million people can attach telephones at random. What then would be the chance of any coherent conversation, for that is what the implementation of 27MHz in its present form would mean in

London alone, without extending this simplistic argument to the rest of the country.

There is undoubtedly, a very strong lobby against CB in this country, composed in the main of vested interest and political motivation, which takes comfort in the rift between those who are working for CB and those who are repeatedly putting back the clock by demanding no system unless it be on 27MHz. The arrogant, self-opinionated, and totally negative attitude of these people was forcibly demonstrated in Trafalgar Square by their attempts to break up a successful demonstration and to insult the Members of Parliament present, who have done so much for the British CB movement. If a test were to be made of responsibility before handing over air-waves to these sort of people, there will never be legal CB in Britain.

After the many years of work, let us not wreck the chances of a successful outcome by allowing this handful of egoists to lead us into a blind alley. The choice of frequency is for Government, and Government alone. Our task is to close ranks, and demand the implementation of the "Agreement in Principle" by the 1st January 1981. And yes, if it should be on 27MHz we would welcome it.

Theo Yard Chairman, National Committee for the Legalisation of Citizens' Band Radio

Our last item comes from Bernie Murray, our CBVIP this month. He and Bill Gittings (CBRAG) went over to Frankfurt last month on the invitation from an American and German CB Club (run by the United States Airforce). The event was a CB jamboree, used to raise funds for underprivileged children. Whilst over there the UKCBC and CBRAG were affiliated to the club and they even received a trophy for being the most distant delegates. Part of the fund-raising was a 'Temporary Jail' event, people are put in jail by the organisers. To get out you have to pay a small fine. Apparently both Bernie and Bill went to jail three times each. No comment!

Stay lucky, see you next month.

HE

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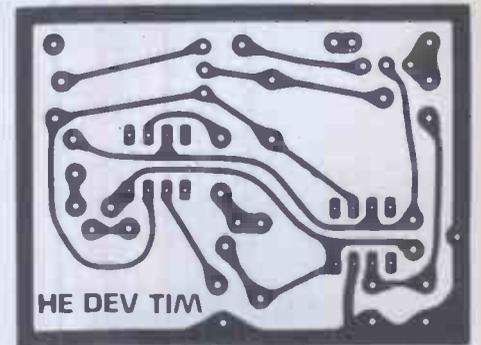
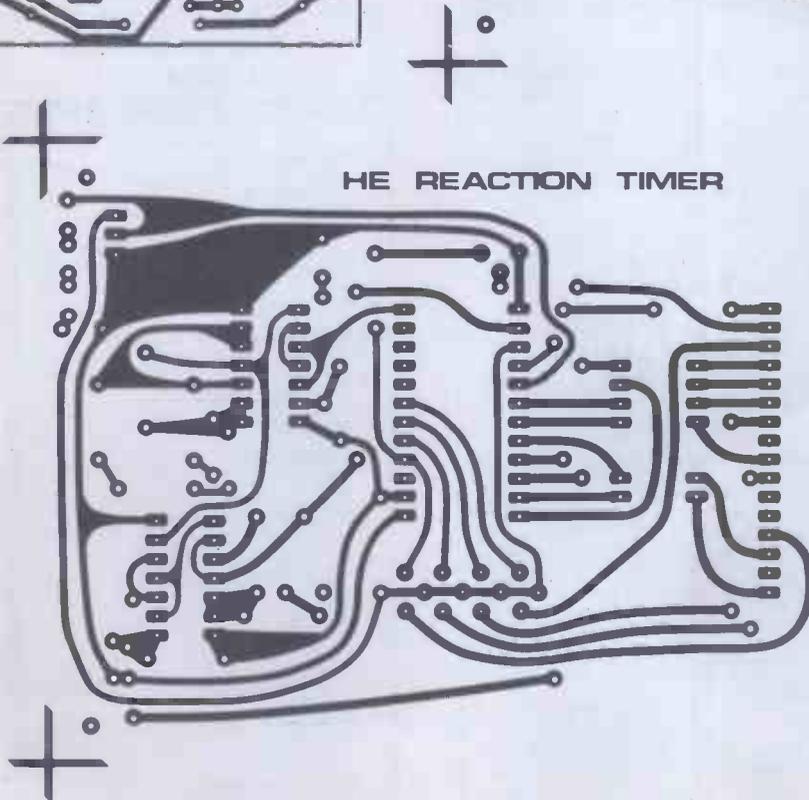
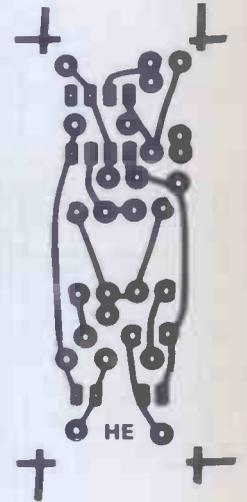
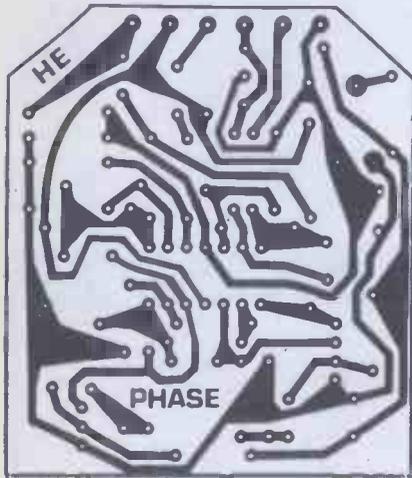
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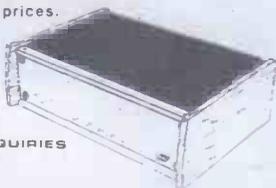
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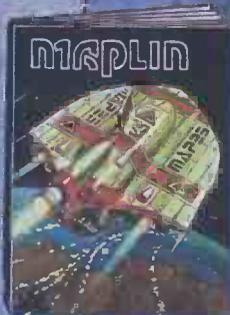


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