

electronics today

INTERNATIONAL FEBRUARY 1983 85p

THE ETI ELECTRONIC ORGAN

Multi-voice rhythm section • Pedal Bass
Full kit less than £300 • Starter kit under £100
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Single-finger chords • Two Keyboards



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• BASIC on the Cortex
• Improving your ZX81

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Star features **

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DJ90 Stereo Mixer — this is a really versatile new mixer that enables the constructor DJ to produce a professional performance every time. There are two stereo inputs for magnetic cartridges, a stereo auxiliary input and mike input. Other 'plus' features are auto-panning for fast or slow slider controls, multi-mixing, ducking, interrupt, input modulation, in short everything the whole works — AND — under £100 complete! Complete kit £97.50 + VAT

TRANSCENDENT 2000 — Although only a 3 octave keyboard the '2000' features the same design ingenuity, careful engineering and quality components of its larger brethren. The kit is well within the scope of the first time builder — buy it, build it — play it! You will know you have made the right choice.

Complete kit £165.00 + VAT



SALES COUNTER Collect your order from the factory. Open 9-12/1-4.30 Mon-Thurs. Easy parking, no waiting



This versatile modular mixer, featured as a constructional article in Practical Electronics can be built up to a maximum of 24 inputs, 4 outputs and an auxiliary channel. Each input channel has Mic and Line inputs, variable gain, bass and treble controls and a parametric middle frequency equalizer. There are send and return jacks, auxiliary, pan and fader controls and output and group switching. The output channels have PPM displays and record and studio outputs. The auxiliary channel also has a PPM display and there is a headphone monitor jack and a built-in talk-back microphone. The mixer modules plug into base units each of which takes up to 6 channels. To eliminate hum, the power supply is in a separate cabinet.

KIT PRICES

Input channel	£19.90	Base unit and wooden front	£27.50
Output channel	£18.50	Pair of mahogany end cheeks	£12.50
Auxiliary channel	£22.50	Power Supply and cabinet	£19.50
Blank Panel	£3.00		

All prices are VAT exclusive

TRANSCENDENT POLYSYNTH — A four octave polyphonic synthesiser with outstanding design characteristics and versatility and performance to match.

Complete kit £275.00 plus VAT (single voice)

Extra voice (up to three more) £42.00 plus VAT

DEMONSTRATION TAPE —

Demonstration tape available of Transcendent synthesisers (30 minutes) £2.00



Free Soldering Practise Kit on request with your first kit — useful tips, well illustrated.

Component packs for most kits are available See our great free catalogue, full details of all our range

Digital Delay Line — With its ability to give delay times from 1.6 mSecs to up to 1.6 secs. Many powerful effects including phasing, flanging, A.D.T., chorus, echo &



vibrato are obtained. The basic kit is extended in 400 mS steps up to 1.6 secs. Simply by adding more parts to the PCB. Compare with units costing over £1,000!

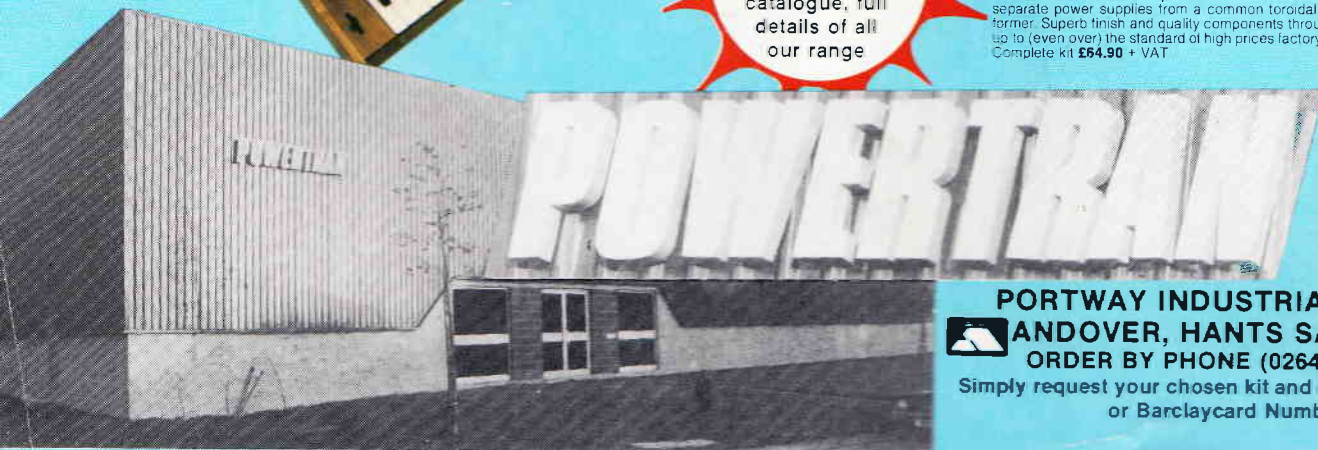
Complete kit (400 mS delay) z9130 + VAT
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MPA 200 — is a low price, high power 100W amplifier, its smart styling, professional appearance and performance, make it one of our most popular designs. With adaptable inputs the mixer accepts a variety of sources yet straightforward construction makes it ideal for

the first time builder. Complete kit £49.90 + VAT
Chromatheaque 5000 — a 5 channel lighting system powerful enough for professional discos yet controllable for home-effects. Sound to light, strobe to music level, random or sequential effects — each channel can handle up to 500W yet minimal wiring is needed with our unique single board design. Complete kit £49.50 + VAT

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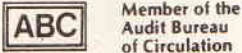
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Dave Bradshaw: Editor
Peter Green: Assistant Editor
Phil Walker: Project Editor
Jerry Fowler: Technical Illustrator
Gary Price: Advertisement Manager
Ron Harris B.Sc: Managing Editor
T.J. Connell: Managing Director

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FEATURES

- DIGEST** 11
 Sony's new video, test gear, games, components, catalogues, lots and lots of shorts and a silly caption.
- DESIGNING MICRO SYSTEMS** ... 26
 For his final trick Owen Bishop pulls a cassette recorder and a disc drive from his hat, and proceeds to explain how they store data and how to choose which is the best for your needs (and your pocket).
- CORTEX BASIC PART 1** 44
 We're glad to say that Corti (Cortices?) are selling well, so here's the first of a series of articles which set out to explain the niceties of Cortex BASIC.
- READER SURVEY** 49
 Now is the time for all good readers to come to the aid of the magazine staff. Fill out our new, improved, expanded, postage-paid survey and let us know what you want out of the magazine.
- INDUCTION LOOPS** 55
 In this article Vivian Capel touches on the seldom-discussed topic of induction loops for the hard-of-hearing. If you want *everyone* to get the most out of your theatre/hall/auditorium, this is the place to start reading.
- TECH TIPS** 66
 Two more pages of novel circuits submitted by our ingenious readership.
- CONFIGURATIONS** 77
 This month Ian Sinclair is searching the heavens for a sine — a sine wave, that is. Here are some of the many circuits that are used to produce sine waves for radio frequency carriers, for example.
- READ/WRITE** 89
 In our two page selection of readers' letters this month, we have a few interesting suggestions and comments.

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- ORGAN** 19
 There are people out there in readerland who, while admiring the circuitry involved in our synthesizers, want to know when we're going to publish a *real* musical instrument. If you're an organ freak, the answer is — right now. It's cheap and it's good.
- STAGE LIGHTING PART 2** 34
 In this month's excursion into the world of greasepaint, tinsel and 120 amp lighting gantries, we look at some improvements to last month's circuits as well as the initial construction procedures.
- OSCILLOSCOPE UPDATE** 41
 This project was an excellent design but has unfortunately been dogged by component supply problems. Here's everything you wanted to buy for the oscilloscope but didn't know where to get it.
- ZX81 TAPE MOD** 61
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- DESIGN COMPETITION** 71
 You certainly made it difficult for us to decide on a winner for our free PCB design competition! We made a choice eventually, but were sufficiently impressed by the other entries to publish a couple of runners up as well as our £100 winner.
- FOUR MINI-MICRO PROJECTS** ... 85
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ELECTROLYTIC CAPACITORS: (Values in uF) 500V: 10uF 52p; 47 75p; 63V: 0.47, 1.0, 1.5, 2.2, 3.3, 4.7 8p; 10 15p; 15, 22, 33, 47, 100, 220, 330, 470 25p; 1000 100p; 2200 200p; 50V: 68 20p; 100 17p; 220 24p; 40V: 6.8 15p; 10 22p; 33 33p; 47 33p; 100 48p; 220 85p; 25V: 1.5, 4.7, 10, 22, 47 8p; 100 11p; 150 12p; 220 15p; 330 22p; 470 25p; 680, 1000 34p; 1500 44p; 2200 55p; 2200 55p; 3300 74p; 4700 82p; 16V: 47, 68, 100 8p; 125 12p; 330 14p; 470 20p; 680 34p; 1000 37p; 1500 31p; 2200 38p; 4700 74p.

TAG-END CAPACITORS: 64V: 2200 133p; 3300 180p; 4700 250p; 63V: 2200 110p; 3300 154p; 40V: 4700 180p; 25V: 2200 80p; 3300 100p; 4700 130p; 10 000 220p; 15 000 340p; 18V: 22 000 380p.

POLYESTER CAPACITORS: Axial Lead Type
 400V: 1nF, 1n5, 2n2, 3n3, 4n7, 6n8 11p; 10n, 15n, 18n, 22n 12p; 33n, 47n, 68n 15p; 150n 20p; 220n 22p; 330n 24p; 470n 27p; 680n 31p; 1000n 34p; 1500n 37p; 2200n 40p; 3300n 43p; 4700n 46p; 10000n 49p; 15000n 52p; 22000n 55p; 33000n 58p; 47000n 61p; 68000n 64p; 100000n 67p; 150000n 70p; 220000n 73p; 330000n 76p; 470000n 79p; 680000n 82p; 1000000n 85p; 1500000n 88p; 2200000n 91p; 3300000n 94p; 4700000n 97p; 6800000n 100p; 10000000n 103p; 15000000n 106p; 22000000n 109p; 33000000n 112p; 47000000n 115p; 68000000n 118p; 100000000n 121p; 150000000n 124p; 220000000n 127p; 330000000n 130p; 470000000n 133p; 680000000n 136p; 1000000000n 139p; 1500000000n 142p; 2200000000n 145p; 3300000000n 148p; 4700000000n 151p; 6800000000n 154p; 10000000000n 157p; 15000000000n 160p; 22000000000n 163p; 33000000000n 166p; 47000000000n 169p; 68000000000n 172p; 100000000000n 175p; 150000000000n 178p; 220000000000n 181p; 330000000000n 184p; 470000000000n 187p; 680000000000n 190p; 1000000000000n 193p; 1500000000000n 196p; 2200000000000n 199p; 3300000000000n 202p; 4700000000000n 205p; 6800000000000n 208p; 10000000000000n 211p; 15000000000000n 214p; 22000000000000n 217p; 33000000000000n 220p; 47000000000000n 223p; 68000000000000n 226p; 100000000000000n 229p; 150000000000000n 232p; 220000000000000n 235p; 330000000000000n 238p; 470000000000000n 241p; 680000000000000n 244p; 1000000000000000n 247p; 1500000000000000n 250p; 2200000000000000n 253p; 3300000000000000n 256p; 4700000000000000n 259p; 6800000000000000n 262p; 10000000000000000n 265p; 15000000000000000n 268p; 22000000000000000n 271p; 33000000000000000n 274p; 47000000000000000n 277p; 68000000000000000n 280p; 100000000000000000n 283p; 150000000000000000n 286p; 220000000000000000n 289p; 330000000000000000n 292p; 470000000000000000n 295p; 680000000000000000n 298p; 1000000000000000000n 301p; 1500000000000000000n 304p; 2200000000000000000n 307p; 3300000000000000000n 310p; 4700000000000000000n 313p; 6800000000000000000n 316p; 10000000000000000000n 319p; 15000000000000000000n 322p; 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15000n 736p; 22000n 739p; 33000n 742p; 47000n 745p; 68000n 748p; 1000n 751p; 1500n 754p; 2200n 757p; 3300n 760p; 4700n 763p; 6800n 766p; 100n 769p; 15000n 772p; 22000n 775p; 33000n 778p; 47000n 781p; 68000n 784p; 1000n 787p; 1500n 790p; 2200n 793p; 3300n 796p; 4700n 799p; 6800n 802p; 100n 805p; 15000n 808p; 22000n 811p; 33000n 814p; 47000n 817p; 68000n 820p; 1000n 823p; 1500n 826p; 2200n 829p; 3300n 832p; 4700n 835p; 6800n 838p; 100n 841p; 15000n 844p; 22000n 847p; 33000n 850p; 47000n 853p; 68000n 856p; 1000n 859p; 1500n 862p; 2200n 865p; 3300n 868p; 4700n 871p; 6800n 874p; 100n 877p; 15000n 880p; 22000n 883p; 33000n 886p; 47000n 889p; 68000n 892p; 1000n 895p; 1500n 898p; 2200n 901p; 3300n 904p; 4700n 907p; 6800n 910p; 100n 913p; 15000n 916p; 22000n 919p; 33000n 922p; 47000n 925p; 68000n 928p; 1000n 931p; 1500n 934p; 2200

SWITCHES
TOGGLE: 2A, 250V SPST 33p DPDT 44p
SPST 33p
DPDT 44p
SPB-MIN TOGGLE
 SPST on/off 54p
 SPDT c/over 60p
 SPDT centre off 85p
 SPDT biased both ways 105p
 DPDT 6 ways 75p
 DPDT centre off 88p
 DPDT biased both ways 145p
 DPDT 3 positions on/on/off 185p
 3-pole/2 way 205p
SLIDE 250V:
 DPDT 1A 14p
 DPDT 1A c/off 13p
 DPDT 1/2A 13p
PUSHBUTTON 6A
 with 10mm Button
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 SPDT latching 95p
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 12 inches 195p 215p 315p 490p
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IDC Header Socket Jumper Leads 24 pin
 20 pin 26 pin 34 pin 40 pin
 Single ended 180p 200p 280p 300p
 Double ended 250p 370p 460p 625p

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 3-0-3V; 8-0-8V; 9-0-9V; 12-0-12V; 15-0-15V
 @ 100mA
 pcb mounting. Miniature, Split Bobbin
 3VA: 2x8V-0.25A; 2x8V-0.15A; 2x12V-0.12A;
 2x15V-0.1A 200p
 5VA: 2x8V-0.5A; 2x9V-0.3A; 2x12V-0.25A;
 2x15V-0.2A 270p
 Standard Split Bobbin type:
 6VA: 2x8V-0.5A; 2x9V-0.4A; 2x12V-0.3A;
 2x15V-0.25A 220p
 12VA: 2x4.5V-1.3A; 2x8V-1A; 2x9V-0.6A;
 2x12V-0.5A; 2x15V-0.4A; 2x20V-0.3A 290p
 24VA: 2x8V-1.5A; 2x9V-1.2A; 2x12V-1A;
 2x15V-0.8A; 2x20V-0.6A 330p (60p p/p)
 36VA: 2x8V-2.5A; 2x9V-2.5A; 2x12V-2A; 2x15V-1.5A;
 2x20V-1.2A; 2x25V-1A; 2x30V-0.8A 465p (60p p/p)
 Specially wound for Multirail Computer PSUs
 20VA: Outputs +5V/5A; +12V; +25V; -5V
 -12V at 1A 575p (60p p/p)
 30VA: 2x12V-4A; 2x15V-3A; 2x20V-2.5A;
 2x25V-2A; 2x30V-1.5A; 2x50V-1A 820p (75p p/p)
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4010	24	4089	125	4556
4011	10	4093	20	4556
4012	18	4094	7A	4558
4013	20	4095	95	4559
4014	46	4096	70	4560
4015	40	4096	75	4561
4016	20	4098	110	4562
4017	32	4099	110	4566
4018	46	4160	95	4568
4019	25	4181	95	4569
4020	42	4182	95	4572
4021	40	4183	95	4580
4022	40	4174	95	4581
4023	13	4175	105	4582
4024	13	4194	105	4583
4025	13	4408	790	4584
4026	80	4409	790	4585
4027	20	4410	725	4589
4028	39	4411	675	4593
4029	45	4412	775	4608
4030	15	4415	480	4609
4031	125	4419	280	4609
4032	80	4422	770	4610
4033	125	4435	860	4610
4034	140	4440	990	4610
4035	45	4450	350	4613
4036	275	4451	350	4614
4037	115	4490	350	4615
4038	110	4500	675	4616
4039	280	4501	28	4617
4040	40	4502	60	4618
4041	40	4503	40	4619
4042	40	4504	75	4620
4043	40	4505	185	4621
4044	40	4506	36	4622
4045	40	4507	36	4623
4046	4508	130	4624	105
4047	4510	46	4625	115
4048	4511	46	4626	115
4049	4512	90	4627	90
4050	4513	199	4628	90
4051	4514	115	4629	78
4052	4515	115	4630	78
4053	4516	85	4631	85
4054	4517	275	4632	185
4055	4518	40	4633	185
4056	4519	30	4634	185
4057	4520	60	4635	245
4058	4521	110	4636	245
4059	4522	125	4637	245
4060	4523	70	4638	245
4061	4524	85	4639	245
4062	4525	150	4640	255
4063	4526	130	4641	260
4064	4527	85	4642	260
4065	4528	70	4643	260
4066	4529	160	4644	260
4067	4530	90	4645	260
4068	4531	130	4646	260
4069	4532	70	4647	260
4070	4533	465	4648	260
4071	4534	465	4649	260
4072	4535	275	4650	260
4073	4536	90	4651	260
4074	4537	90	4652	260
4075	4538	90	4653	260
4076	4539	110	4654	260

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 33/4 x 17" 380p 232p
 13/4 x 17" 470p
 Pkt. of 100 pins 50p
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 + 50p P&P

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 8pin 8p 25p
 14pin 10p 35p
 16pin 10p 42p
 18pin 16p 52p
 20pin 20p 60p
 22pin 22p 65p
 24pin 25p 70p
 28pin 28p 80p
 40pin 30p 88p

EDGE CONNECTORS
 2 x 15 way 115p
 2 x 14 way 180p 145p
 2 x 22 way 185p 200p
 2 x 23 way 175p
 2 x 25 way 225p 220p
 2 x 28 way 190p
 2 x 30 way 245p
 2 x 36 way 255p
 2 x 40 way 315p
 2 x 43 way 395p
 2 x 75 way 550p

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 CCN-15W 495p CX25W 500p
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 Spare Elements 210p
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SIL SOCKET
 0.1" pitch 20 way 75p
 20 way 85p

VOLTAGE REGULATORS
 1A TO220 Plastic Casing
 +ve -ve
 5V 7805 40p 7905 45p
 12V 7812 40p 7908 80p
 15V 7815 40p 7912 45p
 18V 7818 45p 7915 45p
 24V 7824 40p 7918 45p
 TO92 Plastic package
 5V 78L05 30p 79L05 80p
 6V 78L06 30p
 9V 78L09 30p
 12V 78L12 30p 79L12 80p
 15V 78L15 30p 79L15 80p

ALUM BOXES
 3 x 2 x 1" 65p
 4 x 2 x 2" 85p
 4 x 2 x 2 1/2" 105p
 4 x 4 x 2 1/2" 105p
 4 x 4 x 2 1/2" 120p
 5 x 4 x 1 1/2" 95p
 5 x 4 x 2 1/2" 120p
 5 x 2 1/2 x 1 1/2" 90p
 5 x 2 1/2 x 2 1/2" 120p
 6 x 4 x 2 1/2" 120p
 6 x 4 x 3" 150p
 7 x 5 x 3" 180p
 8 x 6 x 3" 210p
 10 x 4 x 3" 240p
 10 x 7 x 3" 275p
 12 x 5 x 2 1/2" 260p
 12 x 8 x 3" 295p

SOLDERCON PINS
 Ideal for making SIL or DIL Sockets
 100 pins 75p
 500 pins 350p

OPTO ELECTRONICS
 LEDs with Clips
 TIL209 Red 10
 TIL211 Grn 14
 TIL212 Yel 14
 TIL220 2" Red 12
 2" Green, Yellow or Amber 80
 0.2" Bi colour Red/Green 65
 Red/Green 78
 Green/Yellow 78
 Red/Yellow 78
 Red/Green/Yellow 85
 Hi-Brightness Red 50
 Fluorescing red 50
 0.2" red 55
 Square LEDs, Red, Green, Yellow 30
 Rectangular Stackable LEDs 30
 Red, Green or Yell 18
 Triangular LEDs 18
 Red 18
 Green or yellow 22
 LD771 Infra Red 46
 SFH205 Detector 118
 TIL32 Infra Red 58
 TIL78 Detector 46
 TIL38 45
 TIL100 60
 SEGMENT GRAPH. Red 10 segments 225
ISOLATORS
 IL74 65
 ILD74 99
 IL074 165
 TIL111/2/4 90
 TIL117 125
 4N33 Photo Darlington 135
7 Segment Displays
 TIL307 875
 TIL312 3" CA 105
 TIL313 3" CC 105
 TIL321 5" CA 115
 TIL322 5" CC 115
 DL704 3" CC 99
 DL707 3" CA 99
 FND357 Red 120
 FND500 115
 3" Green CA 160
 6" Green CA 215
 3" ± 1 Red CA 150
 3" ± 1 Green CA 180
 DVM78 185p
 LCD 31 Digits 485
 LCD 4 Digits 630
 LCD 6 Digits 825

COMPUTER CORNER
 ● MX80FT/3 EPSON PRINTER 10" Friction feed, 9 x 9 matrix 80 column, Speed 80CPS, Bidirectional, Centronics Interface standard, Baud-rate 110-9600 (RS232, Hi-Res, Bit Image graphics, Subscript & Superscript, Italics & Underlining facility plus 500 sheets of paper FREE.
 ● MX100 EPSON PRINTER. 136 Column, 15" carriage, plus all the features of MX80FT/3. Plus FREE 500 sheets of Paper. Only £425 + carr.
 ● SOFTY II. An intelligent Eprom Programmer and Emulator. Accepts a 24 pin 5V Eprom. Has Memory Map TV Display. RS232 and Centronics I/P & O/P. Copies, Emulates and programs. RS 232 and centronics routines standard. PSU included. £169
 ● TEX EPROM ERASER Erases up to 32 ICs in 15-30 minutes. £35
 ● TEX EPROM ERASER with a safety switch. £35
 ● TEX EPROM ERASER plus our Solid State ELECTRONIC TIMER. £44
 ● ELECTRONIC TIMER, Solid state, 15-30 min. Connects directly to above Erasers. Protects your expensive Chips from overcooking. Our timer pays for itself in no time. £15
 ● SPARE UV Lamp bulb. £8
 ● POWER SUPPLY. Regulated with Overload protection. Variable Output. 5V to 15V at 4A. Professionally finished. £38
 ● MULTIRAIL POWER SUPPLY KIT. Especially designed for Micros. Tested output: +5V/5A; +12V; +25V; -12V of 1A £37
 ● Stack-Pac Unique stackable twin drawer racking system for storing cassettes. 5 Drawers (10 sections) including labels and 10 x C12 Computer grade cassettes. £50p
 ● C12 COMPUTER GRADE CASSETTES in library cases. 40p
 ● B3" Fan Fold paper (1000 sheets). £7
 ● 9 1/2" Fan Fold paper (1000 sheets). £7
 ● SEIKOSHA GP100A, 10" Tractor Feed, 80 Colmn. 30CPS, Normal and Double Width Char. Dot Res Graphics. £175 (£7 car)
 ● SEIKOSHA GP250X. 10", 50 CPS, Normal and Double width and height Char. RS232 and Centronics Intf. standard £240 (£7 car)
 ● Printer Cable for our printers and BBC. £12

FLOPPY DISC DRIVES
 ● TEAC FD50A - Uncased, S/S, 40 track, 5 1/4", 100K. £125
 ● TEAC FD50A - Cased, S/S, 40 track, 5 1/4", no PSU. £150
 ● TEAC FD50A - Cased with PSU, S/S, 40T, 5 1/4". £180
 ● TEAC FD50A - Twin Cased, PSU, S/S, 5 1/4", 200K. £350
 ● TEAC FD50E - Twin Cased, PSU, D/S, 80 track, 400K. £475
 ● Drive CABLES for BBC Micro: Single £8; Double £12
 N.B. All above drives are BBC Micro compatible
 ● SIEMENS FDD 100-5 Drive. Cased with PSU. Has track zero micro switch and motor control. PCB with read, write and control electronics. Connecting cable incl. Especially made for APPLE II Micro. £215
 ● Apple II Interface Card for above. £42
 ● APPLE II 80 column Hi-Res Card for above. £135
 ● 10 VERBATIM Diskettes 5 1/4", S.S.D. £20
 ● 10 VERBATIM Diskettes 5 1/4", D.S.D. £30
 ● 10 VERBATIM Diskettes 8", S.S.D. £28
 N.B. Carriage is extra on all disc drives.

NEONS
 Rectangular, nut fixing Red, Amber, Green 30p
 REFLECTIVE Optical Switch type TIL139 170p
 SLOTTED Optical BFX25 185p
 Comp. s. similar to RS 185p

IDC CONNECTORS
 PCB Pkg with lead
 Pins Pin Angle
 Strt 90p 85p 120p
 10 way 90p 85p 120p
 16 way 130p 150p 110p
 20 way 145p 165p 125p
 28 way 175p 200p 150p
 34 way 205p 235p 185p
 40 way 225p 250p 190p
 50 way 255p 275p 200p
 60 way - 230p 495p

EURO CONNECTORS
 Female Socket Strt. Angle
 Pins Pins Pins Pins
 DIN1617 170p - - 175p
 DIN1612 2x32 A+B 25p 35p 220p 25p
 DIN1612 2x32 A+C 300p 340p 240p 300p
 DIN1612 2x32 A+B+C 300p 385p 280p 400p

DIL PLUG (Header)
 Solder IDC
 14pin 40p 80p
 16pin 45p 105p
 24pin 65p 175p
 40pin 250p 255p

RIBBON CABLE
 price per foot
 Grey Color
 10 way 12p 22p
 16 way 18p 32p
 20 way 25p 40p
 24 way 35p 60p
 34 way 45p 80p
 40 way 55p 75p
 50 way 65p 90p
 64 way 85p 110p

ZIF DIL SOCKETS
 24 pin 575p
 28 pin 620
 40 pin 975p

D CONNECTORS: Miniature
 9 way 15way 25way 37way
 Plugs Solder lugs 80p 110p 180p 250p
 Angle Pins 180p 210p 250p 355p
 W/Wrap Pins 120p 130p 195p 295p
 Sockets Solder lugs 110p 160p 210p 350p
 Angled Pins 165p 210p 290p 440p
 W/Wrap Pins 150p 80p 240p 420p
 Covers 85p 95p 110p 110p
 IDC 25 way plug 38p

SPECIAL OFFER
 TEX EPROM ERASER
 Only £29.95

PANEL METERS
 FSD 60 x 45 x 35mm
 0-50mA
 0-100mA
 0-500mA
 0-1mA
 0-5mA
 0-10mA
 0-50mA
 0-100mA
 0-500mA
 0-1A
 0-2A
 0-25V
 0-50V AC
 0-300V AC
 "VU" 45p each

CRYSTALS
 32.768KHz 100
 100KHz 235
 200KHz 280
 455KHz 370
 1MHz 275
 1.008M 275
 1.28MHz 382
 1.6MHz 395
 1.8MHz 395
 1.8432M 250
 2.0MHz 225
 2.4576M 200
 3.2768M 200
 3.5794M 98
 3.8884M 300
 4.0MHz 150
 4.032MHz 200
 4.8MHz 200
 4.94304M 200
 4.433619M 100
 5.0MHz 180
 5.185MHz 200
 5.24288M 390
 6.0MHz 140
 6.144MHz 150
 6.5536MHz 225
 7.0MHz 160
 7.168MHz 250
 7.68MHz 200
 8.0MHz 180
 8.08333M 395
 8.86723M 175
 9.00MHz 160
 10.0MHz 175
 10.24MHz 200
 10.7 150
 12.0MHz 175
 12.528M 300
 14.31814M 170
 16.0MHz 200
 18.0MHz 180
 18.432M 180
 20.0MHz 200
 19.988MHz 160
 24.0MHz 170
 24.580MHz 325
 26.89M 150
 27.648M 170
 27.145M 190
 38.86667M 175
 48.0MHz 170
 100.0MHz 295
 116.0MHz 290

RELAYS
 Miniature, enclosed, PCB mount. Our RLE series
 S.P.C.O
 RL6-31 170i coil, 7V5 to 12V DC
 350V/5A AC, 1300VA/50W 210p
 D.P.C.O.
 43i coil, 4V2-7V DC; 250V AC; 5A;
 1100VA/150W 218p
 RL6-111 170i coil, 8V-14V; 250V AC 5A
 RL6-111 740i coil, 17V5-29V 250V 0-1A 222p

AMPHENOL PLUGS
 IEEE 24 Way 550
 Centronics Parallel 36 Way solder 530
 Centronics Parallel 36 way IDC 495

BUZZERS, miniature, solid-state 6V; 9V & 15V 75p
PIEZOE TRANSDUCERS PB2720 65p

LOUDSPEAKERS
 Miniature, 0.3W; 8Ω 2in, 3in, 2 1/2in, 3in
 2 1/2in 40Ω, 64Ω or 80Ω 80p

Rapid Electronics

MAIL ORDERS:
Unit 1, Hill Farm Industrial Estate,
Boxted, Colchester, Essex CO4 5RD.

TELEPHONE ORDERS:
Colchester (0206) 36412.

ACCESS AND BARCLAYCARD WELCOME

MICRO		75		290		81LS96		CRYSTALS	
2114L-2	2716	205	Z80A P10	260	81LS97	85	100KHz	235	4.43M 100
2532	340	Z80A CTC	260	1488	55	1.8432M	200	7.0M 150	
2732	340	Z80A S10	900	1489	55	2.0M	225	8.0M 140	
4116 P20	70	Z80A DMA	1150	Epson Printers and D		2.4576M	200	10.0M 170	
6116-P3150ns	365	Z80A DART	500	Connectors now available at low low prices.		2.5776M	95	12.0M 170	
4164	40	81LS95	85			4.0M	140	16M 200	

CMOS		4016		20		4034		140		4054		78		4081		12		40193		65		4528		45	
4000	10	4010	20	4020	25	4040	40	4060	40	4080	40	4100	40	4120	40	4140	40	4160	40	4180	40	4200	40	4220	40

LS TTL		LS20		12		LS75		20		LS133		34		LS160		35		LS197		45		LS353		60	
LS00	11	LS26	14	LS83	35	LS132	35	LS163	35	LS241	55	LS367	28	LS422	55	LS368	28	LS524	55	LS373	58	LS503	12	LS32	13

TTL		7413		17		7444		85		7483		30		74122		38		74161		46		74190		40	
7400	11	7417	19	7448	43	7489	180	74126	33	74164	46	74193	40	7401	11	7420	14	7450	14	7490	19	74132	30	74165	46

CAPACITORS

Polyester, radial leads. 250v. C280 type: 0.01, 0.1, 0.022, 0.033, 0.047, 0.068, 0.1, 0.15, 0.22, 0.22, 0.33, 0.47, 0.1, 0.33, 0.68, 20p, 1u - 2u.

Electrolytic, radial or axial leads. 0.47/63V, 1/63V, 2/25V, 4/7.63V, 10/25V, 7p, 22/25V, 47/25V, 8p, 100/25V, 9p, 220/25V, 14p, 470/25V, 22p, 1000/25V, 30p, 2200/25V, 50p.

Tag end power supply electrolytics. 2200/40V, 110p, 4700/40V, 160p, 2200/63V, 140p, 4700/63V, 230p.

Polyester, miniature Siemens PCB. 1n, 2n, 3n, 4n, 7n, 10n, 15n, 22n, 33n, 47n, 68n, 8p, 100n, 9p, 150n, 11p, 220n, 13p, 330n, 20p, 470n, 26p, 680n, 29p, 1u/33p, 2u, 50p.

Tantalum bead. 0.1, 0.22, 0.33, 0.47, 1.0 @ 35V, 12p, 2.2, 4.7, 10 @ 25V, 20p, 15/16V, 30p, 22/16V, 27p, 33/16V, 45p, 47/16V, 27p, 47/16V, 50p, 68/16V, 40p, 100/10V, 90p, Cer. disc. 22p, 0.01u, 50V, 3p each. Mullard miniature ceramic plate: 1.8p to 100pF 6p each.

Polystyrene, 5% tol: 10p, 1000p, 6p, 1500/4700, 3p, 6800/0.12u, 10p.

Trimmers, Mullard 808 series: 2.10 pF, 22n, 2.22pF, 30p, 5.56pF, 35p.

POTENTIOMETERS

Rotary, Carbon track Log or Lin 1K - 2M2, Single 30p, Stereo 85p. Single switched 80p. Slide 60mm travel single Log or Lin 5K - 500K 85p each.

Preset submin. hor. 100 ohms - 1M 7p each.

Cermet precision multi-turn, 0.75W 1/100 ohms to 100K, 88p each.

REGULATORS

78L05	30	79L05	65
78L12	30	79L12	65
78L15	30	79L15	65
7805	35	7905	40
7812	35	7912	40
7815	35	7915	40

SOLDERING IRONS

Antex CS 11W Soldering iron 46p

2.3 and 4.7mm bits to suit 65

CS 11W iron, 450, element: 21p

Antex CS 25W iron 46p

3.2 and 4.7mm bits to suit 65

Solder pump desoldering tool, 48p

Spare nozzle for above 70p

10 metres 22wvg solder 100

PCB MATERIALS

Alfaco transfer sheets, please state type (eg. DIL pads etc.) 45

Dalco clear resist pen 100

Fibre glass board, 3.75"x4.8" 80

Ferric chloride 250ml bottle, 100

COMPONENT KITS

An ideal opportunity for the beginner or the experienced constructor to obtain a wide range of components at greatly reduced prices. 1W 5% Resistor kit. Contains 10 of each value from 4.7 ohms to 1M (total of 650 resistors) 480

Ceramic Cap. kit, 5 of each value - 22p to 0.01u (135 caps) 370

Polystyrene Cap. kit, 5 of each value from 0.01 to 1uF (65 caps) 575

Preset kit, Contains 5 of each value from 100 ohms to 1M (total 65 presets) 425

Nut and Bolt kit (total 300 items): 180p

25 6BA 1/8" bolts 50 6BA washers 50 6BA nuts

25 6BA 1/4" bolts 25 4BA 1/4" bolts 50 6BA washers 50 6BA nuts

TOOLS

Small trimming tool 22

Small pocket screwdriver 16

Large pocket screwdriver 13

6 piece precision screwdriver set in plastic case 170

Low cost side cutters 160

High quality side cutters 630

Low cost pliers 160

High quality pliers 650

Wire strippers 120

Explo. reliant drill 695

Expo Titan drill 1025

Drill stand 1200

Reduced Shank drill bits for above 0.8mm, 1mm, 1.4mm 60

OPTO

3mm red 7 5mm red 7

3mm green 10 5mm green 10

3mm yellow 10 5mm yellow 10

Clips to suit - 3p each

Rectangular

red 12 TL132 40

green 17 TL111 60

yellow 17 ORP12 85

TL138 40 TL110 90

2N5777 45 Dual colour 60

Seven segment displays

Com. cathode Com. anode

DL704 0.3" 95 DL707 0.3" 95

FND500 FND507 100

0.5" 100 0.5" 100

TL1313 0.3" 115 TL1312 0.3" 115

TL13220 5" 115 TL1321 0.5" 115

LCD - 3 1/2 digit, 580p, 4 digit 620p.

TRIACS

400V 8A	65
400V 16A	95
400V 4A	50
BR100	25

SWITCHES

Submin toggle

SPST 55p SPST 60p DPDT 65p

Miniature toggle

SPDT 80p SPDT centre off 90p

DPDT 90p DPDT centre off 100p

Standard toggle

SPST 35p DPDT 45p

Miniature DPDT slide 12p

Push to make 12p

Push to break 22p

Rotary type adjustable stop

PF12W, 2P6W, 3P4W all 55p each.

DIL switches

4SPST 80p 6 SPST 80p 8SPST 100p

VERO

Single sided 350

VEROBLOC 4

Size 0.1 matrix

2.5 x 1 22

2.5 x 3 75

2.5 x 5 85

3.75 x 5 95

VPO board 150

Veropins per 100

Single sided 60

Double sided 60

Spot face cutter 105

Pin insertion tool 162

Wiring pen and scribe 310

Spare spool 75p Combs 6

DIODES

BY127	12	1N4001	3
OA44	10	1N4002	5
OA90	6	1N4006	7
OA91	7	1N4007	7
OA200	8	1N5401	12
OA202	8	1N5404	16
1N914	4	1N5406	17
1N1418	2	400mW Zen	6

CABLES

20 metre pack, single cores connecting cable ten different colours, 80p

Speaker cable	100m
Standard screened	150m
Twin screened	240m
2.5A 3 core mains	230m
10 way rainbow ribbon	650m
20 way rainbow ribbon	1200m

TRANSFORMERS

Please add carriage charges to our normal post charges.

Miniature mains

606V, 909V, 12012V all @ 100mA 100p each.

PCB mounting, Miniature

3VA 0-6, 0-6 @ 0.25A, 0.9, 0.9 @ 0.15A, 0-12, 0-12 @ 0.12A 200p each.

6VA 0-6, 0-6 @ 0.5A, 0.9, 0.9 @ 0.3A, 0-12, 0-12 @ 0.25A 270p each.

High quality, Solid bobbin construction

6VA 0-6, 0-6 @ 0.5A, 0.9, 0.9 @ 0.4A, 0-12, 0-12 @ 0.3A 220p each.

12VA 0-6, 0-6 @ 1A, 0.9, 0.9 @ 0.8A, 0-12, 0-12 @ 0.5A, 0-15, 0-15 @ 0.4A 295p (plus 40p carriage)

25VA 0-6, 0-6 @ 1.5A, 0.9, 0.9 @ 1.2A, 0-12, 0-12 @ 1A, 0-15, 0-15 @ 0.8A 330p each (plus 60p carriage)

50VA 0-12, 0-12 @ 2A, 0-15, 0-15 @ 1.5A 440p each (plus 75p carriage)

HARDWARE

PP3 battery clips 6

Red or black crocodile clips 15

Black pointer control knob 15

Pr. Ultrasonic transducers 350

6V Electronic buzzer 60

12V Electronic buzzer 65

PB2720 Piezo transducer 75

64mm 8 ohm speaker 70

64mm 8 ohm speaker 70

20mm panel fuseholder 25

CONNECTORS

DIN Plug Skt Jack Plug Skt	
2 pin 11p 9p 2.5mm 10p 10p	
3 pin 12p 10p 3.5mm 9p 9p	
5 pin 13p 11p Standard 16p 20p	
Phono 10p 12p Stereo 24p 25p	
1mm 12p 13p 4mm 18p 17p	
UHFF (CB) Connectors	
PL259 Plug 40p Reducer 14p	
SO239 square chassis skt 38p	
SO239S round chassis skt 40p	
IEC 3 pin 250V/6A	
Plug chassis mounting	38p
Socket free hanging	60p
Socket with 2m lead	120p

BOXES

Aluminium	
Plastic with lid - screws	3x2x1" 70
	4x3x1" 85
	5x3x1" 100
	6x4x2" 120
	7x4x2" 160

MULTIMETERS

HT-120 4,000 opv

A smart looking 11 range pocket sized multi-meter with an impressive spec. Complete with battery, etc. 650p each.

HT-320 20,000 opv

Highly sensitive 19 range multi-meter including transfer tester, Overload protection, DC volts 1000, AC volts - 1000, DC current 0.25A, 4 resistance ranges. Complete with batteries, leads, etc. 1395p

SCRs

400V 8A	70
400V 12A	95

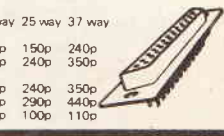
BRIDGE RECTIFIERS

2A 200V	40
2A 400V	45
5A 100V	80
5A 400V 95	
1A 50V	20
2V 1M1 DIL 0.9A	
1A 400V	35
VM28	50

MIN. D CONNECTORS

9 way 15 way 25 way 37 way

Plugs	
Socket lugs	75p 110p 150p 240p
Right angle pcb mount	75p 200p 240p 350p
Sockets	
Socket lugs	105p 200p 240p 350p
Right angle pcb mount	100p 210p 290p 440p
Covers	160p 90p 100p 110p



RESISTORS

1/4W 5% Carbon film E12 series 4.7 ohm - 1M, 1p each.

1/4W 5% Carbon film E24 series 4.7 ohm to 4M7, 2p each.

1/4W 1% metal film E24 series 10 ohm - 1M, 6p each.

SOCKETS

Low profile	Wire-wrap
8 pin	6p
14 pin	25p
16 pin	35p
18 pin	42p
20 pin	52p
22 pin	60p
24 pin	70p
26 pin	80p
28 pin	90p
40 pin	25p
50 pin	38p

Soldercom pins 60P/100P

The Rapid Guarantee

★ Same day despatch ★ Competitive prices
★ Top quality components ★ In-depth stocks

LINEAR

555CM05	90	ICL7106	790	LM339	45	LM3911	120	NE566	140	TLO64	95
555CM05	150	ICL7111	95	LM346	60	LM3914	175	NE567	100	TLO71	30
789	25	ICL7221	180	LM358	50	LM3915	195	NE570	370	TLO72	50
741	14	ICL7222	180	LM377	170	LM3960	105	NE571	370	TLO74	95
748	35	ICL8038	295	LM384	130	LM922	400	RC4136	55	TLO81	25
940C03	350	ICL821A	200	LM386	65	ML924	195	RC4558	100	TLO82	45
AY-31270	720	ICM724	785	LM387	120	ML925	210	SL480	170	TLO84	95
AY-31891	170	ICM7555	800	LM393	100	ML926	140	SL480	250	TLO85	45
AY-31912	540	LF351	45	LM709	25	ML927	140	SN76477	380	UA2240	120
CA3046	60	LF351	85	LM711	50	ML928	140	SN76477	380	UA2203	85
CA3080	65	LF356	90	LM725	350	ML929	140	SP829	250	UA2204	90
CA3089	190	LM10	360	LM733	75	MM5874A	465	TBA1205	70	XR2206	290
CA3100	375	LM301A	25	LM741	14	NE529	225	TBA800	75	ZN14	100
CA3106	95	LM311	70	LM747	60	NE531	150	TBA810	96	ZN423	135
CA3140E	36	LM318	120	LM747	60	NE544	205	TBA820	70	ZN424	135
CA3161	100	LM324	40	LM791	50	NE544	205	TBA850	220	ZN425	350
CA3189	290	LM334Z	100	LM8201	200	NE555	15	TDA1008	320	ZN426	650
CA3240E	110	LM335Z	125	LM8201	200	NE555	15	TDA1024	125	ZN427	650
				LM8202	45	NE555	45	TDA1024	125	ZN428	480
				LM8203	70	NE555	45	TDA1024	125	ZN429	285
				LM8204	110	NE555	110	TDA1024	125	ZN430	200

TRANSISTORS

BC107	40	BC177	18	BC178	18	BC179	18	BC183	10	BC184	7	BC185	7	BC186	7	BC187	7	BC188	7	BC189	7	BC190	7	BC191	7	BC192	7	BC193	7	BC194	7	BC195	7	BC196	7	BC197	7	BC198	7	BC199	7	BC200	7	BC201	7	BC202	7	BC203	7	BC204	7	BC205	7	BC206	7	BC207	7	BC208	7	BC209	7	BC210	7	BC211	7	BC212	7	BC213	7	
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**NEXT
MONTH**

electronics today

INTERNATIONAL

HIGH DEFINITION TV

Back in the November 82 issue, Vivian Capel reported on the state of play with regard to satellite TV. Since then, wheels have been turning, wires have been humming, hands have been wrung and metaphors have been mixed, until finally the momentous decision has been made. Satellite transmissions are to be made using the MAC system (Multiple Analogue Components) rather than the extended PAL system. So next month we've got Vivian Capel to revisit the topic and explain what these systems are, what the proponents (the IBA and the BBC) claim for them, and why MAC was chosen.

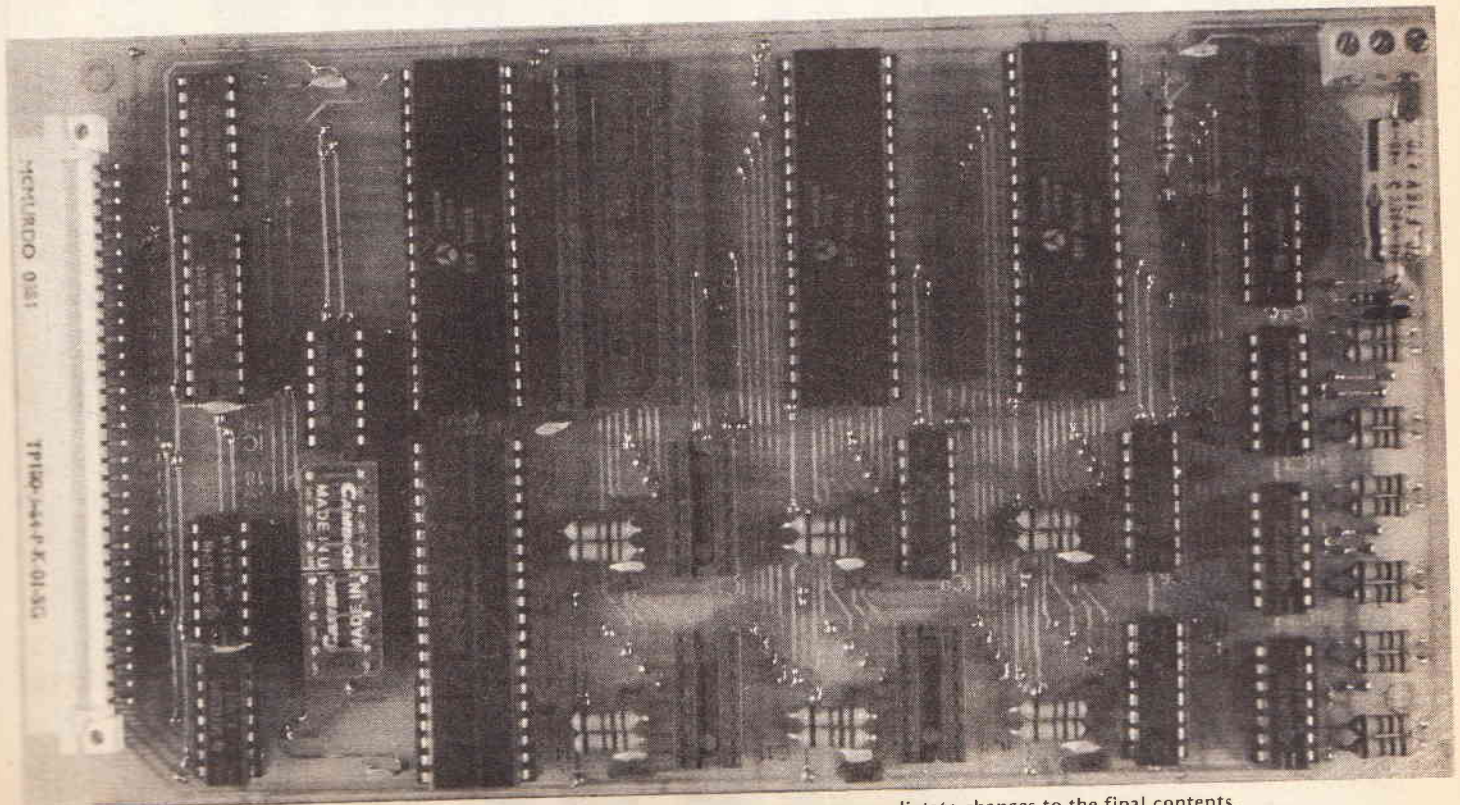
ALARM MODULE

A noisy little beast, this, which consists of a small, compact and completely self-contained project designed to monitor both open and closed loop alarm circuits, together with the main power supply. Short any alarm switches — the siren goes off. Break any alarm cables — the alarm goes off. Rip the thing off the wall — well, you can probably guess. An unimaginative behaviour pattern, perhaps, but very useful in these days of rampant crime. With a built-in piezo speaker and rechargeable battery, this alarm module gives a whole new meaning to the phrase "piercing ears". Don't miss the March edition of ETI.

6502-BASED ANALOGUE BOARD

Here's an excellent project that will appeal to all users of 6502-based microcomputers and Tangerine owners in particular. On one standard-sized printed circuit board (which is designed to accept a TANBUS edge connector, but could easily be modified for other systems), you get up to six channels of eight-bit digital-to-analogue conversion, plus an AY-3-8910 three-channel sound generator. Why not take a break from clever graphics and try your hand at playing tunes, with next month's ETI.

**LOOK OUT FOR THE
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Articles described here are in an advanced state of preparation. However, circumstances may dictate changes to the final contents.

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	BIT	ON	DATA	RENUM	DEF
FUNCTIONS	CRB	GOTO	READ	BOOT	NEW
ABS	CRF	GOSUB	RESTOR	GRAPH	END
ADR	MEM	POP	RETURN	TEXT	BIT
ASC	MWD	REM	STOP	PLOT	CRB
ATN	LEN	FOR	TIME	UNPLOT	CRF
SIN	MCH	NEXT	WAIT	COLOUR	MEM
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DIGEST



Monkey Business

You start out as an amoeba trying to advance up the evolutionary chain to become a human. To attain this goal you have to go through a total of six distinctly different evolutionary steps. Do you have the instincts and reflexes to survive and evolve to a higher life form? That's the description of the latest computer game to arrive in the UK. Called 'Evolution', it was written for the Apple Computer System by two Vancouver teenagers.

The game starts with the player controlling an amoeba, which has to fight off bacteria whilst searching for food. If successful, the player evolves into a tadpole, which is chased by a fish, then into a rat trying to escape from snakes, a beaver crossing alligator-infested waters, a gorilla harassed by monkeys and ultimately into man under laser attack. In 'Evolution', only the strong survive. However, the game has a twist of fate. If the player survives the laser attack, he is destroyed by an atomic explosion and has to return to a more difficult 'Evolution' process. Altogether there are 99 levels (!), and the photo shows a fully evolved player. Amazing how he's got the animal trained so he can sit in its hand...

Sydney Development Company (UK) Ltd is based at 13 Wilton Place, London SW1X 8RL (telephone 01-235 2839).

Hold Everything

The new Boston hand-held instrument case range from West Hyde is moulded from black ABS, although other colours are available for large orders. The styling, which has resulted in an extremely attractive as well as functional case, is ideal for all applications involving hand-held digital readouts such as thermometers and tachometers. The cases feature a separate battery compartment and an optional thumb-button which could be used to operate on-off or range-change switches for example. A choice of display aperture sizes allows for a variety of digital displays to be fitted. The Boston is available ex-stock from West Hyde from whom a data sheet can also be obtained giving further details of this handy sized case. For further information, please contact West Hyde Developments Ltd, Unit 9, Park Street Industrial Estate, Aylesbury, Bucks HP20 1ET (telephone 0296 20441).



Sony Stereo

Those awfully nice Sony people have just launched their latest video recorder. The new machine — designated C9 — is Sony's replacement for the C7, and improves on the performance of its predecessor in virtually every way. The C9 is Britain's slimmest video recorder and a front-loader, with virtually all controls accessible from its front surface. It is thus fully-rackable, and at 430 mm is the same width as a standard audio component.

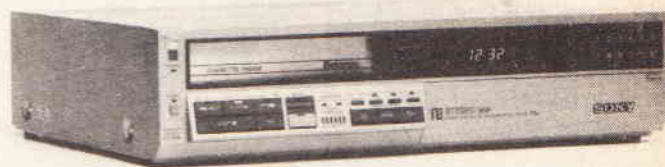
Audio performance is most important, as the C9 is the first Sony home video recorder to offer a stereo or bilingual sound capability. In addition, the machine is equipped with Beta Noise Reduction (BNR), which when utilised will give an audio signal-to-noise ratio of better than 43 dB. Purchasers of C9 will not, of course, be restricted to using stereo cassettes as the new recorder is totally compatible with all existing and future Beta-format machines and tapes, be they mono or stereo.

C9 will be available this week throughout Britain and its likely retail price will be approximately £699 including VAT. But will the software backup be there? Apparently so, since most of the major distributors of pre-recorded video cassettes have already taken the decision to release their titles on stereo wherever possible, and many such titles will be available within days of

C9's launch. CBS/Fox for instance, have chosen seven of their classic titles for re-release in stereo — Star Wars, Quest for Fire, Alien, Chariots of Fire, All That Jazz, The Rose and Nine to Five. In addition, all new releases will be issued on stereo and that includes three this month — Taps, Oh Heavenly Dog and South Pacific.

Warner Home Video is another company which has decided to back stereo, and this month will be releasing the following stereo titles — For Your Eyes Only, Moonraker, Outland, West Side Story, Honeysuckle Rose and Rocky II. In addition, the first 10,000 purchasers of C9 will each receive a Beta-exclusive copy of Warner's 'Simon and Garfunkel in Central Park' — a recording of the almost magical open-air reunion concert containing all the duo's classic songs. MGM/UA has also chosen the stereo route, having already released in stereo The Compleat Beatles cassette — a musical anthology spanning the group's history and which includes rare stereo footage of some of their most popular material. In addition, as with other distributors, in future all MGM/UA's titles will be released in stereo where a stereo soundtrack exists.

Of course, with the reappearance of Sony's adverts on the Underground on our way to work, we just couldn't resist poking a bit of fun — see the last page of Digest.



A Voice For VIC

Two new speech synthesiser units for use on VIC computer systems were exhibited for the first time at the Manchester Computer Fair on the 25th November. The Chatterbox and the Mynah Module (good grief!) have been developed by Currah Computer Components of Hartlepool in Cleveland, and offer useful applications at economical prices. The design of Chatterbox allows for it to be used on the VIC 20 expansion port, and a series of software routines have been incorporated into EPROM to allow the user a flexible method of word construction which is easy to learn and use. The Mynah Module has the same specifications as the Chatterbox except for the integral software enhancement. The absence of this software, however, does not impair the operational effectiveness of the unit. In fact, say the designers, it creates an added enjoyment for the more enthusiastic user in that the user has to refer to the master list in order to select the

appropriate allophones to be incorporated into the programme. Hmmm...

The units operate by using a series of allophones (part of speech), drawn from a master list, to generate English words. They both come complete with a master list of allophones and an informative manual with tables and guide lines as to the use of the allophones. The design of both the units has enabled Currah to reduce component and general costs, therefore allowing for competitive pricing, while giving the confidence to offer a 12 month warranty.

Speech synthesis is particularly useful for educational purposes, and other areas where the units could have interesting applications including games, software and the music industry. The company believes that the Chatterbox and the Mynah Module will both be useful in commercial terms as promotional tools, allowing companies to advertise their products at the press of a function key.



MULLARD SPEAKER KITS

Purposefully designed 40 watt R.M.S. and 30 watt R.M.S. 8 ohm speaker systems recently developed by MULLARD'S specialist team in Belgium. Kits comprise Mullard woofer (8" or 5") with foam surround and aluminium voice coil, Mullard 3" high power domed tweeter. B.K.E. built and tested crossover based on Mullard circuit, combining low loss components, glass fibre board and recessed loudspeaker terminals. SUPERB SOUNDS AT LOW COST. Kits supplied in polywoven packs complete with instructions.

6" 40W system - recommended cabinet size 240 x 216 x 445mm.
Price £14.90 each + £2.00 P & P.

5" 30W system - recommended cabinet size 160 x 175 x 295mm.
Price £13.90 each + £1.50 P & P.

Designer approved flat pack cabinet kits, including grill fabric. Can be finished with iron on veneer or self adhesive vinyl etc.

8" system cabinet kit £8.00 each + £2.50 P & P.
5" system cabinet kit £7.00 each + £2.00 P & P.

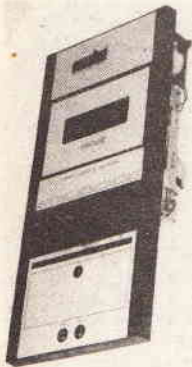


STEREO CASSETTE TAPE DECK MODULE

Comprising of a top panel and tape mechanism coupled to a record/play back printed board assembly. Supplied as one complete unit for horizontal installation into cabinet or console of own choice. These units are brand new, ready built and tested.

Features: Three digit tape counter. Autostop. Six piano type keys, record, rewind, fast forward, play, stop and eject. Automatic record level control. Main inputs plus secondary inputs for stereo microphones. Input Sensitivity: 100mV to 2V. Input Impedance: 68K. Output level: 400mV to both left and right hand channels. Output Impedance: 10K. Signal to noise ratio: 45dB. Wow and flutter: 0.1%. Power Supply requirements: 18V DC at 300mA. Connections: The left and right hand stereo inputs and outputs are via individual screened leads, all terminated with phono plugs (phono sockets provided). Dimensions: Top panel 5 1/2" x 11 1/2". Clearance required under top panel 2 1/2". Supplied complete with circuit diagram and connecting diagram. Attractive black and silver finish.

Price £26.70 + £2.50 postage and packing.
Supplementary parts: for 18V D.C. power supply (transformer, bridge rectifier and smoothing capacitor) £3.50.



6 piano type keys

NEW RANGE QUALITY POWER LOUD-SPEAKERS (15", 12" and 8"). These loudspeakers are ideal for both hi-fi and disco applications. Both the 12" and 15" units have heavy duty die-cast chassis and aluminium centre domes. All three units have white speaker cones and are fitted with attractive cast aluminium (ground finish) fixing escutcheons. Specification and Price:-

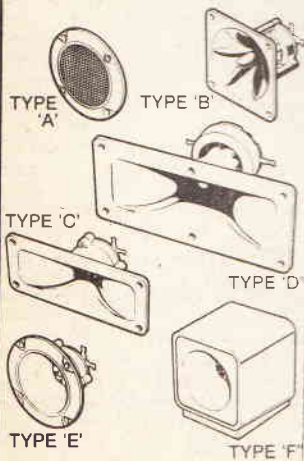
15" 100 watt R.M.S. Impedance 8ohm 59 oz. magnet, 2" aluminium voice coil. Resonant Frequency 20Hz. Frequency Response to 2.5KHz. Sensitivity 97dB.
Price £32 each £3.00 Packing and Carriage each.

12" 100 watt R.M.S. Impedance 8 ohm, 50 oz. magnet, 2" aluminium voice coil. Resonant Frequency 25Hz. Frequency Response to 4KHz. Sensitivity 95dB.
Price £23.70 each. £3.00 Packing and Carriage each.

8" 50 watt R.M.S. Impedance 8 ohms, 20 oz. 1 1/2" aluminium voice coil, Resonant Frequency 40Hz. Frequency Response to 6KHz. Sensitivity 92dB. Also available with black cone fitted with black metal protective grill. Price: White cone £8.90 each. Black cone/grill £9.50 each. P & P £1.25 each.

PIEZO ELECTRIC TWEETERS - MOTOROLA

Join the Piezo revolution. The low dynamic mass (no voice coil) of a Piezo tweeter produces an improved transient response with a lower distortion level than ordinary dynamic tweeters. As a crossover is not required these units can be added to existing speaker systems of up to 100 watts (more if 2 put in series). FREE EXPLANATORY LEAFLETS SUPPLIED WITH EACH TWEETER.



TYPE 'A' (KSN2036A) 3" round with protective wire mesh, ideal for bookshelf and medium sized Hi-Fi speakers. Price £3.45 each.

TYPE 'B' (KSN1005A) 3 1/2" super horn. For general purpose speakers, disco and P.A. systems etc. Price £4.35 each.

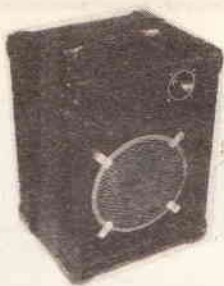
TYPE 'C' (KSN6016A) 2" x 5" wide dispersion horn. For quality Hi-Fi systems and quality discos etc. Price £5.45 each.

TYPE 'D' (KSN1025A) 2" x 6" wide dispersion horn. Upper frequency response retained extending down to mid range (2KHz). Suitable for high quality Hi-Fi systems and quality discos. Price £6.90 each.

TYPE 'E' (KSN1038A) 3 1/2" horn tweeter with attractive silver finish trim. Suitable for Hi-Fi monitor systems etc. Price £4.35 each.

TYPE 'F' (KSN1057A) Cased version of type 'E'. Free standing satellite tweeter. Perfect add on tweeter for conventional loudspeaker systems. Price £10.75 each.

P&P 20p ea. (or SAE for Piezo leaflets).



OMP 80 LOUDSPEAKER

The very best in quality and value. Ported tuned cabinet in hardwearing black vinyl with protective corners and carry handle. Built and tested, employing 10in British driver and Piezo tweeter. Spec: 80 watts RMS; 8 ohms; 45Hz-20KHz; Size: 20in x 15in x 12in; Weight: 30 pounds.

Price: £49.00 each, £90 per pair
Carriage: £5 each, £7 per pair

1K.WATT SLIDE DIMMER



- Controls loads up to 1KW
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16
 - Easy snap in fixing through panel/cabinet cut out
 - Insulated plastic case
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 - Conforms to BS800
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- Innumerable applications in industry, the home, and discos/theatres etc.

Price: £11.70 each + 50p P&P
(Any quantity)

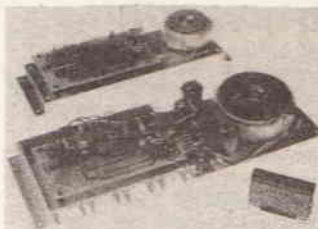
BSR P256 TURNTABLE

P256 turntable chassis ● S shaped tone arm ● Belt driven ● Aluminium platter ● Precision calibrated counter balance ● Anti-skate (bias device) ● Damped cueing lever ● 240 volt AC operation 1Hz ● Cut-out template supplied ● Completely manual arm. This deck has a completely manual arm and is designed primarily for disco and studio use where all the advantages of a manual arm are required.

Price: £28.50 + £2.50 P&P



POWER AMPLIFIER MODULES



100 WATT R.M.S. AND 300 WATT R.M.S. MODULES

Power Amplifier Modules with integral toroidal transformer power supply, and heat sink. Supplied as one complete built and tested unit. Can be fitted in minutes. An LED Vu meter is available as an optional extra.

SPECIFICATION:

Max Output Power: 110 watts R.M.S. (OMP 100) 310 watts R.M.S. (OMP 300)
Loads: Open and short circuit proof. 4-16 ohms.
Frequency Response: 20Hz - 25KHz ± 3dB.
Sensitivity for Max. Output:
500mV at 10K (OMP 100) 1V at 10K (OMP 300)
T.H.D.: Less than 0.1%
Supply: 240V 50Hz
Sizes: OMP 100 360 x 115 x 72mm
OMP 300 460 x 153 x 68mm
Prices: OMP 100 £31.50 each + £2.00 P&P
OMP 300 £89.00 each + £3.00 P&P
Vu Meter £6.50 each + 50p P&P

Matching 3-way loudspeakers and crossover

Build a quality 60watt RMS system 8ohms

Build a quality 60 watt R.M.S. system.

- ★ 10" Woofer 35Hz-4.5KHz
- ★ 3" Tweeter 2.5KHz-19KHz
- ★ 5" Mid Range 600Hz-8KHz
- ★ 3-way crossover 6dB/oct 1.3 and 6KHz

Recommended Cab-size 26" x 13" x 13"

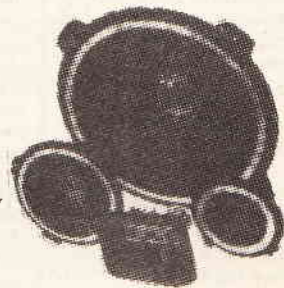
Fitted with attractive cast aluminium fixing escutcheons and mesh protective grills which are removable enabling a unique choice of cabinet styling. Can be mounted directly on to baffle with or without conventional speaker fabrics. All three units have aluminium centre domes and rolled foam surround. Crossover combines spring-loaded loudspeaker terminals and recessed mounting panel.

Price £22.00 per kit + £2.50 postage and packing. Available separately, prices on request.

12" 80 watt R.M.S. loudspeaker.

A superb general purpose twin cone loudspeaker. 50 oz. magnet, 2" aluminium voice coil, Rolled surround. Resonant frequency 25Hz. Frequency response to 13KHz. Sensitivity 95dB. Impedance 8ohm. Attractive blue cone with aluminium centre dome.

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Size: 100mm x 100mm x 2mm. Price: £5.99 + 35p P&P

Alpha Numeric Keyboard Full size 55 key non encoded keyboard with the commonly required functions in a Query array. Matrix output via a 16 pin DIL socket.
Size: 350mm x 100mm x 2mm. Price: £13.99 + 50p P&P



B.K. ELECTRONICS

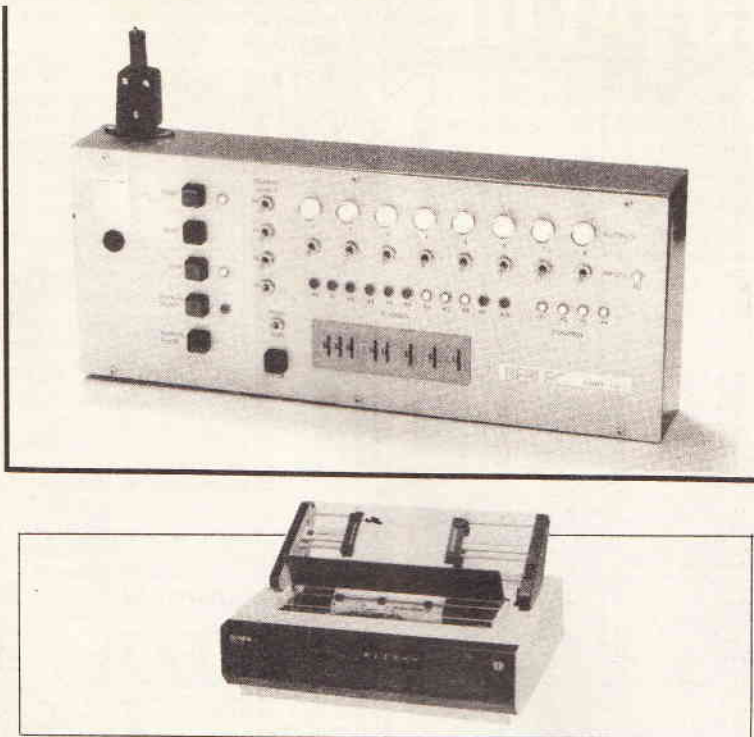
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Daisy, Daisy . . .

From Intelligent Interfaces Ltd comes the new Olympia ESW 3000 daisywheel printer (RRP £1,036). This printer has been developed for applications requiring high quality print and high speed operation. Capable of print speeds up to 50 cps in 10, 12, 15 pitch and proportional spacing, this advanced printer offers bidirectional printing with shortest path seeking to provide maximum output and bold, expanded and double print for presentation. The internal 4K memory allows data to be downloaded to the ESW 3000 from the computer, freeing the operator to select the next task. The Olympia ESW 3000 is capable of handling any type of stationery and options include a sheet feeder and tractor feed. The ESW 3000 joins the Olympia ESW 102 and 103 KSR daisywheel printers already available from Intelligent Interfaces Ltd. They can be contacted at PO Box 30, Stratford on Avon, Warwickshire CV37 7BH (telephone 0789 295385).



Shorts

- OK supplies everything, OK? Well, almost — so they're not the OK they once were. OK Machine & Tool (as were) have decided to change their name to OK Industries (UK) Ltd, in order to reflect the growing range of wares. But they're still at Dutton Lane, Eastleigh, Hants SO5 4AA, and they still produce a lot of excellent equipment.
- Speaking of which, the new OK catalogue has been unleashed upon the waiting world, with 108 pages of tools for all occasions. This includes a special product line of low cost tools and other products for use in schools and home, plus lots of useful info. Write to the address above, or phone (0703 610944); and don't forget to mention us, will you?
- What is IT? Well, it's a bit late in the year to be wondering, but for anyone who is, Macmillan Reference Books have just published the 'Dictionary of Information Technology'. The 400 page book has over 6,000 entries and more than 100 illustrations, and costs £20 hardback, £6.95 paperback. From all good bookshops, as the saying goes.
- We often get concerned at the lack of women in the electronics profession — where are you, ladies? — so it was good to hear that the Federation of British Audio has chosen a woman as its Chairman for the second time in its short history. Mrs Sue Sharp of Goldring replaced Roger Fearn of Wharfedale by a unanimous vote, and both expressed long term confidence in the future of British audio products.
- Not only an education but an

interest-free credit purchase of a Zenith Z100 computer. That's the opportunity being offered to the lucky students at Clarkson College, New York, where the university will be providing desk-top computers for all incoming students from Autumn 1983. Students pay \$200 each semester plus an initial one-time maintenance fee of \$200, and when they graduate, the computer's theirs.

- The new 7752 voice synthesiser chip from NEC Electronics uses CMOS technology to combine good speech quality with low bit rate and low power consumption. At 1500 bits per second the 32K on-chip ROM contains about 21 seconds of speech which may be composed of up to 63 messages; for longer messages, extra speech data may be stored in external ROM.

- Wave your flags, everybody; the British Teletext system is fast becoming the world standard. Over 95% of teletext sets sold throughout the world are based on the British system and working services operating to this standard are now running in 13 different countries. Most encouraging of all, the UK system is the only one to be effectively sold in the USA, and the 'Keyfax' teletext magazine was launched there last month nationwide.

- Amateur radio enthusiasts in the Pontefract vicinity will no doubt be interested to hear of the third Pontefract & District Amateur Radio Society's Components Fair. Black boxes are out and home construction in at this event, which takes place on Sunday 13th March (1983 of course!) at the Carleton Grange Community Centre, Carleton, Pontefract. Times are 11.00 am to 4.30 pm and more

information can be obtained from P. N. Butterfield G4AAQ, 43 Lynwood Crescent, Pontefract, WF8 3QT.

- Go without a pint of petrol (or a pint of beer), and blow the fiver you'll save on the Mitsubishi 1982 Data Book. Currently available from Altek Microcomponents Ltd, 22 Market Place, Wokingham, Berkshire RG11 1AP, the book contains sections on RAM, ROM, microprocessors, LSI for peripheral circuits, speech synthesis, general purpose MOS LSI, microcomputer systems and software. Full functions and specs are given, plus 111 pages with applications for dynamic and static RAMs, a single board computer, and advice on error detecting and correction.

- Wander into your friendly neighbourhood electrical retailer and you may spot the new Smiths Industries dispenser. The "Superpack" (oh, dear) is an illustrated display carton which can contain up to a dozen time switches, plus leaflets. This should help out the consumer who is often unaware of the huge variety of time switches available.

- The Big One is back. The customary two-year lifespan of the Maplin catalogue has expired, and the new improved version is now available. This monster of the marketing world weighs one-and-a-half pounds and costs one-and-a-half pounds — if you buy it mail order. Otherwise it's £1.25 (£1.90 overseas). Considerably thicker than before, the catalogue contains two new sections on Communications and Computers, but disappointingly there are few new ICs listed. Further details can be found in Maplin's ads. Hi-de-hi.

It's Under Control

Submin 111 is a new compact sequential controller which has been introduced by Beblec of Weston-Super-Mare to meet industry's needs for a low-cost, versatile and robust controller which can be quickly programmed without the use of ancillary equipment. The new controller has eight input/output channels and a capacity for 2048 sequential steps which can be divided between all channels in any recognised combination. It is capable of processing a wide variety of control instructions at high speeds for a diverse range of applications. Simple toggle switch selection enables either of two programme channels to be selected, A or B, and within each channel there are 1024 sequential programming steps available. The combination of steps ranges from two steps with 512 commands to 16 steps with 64 commands on each of the channels A and B. Programming step speeds can be selected as multiples of the base speed which is 40 ms/step. Submin 111 also incorporates facilities for further time adjustment of 30% either side of the selected speed to give fine programme time control.

In its standard form, Submin 111 is supplied with a RAM (random access memory) which is easily programmed by thumbwheels mounted on the front panel. There is also simple thumbwheel selection of a variety of standard programmable features such as autostart, reset, cycle and interlock facilities. The front panel also houses five pushbutton controls for start, reset, stop, manual select and manual step. A particular feature of Submin 111 is an on-board simulator which enables programmes to be verified before the equipment is connected to any machine or process control. The unit also incorporates LEDs to show the state of each output channel, display of programme address, outputs, control codes and input channel states.

The new controller is housed in a cabinet measuring only 400 x 160 x 82mm. This enables it to be mounted unobtrusively on many machines. Its output channels provide 24 V DC signals for actuating a range of equipment such as microswitches, relays, solenoids, and the like. The Submin 111 can be supplied with a EPROM (erasable programmable read-only memory) while maintaining all the above standard features for economical process and machine control. Beblec also supply many extras including an eight-channel expander, a four-channel inverter for hydraulic drive, an analogue/digital converter, timers and a 16K memory. For further information please contact Beblec Ltd, 28 Lynx Crescent, Winterstroke Road, Weston-Super-Mare, Avon BS24 9DG (telephone 0934 412598).

ELECTROVALUE

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 270, 330, 390, 470, 560, 680, 820pF; 1n,
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 10p; 5n6, 6n8, 8n2, 10n, 13p
 Ceramic Very small 1.8, 2.2, 2.7 etc, up to
 1n5 pF each, 1n6, 2n2, 3n3, 4n7, 6n8, 8p;
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 Polyester, Siemens Layer Type 7.5mm
 lead spacing 100V
 1n, 1n5, 2n2, 3n3, 4n7, 6n8, 8n2, 10n
 12n, 15n, 18n, 22n, 33n, 47n, 7p, 56n, 68n,
 7p; 82n, 100n, 3p 120n, 150n, 15p, 180n,
 220n, 12p; 270n, 330n, 330n, 390n, 470n,
 15p; 500n, 600n, 74p; 10mm spacing 1uF
 25p; 15mm spacing 2u 35p; 22.5mm,
 spacing 1uF 400V 50p; 3.33uF 100V 60p; in
 depth stocks.

DIGITAL & ANALOGUE I.C. SECTION

COMPUTER			74LS		
74LS00	11	74LS161	37	7413	18
74LS02	12	74LS163	36	7414	20
74LS04	12	74LS164	43	7420	16
74LS08	12	74LS165	60	7430	14
74LS10	12	74LS166	90	7440	14
74LS11	12	74LS173	55	7442	32
74LS14	30	74LS174	45	7443	32
74LS16	12	74LS175	40	7444	60
74LS18	12	74LS191	50	7447	36
74LS20	12	74LS193	40	7448	40
74LS22	14	74LS196	39	7450	14
74LS24	12	74LS197	60	7453	14
74LS26	12	74LS221	51	7454	14
74LS28	14	74LS240	55	7460	14
74LS30	12	74LS241	55	7470	24
74LS32	14	74LS242	75	7472	26
74LS34	14	74LS243	75	7474	28
74LS36	14	74LS244	60	7474	24
74LS38	14	74LS245	65	7475	32
74LS40	14	74LS251	55	7476	30
74LS42	14	74LS253	43	7480	35
74LS44	14	74LS257	35	7482	35
74LS46	14	74LS259	64	7483	38
74LS48	14	74LS266	28	7483	60
74LS50	20	74LS273	60	7485	60
74LS52	32	74LS279	40	7486	20
74LS54	32	74LS299	250	7489	150
74LS56	32	74LS307	34	7490	28
74LS58	32	74LS309	34	7491	40
74LS60	32	74LS311	34	7492	38
74LS62	32	74LS313	34	7493	38
74LS64	32	74LS315	34	7494	38
74LS66	32	74LS317	34	7495	38
74LS68	32	74LS319	34	7496	38
74LS70	32	74LS321	34	7497	38
74LS72	32	74LS323	34	7498	38
74LS74	32	74LS325	34	7499	38
74LS76	32	74LS327	34	7500	38
74LS78	32	74LS329	34		
74LS80	32	74LS331	34		
74LS82	32	74LS333	34		
74LS84	32	74LS335	34		
74LS86	32	74LS337	34		
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74LS178	32	74LS429	34		
74LS180	32	74LS431	34		
74LS182	32	74LS433	34		
74LS184	32	74LS435	34		
74LS186	32	74LS437	34		
74LS188	32	74LS439	34		
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74LS196	32	74LS447	34		
74LS198	32	74LS449	34		
74LS200	32	74LS451	34		
74LS202	32	74LS453	34		
74LS204	32	74LS455	34		
74LS206	32	74LS457	34		
74LS208	32	74LS459	34		
74LS210	32	74LS461	34		
74LS212	32	74LS463	34		
74LS214	32	74LS465	34		
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74LS222	32	74LS473	34		
74LS224	32	74LS475	34		
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74LS266	32	74LS517	34		
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74LS272	32	74LS523	34		
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74LS446	32	74LS697	34		
74LS448	32	74LS699	34		
74LS450	32	74LS701	34		
74LS452	32	74LS703	34		
74LS454	32	74LS705	34		
74LS456	32	74LS707	34		
74LS458	32	74LS709	34		</

Measuring Gigahertz

The Sabtronics Model 8000 nine-digit frequency meter is a low cost, battery or mains operated, portable instrument capable of measuring frequencies between 1 Hz and 1 GHz. Frequency is covered in three ranges and three gate times are pro-

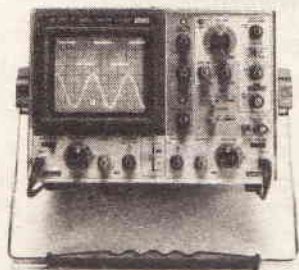
vided. Sensitivity ranges from 20 mV at 10 Hz to 35 mV at 1 GHz. Maximum resolution is 0.1 Hz (10 MHz range), 1 Hz (100 MHz range) and 10 Hz (1 GHz range) all using 10 second gate time. The 8000 costs £155 (plus VAT) and the full specification is available from Black Star Ltd, 9A Crown Street, St. Ives, Cambs, PE17 4EB (telephone 0480 62440).

Hitachi Scopes Stretch Waves

The newly introduced V-303F and V-353F oscilloscopes from Hitachi-Denshi feature a fully variable sweep delay system which enables any section of a waveform to be greatly expanded, thus allowing more detailed examination of complex signals. The sweep delay time is variable between 1 microsecond and 100 milliseconds via a five-way switch and coarse and fine variable controls. A trace intensity mode brightens up the portion of the

waveform following the delay providing a rapid method of the finding the desired point on the waveform which requires expansion. Delay time jitter is better than 1 part in 5,000 so very high levels of expansion can be achieved.

The V-203F is a 20 MHz dual trace model featuring 1 mV/div vertical sensitivity, add and subtract modes, active sync separation for video signals, and a rectangular CRT with internal graticule and variable illumination. The V-353F has a 35 MHz bandwidth, a higher tube EHT, a signal delay line, and a higher calibrated maximum sweep speed of 20 nanoseconds/div. Both oscilloscopes carry a full two-year warranty and the prices (excluding VAT) are £340 for the V-203F, and £480 for the V-353F. Reltech Instruments supply the units and can be found at Coach Mews, St. Ives, Huntingdon, Cambs PE17 4BN (telephone 0480 63570).



Nellie Packs Her Trunk

Nellie is probably the oldest first generation computer to have been kept in regular commercial use anywhere in Britain, perhaps even anywhere in the world. Such historic equipment is now so rare that her owners, Bruce Banks Sails Ltd of Sarisbury, Southampton, have been determined that she should not be scrapped so long as any possibility remained that she could be preserved for posterity.

Nellie, a Stantec Zebra computer, was built by Standard Telephones and Cables in the late 1950s. STC has now agreed to take her back for the company archives. The dismantling and removal of her tons of equipment was scheduled to begin on Tuesday, November 30th.

When Nellie is operating, it takes three kilowatts to heat up her 600 valves and 21 fans to make sure they do not overheat. It then takes

another four kilowatts to enable her to do her sums when the high tension circuits are switched on. Requiring a 270 square foot computer room of her own, she had a capacity equivalent to a small desk top micro of today.

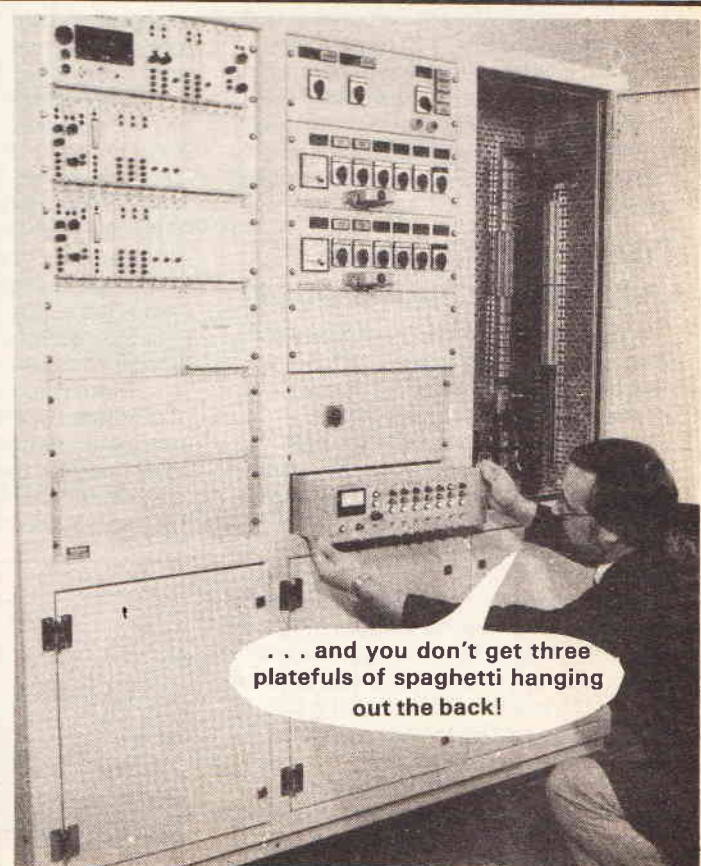
For those interested in computers, the Stantec Zebra can be described as a serial digital computer with a 33-bit word length. Operation is based entirely on a magnetic drum rotating at 100 revolutions per second, 32 words per track giving a word cycle time of about 312 microseconds. Although this sounds absurdly slow compared with modern computers, the long word length enables a high degree of arithmetical precision to be combined with a multiplicity of switching operations that could take place in one word time. For precision mathematics the machine's efficiency is still close to that of the latest equipment available. You can see Nellie, and her PET replacement, in the first episode of the new BBC Computer series.

Transportables Of Delight

A new range of portable stereo radio cassette players that combine "portability with a sound quality equal to many larger home component systems" has been launched by Pioneer. Called 'transportables', the five mobile high fidelity systems start with the SK303L model with a power output of 15 W of music power and retailing at £79 through to the top-of-the-range SK909L model which boasts a power output of 40 W, incorporates a six band graphic equalizer, auto music repeat, skip search and sells for £269. The other models are the SK353L with 15 W of music power and a one-touch record

selling at £99.90; the SK707L with 23 W of music power and a music search system selling at £169.90; and the SK757L with 23 W of music power and automatic repeat, selling at £199.90.

Pioneer say the launch follows as a result of their research which reveals that the growing appreciation of quality in home based hi-fi equipment is not matched by public expectations of quality from sound portables which "is virtually non-existent". Pioneer expect the range to become popular with the outdoor leisure market, ethnic groups like the Jamaican community — and high income groups who, already owning a larger quality component system, will supplement its use with a Pioneer portable "to take from room to room". How the other half lives!

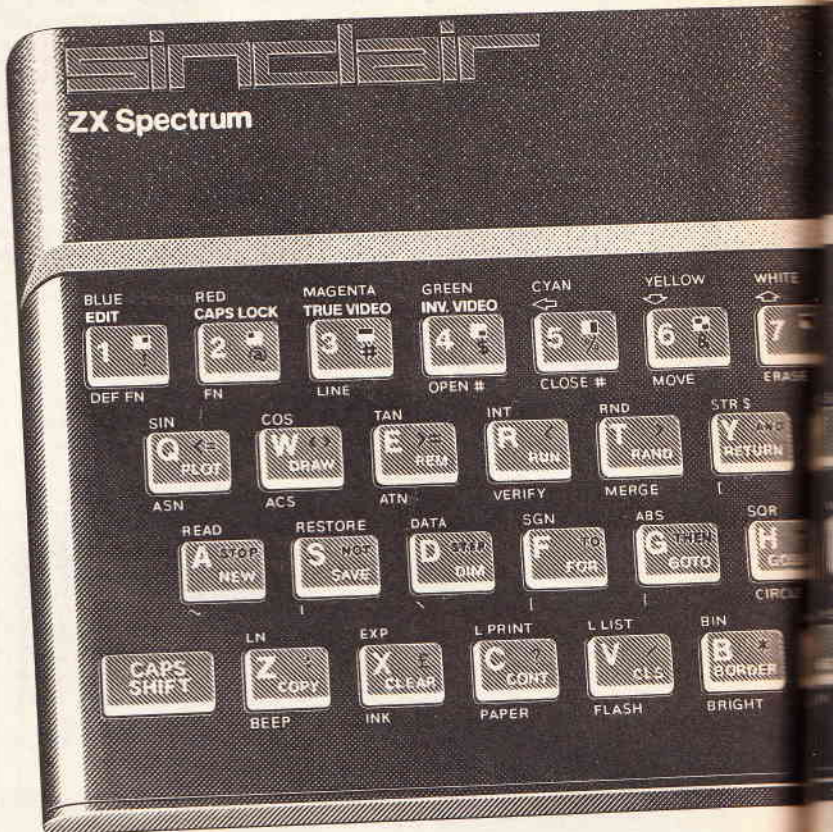


... and you don't get three platefuls of spaghetti hanging out the back!

Sinclair ZX Spectrum

**16K or 48K RAM...
full-size moving-
key keyboard...
colour and sound...
high-resolution
graphics...**

**From only
£125!**



First, there was the world-beating Sinclair ZX80. The first personal computer for under £100.

Then, the ZX81. With up to 16K RAM available, and the ZX Printer. Giving more power and more flexibility. Together, they've sold over 500,000 so far, to make Sinclair world leaders in personal computing. And the ZX81 remains the ideal low-cost introduction to computing.

Now there's the ZX Spectrum! With up to 48K of RAM. A full-size moving-key keyboard. Vivid colour and sound. High-resolution graphics. And a low price that's unrivalled.

Professional power— personal computer price!

The ZX Spectrum incorporates all the proven features of the ZX81. But its new 16K BASIC ROM dramatically increases your computing power.

You have access to a range of 8 colours for foreground, background and border, together with a sound generator and high-resolution graphics.

You have the facility to support separate data files.

You have a choice of storage capacities (governed by the amount of RAM). 16K of RAM (which you can uprate later to 48K of RAM) or a massive 48K of RAM.

Yet the price of the Spectrum 16K is an amazing £125! Even the popular 48K version costs only £175!

You may decide to begin with the 16K version. If so, you can still return it later for an upgrade. The cost? Around £60.

Ready to use today, easy to expand tomorrow

Your ZX Spectrum comes with a mains adaptor and all the necessary leads to connect to most cassette recorders and TVs (colour or black and white).

Employing Sinclair BASIC (now used in over 500,000 computers worldwide) the ZX Spectrum comes complete with two manuals which together represent a detailed course in BASIC programming. Whether you're a beginner or a competent programmer, you'll find them both of immense help. Depending on your computer experience, you'll quickly be moving into the colourful world of ZX Spectrum professional-level computing.

There's no need to stop there. The ZX Printer—available now—is fully compatible with the ZX Spectrum. And later this year there will be Microdrives for massive amounts of extra on-line storage, plus an RS232/network interface board.



Key features of the Sinclair ZX Spectrum

- Full colour—8 colours each for foreground, background and border, plus flashing and brightness-intensity control.
- Sound—BEEP command with variable pitch and duration.
- Massive RAM—16K or 48K.
- Full-size moving-key keyboard— all keys at normal typewriter pitch, with repeat facility on each key.
- High-resolution—256 dots horizontally x 192 vertically, each individually addressable for true high-resolution graphics.
- ASCII character set—with upper- and lower-case characters.
- Teletext-compatible—user software can generate 40 characters per line or other settings.
- High speed LOAD & SAVE—16K in 100 seconds via cassette, with VERIFY & MERGE for programs and separate data files.
- Sinclair 16K extended BASIC— incorporating unique 'one-touch' keyword entry, syntax check, and report codes.

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DIGITAL THERMOMETER	K2557 £26.57
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NEW TELETEXT KIT NOW AVAILABLE
WITH PRESTEL ADAPTER (OPTIONAL EXTRA)
BASIC KIT £120

COMPUTER CHIPS NOW AVAILABLE

Z80A CPU £3.20	2732 300NS £7.50
Z80A CTC £3.20	2764 300NS £11.00
Z80A P10 £3.20		

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*available in kit form £16.95 + VAT

- Built-in electronic siren drives 2 loud speakers
- Provides exit and entrance delays together with fixed alarm time
- Battery back-up with trickle charging facility
- Operates with magnetic switches, u/sonic or I.R. units
- Anti-tamper and panic facility
- Stabilised output voltage for external units
- 2 operating modes - full alarm/anti-tamper and panic facility
- Screw connections for ease of installation
- Separate relay contacts for switching external loads
- Test loop facility

only
£19.95
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ULTRASONIC ALARM MODULE

US 4012

Fully built
& tested



Adjustable range
from 5ft. to 25ft.

A really effective fully built module containing both ultrasonic transmitter and receiver and circuitry for providing false alarm suppression. This module, together with a suitable 12V power supply and relay unit as shown, forms an effective though inexpensive intruder alarm. Supplied with comprehensive Data Sheet, it is easily mounted in a wide range of enclosures. A ready-drilled case and necessary hardware is available below.

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£10.95
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DIGITAL VOLTMETER MODULE DVM 314

Fully built & tested



- Positive & negative voltage with an FSD of 999mV which is easily extended
- Requires only single supply 7-12V
- High overall accuracy - 0.1% + 1 digit
- Large bright 0.43" LED displays
- Supplied with full applications data

only
£11.95
+ VAT

With this fully built and calibrated module a wide range of accurate equipment such as multimeters, thermometers, battery indicators etc. can be constructed at a fraction of the cost of ready-made units. Full details are supplied for extending the voltage range, measuring current, resistance and temperature. Fully guaranteed, the unit has been supplied to electricity authorities, Government departments, etc.

Temperature Measurement Kit DT.10

£2.25 + VAT

Using the I.C. probe supplied, this kit provides a linear output of 10mV/°C over the temperature range from 10°C to +100°C. The unit is ideal for use in conjunction with the DVM module providing an accurate digital thermometer.

Power Supply PS.209

£4.95 + VAT

This fully built mains power supply provides two stabilised isolated outputs of 9V, 250mA each. The unit is ideally suited for operating the DVM at Temperature Measurement module.

Power Supply & Relay Units PS 4012

£4.25 + VAT

Provides a stabilised 12V output and relay with 3A contacts. The unit is designed to operate one or two of the above ultrasonic units. Fully built and tested.

Hardware Kit

HW 4012 £4.25 + VAT

A suitable ready-drilled case with the various mounting pillars, mains switch socket and nuts and bolts. Designed to house the ultrasonic alarm module together with its power supply. Size: 153mm x 120mm x 45mm.

Siren Module

SL 157

£2.95 + VAT

Produces a loud and penetrating sliding tone operating from 9-15V. Capable of driving 2 off 8 ohm speakers to SPL of 110db at 2M. Contains an inhibit facility for use with shop lifting loops etc. or other break to activate circuits

* ACCESSORIES *

3-position Key Switch for use with CA 1250 supplied with 2 keys	£3.43
Magnetic switch (with magnet)	£1.17
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THE ETI ORGAN

PART 1

We wanted to publish another top-notch musical project but we also wanted to get away from the synthesiser syndrome. Hence this first-class organ, which is designed to fit large, medium or small pockets/rooms/ambitions. Design by Richard Watts.

The 'Victory' electronic organ was designed as an instrument with capabilities equivalent to those available on manufactured home organs. ETI has previously published designs for synthesisers which, while excellent as a solo instrument, are not able to give a complete ensemble with drums and backing. Part 1 of this article deals with the design of the upper keyboard and a selection of voices such that a working keyboard is possible for a very modest outlay. Subsequent parts will complete the instrument and provide expansion sockets for up-grading the organ at a later date. The entire electronics (with the exception of the amplifier/PSU) is mounted on one double-sided printed circuit board for ease of construction and installation.

Specification

Part 1 consists of a single full-size 44-note industry standard keyboard (F-C) with the following voices: Flute 16', Flute 8', Flute 4', Clarinet 16', and Trombone 16'. The effects available are sustain and vibrato. Part 2 describes the preset voices — piano, harpsichord, Hawaiian guitar, banjo with repeat, and accordion — plus the lower keyboard, an additional 44-note keyboard with melodia and rhythm guitar voices, lower manual accent effect, a 13-note pedalboard with electronic left priority, 8' or 8' plus 16' voices, pedal accent and built-in sustain. There is a choice of bass played from the lower keyboard or the pedal board: a swell pedal with glide control is also included. Finally there is the amplifier, the PSU, a special 12" speaker and a headphone socket.

Part 3 will describe the remaining features of the organ —



A fully-expanded version of the organ containing all of the features mentioned in the text.

the rhythm and automatic accompaniment (comprising 16 modern rhythms), speed and volume controls and a down beat indicator; the rhythm section voices (bass drum, tom-tom, claves, snare drum, long and short cymbal, cymbal strike tone and selectable handclap); plus the automatic features, which include single finger chord (12 major, 12 minor, 12 seventh, 12 minor seventh) with latch for chord control, lower manual memory, long and short chord modulation, and choice between two independent bass

patterns per rhythm or constant bass.

Keyboard Operation

As can be seen from the keyboard circuit diagram, utilisation of the M208 with its 'matrix scanning' switching results in only 17 connections being required for the 44 notes on the upper keyboard. This is achieved by sending the 12 scanning outputs (F1 to F12), active low, from the M208 pins 21 to 32 through diodes to single key contacts such that all C notes are supplied from the same

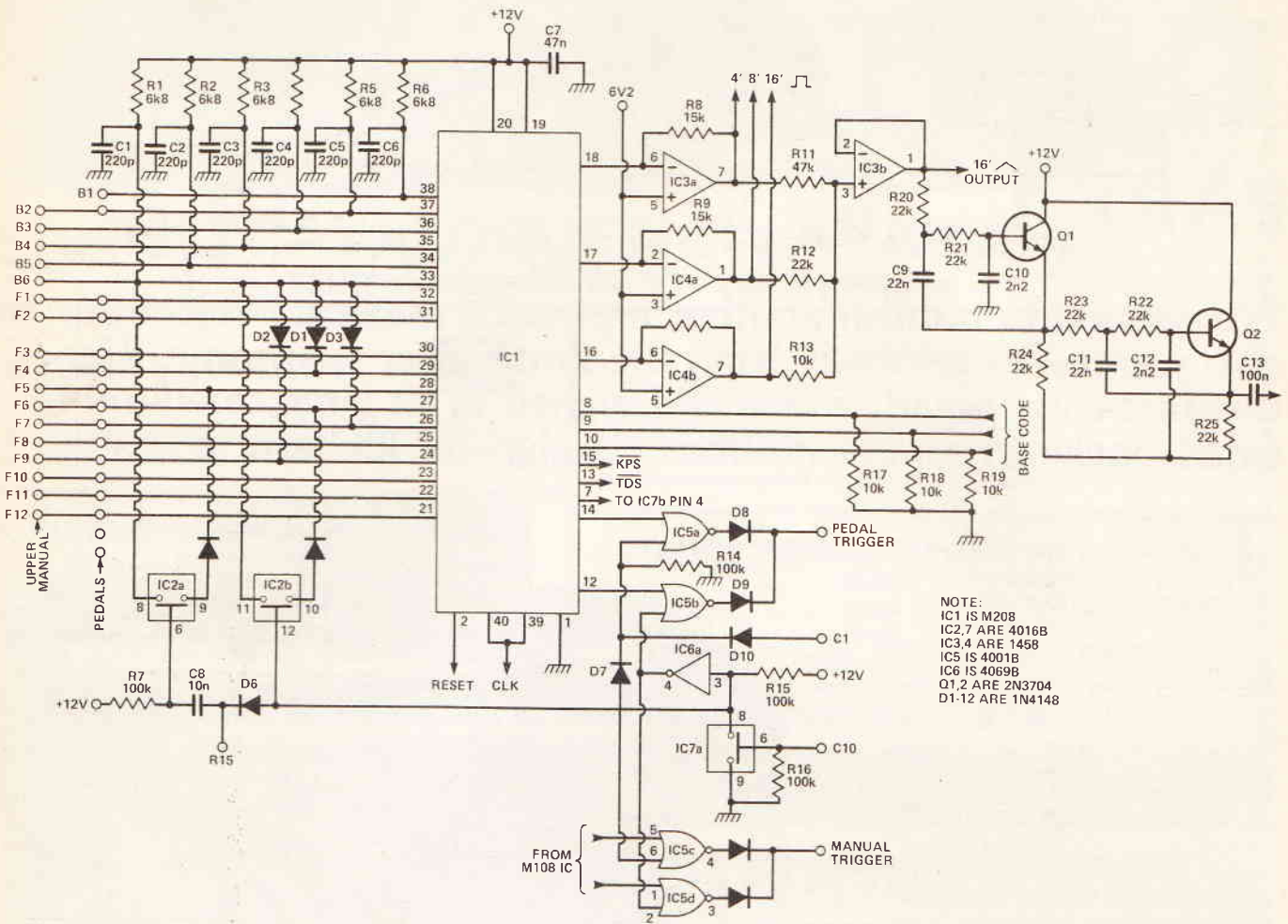


Fig. 1 Circuit diagram of the keyboard scanning and audio generating circuitry, IC2a and b and associated components, IC5, 6a, and 7a and all their associated components are not used in the basic version, nor are pins 7, 13, 14 and 12 of IC1, but have been drawn anyway to save re-drawing the entire circuit next month.

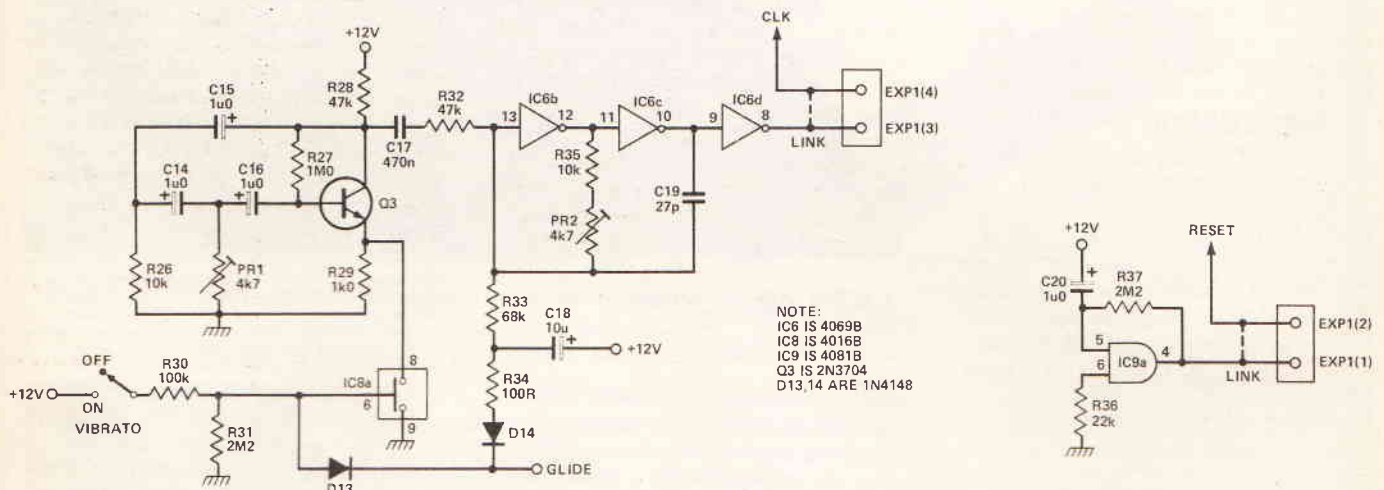


Fig. 2 The clock generator and vibrato circuitry (left) and the master reset circuit (right). D13, D14, R34 and the EXP1 sockets are not included in the basic version.

pin, all D notes from another pin and so on. Keyboard data is collected and returned to the M208 on five separate buss bars, three of which contain a full octave of data (B3, B4, B5), one contains data on the lowest seven notes (B2) and the other (B6) contains only information concerning the state of the highest

C key. The B6 line is also used elsewhere for function switching within the M208 as will be shown later.

The M208 control scanning as well as its analogue (audio) outputs are derived from a 1 MHz clock which is input to pins 39 and 40. The clock is obtained from three

inverters within IC6 along with C19, R35 and the preset pot PR2. Since PR2 controls the clock frequency it is also used as the master tuning control for the whole organ. Transistor Q3 and its associated components C14, C15, R26, R27, R28 and R29 and the preset pot PR1 form a low frequency oscillator

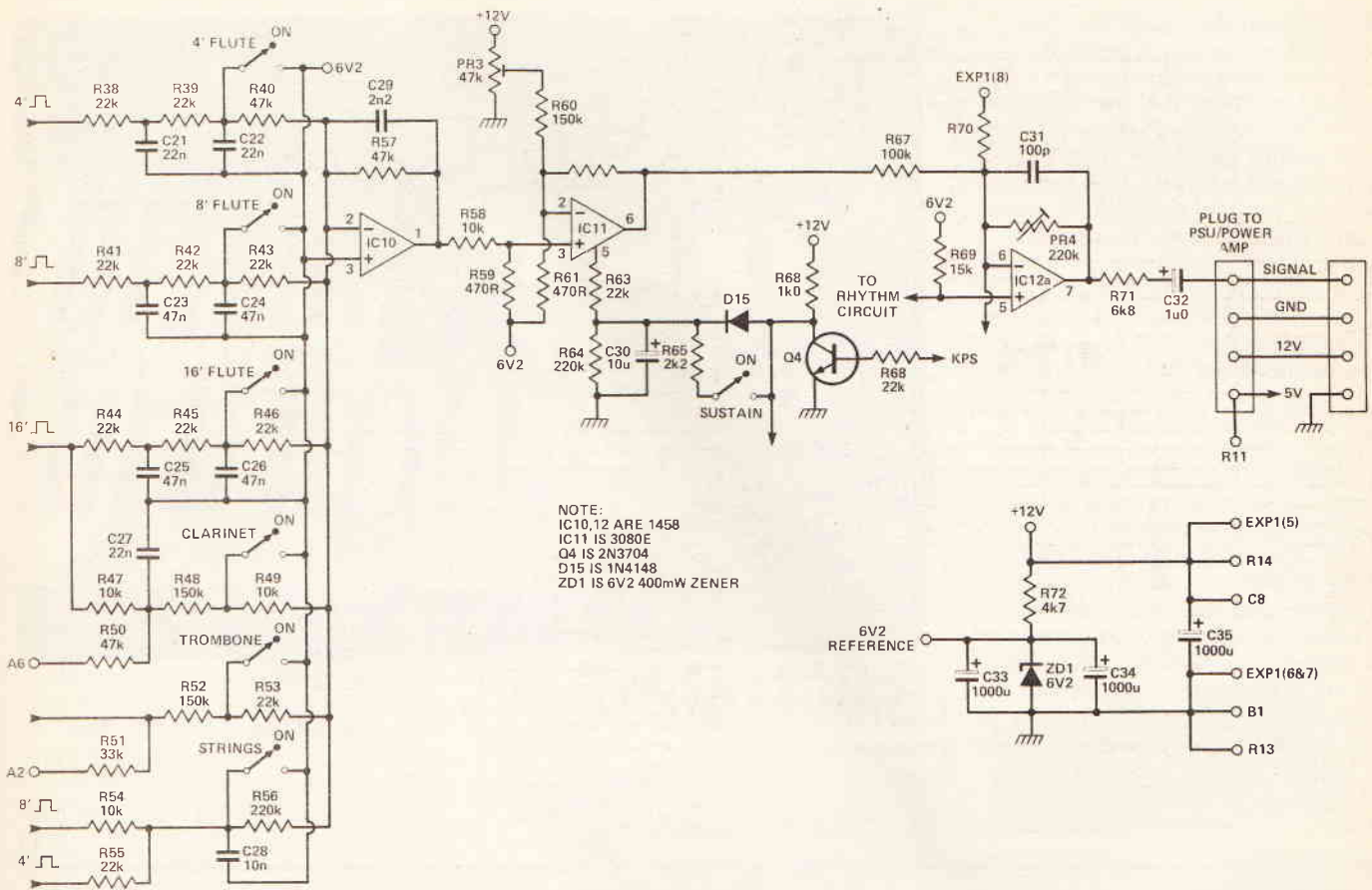


Fig. 3 The filtering and output circuitry for the basic organ.

(approximately 6 Hz) which, when enabled performs as the vibrato oscillator. It is enabled when +12 V is switched from the Vibrato switch through R30 to the analogue switch IC8a. This causes the emitter of Q3 to be connected directly to ground, increasing stage gain and causing the circuit to oscillate. This 6 Hz sine wave is coupled via C17 and R32 to the 1 MHz clock resulting in frequency modulation of the clock frequency, ie vibrato. PR1 sets the vibrato speed.

When a key or keys are depressed, the keyboard data is input to the M208 'B' lines. The chip debounces and decodes this switch information internally and outputs the relevant note frequencies to pins 16, 17 and 18. This analogue information appears as current outputs, such that the note frequencies which appear on pin 18 are exactly twice those appearing on pin 17 which are in turn exactly twice those on pin 16. These outputs constitute the 4', 8' and 16' pitches respectively and are sent directly to op-amps IC3 and IC4 which act as current-to-voltage converters as well as providing a convenient low impedance source

for feeding the filter circuits.

The outputs from these op-amps are square wave signals in the form required for filtering or voicing. This square wave with a duty cycle of 50% contains only odd harmonics and is suitable for only the flute type voices. Other voices require both odd and even harmonics and this is obtained by 'staircasing' the three square waves in the ratio of the resistors R11-13 connected to IC3b in the voltage follower mode. Since the largest element of this waveform is at 16' pitch, it is referred to as the 16' staircase.

Referring back to the input side of the M208 briefly, the diode D1 connected between F4 and B6 of the M208 causes the last note or notes played to remain latched at the outputs of the M208. This facility is necessary for the sustain feature to be described later. It can be seen that the current-to-voltage converters IC3 and 4 each have their non-inverting inputs tied to $\frac{1}{2} V_{DD}$; this is an operational requirement of the M208 and is further utilized in the voicing and preamp section, enabling all the op-amps to be run from a single supply rail.

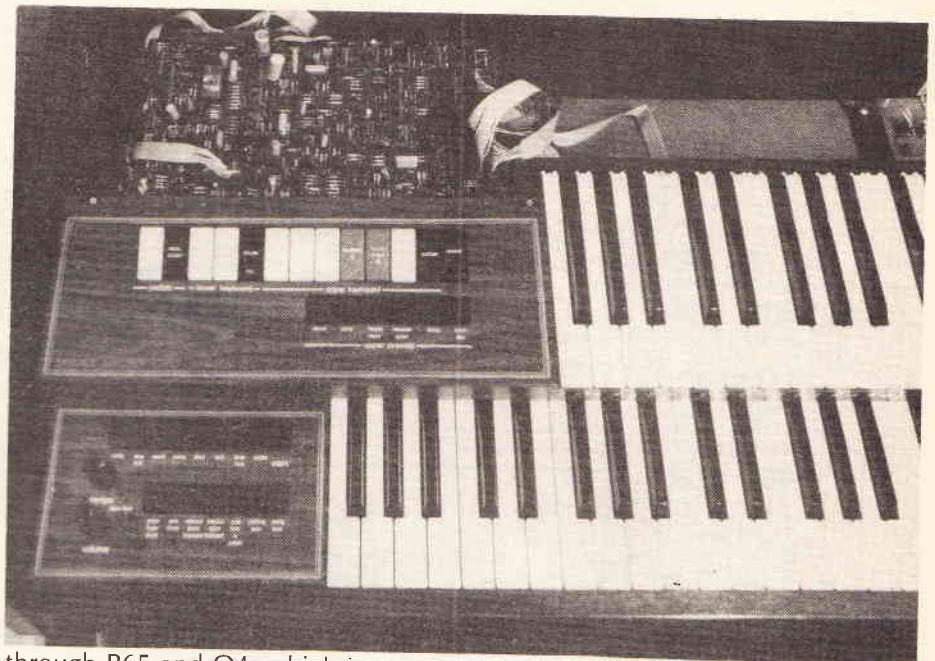
Non-percussive Voicing

These are mainly derived from passive low-pass filters and their selection method is the same. As an example, for the 8' Flute voice the 8' square wave signal from IC4a is applied to the network comprising R41, R42, C23 and C24. The voice switch in the 'off' position switches the filter output directly to $\frac{1}{2} V_{DD}$ which is used as 'signal ground' (as distinct from power supply ground). This shorts out the filter output and so this voice is not heard. In the 'on' position the signal is allowed to pass through R43, which determines its level relative to the other voices, into the mixer amp IC10. It can be seen that for the more complex voice of the String an 8' staircase is made up from R53 and 54 driven from 8' and 4' square waves. The other exception is the Trombone voice which utilises the 16' staircase waveform applied to the active filter circuit comprising Q1, Q2 and associated components.

Output Gating

The output from the mixer amp is fed to IC11 which is an OTA, the 3080E. Its function here is that of a

voltage-controlled amplifier. Since the 3080E is actually a current-controlled device (this being supplied via R63), it is the voltage across R64 which will determine the audio output envelope. It can be seen that the base of Q4 is fed via R68 from a signal called KPS, short for Key Pressed Solo. This is a control signal developed within the M208 which is normally high (+12 V), goes low (0 V) when any key is depressed and remains low until all keys are released. So, with no keys depressed, Q4 is saturated, its collector low and therefore no current is supplied to the OTA. Although the audio from the last notes played is still present at the input of the OTA (due to the latched output facility being enabled on the M208), it is allowed to pass no further and no voice is heard. However, when a key is depressed, Q4 collector goes high and charges C30 via D15: current is supplied through R63 to the OTA resulting in audio appearing at its output. When the key is released, assuming the sustain switch to be in the 'off' position, C30 is discharged quickly



through R65 and Q4, which is saturated again. The result is that the OTA is shut off and no audio passes. If the sustain is switched on the same process take place except that the discharge path is through R64. Now the discharge is much

longer and consequently a sustain envelope is applied to the OTA and the audio decays gradually. The output of IC11 is connected to IC12a, the output amplifier/mixer. Overall volume is set by preset PR4.

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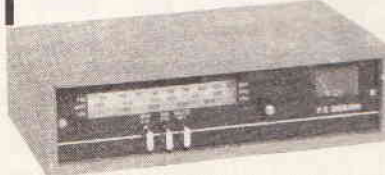
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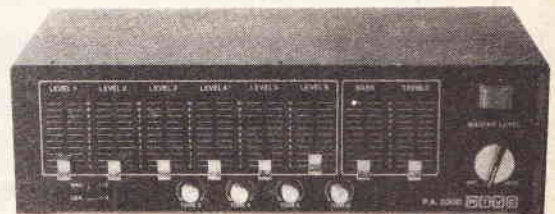


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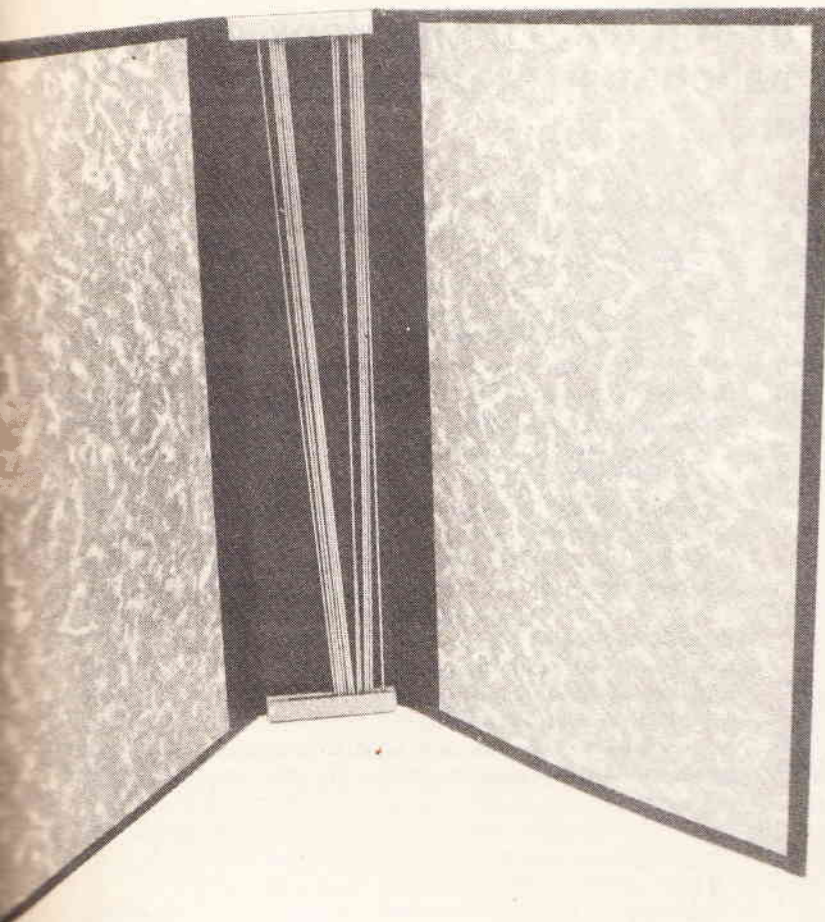
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DESIGNING MICRO SYSTEMS PART 7

To conclude the series, Owen Bishop takes a brief look at the two main ways in which information may be stored and retrieved by the microcomputer.

While the micro is in use, a lot of information may be held in ROM and in RAM. When the power is switched off, all the information in RAM is lost. This might consist of programs, tables of data, and information of various other kinds. If we want to retain this information for use on a future occasion, it must be stored in a form in which it can easily be put back into RAM when required. For certain applications RAM is not large enough to hold all the information we have to deal with. A business might be running a data-base program and require access to names and addresses of thousands of customers. These cannot be held simultaneously in RAM, so they must be loaded in and dealt with batch by batch. A complicated program may be too long to be held in RAM, but can be broken down into sections which are loaded individually for use when required. Some system of transferring information into and out of the micro is therefore almost essential.

The two methods of storage most commonly used involve transferring the information to a magnetic medium. Almost all micros provide a means of transferring information between RAM and a cassette tape. The other

method makes use of a plastic disc coated on one or both sides with magnetic material. This is often referred to as a **floppy disc**, to contrast it with the **hard disc** which is often used with minicomputers but (at present) rarely with micros. Discs are made in two standard sizes, 8" and 5¼" in diameter. The smaller of these is the kind most often used with micros and is more correctly described as a **diskette**. Diskettes of even smaller diameter are now being produced, most notably for the ZX81 and Spectrum microcomputers (the Sinclair Microdrives).

Tape Measures

Information is stored on tape in the form of a square wave. Successive regions of the tape are magnetised in one direction or the other. The prime requirement is for a tape with low noise and freedom from blemishes. With an audio tape the occasional region with faulty coating makes little difference to the sound, but when the tape is being used for recording binary digits, such a 'drop-out' may convert a 0 to a 1 or the other way about, rendering the recording nonsensical from that point onward. Although it is possible to use ordinary tape for recording computer programs, most people prefer to use specially tested

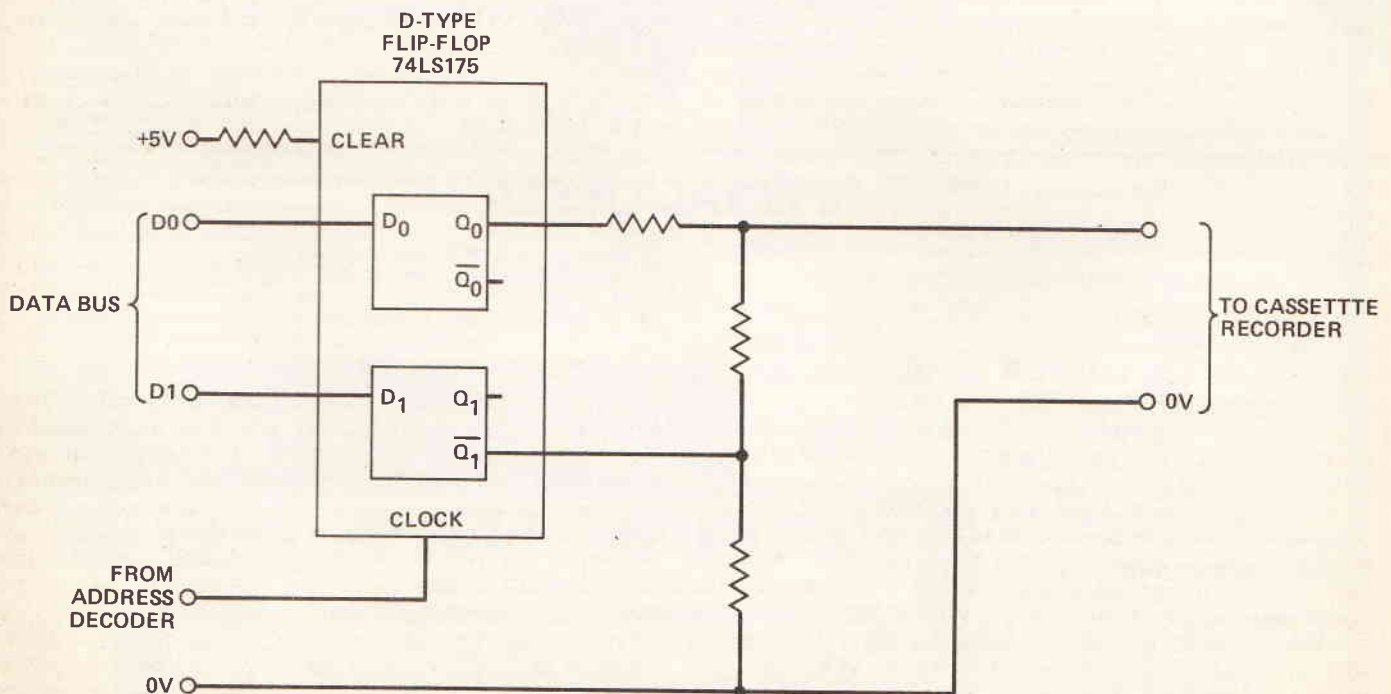


Fig. 1 Typical cassette output circuit (based on the TRS-80). Data is transferred to the outputs Q and \bar{Q} when the clock input is made low. It is then latched until the next write operation. The resistors are chosen to give suitable output levels with different combinations of outputs from the flip-flops.

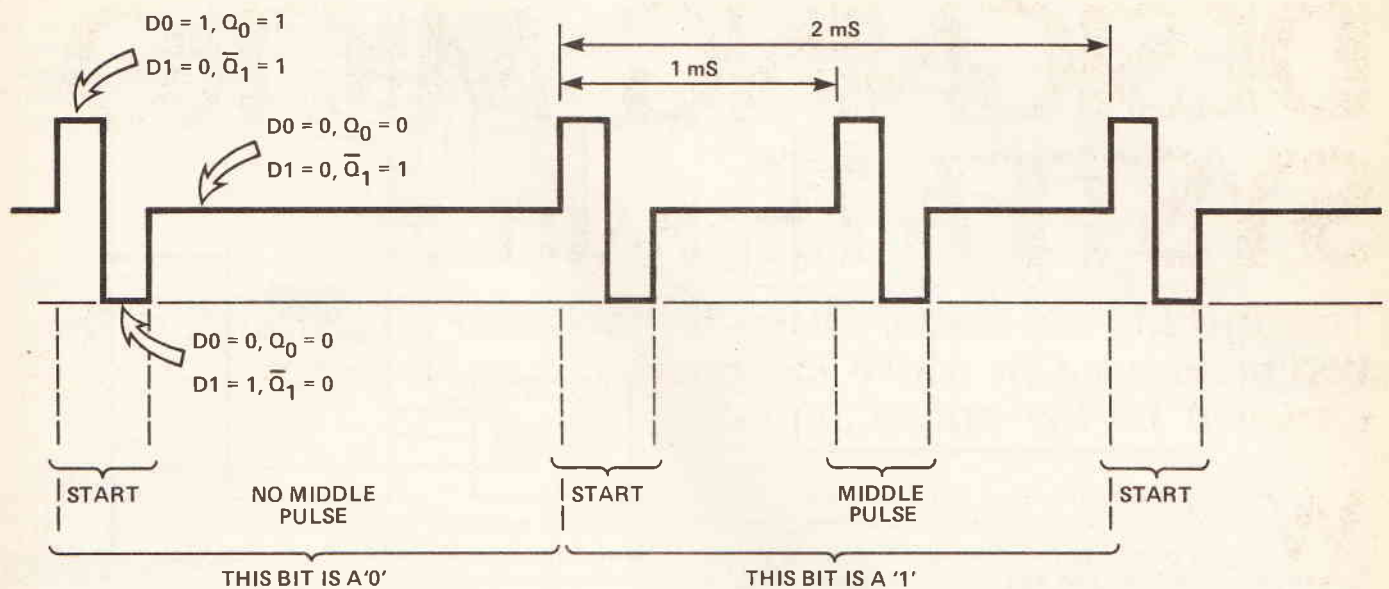


Fig. 2 The coding of the bits in the TRS-80.

'digital' tapes which are guaranteed free from such defects. They are usually supplied in shorter lengths than audio tapes. For example, C10 and C15 are two commonly available lengths. A program of 16K (or slightly longer) fits into a single side of such a tape when recorded at the standard rate of 300 baud. If your program is longer than this, you will probably prefer not to wait as long as 10 minutes or a quarter of an hour to load it and will be thinking of investing in a disc drive.

Figure 1 shows the circuit of a typical cassette output circuit. It occupies a single address in the memory stage of the computer. Data is fed to it as a series of 0s and 1s and a corresponding voltage is fed to the recorder. In the example shown, a positive voltage represents 1, 0V represents 0. In the absence of a signal the output voltage is one half of the '1' level. However, there is little standardisation of microcomputer outputs to cassette recorders, and there are many variations on this theme.

All micros record and load the data serially, that is to say, one bit at a time. Before a byte of information is recorded it is broken down into its eight bits and each bit is sent separately to the cassette output circuit. Methods of coding the information vary widely from one micro to another. This is why it is almost impossible to load one micro with a program saved on a machine of different make.

Bits And Blips

Not only does each micro have its own system of formatting the tape — the way it begins and ends each transmission of data — but the 1s and 0s may be represented in several different ways. The TRS-80, for example sends data at the rate of one bit every 2 mS (500 baud). It indicates the beginning of each bit by a 'start pulse' or 'blip' as in Fig. 2. This is a short swing to high, then to low and finally a return to the 'no-signal' level. If the bit is a 0, no further signal is sent. After 2 mS the next 'blip' indicates the start of the next bit. If the bit is a 1, a blip is sent exactly 1 mS after the start pulse.

When the tape is played back the signal is taken in through a circuit as in Fig. 3, where the 'blips' are detected. Though they do not have exactly the same form as the original signal, the timing is the same and this is all that matters. The micro is programmed to wait until a signal is detected and to sample the input exactly 1 mS

later. If a signal is detected at this stage too, the bit is taken to be a 1. If no pulse is detected, the bit is taken as a 0. It then awaits the arrival of the next signal to indicate the beginning of the next bit. At each stage it stores which kind of bit (0 or 1) it has received. When it has received eight bits these are assembled into a byte and stored in RAM. If a flaw in the tape causes a bit to be missed, or an extra bit to be recorded, this upsets the decoding of all bytes for the remainder of the recording. An incorrectly-read bit may alter only the byte it is part of. This too can affect the interpretation of the whole of the remainder of the recording, especially if the recording is a machine-code program.

Another system of recording data depends on **frequency shift keying** (FSK, for short). This method is also used in transferring data from one micro to another by wire. Two standard frequencies are used, one of them having perhaps twice the frequency of the other. When we say 'standard' we mean standard for that model of micro, but for tape recording different makes of micro almost invariably work to different standards. A 0 is represented by a short tone burst of one frequency and a 1 by a burst of the other frequency. On playback (or on receiving the transmission over a line) the computer can easily measure pulse length and so find out which frequency is being sent at each instant. This information is then converted into 0s and 1s and assembled into bytes to be stored in RAM.

Tape Versus Disc

Tape recording computer programs and data files has some considerable advantages which must be matched against considerable disadvantages. The main advantage is **cheapness**. Within the computer we need relatively simple output and input circuits. The tape recorder itself can be a simple and cheap mass-produced model. Many intending microcomputer owners already possess a tape recorder, so the only expense is the lead to connect it to the micro. A sophisticated hi-fi recorder often gives trouble owing to its noise reduction circuits which turn up the volume during periods of no signal, so feeding the computer with amplified tape noise and confounding its signal detection program. It has often been said the the cheaper recorder, the better it is for use with a micro. However, certain micros give problems

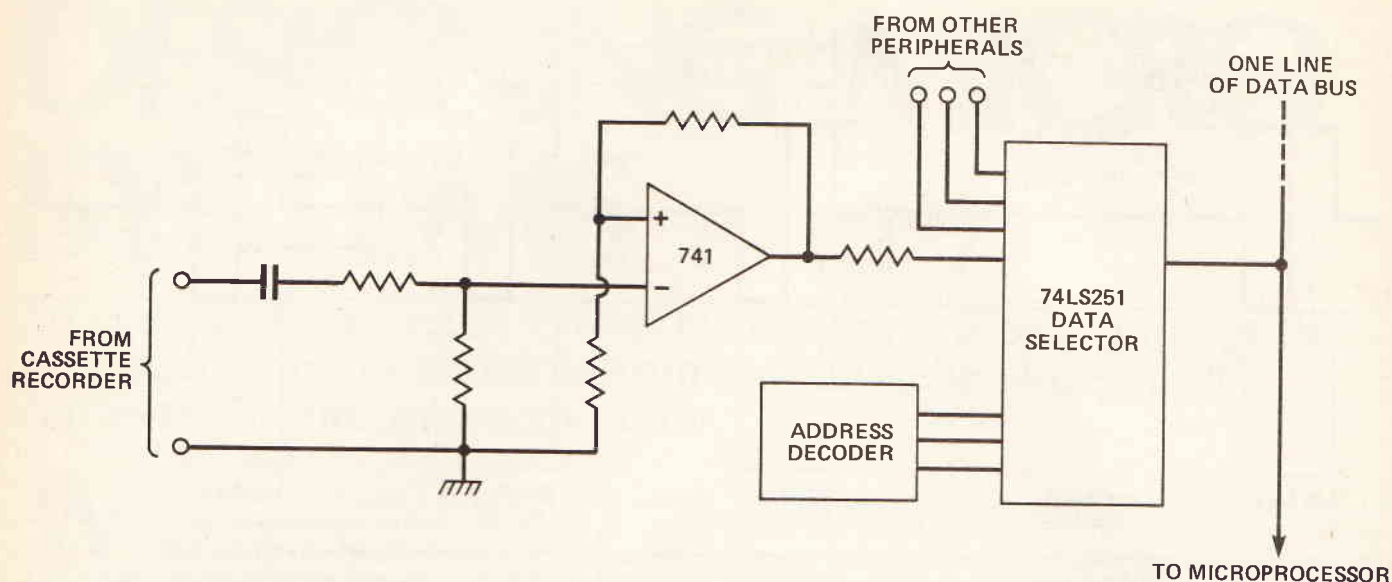


Fig. 3 A typical cassette input circuit has an op-amp wired with positive feedback so that it saturates and its output swings fully in either direction. The data selector is used to send the input from the recorder or from other peripherals such as games controllers.

when loading from tape, and make it necessary to set the playback volume fairly carefully to avoid either too small a signal or a large signal which saturates the input circuits.

Manual Controls

Provided that the user requires only to save and load relatively short programs, the cheapness and availability of cassette recorders outweighs their disadvantages. If a large amount of data is to be handled and if time is costly, the balance of advantage swings firmly toward the disc. One of the disadvantages of the cassette recorder is that its 'record', 'play' and tape winding controls cannot be operated automatically by the computer. They must be operated by the user, with the inevitable consequence of making a mistake. At the least, this wastes time and, at the worst, may cause a valuable program or set of data to be erased.

The only control which micros have over the recorder is to start and stop the motor at the beginning and end of each recording. There is a small relay in the computer which is connected in place of this 'on/off' switch often found on the stem of a microphone. This relay is controlled by the MPU, having its own address or addresses in memory. Usually there is a flip-flop which is toggled by writing to one address or the other. Figure 4 is a typical motor-switching circuit. Such a circuit is very simple and therefore found in all except the very cheapest micros.

A cassette tape passes over the recording/playback head at the standard speed of 1 15/16 inches per second (50 mm/S). At this relatively low speed the rate of recording is limited to a few hundreds of bits per second. Consequently it takes several minutes to record a program which is more than a few kilobytes long. This results in excessively long delays when running data-bases and similar programs.

Other problems with tape are connected with the fact that programs or data files are recorded one after the other along the length of the tape. Recordings can be played back only in the order on which they were recorded. If you want to return to a recording which is earlier on the track, it is necessary to operate the recorder manually, rewinding it to a position in advance of its new starting point. This takes time and is a tedious operation even with

the aid of the footage meter. If the item of data you need is part of a long recording, you have to play the recording through from beginning to end to retrieve the single item you need.

Discs have none of these disadvantages and are altogether more reliable than cassette tapes. On the other hand, a disc drive is considerably more expensive than an ordinary cassette recorder. But if we abandon the idea of cheap data storage, we can take advantage of the best available technology and design a device which is ideal for its purpose.

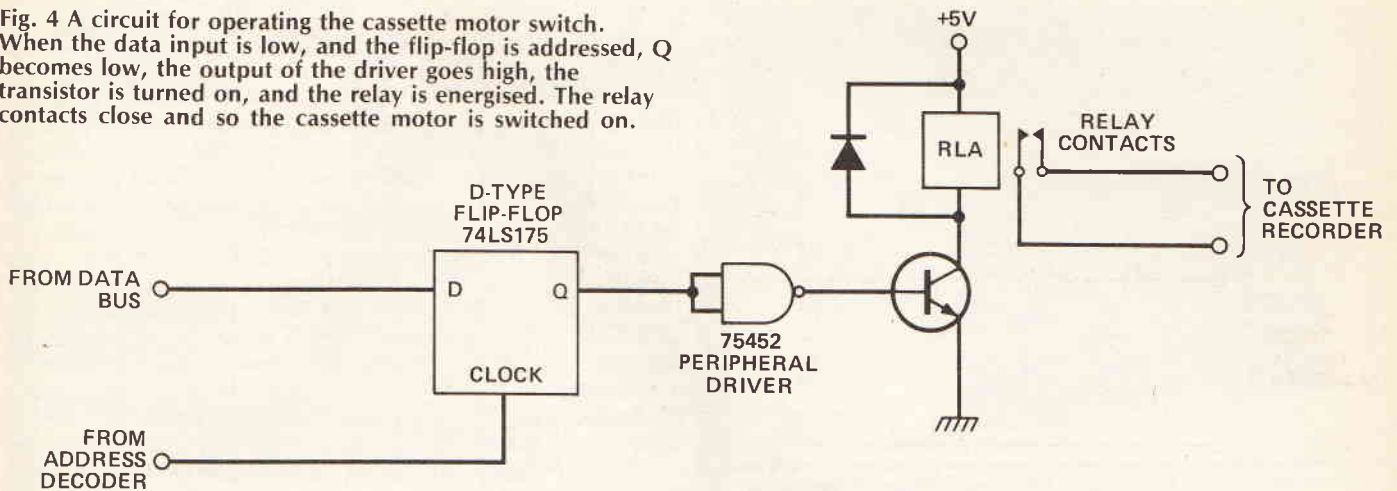
Spin A Disc

The recording medium, disc or diskette, consists of a disc of mylar film coated with magnetic oxide; it may be coated on one side only or on both sides. The magnetic head is very close to the disc when reading and writing data and the disc rotates at high speed, so it is essential to exclude particles of dust. Even the dust from cigarette smoke can cause malfunction (another good reason for giving up — Ed). The disc is therefore sealed in a plastic sleeve, lined with a textured material which lubricates the surface of the disc and removes debris. The case has a slot (Fig. 5) to allow the magnetic head access to the disc. It also has a small hole through which the **sector holes** are visible. These are holes punched in the disc and spaced regularly around it. There is a fixed number, depending on the system on which the disc is being used. Commonly there are 16 such holes, giving a 16-sector disc. The effect of these is that the tracks on the disc, which are concentric, are divided into 16 sectors. The disc drive has a light source located on one side of the disc to shine through the sector holes as the disc spins around. A phototransistor on the other side of the disc detects when a hole passes. This aids the drive in sensing the position of the disc.

Discs which have holes to mark the sectors are known as **hard-sectored** discs. An alternative system has a single hole for detecting each rotation of the disc but relies on software for dividing the track into sectors. Such a disc is known as a **soft-sectored** disc.

Another phototransistor in the drive is used to detect whether the disc is 'write-protected'. There is a notch in

Fig. 4 A circuit for operating the cassette motor switch. When the data input is low, and the flip-flop is addressed, Q becomes low, the output of the driver goes high, the transistor is turned on, and the relay is energised. The relay contacts close and so the cassette motor is switched on.



the edge of the case of the disc: light shines through this notch from below and falls on the phototransistor. The user may fix a sticky tag over this notch to prevent light from passing. In this event, the phototransistor is not activated and the writing action of the drive is inhibited. This serves to prevent the accidental or intentional overwriting or altering of data or programs. This is simply a safety measure: the tag is peeled off should further writing be required.

The Faster Format

In a typical disc drive the disc is rotated at a constant speed of several hundred revolutions per minute. For example, the Siemens FDD100-5 drive rotates at 300 RPM. At the middle track, this gives the magnetic material a

speed of about 1400 mm/S relative to the head, compared with 50 mm/S in the cassette recorder. As a result of this and the physically small size of the read/write head, data can be recorded and read at 125 kilobits per second. Reading and writing of data is therefore extremely fast. There is a delay of one second while the disc comes up to full speed: the head takes an average of 300 mS to find the required track and a further 15 mS to settle into position. After that, data is transferred at the rate mentioned above. Should the head need to change from one track to another, as it will if much data has to be transferred, it takes only 25 mS to move from one track to another.

It is evident from the description above that access to data is very much quicker and more direct than is the case with tape. Instead of having to run from one end of a tape

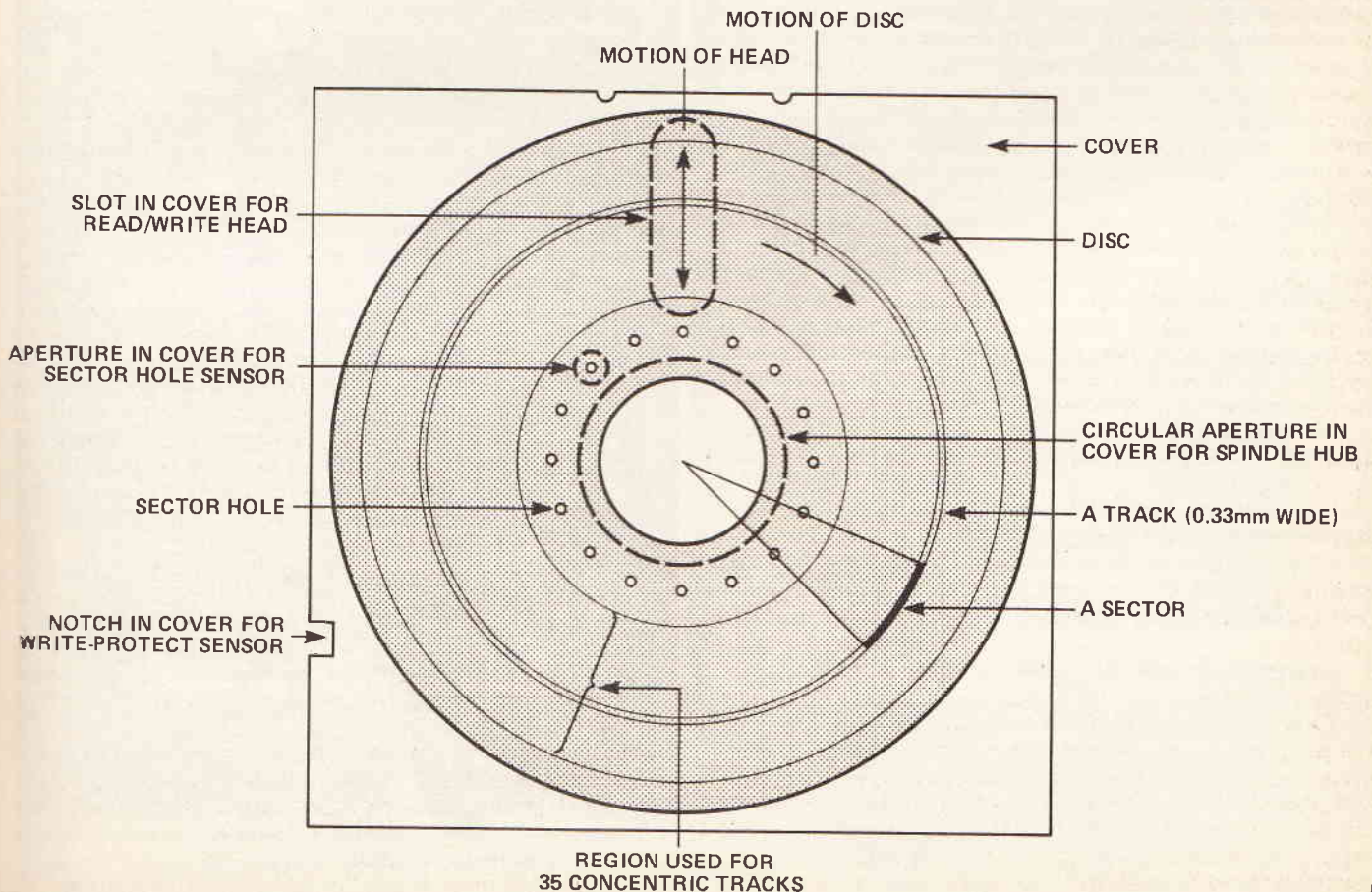
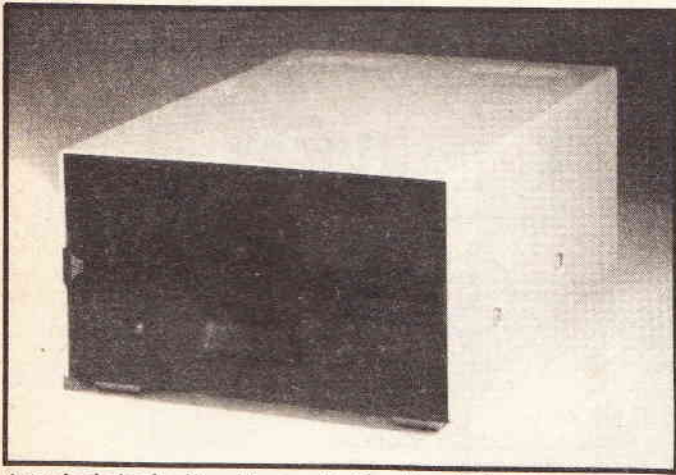


Fig. 5 'See-through' diagram of a hard sectored floppy diskette in its cover. Normally, of course, you cannot see the disc itself.



A typical single disc drive unit. The disc (still in its cover) is inserted in the slot which runs almost the full width of the case. The LED is lit to indicate when the drive is in operation.

to the other, the head can go directly to the track, then to the sector within the track, to find what is required. Changing from one track to another is effected by a stepper motor connected to a worm gear which moves the head radially. The signals from the sector hole sensor tell the drive when the required sector is in position to be read from or written to.

Naturally, the operation of the drive cannot be manual. The drive contains a complicated array of electronics (see photo) to control the disc, the stepper motor, the raising and lowering of the head, as well as those circuits responsible for handling the signals which are to be put on to the disc or have been taken from it. Synchronising these operations requires an impressive amount of logic circuitry: some of the more advanced disc drives even incorporate a microprocessor to take charge of the operation. This has several advantages, especially with a soft-sectored disc. The rate at which the medium passes the head depends on the radial distance from the centre: consequently data is more compressed on the inner tracks and widely spaced on the outer tracks. For reliability, it is the speed on the innermost track which limits the maximum rate of data transfer. Using a microprocessor, it is possible to perform rapid calculations which allow the drive to vary the rate of data transfer according to the radial position of the head. Data is stored at *about* the same density on all tracks but the outer tracks can have more sectors, so the overall storage capacity of the disc is markedly increased.

On the whole, the standard method of storage is adequate. A $5\frac{1}{4}$ " mini-diskette may have 31 tracks each of 16 sectors, and each sector stores 256 bytes. This gives a total storage of 124 kilobytes on a single-sided disc. Double-sided discs store twice this amount, and the capacity can be further increased by using 'double density' discs in which there are almost twice as many tracks, placed closer together.

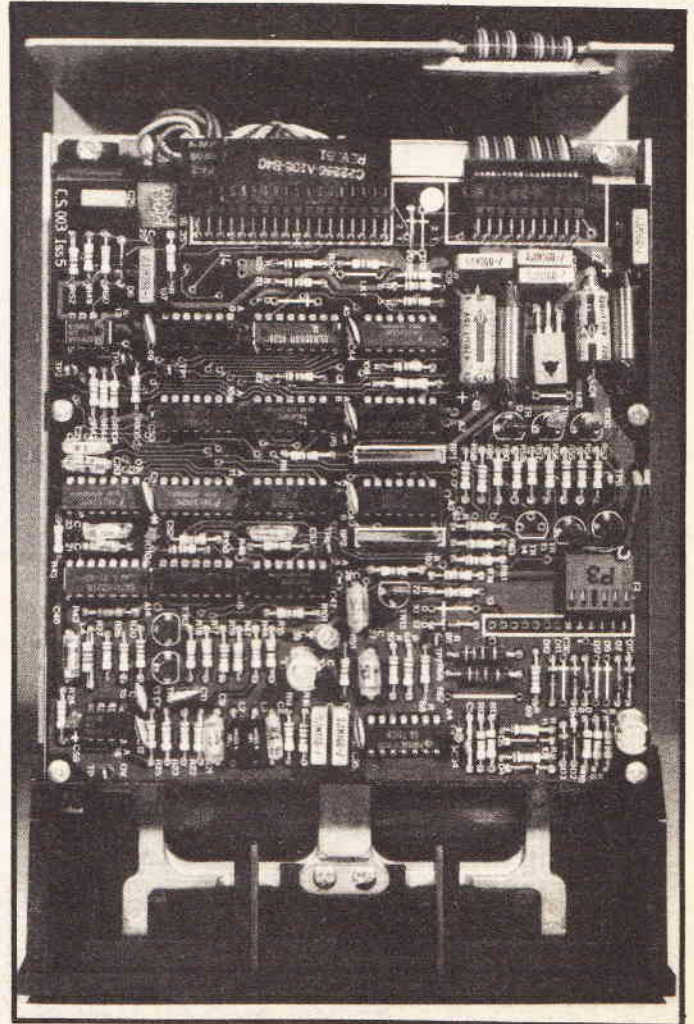
Keeping Track Of The Tracks

The disc referred to above which has 31 tracks available for storage of data or programs also has four additional tracks reserved for use by the disc operating system. In order to make efficient use of the disc space, in which items of data may be continually being written, replaced, and deleted, it is essential for a large amount of 'book-keeping' to be done. The system must know on which sector of which track each item has been placed. Items longer than 256 bytes occupy more than one sector,

so the system must know how to direct the head from sector to sector to pick up all the data in the correct order.

The reserved tracks contain an index or directory of the contents of the disc so that the whereabouts of every item of data is known. The directory also helps the head to find vacant sectors when a new item of data is to be placed on the disc. The reserved tracks also hold a special program, the disc operating program, which is loaded into RAM when the micro is first powered up. This provides the instructions for accessing the directory tracks and obtaining whatever information is required, and for placing new information on the disc. This program (provided it is well written, which some are not) together with the hardware of the disc drive itself, completely automates the transfer of information between micro and magnetic storage medium. The operator is almost unaware of what is happening except for the comforting clunks and whirrs emanating from the drive. With a well-made drive and by observing a few simple precautions in gentle handling of the discs themselves, the reliability is far higher than with tapes, making this a relatively expensive but infinitely preferable method of data storage.

In concluding this series, we would like to thank Cumana Ltd., 35 Walnut Tree Close, Guildford, Surrey GU1 4UN, for helpful information and for permission to reproduce the photograph of their circuit-board for the Siemens drive, as adapted for use with the Apple II computer.



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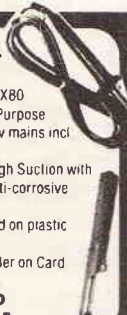
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PROGRAMMABLE STAGE LIGHTING PART 2

In the second part of this project, we look at the construction for the first of the boards, as well as some alterations to last month's circuits for improved performance. Design by David Colven and Ian Cleverley.

Before moving on to the constructional details for this project, mention must be made of some alterations and improvements to the circuits we published last month. The first of these is on the memory board (Fig. 4 of last month): the output of IC21a (clock signal PC) must be inverted before passing into IC14, and this may be accomplished by using one of the spare gates in IC21 as an inverter.

The second change is more extensive, and consists of an improvement in the digital-to-analogue circuit in the auto-fade

unit (Fig. 6 last month). Because of the extent of the modification, we have reproduced the circuit diagram (see Fig. 1) to show the new system. This has involved a bit of renumbering, but the overlays and Parts List match. Also we showed two R70's last month. Let's call the one near IC30 R62. Sorry!

DAC Mark II

As before, the brightness of the lamps is controlled by the three bits latched on the outputs from IC31 (on pins 16, 15 and 10), but in the new circuit these are fed directly into the inputs of IC37, a 4028B

BCD-to-decimal decoder. This IC will send one of its outputs high depending on the binary number present on its inputs; in this case we are only using the three least significant bits and the D input (pin 11) is tied to ground.

Thus when light level data is latched into IC31, one of the outputs ('0' to '7') of IC37 will go high, producing a voltage at the inverting input of the voltage comparator IC29 via one of the blocking diode/preset pairs. With this system, the required voltage level for each binary input may be individually set to the correct value

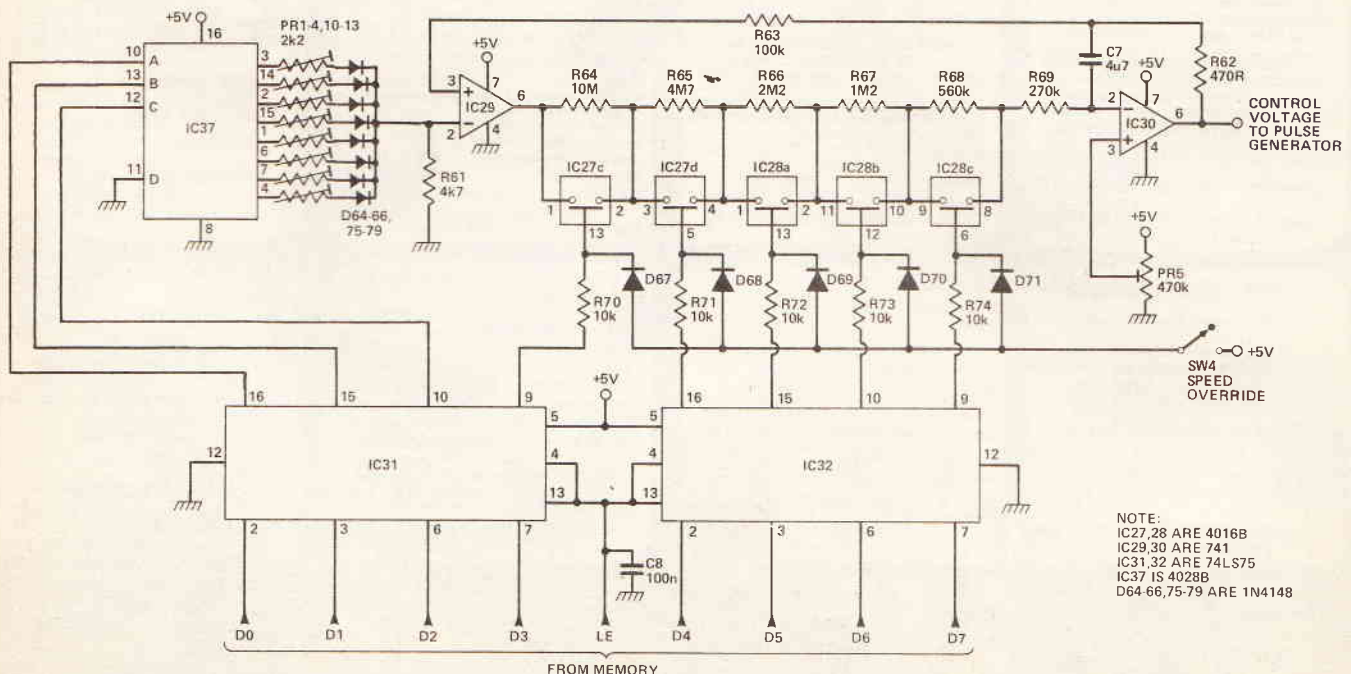


Fig. 1 This modified auto-fade unit offers an improved performance and easier setting up.

(as described last month, phase switching needs a non-linear response). Table 1 summarizes the conversion in order of increasing brightness and shows which preset to adjust for each value: although this requires an extra four presets, the resulting setting-up procedure is much simpler and gives better independent control over the eight levels. The full power setting (level 7) is also better.

Construction

The prototype stage lighting unit was built for use in school productions and most of the units were salvaged from ex-government equipment, so the techniques used are not generally applicable. However, we can offer some guidelines and in any case, most constructors will want to alter things to suit their own particular situation.

If a sufficiently large case can be found (or made — it doesn't require much skill at carpentry to produce good results), then the ideal approach is to put the main memory board, manual controls, scene change switches, programming keypad, auto-fade boards and the first two power supplies into one enclosure. To make operation of the unit more convenient, you should try to get one of the sloping-front desk versions. If you are going to use the keypad as a separate hand-held unit, there are plenty of small cases available that will suit the task admirably.

If you can't get a case big enough, or find it more convenient to split things up, then the main memory and manual controls, etc, can be in the desk-top case with the auto-fade units rack-mounted separately. In this case (pun unintended), the auto-fade cards could be connected by edge connectors to a backplane which in turn is connected to the control console by some (very) multi-way cable or ribbon cable.

The power triac and suppressor circuits can also be wall-mounted in

BRIGHTNESS LEVEL	CODE			CURRENT SOURCE	VOLTAGE MEASURED AT IC30 PIN 6
	Q ₂	Q ₁	Q ₀		
0	0	0	0	PR1	1.75
1	0	0	1	PR2	2.5
2	0	1	0	PR3	2.75
3	0	1	1	PR4	2.85
4	1	0	0	PR10	3.00
5	1	0	1	PR11	3.15
6	1	1	0	PR12	4.00
7	1	1	1	PR13	4.25

a rack system, although edge connectors would not be able to take the high currents involved in this section of the circuit. The live and neutral connections must have a high current bus for the common connections to the light power circuits: for example, the neutral busbar (RS 335-609) is ideal, if you can get hold of it through a local stockist.

Sockets for the lighting circuits can be mounted on the main power case, with a 10 A fuse for each channel as shown in the circuit diagram last month. The main power control unit will, of course, have to have a 120 A isolation switch and suitable fuse. The delta capacitor network and choke combination is there to eliminate most of the mains-borne interference, and the coil consists of 14 turns of 15 A cable on a $\frac{3}{8}$ " ferrite rod: bear in mind, however, that you'll never get rid of all the interference, so be careful where you put your mikes, amps and pickup cables.

Each triac is heatsinked at about 1.5-2° C/W. The prototype used a 150 mm square of 16 gauge aluminium sheet which seemed more than adequate, but do make sure that the power unit has sufficient ventilation top and bottom and mount the fins vertically. **WARNING:** the lamps and all the triac wiring is live and it is recommended that the whole unit is isolated if any work is to be done on gantries etc. We also recommend that if you hire extension cables or lamps for your production (or even if you don't!), check them thoroughly, preferably with the correct type of instrument (not a megger or you'll be buying lost of new triacs). The authors had one cable once where someone had connected all three wires, live, neutral and earth, to the earth terminal in the socket! That eliminated four triacs in a rather bright flash.

PARTS LIST

KEYPAD AND SCENE SELECTOR

Resistors (all $\frac{1}{4}$ W, 5%)
R51-60 470R

Semiconductors
D1-63 1N4148

Miscellaneous
PB1-9 push-to-make switches
SW2, 3 1 pole 10 way rotary switches
PCB (see Buylines); case to suit (see text).

Next month we shall be publishing the remaining overlays and parts lists, together with the setting up instructions.

NOTE

Dr. David Colven B.Sc. Ph.D. is head of Physics and Electronics at St. Birinus' School, Didcot. Ian Cleverley is a fifth form pupil at the school. The design presented here is based on their entry to the Hobby Electronics Wales and West Schools' Electronic Project Competition last year.

BUYLINES

Most of the components used in this project are completely standard and should be available from any mail order supplier of electronic components. The push-buttons were keyboard switches from Maplin but other types could be wired to the board. The PCBs will be available from our PCB Service from next month.

PROJECT: Stage Lighting

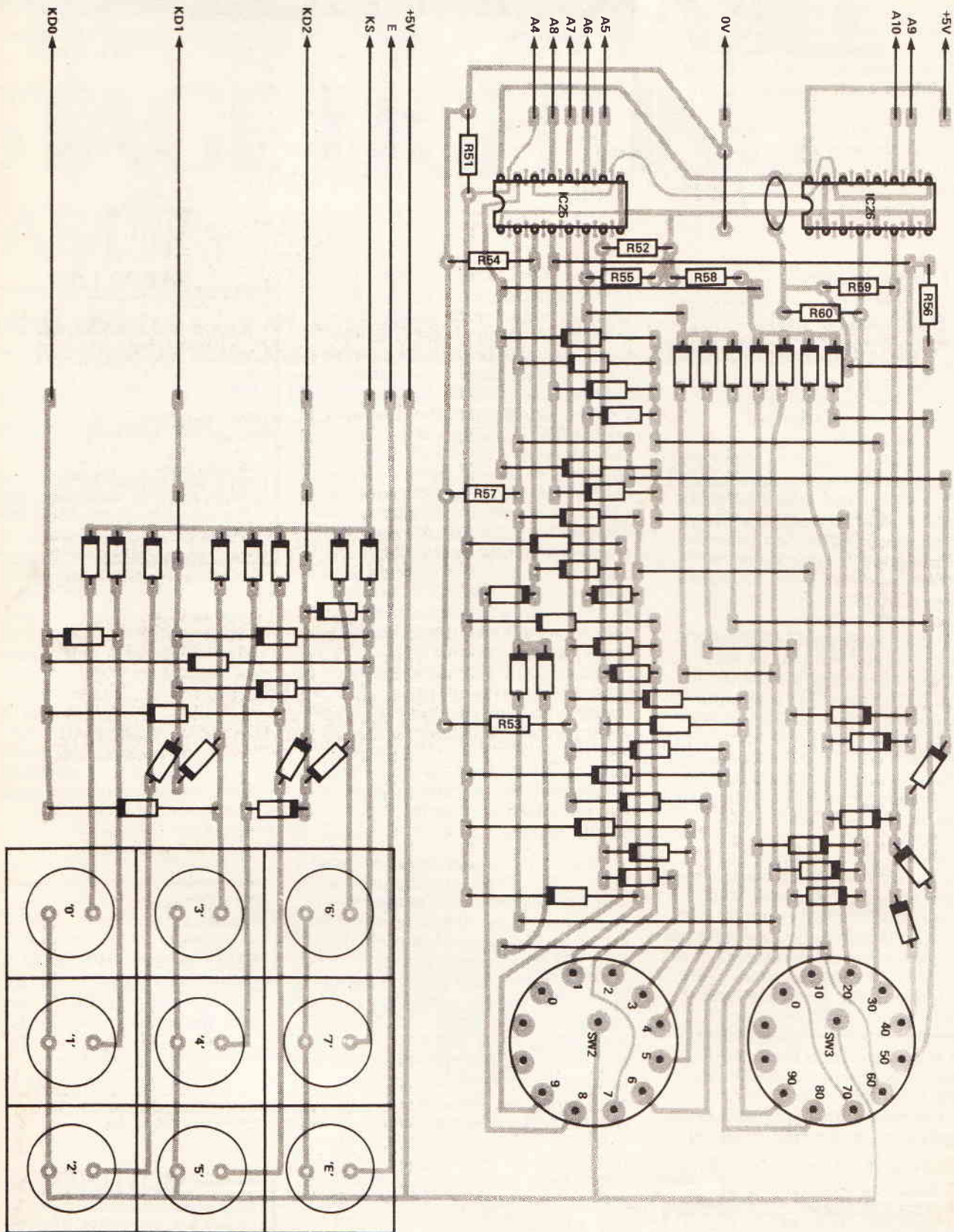
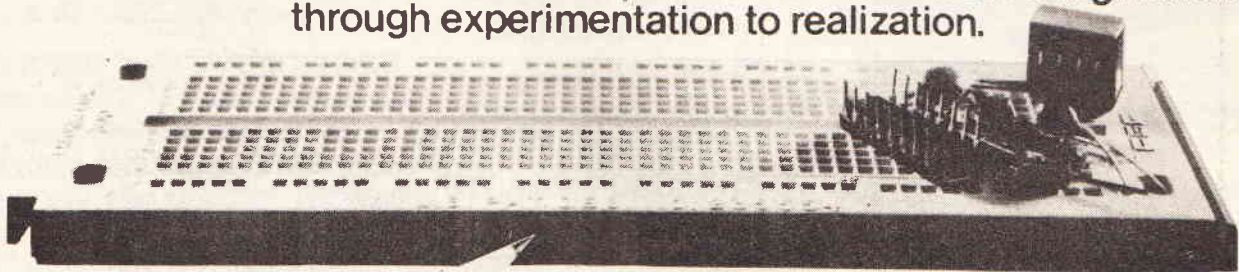


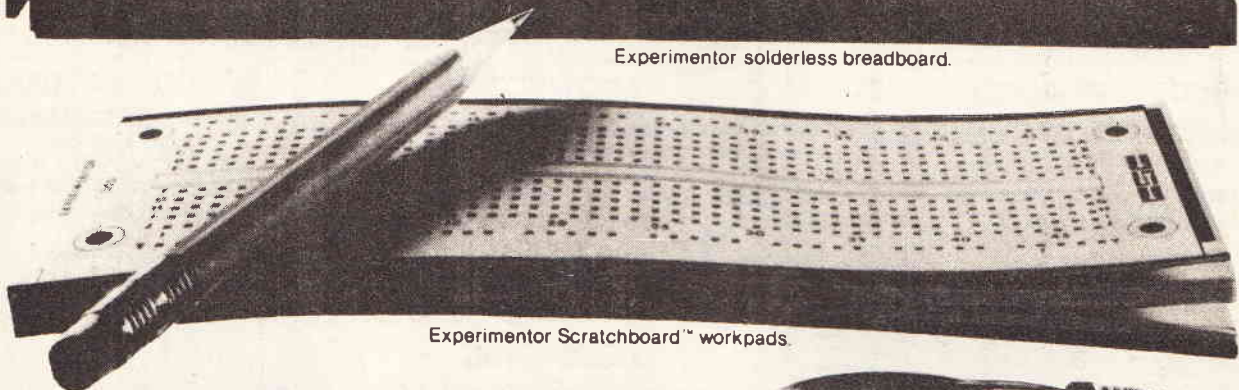
Fig. 2 The overlay for the keypad controller and the scene selector switches. This has been designed as one board, but if your layout requires it, the PCB may be cut up the middle. Two 5 V connections are provided for this possibility. All the diodes are 1N4148s and the unmarked capacitor near IC26 is a 100n polycarbonate or ceramic smoothing capacitor that you may find it necessary to fit.

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34	200p	180p	380p
49	220p	190p	550p
50	235p	200p	600p

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4in Ribbon Cable with headers	14 pin	16 pin	24 pin	40 pin
1 end	145p	165p	240p	380p
2 ends	210p	230p	345p	540p
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1 end	180p	210p	270p	300p
2 ends	290p	385p	490p	540p
24in Ribbon Cable with D. Conn	25 way Male	500p	Female	600p

CONNECTOR SYSTEMS

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34 way	220p
40 way	285p
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D-CONNECTORS

8 way	15 way	25 way	37 way
MALE			
Solder	90p	130p	180p
Angled	180p	230p	285p
FEMALE			
Solder	110p	160p	210p
Angled	175p	240p	310p
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41617 21 way	170p	170p	2x18 way	- 140p
41617 31 way	180p	180p	2x22 way	200p
41612 2 x 32 way	250p	320p	2x23 way	210p
Angled 2x32 way	325p	375p	2x25 way	225p
41612 3x32 way	275p	380p	1x43 way	280p
Angled 3x32 way	- 400p	-	2x43 way	395p
2x32 way zidc a + c	- 525p	-	1x77 way	-
(for 2x32 way specify a + b or a + c)	-	-	2x50 way	700p
			1x77 way	- 600p

EDGE CONNECTORS

0.1in		0.156in
2114L	80p	250p
2716 (+5v)	80p	350p
2532	80p	450p
4116-2	80p	450p
4164-2	80p	450p
6116P-3	80p	350p

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This is not a logic analyser or
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stock. As for our list.

PLEASE SEND SAE FOR PRICE LIST

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7402	11p	74221	55p	74LS251	35p	4019	25p	AN103	200p	LM381AN	180p	RC4136	80p	1802CE	650p	TMS2716	750p	CRYSTALS	
7403	12p	74259	100p	74LS252	30p	4020	48p	AY-1-0212	100p	LM382	120p	RC4151	200p	2650A	£12	8728	120p	32.768KHz	100p
7404	12p	74265	45p	74LS258	35p	4021	40p	AY1-1313	600p	LM386	90p	S5668	225p	6502	350p	8735/96	90p	100KHz	250p
7405	12p	74273	120p	74LS260	30p	4022	45p	AY1-1322	225p	LM387	120p	SAA1800	£18	6502A	300p	81LS59/96	90p	200KHz	280p
7406	18p	74276	90p	74LS261	35p	4023	13p	AY1-5050	90p	LM389	95p	SFF9634	600p	6800A	225p	9602	220p	Freq in Mhz	
7407	18p	74278	100p	74LS262	20p	4024	32p	AY3-1270	625p	LM389	95p	SL490	90p	6809	650p	9602	220p	200KHz	280p
7408	14p	74279	40p	74LS263	20p	4025	13p	AY3-1350	400p	LM392N	60p	SN76131	125p	6809A	£12	9602	220p	200KHz	280p
7409	14p	74283	50p	74LS264	20p	4026	20p	AY3-8910	400p	LM393	100p	SN76131	125p	6809B	£12	9602	220p	200KHz	280p
7410	14p	74284	160p	74LS270	225p	4027	20p	AY3-8910	400p	LM393	100p	SN76131	125p	6809C	£12	9602	220p	200KHz	280p
7411	16p	74285	160p	74LS275	30p	4028	45p	AY3-8910	400p	LM393	100p	SN76131	125p	6809D	£12	9602	220p	200KHz	280p
7412	14p	74290	80p	74LS280	40p	4029	45p	AY3-8910	400p	LM393	100p	SN76131	125p	6809E	£12	9602	220p	200KHz	280p
7413	14p	74293	80p	74LS283	40p	4030	15p	AY3-8910	400p	LM393	100p	SN76131	125p	6809F	£12	9602	220p	200KHz	280p
7414	18p	74298	100p	74LS284	40p	4031	125p	AY4007D	£8	LM710	50p	SN76680	120p	6809G	£12	9602	220p	200KHz	280p
7415	18p	74351	150p	74LS285	40p	4032	80p	CA3028A	£8	LM711	50p	SN76680	120p	6809H	£12	9602	220p	200KHz	280p
7416	18p	74365	30p	74LS297	30p	4033	125p	CA3019	80p	LM733	60p	SP815	750p	6809I	£12	9602	220p	200KHz	280p
7417	18p	74366	30p	74LS298	90p	4034	45p	CA3046	70p	LM741	18p	TA7120	150p	6809J	£12	9602	220p	200KHz	280p
7418	18p	74367	30p	74LS299	90p	4035	45p	CA3048	220p	LM747	70p	TA7130	150p	6809K	£12	9602	220p	200KHz	280p
7419	20p	74368	30p	74LS300	100p	4036	275p	CA3048	220p	LM747	70p	TA7200	200p	6809L	£12	9602	220p	200KHz	280p
7420	20p	74376	100p	74LS301	100p	4037	110p	CA3059	285p	LM748	35p	TA7202	200p	6809M	£12	9602	220p	200KHz	280p
7421	20p	74380	100p	74LS302	100p	4038	290p	CA3080	350p	LM748	35p	TA7202	200p	6809N	£12	9602	220p	200KHz	280p
7422	20p	74390	75p	74LS303	100p	4039	290p	CA3080E	350p	LM748	35p	TA7202	200p	6809O	£12	9602	220p	200KHz	280p
7423	18p	74392	90p	74LS304	100p	4040	40p	CA3086	48p	LM1801	300p	TA7202	200p	6809P	£12	9602	220p	200KHz	280p
7424	18p	74430	90p	74LS305	100p	4041	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809Q	£12	9602	220p	200KHz	280p
7425	18p	74430	90p	74LS306	100p	4042	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809R	£12	9602	220p	200KHz	280p
7426	18p	74430	90p	74LS307	100p	4043	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809S	£12	9602	220p	200KHz	280p
7427	18p	74430	90p	74LS308	100p	4044	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809T	£12	9602	220p	200KHz	280p
7428	18p	74430	90p	74LS309	100p	4045	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809U	£12	9602	220p	200KHz	280p
7429	18p	74430	90p	74LS310	100p	4046	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809V	£12	9602	220p	200KHz	280p
7430	18p	74430	90p	74LS311	100p	4047	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809W	£12	9602	220p	200KHz	280p
7431	18p	74430	90p	74LS312	100p	4048	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809X	£12	9602	220p	200KHz	280p
7432	18p	74430	90p	74LS313	100p	4049	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809Y	£12	9602	220p	200KHz	280p
7433	18p	74430	90p	74LS314	100p	4050	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809Z	£12	9602	220p	200KHz	280p
7434	18p	74430	90p	74LS315	100p	4051	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809AA	£12	9602	220p	200KHz	280p
7435	18p	74430	90p	74LS316	100p	4052	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809AB	£12	9602	220p	200KHz	280p
7436	18p	74430	90p	74LS317	100p	4053	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809AC	£12	9602	220p	200KHz	280p
7437	18p	74430	90p	74LS318	100p	4054	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809AD	£12	9602	220p	200KHz	280p
7438	18p	74430	90p	74LS319	100p	4055	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809AE	£12	9602	220p	200KHz	280p
7439	18p	74430	90p	74LS320	100p	4056	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809AF	£12	9602	220p	200KHz	280p
7440	18p	74430	90p	74LS321	100p	4057	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809AG	£12	9602	220p	200KHz	280p
7441	18p	74430	90p	74LS322	100p	4058	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809AH	£12	9602	220p	200KHz	280p
7442	18p	74430	90p	74LS323	100p	4059	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809AJ	£12	9602	220p	200KHz	280p
7443	18p	74430	90p	74LS324	100p	4060	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809AK	£12	9602	220p	200KHz	280p
7444	18p	74430	90p	74LS325	100p	4061	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809AL	£12	9602	220p	200KHz	280p
7445	18p	74430	90p	74LS326	100p	4062	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809AM	£12	9602	220p	200KHz	280p
7446	18p	74430	90p	74LS327	100p	4063	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809AN	£12	9602	220p	200KHz	280p
7447	18p	74430	90p	74LS328	100p	4064	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809AO	£12	9602	220p	200KHz	280p
7448	18p	74430	90p	74LS329	100p	4065	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809AP	£12	9602	220p	200KHz	280p
7449	18p	74430	90p	74LS330	100p	4066	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809AQ	£12	9602	220p	200KHz	280p
7450	18p	74430	90p	74LS331	100p	4067	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809AR	£12	9602	220p	200KHz	280p
7451	18p	74430	90p	74LS332	100p	4068	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809AS	£12	9602	220p	200KHz	280p
7452	18p	74430	90p	74LS333	100p	4069	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809AT	£12	9602	220p	200KHz	280p
7453	18p	74430	90p	74LS334	100p	4070	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809AU	£12	9602	220p	200KHz	280p
7454	18p	74430	90p	74LS335	100p	4071	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809AV	£12	9602	220p	200KHz	280p
7455	18p	74430	90p	74LS336	100p	4072	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809AW	£12	9602	220p	200KHz	280p
7456	18p	74430	90p	74LS337	100p	4073	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809AX	£12	9602	220p	200KHz	280p
7457	18p	74430	90p	74LS338	100p	4074	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809AY	£12	9602	220p	200KHz	280p
7458	18p	74430	90p	74LS339	100p	4075	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809AZ	£12	9602	220p	200KHz	280p
7459	18p	74430	90p	74LS340	100p	4076	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809BA	£12	9602	220p	200KHz	280p
7460	18p	74430	90p	74LS341	100p	4077	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809BB	£12	9602	220p	200KHz	280p
7461	18p	74430	90p	74LS342	100p	4078	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809BC	£12	9602	220p	200KHz	280p
7462	18p	74430	90p	74LS343	100p	4079	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809BD	£12	9602	220p	200KHz	280p
7463	18p	74430	90p	74LS344	100p	4080	40p	CA3086E	48p	LM1801	300p	TA7202	200p	6809					

OSCILLOSCOPE UPDATE

From the large number of letters we've received on the topic, we gather that there was a lot of interest in the oscilloscope project we published in May, June and July last year; we gather that there were also a few problems over some of the components which we hope this follow-up will sort out.

Resistors

There were some unusual values, weren't there? All the following substitutions are well within the 1% tolerance specified.

Component	Specified	Substitute
R3	90k9	91k
R4, R19	909k	910k
R7, 8, 49	2k05	2k0 + 47R*
R18	332k	330k
R21	500k	1M0/1M0
R45	40k2	39k + 1k2*
R46	20k5	20k + 470R*
R48	4k02	3k9 + 120R*

All resistors except those marked with a * should be 1% metal film. Those marked with a * can be 5% tolerance because they are low value resistors in series with much higher value ones. The higher value one of the pair must, of course, be a 1% tolerance type.

Trimmer Capacitors

Any trimmer that covers the range of values specified may be used; for instance, CV1a is specified as 5-20p so a 3-30 type would do (it must have a sufficiently high voltage rating). Depending on the size of signal you intend to apply to

the 'scope, some of the voltage ratings of the trimmers may be reduced, but this probably is not a good idea unless you know exactly what you want to use the 'scope for (in any case, it probably wouldn't save much money).

Semiconductors

IC1 (μ A733) is available from Verospeed, Stanstead Road, Boyatt Wood, Eastleigh, Hants SO5 4ZY, for 89p (including VAT and p&p). Alternatively, the LM 733 is equivalent and is fairly widely available. Q1 was specified as E430, but U430 is equivalent, and is available from Cricklewood Electronics for £5.60 (plus VAT and postage — see their ad. for ordering details).

D9-12 were specified as BA158 (ITT) but we have successfully used BY207s, and these, as well as BAV20s (D13-16) are also available from Cricklewood.

Switches

Both wafer switches can be made up using wafer switch kits, available from Maplin, or through anyone who deals with RS

Components Ltd (such as your local friendly TV repair shop). SW1 — use five 1p 12w plus two 4p 3w wafers (see Fig. 1 for wiring details). SW3 — use two 1p 12w wafers.

Pot Core

The original pot core is not now available here; however, Neosid of PO Box 86, Welwyn Garden City, Herts AL7 1AS make a similar type. Order it as ET30 kit. Total price is £1.50 including VAT and p&p. Other pot cores are not likely to work, because a particularly large inductance factor is needed. In any case, depending on the current gain of the actual BD135s used for Q18 and Q19, some trimming of the values of R73 and C28 may be necessary.

Note that the phasing between the transformer primary, T1a and the feedback secondary, T1b is important. If it is wrong, the circuit around the pot core won't oscillate, and Q18 and Q19 will just sit there getting hotter and hotter until they burn out.

Wire sizes are often quoted in SWG sizes value than mm. The nearest equivalents are: 1mm: 42 swg; 3mm: 30 swg; 4mm: 27 swg.

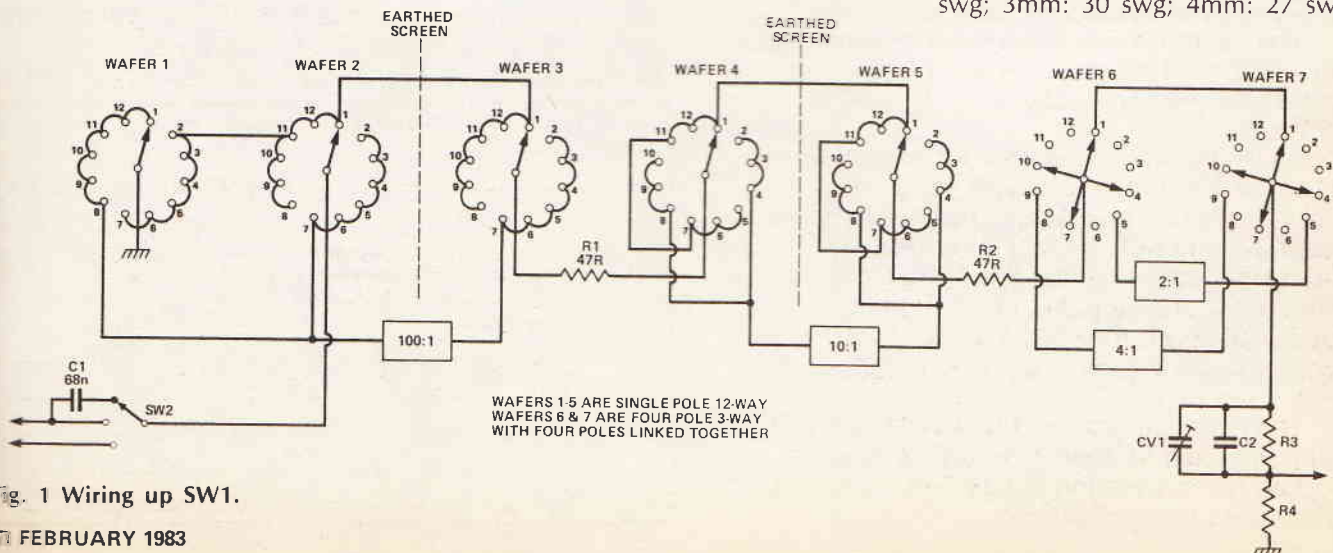


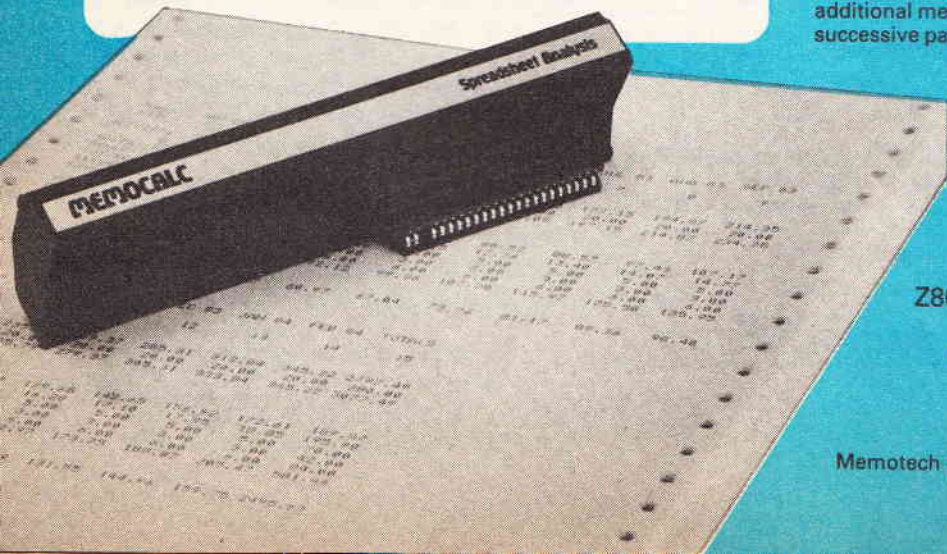
Fig. 1 Wiring up SW1.



MEMOPAK 16K For those just setting out on the road to real computing, this pack transforms the ZX81 from a toy to a powerful computer. Data storage, extended programming and complex displays become feasible. For even greater capacity, memory packs can be added together (16 + 16 + 16K or 16 + 32K). The MEMOPAK 32K and the MEMOPAK 64K offer large memories at economical prices.

MEMOTECH

MEMOCALC The screen display behaves as a 'window' on a large sheet of paper on which a table of numbers is laid out. The maximum size of the table is determined by the memory capacity, and with a MEMOPAK 64K a table of up to 7000 numbers with up to 250 rows or 99 columns can be specified. Each location in the table can be either a number which is keyed in or a formula which generates a number. Every time the command 'calculate' is given, all the formulae in the table are re-evaluated. Spreadsheet analysis started as an aid to cash-flow analysis, but this powerful tool has now been generalised and MEMOCALC with its special ability to perform iterative calculations is invaluable in the performance of numerical tasks.



The Memotech approach to microcomputing is to take the well-proven and popular ZX81 as the heart of a modular system. This small computer houses the powerful Z80A processing unit and acts as the central processor module through which the MEMOPAKS operate.

Memotech has a reputation for professional quality, producing units which are designed to fit perfectly, to look well-balanced, and to work efficiently and reliably.

The modular approach gives ZX81 owners the freedom to design the system they really need. Furthermore, the intercompatibility of the modules ensures that later additions will click straight in, to give you a system that grows with your ambitions and abilities.

As one example, a system with 16K of memory and MEMOCALC is all that is required to perform sophisticated numerical calculations giving the same results as a computer at 10 times the price. The problem may be as complicated as a cash flow or production schedule, or as simple as household accounts or pocket money budgeting. If the bank manager wants to see the cash flow, then a single print instruction to the Centronics I/F will give a printout which is more than acceptable to any bank.

The example system which is shown, on the other hand, would satisfy the needs of someone who wanted to enter data via a light-touch keyboard, construct and label graphs, and then copy the screen to an 80-column printer. Only 16K of memory is used here but with additional memory, more than one video page can be stored. Up to 7 successive pages can be displayed cyclicly to give animated displays.

16K	£26.00 +	£3.90 VAT	£29.90
32K	£43.43 +	£6.52 VAT	£49.95
64K	£68.70 +	£10.30 VAT	£79.00
HRG	£34.70 +	£5.20 VAT	£39.90
C/I/F	£34.70 +	£5.20 VAT	£39.90
MEMOCALC	£26.00 +	£3.90 VAT	£29.90
Z80 ASSEMBLER	£26.00 +	£3.90 VAT	£29.90
KEYBOARD			
WITH BUFFER	£43.43 +	£6.52 VAT	£49.95

Memotech products are available at larger branches of WHSMITH



MEMOPAK HRG This pack breaks down the constraints imposed by operating at the ZX81 character level and allows high definition displays to be generated. All 248×192 individual pixels can be controlled using simple commands, and the built in software enables the user to work interactively at the dot, line, character, block and page levels. Scrolling, flashing and animation are all here.



MEMOPAK Centronics I/F The BASIC commands LPRINT, LLIST and COPY are used to print on any CENTRONICS type printer. All ASCII characters are generated and translation takes place automatically within the pack. Reverse capitals give lower case. Additional facilities allow high resolution printing. The full capabilities of your printer are now under the control of the ZX81.

REALISES THE ZX81 POTENTIAL



MEMOPAK Z80 Assembler This click-in EPROM based pack accepts standard Z80 assembly language mnemonics to allow you to write faster and more compact programs. It has its own ADD, EDIT, LIST, ASSM and QUIT functions, the editor allowing insertion, deletion, automatic line renumbering and error checking. Source code and object code listings can be displayed and printed in decimal or hex format.



MEMOTECH Keyboard The light-touch positive stop keys of this elegant typewriter-pitch keyboard allow you to work faster, more accurately and more confidently. To speed you along we have added an extra SHIFT key to the array at top right. The keyboard is attached by a cable to the Keyboard Buffer which fits in amongst your other Memopaks or straight onto the back of your ZX81.

To ensure that your expectations are realised, care is taken at every stage to design features into the system to anticipate your frustrations and to forestall them. For example:

- 1) Memories are cumulative e.g. 16K and 32K can be added to the MEMOPAK 16K or even to the Sinclair 16K RAM pack.
- 2) The HRG firmware allows commonly used constructions (such as scrolling, shading and labelling graphs), which might otherwise be beyond the user's programming capabilities, to be evoked by a few simple commands.
- 3) The Centronics I/F converts ZX81 character codes into ASCII and expands the print line to the width of the printer, still using the LLIST, LPRINT and COPY commands.

Looking forward, Memotech will continue to back the ZX81 through the use of fast storage devices, pressure sensitive electronic drawing boards and more software packs including a wordprocessor and an RS-232 interface.

MEMOPAKS may be ordered by post (cheque, Access/Barclaycard or credit card number) or by telephone. Please make cheques payable to Memotech Ltd. and please include £2.00 per unit for packaging and postage inland (overseas £3.00).

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CORTEX BASIC

The BASIC used on the Cortex contains many statements which will be unfamiliar to readers who are used to Microsoft. Beginning this month, we'll be taking a brief look at the keywords and their functions. This month: graphics.

BASIC on the Cortex is a derivative of Texas Instruments' Power BASIC, with some additional keywords necessary to make use of some of the features of the Cortex. Some of these involve the graphics commands which we are making the basis of this article.

The video display processor in the Cortex is, in fact, capable of four display modes, but only two of these are implemented by the BASIC. The two types of display are accessed by the TEXT and GRAPH commands.

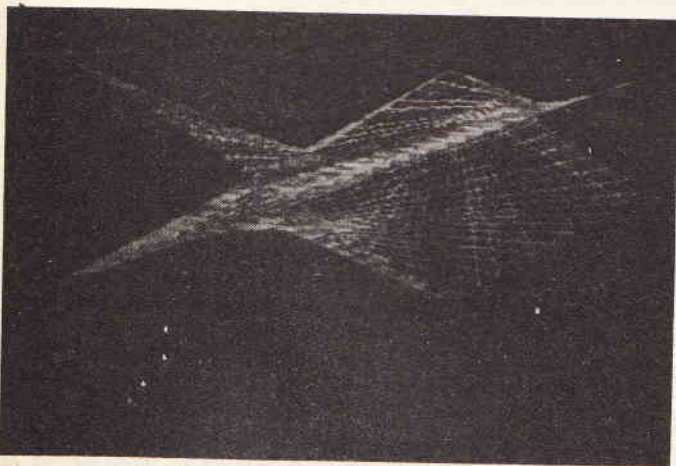
TEXT

The TEXT mode provides 24 40-character rows in two colours and is intended to maximise the capacity of the TV screen to display alphanumeric characters. A diagram of the screen in this mode is shown in Fig. 1. The character cell number is equal to the horizontal position (0 to 39) plus 40 times the vertical position (0 to 23). The only items that may be displayed in this mode are the alphanumeric character set, which are defined on a six by eight grid of pixels (six pixels across, eight pixels down). There are a possible 256 patterns that can be displayed and on power-up these are defined by the BASIC in the EPROM. Examining the characters shows that the first 32 are symbolic representations of the corresponding ASCII control codes, the next 64 are standard upper case ASCII, the next 32 are 'small capitals' rather than lower case ASCII (these small capitals are used in the error messages), and the remaining 128 characters are not assigned any meaningful pattern.

However, any or all of these character patterns may be changed by using the CHAR command. This has the format

CHAR arg1, arg2, arg3, arg4

where arg1 is the number of the character to be changed (0 to 255), and arg2, arg3 and arg4 define the new bit pattern for the



This photograph shows lines plotted in GRAPH mode. The pixel resolution is 256 by 192 but the limitation on colour means some areas (noticeably to the left of the shape) get 'blocked in' colour.

character. These arguments are 16-bit numbers and define the character row by row from top to bottom, with a 1 producing the foreground colour and a 0 producing the background colour. For example, if you type CHAR32,20,20,20: TEXT then your screenful of 'spaces' suddenly develops freckles! (Incidentally, executing TEXT clears the screen and homes the cursor).

Another fun thing to do (although completely pointless!) is to scramble the character set using random numbers. Try

```
10 FOR I = 0 TO 255
20 CHAR I, RND*255,RND*255,RND*255
30 NEXT I
40 TEXT
```

and then type in LIST after running the program. Not so easy to read, eh? To get back the original patterns, just execute a reset with the switch on the rear and the Cortex will re-load the character table from the EPROM.

GRAPH

In GRAPH mode the screen dimensions change to that shown in Fig. 2, a grid of cells 32 by 24. The character cell number is given by the horizontal position (0 to 31) plus 32 times the vertical position (0 to 23). In addition, the screen may also be considered to consist of individual pixels (256 across by 192 down). Thus, each character cell in this mode is eight by eight pixels in size, offering a better pattern resolution than the six by eight pixels of TEXT mode.

As in TEXT mode, executing the GRAPH statement will clear the screen and home the cursor, which in graph mode is an invisible pixel cursor. An alternative method of clearing the screen is to use the program statement

```
PRINT "<OC>"
```

which has the advantage of wiping off any text messages or plotted lines but leaving sprites unaffected. The reason why this statement works will be covered in a future article: suffice it to say that the statement executes the ASCII control code for Clear Screen.

Pixels are numbered from 0 to 255 horizontally and from 0 to 191 vertically. The origin is at the top left-hand corner of the screen as shown in Fig. 2.

PLOT AND UNPLOT

The PLOT statement is used to turn on individual pixels on the text/graphic plane. The basic format is

```
PLOT arg1,arg2 TO arg3,arg4
```

By leaving out various parts of the statement, different actions can be performed. If the entire statement is executed, then a line is drawn in the current foreground colour from the pixel co-ordinates given by arg1 and arg2 (arg1 = horizontal, arg2 = vertical) to the pixel co-ordinates given by arg3, arg4. The in-

0	1	2	3	4	5			37	38	39
40	41	42	43	44	45			77	78	79
80	81	82	83	84	85			117	118	119
880	881	882	883	884	885			917	918	919
920	921	922	923	924	925			957	958	959

Fig. 1 Screen position map for the Cortex in TEXT mode. Here the screen is divided into a 40 by 24 grid which can only display the character set — sprites are not possible in this mode.

0,0	0	1	2	3	4	5				255,0		
	32	33	34	35	36	37			61	62	63	
	64	65	66	67	68	69			93	94	95	
	704	705	706	707	708	709			733	734	735	
0,191	736	737	738	739	740	741			765	766	767	255,191

Fig. 2 The screen position map for the Cortex in GRAPH mode. The grid is now 32 by 24 squares and each square may contain members of the character set or the shape table. In addition, up to 32 sprites may be displayed using the shape table patterns, and individual pixels may be set or reset.

visible pixel cursor is left at arg3, arg4 (horizontal, vertical).

If arg1, arg2 are omitted, ie PLOT TO arg3, arg4, then a line is drawn from the current graphic cursor position to the co-ordinates given by arg3, arg4. If the TO arg3, arg4 part of the statement is omitted, ie PLOT arg1, arg2, then the single pixel specified by the co-ordinates arg1, arg2 is set to the current foreground colour. The UNPLOT statement has the same format and variants as the PLOT statement except that the line or pixel is removed instead of being plotted.

COLOUR, COL

Colours may be set up in TEXT or GRAPH mode by means of the COLOUR statement. The format for this is

COLOUR foreground colour, background colour

The two colour arguments can take the values 0 to 15, the corresponding colours being given in Table 1, Cortex Part 1, November 82 issue. If the foreground colour only is given, eg COLOUR 6, then the current background colour is used.

Two colours only are allowed in TEXT mode. Executing a COLOUR statement in a program or in immediate mode will recolour the entire display. By contrast, all 16 colours may be displayed at once in GRAPH mode, with the limitation that each horizontal line of eight pixels (ie one character cell width) can only have one foreground colour and one background colour. Try this program to see what this means:

```
10 COLOUR 4,7: GRAPH
20 COLOUR 1,13: PLOT 0,0 TO 255,191
```

The pixels in the text/graphic plane can be tested for their colour by reading the code into a variable using the COL function. The format is

```
var = COL arg1, arg2
```

where arg1, arg2 are the horizontal and vertical co-ordinates of the pixel to be tested. The variable var will now have a value equal to the colour code of the pixel.

SHAPE, SPRITE, MAG

The SHAPE statement is used to define one of 256 possible eight by eight pixel shape definitions. The format is

SHAPE arg1, arg2, arg3, arg4, arg5

where arg1 is the shape table entry to use (0 to 255), arg2 is the 16-bit integer pattern of the first and second row of the shape, arg3 gives the third and fourth rows, arg4 gives the fifth and sixth rows and arg5 gives the seventh and eighth rows. For arg2 to arg5 the most significant byte defines the first row and the least significant, the second row. For example, to define a solid block use SHAPE 2, -1, -1, -1, -1.

Once shapes have been defined they can be displayed on screen using the SPRITE command. Each sprite plane can hold one sprite, giving a maximum of 32 on screen at once, and if a sprite on a plane is rewritten into a new position the old one is automatically erased. The format for the statement is

SPRITE arg1, arg2, arg3, arg4, arg5

where arg1 is the sprite plane to hold the sprite (0 to 31), arg2 is the horizontal co-ordinate of the sprite's top left pixel, arg3 is the vertical co-ordinate of the sprite's top left pixel, arg4 is the shape number to use for the pattern (0 to 255) and arg5 is the sprite colour (0 to 15).

There are two limitations to the use of sprites. One is that only four sprites at a time may be displayed on a given horizontal line: an attempt to add a fifth will make the overlapping portion invisible. Try this program:

```
10 COLOUR 1,15: GRAPH: MAG 1,0
20 SHAPE 10, -1, -1, -1, -1
30 FOR T=1 TO 14
40 FOR I=1 TO 100
50 SPRITE T, I-T*2, I-T*2, 10, T
60 WAIT 1
70 NEXT I: NEXT T
```

The second limitation is that you can only use a sprite plane if all the ones above it have been used. Hence you must place your first sprite on plane 0, your second on plane 1 and so on. Of course, once a plane has been initialised in this way you can wipe it if necessary by setting its sprite to an all-zeros shape or setting its colour to transparent.

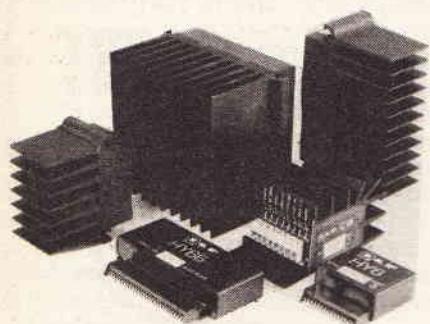
The MAG statement defines both the size and the definition of the sprites. The format is

MAG sprite magnification, sprite definition size

If the sprite magnification is 0 every bit in the shape definition used for the sprite will be displayed as one pixel. If the magnification is non-zero then each bit will be displayed as two pixels horizontally and vertically. If the definition size is zero then one shape table entry will be used to build the sprite. If it is non-zero then four entries will be used. These entries are joined in the following way to build a 16 by 16 point sprite: top left, shape n; bottom left, shape n+1; top right, shape n+2; bottom right, shape n+3, where n is the shape number given to the sprite statement. The shape table entries must start on a four entry boundary, so valid values of n are 0,4,8,12 etc.

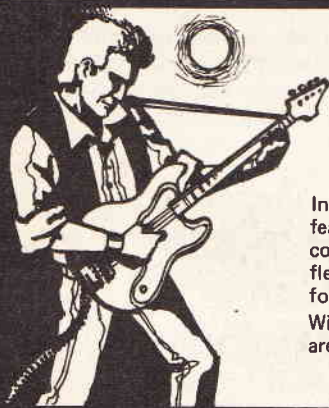
Note that the SHAPE, SPRITE and MAG statements will only work if the Cortex is in GRAPH mode.

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HY30	15	4-8	0.015%	<0.006%	± 18	76 x 68 x 40	240	£8.40
HY60	30	4-8	0.015%	<0.006%	± 25	76 x 68 x 40	240	£9.55
HY6060	30 + 30	4-8	0.015%	<0.006%	± 25	120 x 78 x 40	420	£18.69
HY124	60	4	0.01%	<0.006%	± 26	120 x 78 x 40	410	£20.75
HY128	60	8	0.01%	<0.006%	± 35	120 x 78 x 40	410	£20.75
HY244	120	4	0.01%	<0.006%	± 35	120 x 78 x 50	520	£25.47
HY248	120	8	0.01%	<0.006%	± 50	120 x 78 x 50	520	£25.47
HY364	180	4	0.01%	<0.006%	± 45	120 x 78 x 100	1030	£38.41
HY368	180	8	0.01%	<0.006%	± 60	120 x 78 x 100	1030	£38.41

Protection: Full load line. Slew Rate: 15v/ μ s. Rise time: 5 μ s. S/N ratio: 100db. Frequency response (-3dB) 15Hz - 50KHz. Input sensitivity: 500mV rms. Input Impedance: 100K Ω . Damping factor: 100Hz >400.

PRE-AMP SYSTEMS

Module Number	Module	Functions	Current Required	Price inc. VAT
HY6	Mono pre amp	Mic/Mag. Cartridge/Tuner/Tape/Aux + Vol/Bass/Treble	10mA	£7.60
HY66	Stereo pre amp	Mic/Mag. Cartridge/Tuner/Tape/Aux + Vol/Bass/Treble/Balance	20mA	£14.32
HY73	Guitar pre amp	Two Guitar (Bass Lead) and Mic + separate Volume Bass Treble + Mix	20mA	£15.36
HY78	Stereo pre amp	As HY66 less tone controls	20mA	£14.20

Most pre-amp modules can be driven by the PSU driving the main power amp. A separate PSU 30 is available purely for pre amp modules if required for £5.47 (inc. VAT). Pre-amp and mixing modules in 18 different variations. Please send for details.

Mounting Boards

For ease of construction we recommend the B6 for modules HY6-HY13 £1.05 (inc. VAT) and the B66 for modules HY66-HY78 £1.29 (inc. VAT).

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PSU 41X	1 or 2 HY60, 1 x HY6060, 1 x HY124	£13.83	PSU 53X	2 x MOS128	£17.86
PSU 42X	1 x HY128	£15.90	PSU 54X	1 x HY248	£17.86
PSU 43X	1 x MOS128	£16.70	PSU 55X	1 x MOS248	£19.52
PSU 51X	2 x HY128, 1 x HY244	£17.07	PSU 71X	2 x HY244	£21.75

Please note: X in part no. indicates primary voltage. Please insert "0" in place of X for 110V, "1" in place of X for 220V, and "2" in place of X for 240V.

MOSFET MODULES

Module Number	Output Power Watts rms	Load Impedance Ω	DISTORTION		Supply Voltage Typ	Size mm	WT gms	Price inc. VAT
			T.H.D. Typ at 1KHz	I.M.D. 60Hz/7KHz 4:1				
MOS 128	60	4-8	<0.006%	<0.006%	± 45	120 x 78 x 40	420	£30.41
MOS 248	120	4-8	<0.005%	<0.006%	± 55	120 x 78 x 80	850	£39.86
MOS 364	180	4	<0.005%	<0.006%	± 55	120 x 78 x 100	1025	£45.54

Protection: Able to cope with complex loads without the need for very special protection circuitry (fuses will suffice).

Slew rate: 20v/ μ s. Rise time: 3 μ s. S/N ratio: 100db

Frequency response (-3dB): 15Hz - 100KHz. Input sensitivity: 500mV rms

Input impedance: 100K Ω . Damping factor: 100Hz >400.

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Size 95 x 40 x 80. Weight 410 gms.

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PSU 73X	1 x HY364	£22.54
PSU 74X	1 x HY368	£24.20
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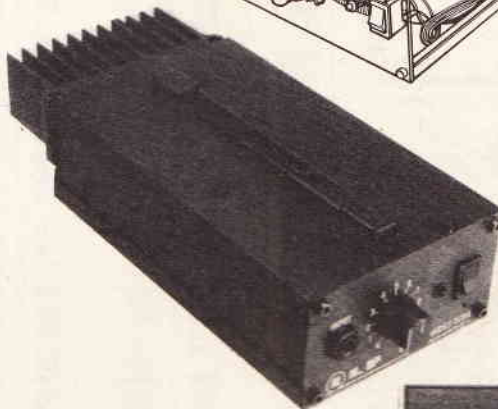
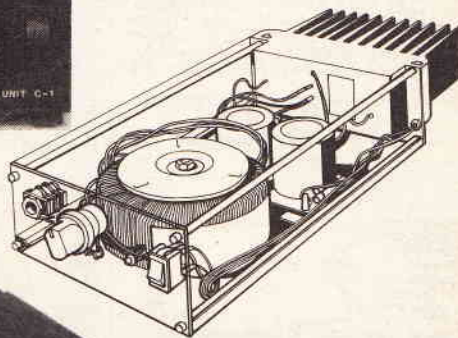
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UP3X	60W/8Ω	Bipolar	Mono	HiFi	£54.95
UP4X	120W/4Ω	Bipolar	Mono	HiFi	£74.95
UP5X	120W/8Ω	Bipolar	Mono	HiFi	£74.95
UP6X	60W/4-8Ω	MOS	Mono	HiFi	£64.95
UP7X	120W/4-8Ω	MOS	Mono	HiFi	£84.95
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US2X	120W/4Ω	Bipolar	Power	Slave	£79.95
US3X	60W/4-8Ω	MOS	Power	Slave	£69.96
US4X	120W/4-8Ω	MOS	Power	Slave	£89.95

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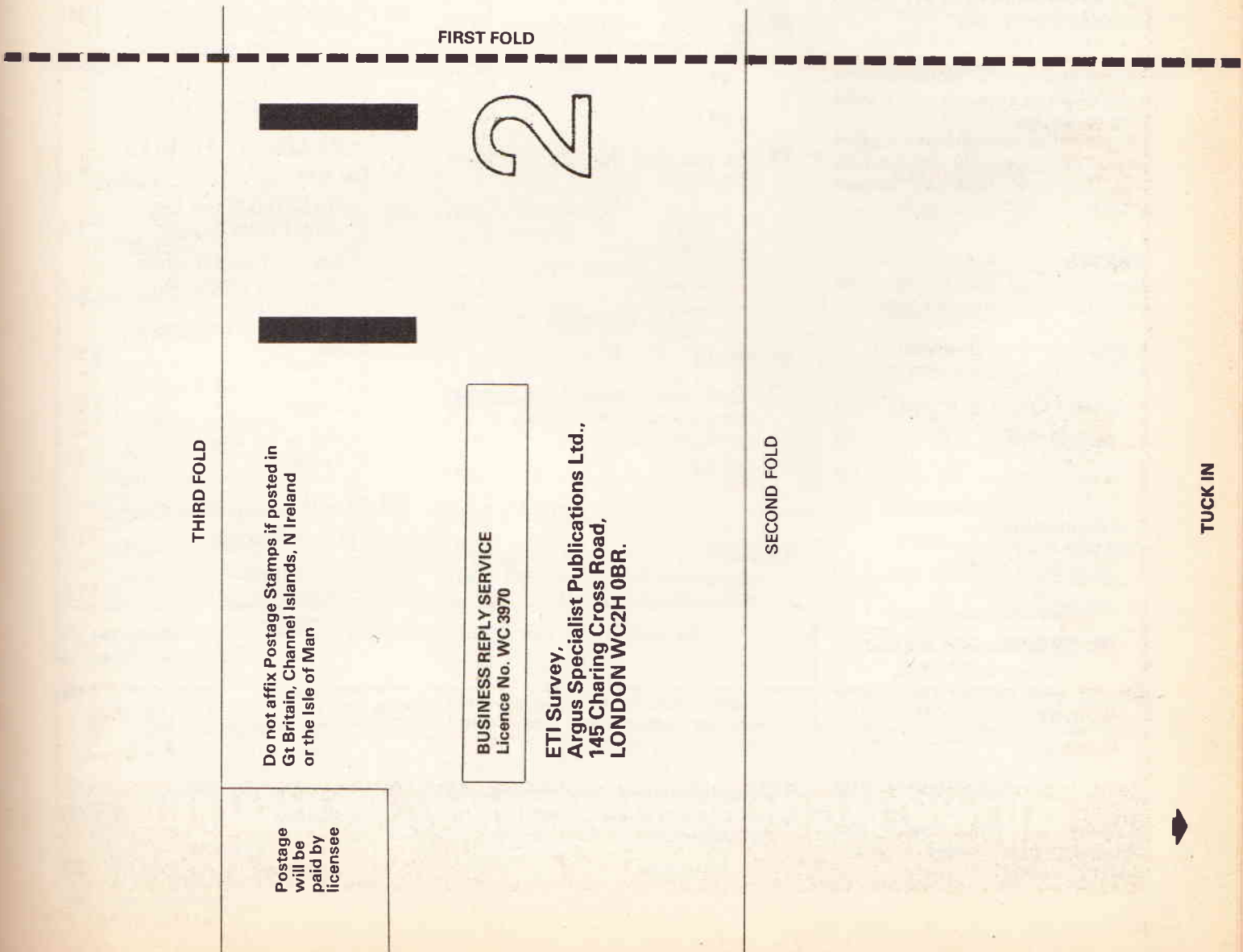
Signature _____

READER SURVEY

Here's your chance to tell us what you think of the magazine, and this year it's reply paid, so you have no excuse not to respond. As you may have noticed, ETI has a new editor, so changes are afoot. To help us decide what changes would make the magazine better, we need your opinions. And to make it as little trouble as possible we've made all the answers multiple-choice. However, we can't think of everything, so we've left a long section at the end for you to write in your opinions if we have not covered a particular point you would like to make in the questions we've asked or in the choices of answer we've provided.

Incidentally, you'll see that there are lots of little numbers in brackets next to the little boxes we're asking you to tick — please ignore these, they're to help us in our computer-assisted analysis (using the Cortex, of course) of your replies.

Because this survey is reply-paid, a little more origami is required than for previous years: first, pull out the survey form from the magazine and fold along the page fold. Then fold along the line at the centre of this page. Finally, fold and tuck in the two flaps, so that the address and licence number are clearly showing.



YOUR INTERESTS

1. What are your main areas of interest within electronics? Please indicate with a tick in the **first** column

- Audio/Hi-Fi (1)
 Computers — design of (2)
 Computers — interfacing and use of (3)
 Digital (other than computers) (4)
 Electronic Music (5)
 Radio & TV (6)
 Robotics (7)
 Test Equipment (8)
 Radio Control (9)
 Domestic Electronics (eg, ELCB) (10)

2. Please tick in the **second** column next to those subjects you would like to see more of in ETI (please don't tick them all.)

3. Please tick in the **third** column next to those subjects you would like to see **less** of in ETI. Please list at the end any subject areas not presently covered in ETI that you think we should cover.

SERIES

Over the past few months, we have run two extended series.

4. Designing Micro Systems

Did you read:

- all or most (1)
 around half (2)
 few or none (3)

5. Configurations

Did you read

- all or most (1)
 around half (2)
 few or none (3)

6. Would you like to see similar series in ETI?

- YES (1)
 NO (2)

If there any other topics you would like to see **series** on please list at the end.

PROJECTS

7. Do you built projects from ETI?

- Yes, two or more a year (1)
 Yes, about one a year (2)
 Yes, but less than one a year (3)
 No, not as yet (4)

8. When you build projects from ETI or other magazines, do you usually:

- Build them more or less as published (1)
 Make a few adaptations to suit yourself (2)
 Make a large number of adaptations (3)

9. Do you:

- Usually buy a complete kit (1)
 Usually buy the special PCB but obtain other components yourself (2)
 Make your own PCB (3)
 Not use a PCB at all (4)

10. Do you usually use the recommended case?

- YES (1)
 NO (2)

11. Do you find the information in 'Buylines':

- Useful (1)
 Inadequate (2)
 Not useful (3)

(List reasons at end)

BUYING

12. Have you bought electronic components from adverts in ETI during the past year?

- YES (1)
 NO (2)

13. Have you bought electronic equipment through adverts in ETI during the past year?

- YES (1)
 NO (2)

Note If you have any complaints against advertisers, we would like to hear them.

14. Approximately how much do you spend a year on your **leisure** electronics?

- £0 to £20 (1)

£20 to £50 (2)

£50 to £100 (3)

£100 to £200 (4)

more than £200 (5)

If more than £200, please estimate and write in £

15. Approximately how much do you spend a year **professionally** on **electronic components**? (please include purchases made indirectly, e.g. requisitioning from company stores)

- Nothing (1)
 Less than £500 (2)
 £500 to £2000 (3)
 £2000 to £5000 (4)
 more than £5000 (5)

If more than £5,000, please estimate £

16. Approximately how much do you spend a year **professionally** on **electronic equipment** (other than components)?

- Nothing (1)
 Less than £500 (2)
 £500 to £2000 (3)
 £2000 to £5000 (4)
 more than £5000 (5)

If more than £5,000, please estimate £

READING HABITS

17. Do you read ETI regularly?

No — this is the first copy I have bought (1)

No — I buy ETI when there is a project or feature that particularly interests me (2)

Yes — but for less than a year (3)

Yes — for a year or longer (4)

18. How do you usually buy ETI?

On subscription (1)

On a regular order from a newsagent (2)

From a 'corner shop' type newsagent without a regular order (3)

From a large newsagent in town centre or similar location (eg railway station) (4)

From a specialist electronics shop (5)

19. How many people read your copy?

- just you (1)
 one other (2)
 several others (3)

20. How long do you usually keep your copies of ETI?

- less than 1 year (1)
 1 year or longer (2)
 selected copies kept for 1 year or longer but others not kept (3)

READERSHIP PROFILE

Below we ask you some questions about yourself which we hope you will not mind answering. If there is any section you do not wish to answer, please leave it blank.

21. Age

- 15 or under (1)
 16 to 25 (2)
 26 to 35 (3)
 36 to 45 (4)
 46 to 55 (5)
 56 to 65 (6)
 66 or over (7)

22. Sex

- Male (1)
 Female (2)

23. Marital Status

- Single (1)
 Married (2)

24. Employment

- At school (1)
 At sixth form or Tech. college (2)
 Student in higher education (3)
 Employed (4)
 Self-employed (5)
 Not employed (6)
 Retired (7)

25. If employed or self-employed please indicate your earnings

- under £4,500 p.a. (1)
 £4,500 to £6,499 (2)
 £6,500 to £9,499 (3)
 £9,500 to £14,000 (4)
 over £14,000 (5)

26. What is your job title? (please write in below)

.....

27. Do you hold a credit card?

- YES (1)
 NO (2)

28. Does your job or course of study involve electronics?

- Mostly (1)
 Sometimes (2)
 Not at all (3)

29. Education: please tick in the first column the standard of education you have already reached

- No formal qualifications (1) (1)
 CSE (2) (2)
 O level (3) (3)
 A level/ Scot. Higher / IB (4) (4)
 ONC (5) (5)
 HNC (6) (6)
 Bachelor's degree (7) (7)
 Higher degree (8) (8)

30. Please tick in the second column if you are still studying for a qualification (full or part time)

31. Are you a home-owner?

- YES (1)
 NO (2)

32. Do you own a car?

- YES (1)
 NO (2)

AUDIO

33. Do you own a stereo system?

- YES (1)
 NO (2)

34. Have reviews in Audiophile influenced your choice of system components?

- YES (1)
 NO (2)

VIDEO

35. Do you own or rent a video recorder?

- YES (1)
 NO (2)

36. If YES, which format is it in?

- VHS (1)
 Beta (2)
 V2000 (3)

COMPUTING

38. Do you own a home computer?

- YES (1)
 NO (2)

38. If 'YES', please indicate which make it is:

- Acorn Atom (1)
 Apple I/II/III (2)
 Atari 400/800 (3)
 BBC Model A/B (4)
 Dragon 32 (5)
 PET (7)
 Sharp MZ80 A/B/K (8)
 Tandy TRS-80 I (9)
 Tandy Colour Computer (10)
 Tangerine (11)
 TI99/44 (12)
 VIC 20 (13)
 Video Genie (14)
 ZX81 (15)
 ZX Spectrum (16)
 Home-brew design (17)
 Other — please list below (18)

Please use this space for any additional comments. Use a separate sheet if necessary.

.....

39. If 'NO', do you think you will be buying a computer in 1983?

YES (1)

NO (2)

40. How much do you think you will spend on personal computing in the next year?

£100 or less (1)

£100 to £300 (2)

£300 to £1000 (3)

more than £1000 (4)

REGULARS

Below is a list of those features fairly regularly in ETI. Please could you rate them, by ticking the appropriate box, on the scale: 1 — essential, wouldn't read the mag without it; 2 — interesting; 3 — sometimes interesting; 4 — not interesting to me; 5 — would prefer to see it discontinued

41 Digest (News) (1) (2) (3) (4) (5)

42 Audiophile

43 Designer's Notebook

44 Tech Tips

45 Read/Write

THE COMPETITION

What other electronics magazines (or magazines that carry constructional projects similar to those in ETI) do you read, and how do you think they compare to ETI?

Roughly how often do you read the competition?

Regu-
larly
(1)

Occas-
ionally
(2)

Rarely/
Never
(3)

MAGAZINE

How do you think the magazines rate in comparison to ETI?

Poor
(1)

Fair
(2)

About
equal
(3)

Slightly
better
(4)

Much
better
(5)

	Regu- larly (1)	Occas- ionally (2)	Rarely/ Never (3)	MAGAZINE	Poor (1)	Fair (2)	About equal (3)	Slightly better (4)	Much better (5)	
50	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	ELECTRONICS AND COMPUTING	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	70
51	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	ELECTRONICS AND MUSIC MAKER	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	71
52	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	ELEKTOR	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	72
53	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	EVERYDAY ELECTRONICS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	73
54	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	HOBBY ELECTRONICS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	74
55	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	ELECTRONICS — THE MAPLIN MAGAZINE	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	75
56	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	PRACTICAL ELECTRONICS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	76
57	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	PRACTICAL WIRELESS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	77
58	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	RADIO AND ELECTRONICS WORLD	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	79
59	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	WIRELESS WORLD	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	79
60	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	TELEVISION	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	80
61	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	BYTE	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	81
62	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	COMPUTING TODAY	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	82
63	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	PERSONAL COMPUTER WORLD	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	83
64	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	PRACTICAL COMPUTING	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	84

46 PUBLISHED PROJECTS

Below is a list of the projects we've published in ETI in the last year or so. Please tick in the **first** column next to projects that you found particularly interesting. If you actually constructed (or have started) all or part of any of the projects, please tick in the **second** column.

Active Loudspeaker (Sept) 1

Auto-volume Control (Sept) 2

Cortex Computer (Nov '82-Jan '83) 3

Dual Logic Probe (Sept) 4

Earth Leakage Circuit Breaker (Dec) 5

Electronic Doorbell (Oct) 6

Fuel Gauge (Jan '83) 7

Heat/Light Controller (Oct) 8

IF Strip Tester (Oct) 9

Message Panel (Oct) 10

Message Panel Interface Board (Nov) 11

Microtutor (Aug-Oct) 12

Playmate Guitar Amp (Aug-Sept) 13

Precision Pulse Generator (Nov) 14

Programmable PSU (Jan '83) 15

Robot: Mobile II (Aug) 16

Robot: Chassis Construction (Sept) 17

Robot: Servo Arm Interface (Oct) 18

Rugby Clock (Aug-Sept) 19

Signal Line Tester (Dec) 20

Sound Track (Aug) 21

Sound-to-Light Unit (Oct) 22

Spectracolumn (Dec) 23

Spectrum Analyst (Nov) 24

Stage Lighting Unit (Jan '83) 25

Touch Switch (Oct) 26

Waveform Multiplier (Jan '83) 27

ZX ADC (Jan '83) 28

electronize

ELECTRONIC IGNITION

KITS OR READY BUILT

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- ★ Is it **EASY TO START** in the cold and the damp? Total Energy Discharge will give the most powerful spark and maintain full output even with a near flat battery.
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Most **NEW CARS** already have **ELECTRONIC IGNITION**. Update **YOUR CAR** with the most powerful system on the market - 3½ times more spark power than inductive systems - 3½ times the spark power of ordinary capacitive systems, 3 times the spark duration.

Total Energy Discharge also features:
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 6 or 12 volt, with or without ballast.

OPERATES ALL VOLTAGE IMPULSE TACHOMETERS:
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Assembled and Tested	£36.45	



ELECTRONIZE DESIGN

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 Tamworth · B77 5BY
 tel: 0827 281000

The basic function of a spark ignition system is often lost among claims for longer "burn times" and other marketing fantasies. It is only necessary to consider that, even in a small engine, the burning fuel releases over 5000 times the energy of the spark, to realise that the spark is only a trigger for the combustion. Once the fuel is ignited the spark is insignificant and has no effect on the rate of combustion. The essential function of the spark is to start that combustion as quickly as possible and that requires a high power spark.

The traditional capacitive discharge system has this high power spark but, due to its very short spark duration and consequential low spark energy, is incompatible with the weak air/fuel mixtures used in modern cars. Because of this most manufacturers have abandoned capacitive discharge in favour of the cheaper inductive system with its low power but very long duration spark which guarantees that sooner or later the fuel will ignite. However, a spark lasting 2000µS at 2000 rev/min. spans 24 degrees and 'later' could mean the actual fuel ignition point is retarded by this amount.

The solution is a very high power, medium duration, spark generated by the **TOTAL ENERGY DISCHARGE** system. This gives ignition of the weakest mixtures with the minimum of timing delay and variation for a smooth efficient engine.

- ★ **SUPER POWER DISCHARGE CIRCUIT A** brand new technique prevents energy being reflected back to the storage capacitor, giving 3½ times the spark energy and 3 times the spark duration of ordinary C.D. systems, generating a spark powerful enough to cause rapid ignition of even the weakest fuel mixtures without the ignition delay associated with lower power 'long burn' inductive systems.
- ★ **HIGH EFFICIENCY INVERTER A** high power, regulated inverter provides a 370 volt energy source - powerful enough to store twice the energy of other designs and regulated to provide sufficient output even with a battery down to 4 volts.
- ★ **PRECISION SPARK TIMING CIRCUIT** This circuit removes all unwanted signals caused by contact volt drop, contact shuffle, contact bounce, and external transients which, in many designs, can cause timing errors or damaging un-timed sparks. Only at the correct and precise contact opening is a spark produced. Contact wear is almost eliminated by reducing the contact breaker current to a low level - just sufficient to keep the contacts clean.

TYPICAL SPECIFICATION

	Total Energy Discharge	Ordinary Capacitive Discharge
SPARK POWER (Peak)	140W	90W
SPARK ENERGY	36mJ	10mJ
STORED ENERGY	135mJ	65mJ
SPARK DURATION	500µS	160µS
OUTPUT VOLTAGE (Load 50pF, equivalent to clean plugs)	38kV	26kV
OUTPUT VOLTAGE (Load 50pF + 500k, equivalent to dirty plugs)	26kV	17kV
VOLTAGE RISE TIME TO 20kV (Load 50pF)	25µS	30µS

TOTAL ENERGY DISCHARGE should not be confused with low power inductive systems or hybrid so called reactive systems.

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INDUCTION LOOPS

Do you know what it's like not to be able to hear what's going on at a concert or a meeting? Vivian Capel describes a system that will enable many hearing-aid users to find out what they've been missing.

Persons with normal hearing rarely appreciate the problems associated with the condition of those who are not so blessed. Hearing aids don't restore normal hearing. Owing to the square law which governs sound propagation, microphones are much more sensitive to nearby sounds than distant ones. The human ear seems able to do a certain amount of filtering out of unwanted sounds that hearing aids are not capable of. The result is that a hearing-aid user is very susceptible to unwanted, distracting sounds.

Another effect experienced by hearing-aid users is that sound from a public address system sounds hollow, and it is difficult to distinguish the syllables. This is due to the reflections and reverberations set up in the auditorium. Here two ears come to the rescue of those with normal hearing because the reflected sound is of random phase whereas the direct arrives in-phase. So our ears ignore much of the reverberation and concentrate on the direct sound.

Faced with these problems, hearing-aid users often try turning up the gain to make the sound more intelligible. Of course it doesn't work, in fact it makes matters worse, as the rustles, coughs and other sundry noises now become deafening. In despair, many turn off their aids altogether and try to hear with what limited natural hearing they have.

Plugged-in Audience?

Ideally, anyone hard of hearing should be plugged in directly to the PA system so that they receive only the sound from the stage microphones minus auditorium reverberation and without the audience noises. In the past some attempt has been made to do this in certain halls where a section would be reserved for deaf people, with a number of audio outlets for headphones.

Such arrangements were fraught with problems. One was that the users might have to be segregated from their friends which made them self-conscious. Another was the constant damage done to the headphones and wiring; it was common for users to forget they were wearing headphones and stand up and move away while still connected! Yet another problem was the regular disappearance of loaned headsets.

All these drawbacks can be overcome by the installation of a magnetic loop around the periphery of the whole auditorium which is fed from the PA system. The PA output can then be received by anyone with a suitable hearing-aid within the area. So there is no segregation, the users can sit where they like; there is no wiring or connections to worry about so no maintenance problems; and the users can still hear if they move from their seats.

Hearing-Aids

What then about the receivers? Special headphone sets with built-in amplifiers and induction pick-up coils have been made by firms such as Beyer, Eagle and others

for some time. However, for this application these are not necessary. Since 1974, all NHS hearing-aids have a selector switch which has two positions marked M and T. In the M position, the internal microphone is switched on for normal usage. The T position is for telephone use and it disconnects the microphone and switches in an induction coil. This responds to the magnetic field of some telephone earpieces and thus enables the user to hear the telephone without double transduction, that is sound generated by the earpiece being converted back to an electrical signal by the hearing-aid microphone. This greatly improves the quality and intelligibility of the sound heard.

When switched to the T position, the normal hearing-aid becomes an ideal receiver for a magnetic induction-loop sound system. The coil is mounted vertically, which is in the same plane as a loop wired around a hall, and so achieves maximum signal pickup.

From the management's point of view, this means no separate hearing devices to be supplied, with their repair liability and disappearances.

From the user's standpoint there is no fuss over having to obtain and return an aid. The aid can be switched from normal to T at the start of the performance and back again at the end, in an instant. All extraneous noises are cut out, in fact in some cases users can hear better than those with normal hearing! A further big advantage is that the volume can be individually adjusted to suit the particular user, as he or she would do when using the aid normally.

Though many privately-sold hearing-aids incorporate a telephone switch, not all do. Those worn inside the ear lack the facility, as there is simply no extra room for a coil and switch. Some others have an induction coil but no switch so that both microphone and coil output are heard at the same time. This is less satisfactory than being able to switch the microphone out, but providing the signal from the loop is high, it is not too great a drawback.

Looping the Loop

Designing a loop is reasonably straightforward, being a matter of taking the area to be covered, length of the longest side, then calculating the cable resistance, number of turns, and amplifier power to produce the required field strength.

The ideal strength is that which presents a signal to the hearing-aid which is comparable to the output of the internal microphone. Too weak a signal is not desirable as this would mean users having to turn the gain well up which would make the noise of the internal amplifier noticeable. There is a British Standard (BS 6083 Part 4: 1981) which specifies the optimum strength as 100 mA in a single-turn loop of 1 metre diameter.

This highlights a basic factor, that it is the current and the number of turns that influence the resulting field in any given size of loop. Because the hearing aids will require

negligible power from the magnetic field, the voltage required is only that need to drive the required current through the resistance of the loop. If the resistance can be made very low, the necessary current can be achieved with only a small voltage, hence with minimum power. However, as the field strength is proportional to the product of the current and the number of turns, it can be an advantage to increase the turns even though this also increases the resistance.

The specified current of 100 mA/metre is for the average signal, but peaks will exceed this especially with music. The BS recommends allowing for peaks of 12 dB above average, which increases the current requirement by four times. If dynamic range compression is used in the feed amplifier, this could be reduced. However, if the system is to be used mainly for speech then only much lower peaks need be accommodated. In practice, allowance for 6 dB peaks or twice the average has been found to be adequate. However, to ensure a good safety margin the following calculations assume peaks of 10 dB or three times average.

If the average current in amps is $a/10$ (where a is the diameter of the loop in metres) the peak is $3a/10$. With the exception of the Albert Hall, few halls are circular. A square loop needs slightly more current to provide the same field, about 112 mA for a square of side 1 metre, so the formula becomes $I = 3a/9$ amps.

However, most halls are rectangular. Doing the calculation properly would be complicated, but for practical purposes we can work out a close figure for halls with a length of no more than $1\frac{1}{2}$ times the width. This can be done by multiplying length and width to give the area, then finding the square root to give the side of a square of equal area. So our formula becomes $I = 3\sqrt{dw}/9$, where d is the length and w the width.

In the case of long narrow areas things are rather different. With a square loop, each side contributes equally to the field. But if we take a square section somewhere near the middle of a long narrow loop, the sides are too far away to have much effect. So only two of the four sides of the square are generating any field. Hence the field is very approximately half what it would be with a square loop of the same width, in the central portions, rising to around three-quarters in the parts adjacent to the sides.

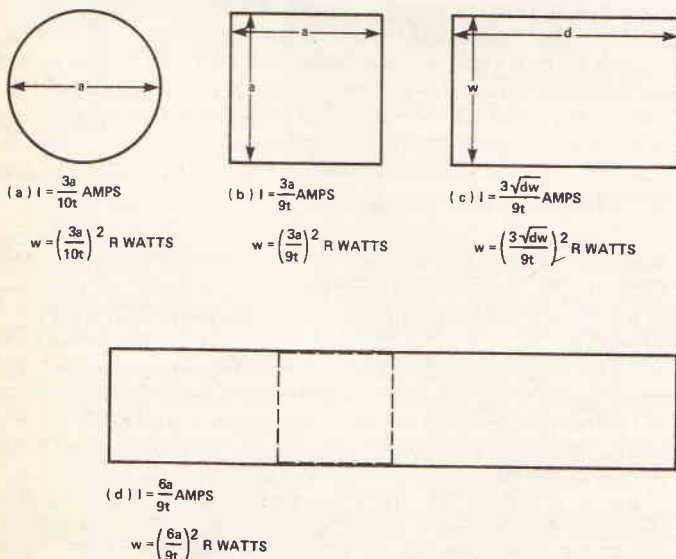


Fig. 1 Formulae for current and power requirement for loops of various shapes.

Choosing The Cable

The above calculations apply for a single-turn loop, but there is no reason why several turns cannot be used to advantage. As you would expect, the current required is divided by the number of turns, so the formula becomes $3a/9t$ for a square loop (where t is the number of turns).

A convenient method of wiring multi-turn loops is to use mains cable and connect the cores in series using a junction box or terminal strip. Thus a single loop of standard three-core mains cable gives a three-turn circuit without actually running three separate turns around the area.

Now we must match the loop resistance to the output of the amplifier. If a separate amplifier having a four-ohm output is used, the loop should equal this or be a little higher, say five ohms. This is about the lowest resistance that can normally be matched to a standard power amplifier.

Table 1 gives the resistance per 100 metres of a single core of various gauge cables. One of the most commonly used is 16/0.2, three-core which has a resistance of 3R6 per core or 10R8 total. The heavier gauge 24/0.2 can also be used if the run is long and resistance high as a result. This comes out at 2R4 per core or 7R2 for three cores.

The first step then is to measure up the total length of the run. This must include detours around door or window frames, and recesses. For a medium-sized hall a run of around 80 metres is a common average. This gives about 8 ohms for 16/0.2 which matches nicely with an 8R output amplifier. Any value below this needs a 4R output even though it may be closer to 8R, because the load should never go below the rated impedance of the amplifier. Really, it is a matter of juggling the gauge and number of cores to produce the desired resistance for the measured length. Never add a series resistor to make up a value as this not only wastes power but it has an adverse effect on the loop performance.

Table 1

Cores No/Dia (mm)	Total Area (mm ²)	Current Rating (A)	Resistance per 100m (R)
1/0.2*	—	—	57.6
7/0.2*	0.22	1.4	8.2
13/0.2*	0.4	2	4.4
16/0.2	0.5	3	3.6
24/0.2	0.75	6	2.4
32/0.2	1.0	10	1.78
1/0.8*	0.5	—	3.6

*Note that these are not mains cables

Amplifier Power

Although the production of the magnetic field is not a function of power out of current alone, a certain voltage is required to produce the necessary current, hence power is expended. So, what power will be needed from the amplifier?

The formula for calculating power is $W = I^2R$, where the symbols used have the usual meanings.

Combining this with the earlier formula we get:

$$W = \left(\frac{3a}{9t}\right)^2 R$$

If we remember that R depends on the number of turns, and write $R = rt$, where r is the resistance per turn, then we can re-write the formula for the power as

$$W = \left(\frac{3a}{9}\right)^2 \frac{r}{t}$$

which shows that the more turns we use, the less power is necessary to drive the loop.

Let us look at an example to illustrate. Supposing a hall

FEATURE: Induction Loops

having 18m as the root of its area and needing 80m of cable to enclose, is wired with 16/0.2. The resistance for a two-core loop would be from the table, 5.8 ohms, and for a three-core loop, 8.6 ohms.

For the two-core loop we have

$$W = \left(\frac{3 \times 18}{9 \times 2} \right)^2 \times 5.8 = 52.2 \text{ watts}$$

In the case of the three-core loop,

$$W = \left(\frac{3 \times 18}{9 \times 3} \right)^2 \times 8.6 = 34.4 \text{ watts}$$

With 24/0.2 cable, the resistance for two-core is 3R8 which although below 4R is probably close enough to work from a 4R output. The three-core cable has a resistance of 5.8 ohms. So using the above formula we have

$$W = \left(\frac{3 \times 18}{9 \times 2} \right)^2 \times 3.84 = 34.4 \text{ watts}$$

for the two-core, and for the three-core

$$W = \left(\frac{3 \times 18}{9 \times 3} \right)^2 \times 5.8 = 23.2 \text{ watts}$$

Amplifiers

A separate amplifier fed from the 'line out' socket of the existing PA amplifier is the most flexible and satisfactory means of supplying a loop. The power rating can be chosen from the formula already described. However, in some cases it is possible to take a feed from the output of the PA amplifier already installed.

If it is a proper PA amplifier it will have a 100V output tap, and this should be used with a suitable matching transformer. The main requirement is that the amplifier has sufficient power to supply both the loop and the speakers. With many PA systems there is an ample reserve, it is not uncommon to find 80-100 watt amplifiers feeding speakers tapped at 25-40 watts.

100V Outputs

A word of explanation regarding 100V operation and transformer power tapings would not be amiss here. A 100V output is a much more convenient method of connecting mixed loads than working out their impedances when connected in parallel and ensuring that they do not fall below that of the amplifier tap being used. Each load has its own matching transformer which enables each one to be individually adjusted.

The 100V is the output voltage obtained when the amplifier is delivering its full rated power. From the formula

$$Z = \frac{E^2}{W}$$

it can be seen that the actual impedance of this tap depends on the wattage rating of the amplifier, for a 50-watt amplifier it is 200 ohms, for a 100-watt, 100 ohms and so on.

The transformers used for matching PA speakers to the 100V output have a secondary rated in ohms: 4, 8, 16, or often all of these via tapings. These are connected to the speaker, of the appropriate impedance. The primary has tapings rated in watts, so that when a particular tapping is selected, the specified wattages will be taken from the 100V output and fed to the speaker.

So you can have a mixed bag of speakers all set to different powers to suit different locations in the PA system, and the only calculation necessary is to add up all the tapings and make sure that the total does not exceed the power rating of the amplifier. Much easier than calculating parallel impedances!

The 100V Loop

The loop is taken to the appropriate secondary tapping on the 100V transformer and the primary tapped to

give the required wattage. Transformers can be obtained from R.S. Components and from Eagle, the latter having fewer tapings and lower ratings but being much cheaper. (R.S. Components do not supply hobbyists direct but TV dealers may be prepared to order for you.)

Some installations in smaller halls may not have a PA amplifier with 100V output, and the speaker system may be operating at low impedance from an ordinary amplifier. In this case there is less room for manoeuvring, but if there is plenty of amplifier power to spare it may be possible if the impedances work out right.

Field Distribution

So much for the electrical features, so now we will consider the magnetic field and its distribution. If the loop is level with the receiving devices and we start at the middle of the loop, the vertical component of the field rises gradually as we move toward the walls supporting the loop. At about halfway between the centre and the walls, it shoots up dramatically to +22dB or thereabouts at a point close to the loop. Then it drops to a null point actually just over the loop at the boundary wall. Beyond this, outside the loop it rises again to about +10dB, then falls linearly. This is shown by the solid line in Fig. 2.

Obviously this is not entirely satisfactory as there are wide differences in field strength across the loop which would call for different gain levels in the user's hearing-aids according to their positions. If instead, the loop is displaced vertically so that it is above or below the level of the hearing-aid coils, the distribution curve can be made more even. Figure 2 also shows vertical components of field distributions for displacements of one tenth, two tenths and four tenths of the loop width.

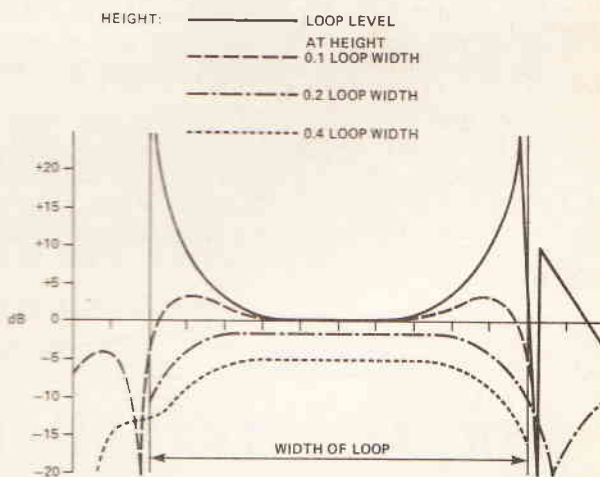


Fig. 2 Vertical field distributions for different heights above (or below) the loop level.

Of all these curves, the one obtained from the one-tenth displacement is the most satisfactory, and usually it is the most convenient. For a hall 10 metres wide which is a fair average for a medium-sized hall, the required displacement will be 1 metre. For seated users, this would put the loop at wainscoting level near the floor, which is a practical place to mount it. It could be at floor level, especially if the hall is wider, as the positioning is by no means critical.

The loop could equally as well be run above the hearing-aid level, and in some cases this may prove to be more practical. Mostly though, this could be rather conspicuous, and may detract from the decor. In both cases, running the loop over door frames or around other relatively small objects will make little difference to the

field level in the body of the hall, though it may cause local anomalies.

Vertical displacement of the loop from the level of the receivers causes a lower signal which should be compensated for by an increase in the loop current, hence power supplied by the amplifier. Table 2 gives the ratios of displacement in units of loop-width with the multiplying factors for current and power. For the one-tenth displacement the power is only 1.2 times and can be ignored. For larger displacements though, the power requirements increase drastically. So this is a further reason for keeping the loop to the one-tenth level.

Table 2

Ratio h/a	Multiply current by	Multiply power by
.1	1.1	1.2
.2	1.25	1.6
.3	1.5	2.25
.4	2.0	4.0
.5	2.5	6.25
.6	3.25	10.6
.7	4.25	18.0
.8	5.5	30.2
.9	7.0	49.0
1.0	8.5	72.2

Null And Overspill

It may be wondered why there is a null point as the receiver passes over the loop, or at greater height, just beyond the loop. It is not that the total field disappears, just the vertical component. If the receiver coil is placed horizontally instead of vertically, then there will be maximum pickup over the loop wire, and minimum within the loop, the opposite of normal. One user was heard to complain that the sound faded out to zero when he bent down to pick up something from the floor. This was of course because the hearing-aid coil was tilted through 90° to the horizontal.

Overspill (the magnetic field outside the loop) is unaffected by normal building materials, but falls off linearly with distance. Beyond about a quarter of the loop width it drops to too low a level for practical use. Even this though can be useful. In one case a delighted user related how he could still hear what was going on a visit to the toilet in the foyer!

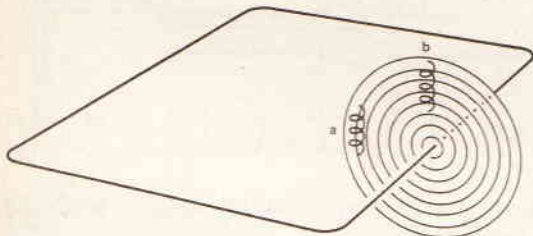


Fig. 3 Field null: at point a the field is entirely vertical; at point b, the field is entirely horizontal.

In The Home

There is no reason why the same technique should not be used in the home of a person with hearing difficulties to enable them to listen to records, for example. The major problem will be getting a loop with a sufficiently high resistance to be fed by a domestic amplifier; however, this difficulty can be overcome by using several turns of fairly thin wire.

Listening to the television this way poses the added difficulty of coupling the output from the TV to the amplifier. Unless your TV has a special output socket, as a few of the more enlightened manufacturers have taken to including, the best solution is to use a TV sound tuner.

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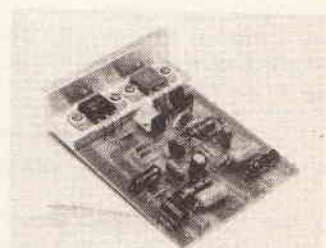
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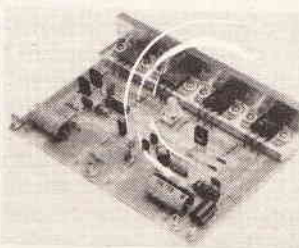
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IMPROVING YOUR ZX81

In the first of an occasional series on mods to popular computers, Ian Ridout gives details of how you can improve the reliability of SAVEing programs on tape.

Since the ZX81 Sinclair personal computer was introduced, over 400,000 have been sold throughout the world. In technical journals and magazines it has been acclaimed by most critics as ideal for self-tuition in the BASIC language and an excellent introduction to computing. By all accounts it represents unequalled value for money both on its own, with just 1K of RAM memory, and also when the 16K RAM plus printer are added.

However, there are three main complaints about the ZX81:

- the mechanical instability of the add-on units can cause a brief disconnection leading to the loss of either TV picture synchronisation and/or loss of the stored program and data;
- an unexplainable loss of program and data (ie a crash);
- unreliable tape storage of programs.

The first complaint can be overcome by making an extension lead so that movements of the individual units can be tolerated without causing momentary memory pack disconnections. However, only the 16K RAM pack should be plugged into the extension; the printer should still be plugged directly into the back of the ZX81. It is necessary to keep the extension lead short (less than 6") or the effect will be to make system crashes occur more often, probably owing to increased capacitive loading and hence memory access delay. Also it is essential to keep the rear edge connector on the computer board clean, using white spirit and cotton buds.

The second problem could well be an internal software fault which is therefore not alterable by ZX81 users. Alternatively, the power supply regulator could be getting too hot because the unregulated

input voltage is too high. I decided that it is better to bolt a much bigger aluminium heat sink to the existing heat sink rather than modify the mains power supply. The reason for this is that reducing the regulator's overhead can spoil its functioning, and therefore you end up with the same problem. The size of the additional heatsink was such that it fitted neatly under the entire keyboard area, hence also eliminating a hot-spot under the left-hand end of the keyboard.

This article describes the steps taken to make the recording of programs onto tape and the loading from tape considerably more reliable.

The Tape Storage System

The IC pin which is used to supply a signal to the TV modulator is also used to supply the signal for tape storage purposes.

Consequently, if you connect an audio amplifier and loudspeaker to the 'tape out' (ie MIC) socket, during normal computer usage you will hear a continuous buzzing sound. The video signal from the IC to the modulator consists primarily of high frequencies but most of what you hear is the television frame rate and its harmonics. The output level of this buzzing sound can be used as a very rough

indication of whether there is sufficient signal coming out of the MIC socket to allow reliable recordings to be made with your particular tape recorder. However, this method is rather poor because the true signal that is recorded is of much higher frequency than that of the buzzing sound.

When you press SAVE (plus NEWLINE) there is a period of several seconds during which the TV screen goes blank and nothing appears at the MIC socket. After the pause, audio frequency tones are emitted from the IC output pin for recording onto the tape. The picture on the TV screen becomes alternate bands of black and white dashes (data), and black (pauses).

At the end of the recording sequence the IC output signal returns to being a compatible TV video signal, hence a buzz is recorded and the picture on the TV screen returns to normal.

The Present Circuit

The tape recording circuit used in the ZX81 consists of just two resistors and two capacitors (Fig. 1) forming a band-pass filter with a band peak at about 3.4 kHz. The filter response rolls off each side of this centre frequency at 6 dB/octave (20 dB/decade).

The response shape of this filter is perfectly acceptable for this

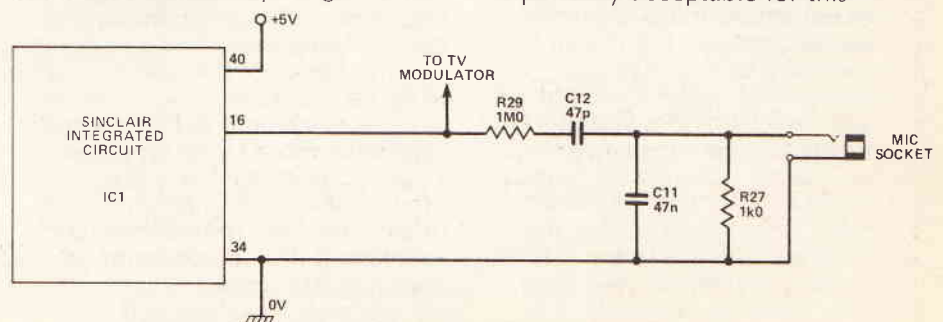


Fig. 1 Original tape-recording circuit.

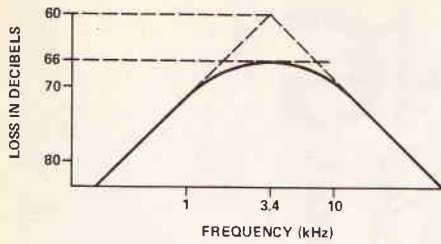


Fig. 2 Response of tape output filter.

application but the characteristic that makes recording unreliable is the low output signal level at the MIC socket. With about 4 V peak-to-peak coming out of the IC, a signal of only 2 mV appears at the MIC output socket even with this socket open-circuit. This is because the filter components give a resistive attenuation of 1000 to 1 and because a further halving of the signal takes place owing to the filter shaper. The response of this filter is given in Fig. 2, the axes being plotted with logarithmic scales.

A signal of 2 mV is insufficient to drive most recorders with manual recording-level control and is not high enough to give an adequate signal to tape-noise ratio on recorders with automatic level control.

Circuitry Modification

To ensure reliable tape recording, it is necessary to amplify the signal by at least 10 times and preferably 100–200 times. This could be achieved by connecting a suitable amplifier of the appropriate gain on the output of the Sinclair filter. However, with such a low signal level, it is possible to pick up interference along with the signal, so one would need to be very careful with the layout of the amplifier input wiring and the power supply to the amplifier.

Because of the high signal level and the large bandwidth of the signal at the IC output, it is not practicable to put an amplifier before the filter. It is therefore necessary to redesign the filter connected between the IC output and the MIC socket. The design has to present the original high impedance load to the IC output pin, and preferably should present the original output impedance to the MIC socket although the latter is not essential. Also, the same filter shape has to be preserved but the output signal level has to be considerably higher than the 2 mV presently available. Naturally, it is also an aim to keep the cost of the modification to a minimum.

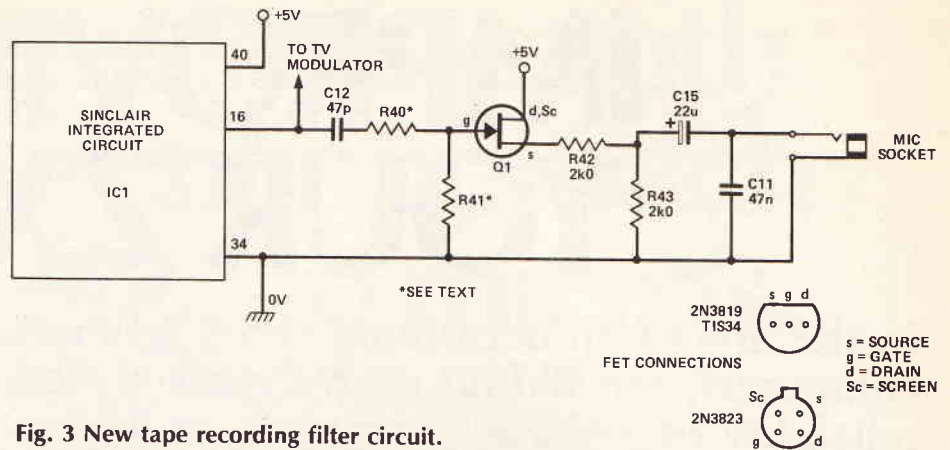


Fig. 3 New tape recording filter circuit.

The result of fulfilling these requirements was a circuit using a cheap junction field-effect transistor (FET) as a source follower, and a few extra resistors, costing in all less than £1. The circuit also has the advantage that the output signal at the MIC socket is not inverted, although this is not essential.

The new tape-recording circuit is shown in Fig. 3. R40 and R41 ensure that the IC is presented with the same resistive load as in the original circuit and C12 gives the same low-frequency roll-off. The DC biasing requirements of the FET dictate that with the gate connected to the negative supply rail, the value of the source resistor should be about 4 k to obtain about 2 V DC on the source. Consequently, to achieve an output resistance in the order of the original 1kΩ, the output is taken from a tap halfway down the source resistor.

The output needs to be AC coupled, hence the need for the 22μ electrolytic capacitor. The 47nF capacitor C11 could have been connected directly across the 2kΩ resistor R43 but it was more convenient to leave it in its original physical position on the PCB directly across the MIC socket.

It was not found necessary to feed the drain of the FET via an RC decoupling network, so the drain was connected directly to the regulated +5 V supply, the drain current being about half a milliamp.

The values of R40 and R41 need to be set according to whether the cassette machine is of the automatic or manual record level type (see Table 1). Most machines likely to be used for this application would be of the automatic record level type so R40 and R41 should be set to 910k and 91k respectively. If the record level is too high and overloading takes place, reduce R41 to about 15k. For manual record

TABLE 1		
	R40	R41
Manual recorders	510k	510k
Auto level recorders	910k	91k*
*See text		

level machines these resistors should be set to 510k each. The sum of the values of R40 and R41 should be between 900k and 1MΩ in order to preserve the filter characteristic.

Doing The Modification

Advantage has been taken of spaces for components on the PCB which are not used in the UK version, namely R30, 31, 32 and D9. Three of the original components need to be removed and only one of these will be used again. The new layout is shown in Fig. 4 but reference to the photograph will assist.

Make the modification as follows: pull off three of the four rubber feet, leaving the one nearest to the TV output socket. Remove the five screws on the back of the case and note that the two short screws come from under the feet under the keyboard. Remove the back of the case.

Remove the two screws holding the printed circuit board to the front half of the case. Carefully raise the PCB ensuring that the strip-connections from the keyboard are not strained and are disturbed as little as possible. DO NOT remove the keyboard connection strips from the PCB sockets because they are not easy to reinsert.

Locate and remove R27 (1kΩ) and R29 (1MΩ). These two resistors will not be used again. The position that R27 occupied will be left empty. Locate and carefully remove C12 (47pF, positioned between C10 and C11). This capacitor will be used in the new circuit.

Before continuing, refer to Fig. 4. Insert the two 2k Ω resistors R42 and R43 into the positions marked on the PCB as R31 and R32. Insert one end of R40 (see Table 1 for the value to be used) into the left-hand hole vacated by the removal of R29. Insert one lead of C12 into the right-hand hole vacated by the removal of R29. Solder together the remaining leads of R40 and C12 above the PCB, keeping their leads short.

Insert the positive end of C15 (22 μ) into the hole shown in Fig. 4. This hole is the one between EAR socket and the modulator which has a PCB track joining it to the two left-hand ends of R42 and R43. Solder the negative end of C15 to the left-hand hole vacated by C12. C15 should be positioned above, but not touching, the EAR socket. Do not be tempted to position C15 in the space between C10 and the modulator because one of the PCB support pillars occupies this space.

Solder the drain of the FET to the hole next to the right-hand end of C11. This is a plated-through hole which is connected to +5V. Solder the source of the FET to the right-hand end of the position marked on the PCB as the cathode end of D9 (not used in the UK version). Position R41 (see Table 1 for its value), so that it is to the right of the FET. Its lower lead is soldered into the left-hand hole of the component designated as R30 (not used) and its upper lead is soldered into the right-hand hole of the position previously occupied by C12. Solder the gate of

the FET to the upper lead of R41.

After cutting off all excess leads and thoroughly inspecting all new solder joints for solder blobs and tracking between adjacent holes, put back the two short screws holding the PCB to the front cover. They are the ones near the regulator and half-way along the rear accessory socket. (You might like to use this opportunity to make the heatsink modification described earlier).

Before screwing on the back cover, connect the power, the television and the cassette recorder, write a very short program and ensure that it SAVes and LOADs properly.

The two short screws go into the holes under the feet behind the keyboard. The new setting for the cassette player volume control will have to be obtained by experimenting.

Fault Finding

If the television picture fails to appear, check that the television is tuned to the correct channel (36) and that the regulator is giving out 5V. Next, check that the FET is wired correctly and that it has 5V on its drain and 0V on its gate. The biasing is such that the source should be at about 2V. If the source is at 5V check the connections to R42 and R43 and their values with a multimeter, after disconnecting the computer power. If the source voltage is higher than 3V5 or less than 1V you have a FET which is on the tolerance limits and the

combined value of the source resistors will have to be changed to compensate. Initially, change only R42, but if it has to be varied significantly to achieve 2V DC on the source then I would suggest replacing the FET.

The type of FET used in this circuit is a junction FET and consequently there are no handling precautions necessary beyond those normally used for bipolar transistors. A 2N3823 was used in the original and the case/screen lead was soldered to the drain before insertion into the PCB. A TIS34 or the very cheap, plastic encapsulated 2N3819 could be used instead.

When a tape has been recorded from the computer, listen to it to see if it is distorted due to overloading. Naturally, it will be necessary to experiment with the playback level when loading the program back into the computer because the record level on the tape will be a little higher even if recorded by an automatic record level machine.

PARTS LIST

Note that this is a list of the *new* components required

Resistors (all $\frac{1}{4}$ W 5%)

R40 See Table 1

R41 See Table 1

R42,43 2k Ω

Capacitors

C15 22 μ 16V axial electrolytic

Semiconductor

Q2 2N3819 or TIS34 or 2N3823

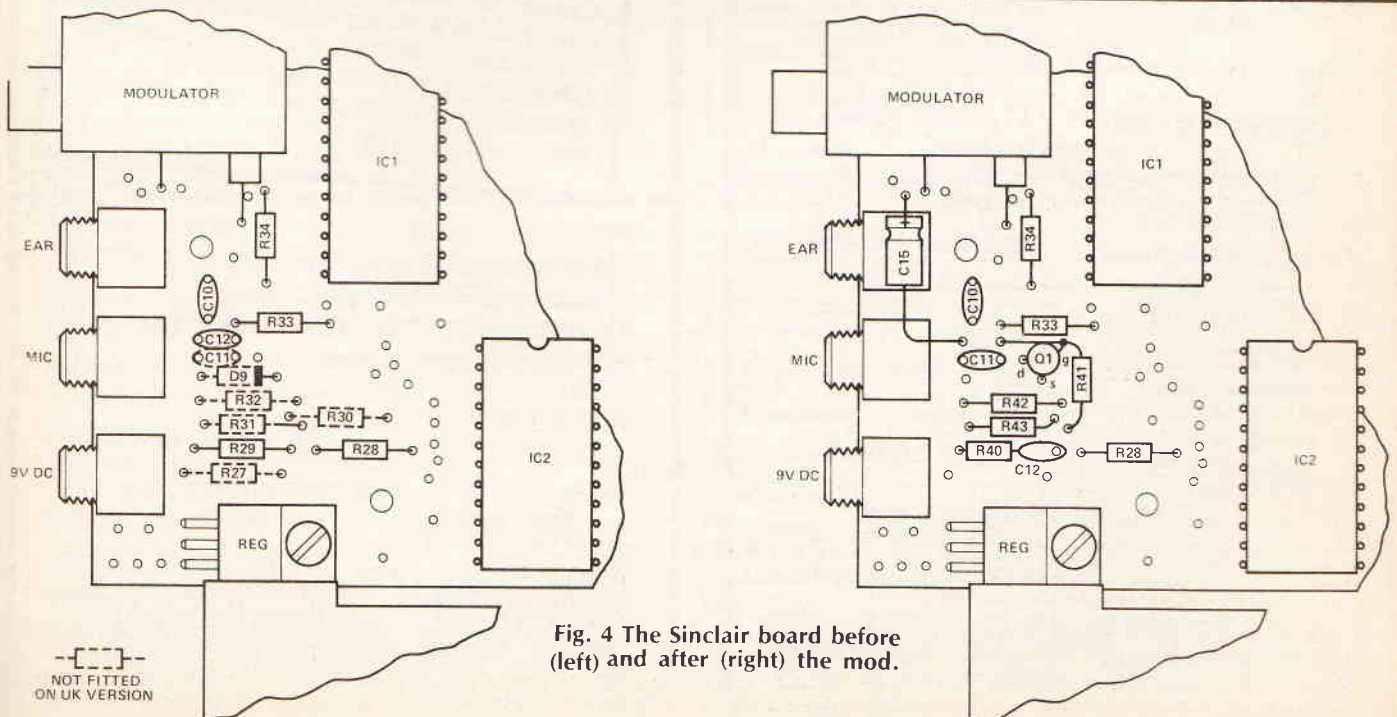
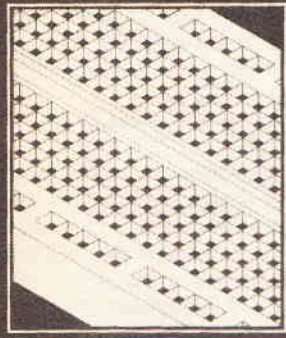


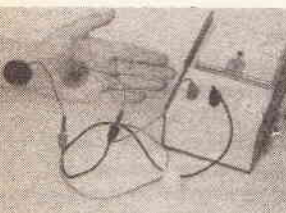
Fig. 4 The Sinclair board before (left) and after (right) the mod.

30 Solderless Breadboard Project — Book 1

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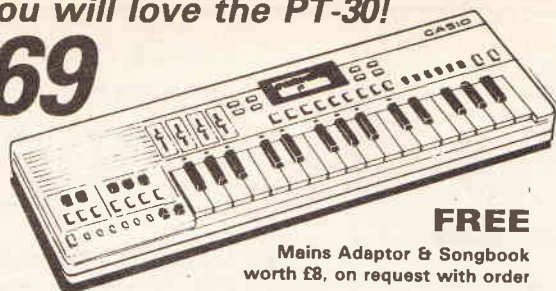


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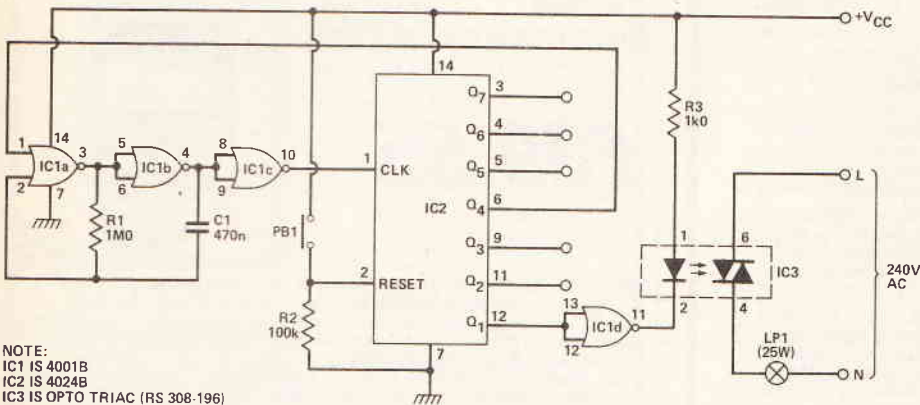
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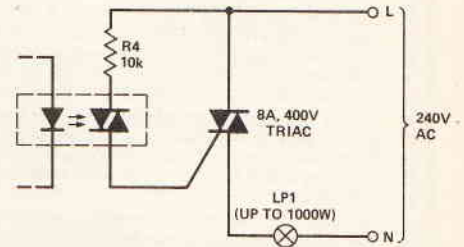
NOTE:
IC1 IS 4001B
IC2 IS 4024B
IC3 IS OPTO TRIAC (RS 308-196)

Doorbell For The Deaf

G. C. Dean, Taunton

This 'doorbell' was designed to alert a deaf person by flashing a light on and off several times. IC1a and IC1b form a CMOS oscillator with a disable input at pin 1 of IC1a. IC1c buffers

the oscillator to clock IC2 — a seven bit binary ripple counter. Before PB1 is pressed Q₄ will be high (and Q₁ — Q₃, low) and this will disable the clock. When PB1 is pressed, IC2 is reset, Q₄ goes low and the oscillator is enabled. IC2 will be clocked, switching Q₁ high and low until Q₄ goes high again, stopping the oscillator. Q₁ is fed via IC1d to IC3, an opto-



triac, which will control mains loads up to 25 W. As more power than this may be needed, Fig. 2 shows how the opto-triac can be used to trigger a more powerful triac. As drawn the doorbell will flash mains light bulbs on and off four times. If more flashes than this are needed, connect pin 1 of IC1 to Q₃ or Q₆ of IC2 and the doorbell will flash eight or 16 times.

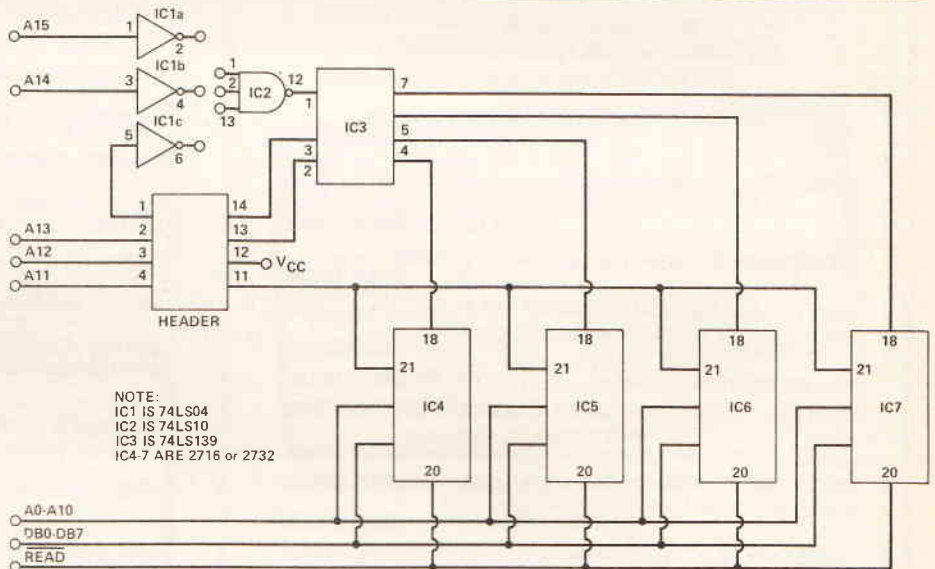
PROM Expansion Card

A. Adnitt, Bracknell

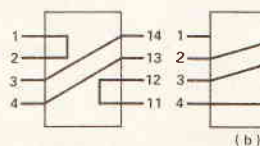
This circuit provides a very expandable expansion card for 16 bit address processors and single supply EPROMs. In all expansion cards I have seen they take either four 2K PROMs or two 4K PROMs leaving two empty sockets. Now, by very simple means, an expansion card can be made to give 8K or 16K of memory as shown in the diagram.

If an 8K set-up is first considered with the header wired as shown in Fig. 1a, then pin 21 (V_{pp}/A11) of IC4-IC7 is held high, A11 and A12 are used for chip select through the 2-to-4 line decoder (half a 74LS139) and IC1 and IC2 are hard-wired to decode address lines A13, 14 and 15 to select a particular 8K block of memory (see table).

Now, when your operator program outgrows this, a new card is not necessary, just a rewire of the header (Fig. 1b) and the larger EPROMs. In doing this, A11 is taken to IC4-IC7, A12 and A13 are used for chip select through IC3 and now with pins 1 and 2 joined together on IC2, hard wiring with IC1 gives a unique 16K block by decoding address lines A14 and A15.



NOTE:
IC1 IS 74LS04
IC2 IS 74LS10
IC3 IS 74LS139
IC4-7 ARE 2716 or 2732



8K BLOCK			
	a	b	c
1st	IN	IN	IN
2nd	IN	IN	OUT
3rd	IN	OUT	IN
4th	IN	OUT	OUT
5th	OUT	IN	IN
6th	OUT	IN	OUT
7th	OUT	OUT	IN
8th	OUT	OUT	OUT

IC1

16K BLOCK		
	a	b
1st	IN	IN
2nd	IN	OUT
3rd	OUT	IN
4th	OUT	OUT

IC1

It must be noted, however, that this can only be used for 2716 and 2732 EPROMs as TEXAS 25XX EPROMs have different pin-outs.

By providing 28-pin sockets and

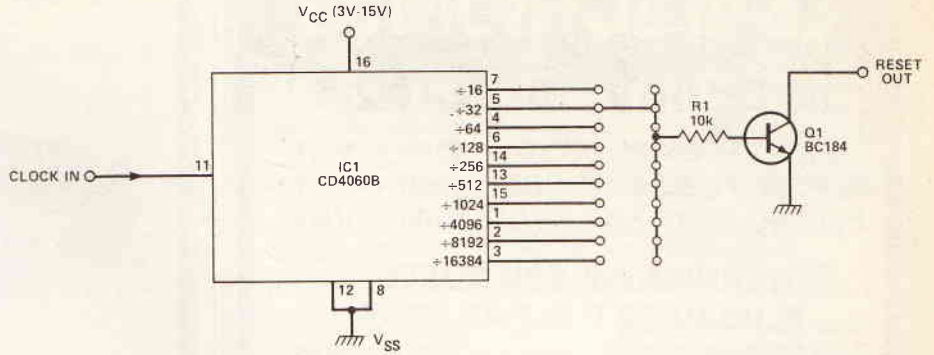
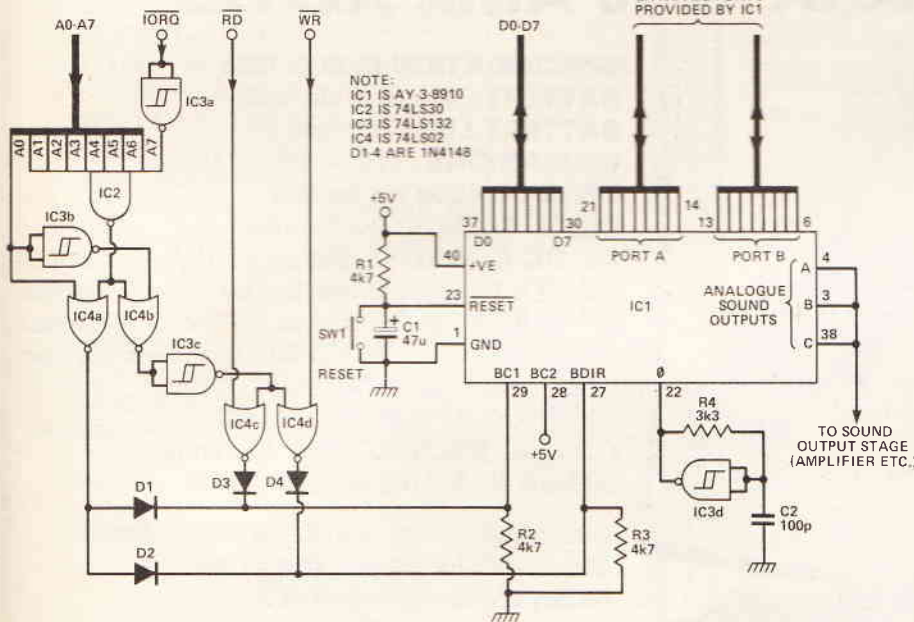
additional wiring, the circuit could be reconfigured to take 2764 PROMs — how's that for versatility, as little as 2K to a mammoth 32K of ROM catered for by one card!

Programmable Sound Generation And the Z80

Bruce Tanner, Malvern

Although the AY-3-8910 Programmable Sound Generator was designed to be operated with General Instruments PIC 1650 series eight-bit microprocessors or the 16-bit CP 1600/1610, it is easily interfaced to the more widely used Z80. The Z80 signals required are A0-A7, IORQ, WR, RD, and D0-D7. In the circuit shown, one of the PSG's registers is selected by writing the required register number to the Z80 port FE (hex) and then the register contents are read/written from/to port FF, although other port numbers may be used by inserting inverters in some or all of A1-A7. In most applications the three PSG audio outputs are connected directly together, although this could be done via manual mixer pots. For a suitable output stage see the computer expansion project in ETI, January 1982.

The PSG offers three independent oscillators with variable amplitudes, a variable noise source and an envelope generator, all in one 40-pin chip. For more information on the chip operation/functions see the General Instrument data sheet, which is often supplied with it.



Microprocessor Debugging Aid

S.K. Garratt B.Sc (Hons), Colchester

If you have ever built a microcomputer system, switched on the power, and found that nothing happened, this simple debugging aid may be of interest to you. The problem with troubleshooting microprocessor circuits is the lack of comprehensible signals when probing around the board with an oscilloscope. The answer is simple: the operation of any microcomputer system is predictable, following a pulse applied to the reset line of that system. A 6502, for instance, will spend six clock cycles sorting itself out internally, then make two memory fetches from the reset

vector at address FFFC and FFFD. Using the circuit shown it is possible, when connected to a faulty microprocessor system, to examine the address bus, data bus and control signals for several clock cycles after a reset with a simple oscilloscope. (It will be necessary to trigger the oscilloscope timebase from the reset signal generated by the debugging aid.) The user should be looking for such things as broken printed circuit tracks, solder bridges or even high resistance links between tracks, many of which may be easily detected by tracing the system operation during the first few clock cycles after reset.

The debugging aid consists of a CD4060B CMOS divider integrated circuit which is fed from the clock signal of the micro system under test. The output of the CD4060 drives a transistor which in turn may be used to drive the reset line of the microprocessor. This debugging reset signal may be switched to any one of 10 outputs from the CD4060 allowing a choice of the number of clock cycles to be examined.

MINIMUM PAYMENT £20

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Drawings should be as clear as possible and the text should be typed. Text and drawings must be on separate sheets. Circuits must not be subject to copyright. Items for consideration should be sent to ETI TECH-TIPS, Electronics Today International, 145 Charing Cross Road, London WC2H 0EE.

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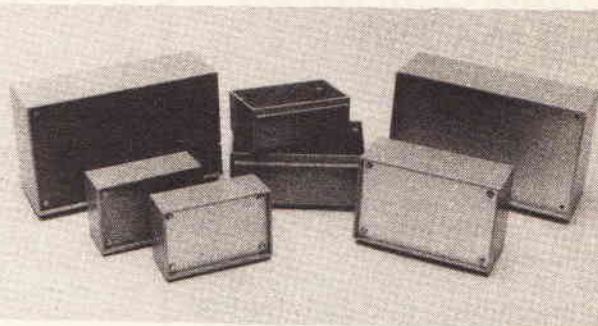
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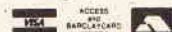
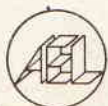
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	1x015	22+22	0.68	
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	2x016	25+25	1.00	
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	3x011	9+9	4.44	
	3x012	12+12	3.33	
	3x013	15+15	2.66	
	3x014	18+18	2.22	
	3x015	22+22	1.81	
	3x016	25+25	1.60	
120 VA 90 x 40mm 1.2 Kg Regulation 11%	4x010	6+6	10.00	£6.90 +P/D £1.29 +VAT £1.29 TOTAL £9.86
	4x011	9+9	6.66	
	4x012	12+12	5.00	
	4x013	15+15	4.00	
	4x014	18+18	3.33	
	4x015	22+22	2.72	
	4x016	25+25	2.40	
160 VA 110 x 40mm 1.8 Kg Regulation 9%	5x011	9+9	8.89	£7.91 +P/D £1.67 +VAT £1.68 TOTAL £11.88
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	5x013	15+15	5.33	
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	6x015	22+22	5.11	
	6x016	25+25	4.50	
	6x017	30+30	3.75	
	6x018	35+35	3.21	
300 VA 110 x 50mm 2.6 Kg Regulation 6%	7x013	15+15	10.00	£10.17 +P/D £2.00 +VAT £1.83 TOTAL £14.00
	7x014	18+18	8.33	
	7x015	22+22	6.82	
	7x016	25+25	6.00	
	7x017	30+30	5.00	
	7x018	35+35	4.28	
	7x026	40+40	3.75	
500 VA 140 x 60mm 4 Kg Regulation 4%	8x015	25+25	10.00	£13.53 +P/D £2.39 +VAT £2.38 TOTAL £18.26
	8x017	30+30	8.33	
	8x018	35+35	7.14	
	8x026	40+40	6.25	
	8x025	45+45	5.55	
	8x033	50+50	5.00	
	8x042	55+55	4.54	
625 VA 140 x 75mm 5 Kg Regulation 4%	9x017	30+30	10.41	£16.13 +P/D £2.30 +VAT £2.72 TOTAL £21.47
	9x018	35+35	8.92	
	9x026	40+40	7.81	
	9x025	45+45	6.94	
	9x033	50+50	6.25	
	9x042	55+55	5.68	
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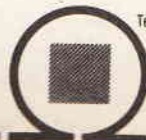
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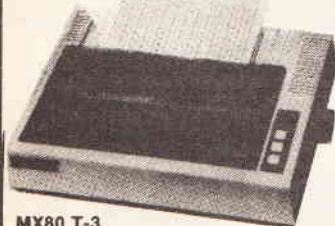
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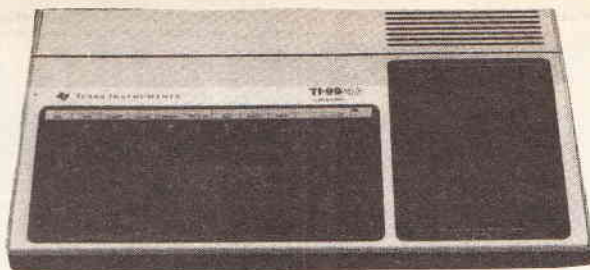
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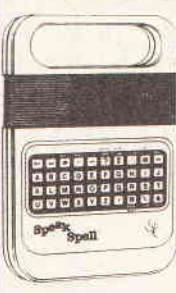


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DESIGN COMPETITION RESULTS

The entries started as a trickle and swelled to a torrent, we couldn't get into our office for them (we're allowed a bit of over-emphasis at this time of year). So here is the winner; we also decided to award two runner-up prizes.

Winner: Tim Tanner, of Rainham, Kent, for the 'Humane Alarm'

This circuit is designed to replace the raucous DC buzzer found in some digital alarm clocks. The idea was to design an alarm circuit which would start off at zero volume and increase in loudness over a period of about 30 seconds. By this method the sleeper is brought to consciousness by the minimum sound level required to wake them, instead of receiving a nasty shock in the ear at the crack of dawn. The circuit uses a Pulse Depth Modulation technique to achieve an increase in volume as well as an unorthodox gated astable design to provide the alarm tone.

The increase in volume with time is achieved with just one gate and a few discrete components. IC1d has two distinct states. When pin 9 is low IC1d acts as an ordinary gate and forces the emitter of Q1 to Vcc. When pin 9 is high IC1d ceases to be a gate and becomes an inverting amplifier due to the feedback of C1. R1, R2 and C1 turn IC1d into an integrator. Initially ENABLE is low and so is pin 9: therefore the emitter of Q1 is at Vcc, pin 8 is at 0V and C1 is charged up to Vcc. When ENABLE goes high C1 starts to discharge through R1 and R2. When pin 9 is high the amplifying action of IC1d maintains pin 8 at the switching voltage, approximately half Vcc. Therefore the emitter of Q1 assumes a level that depends on how much voltage is left across C1. Since this gets less with time, the voltage drop

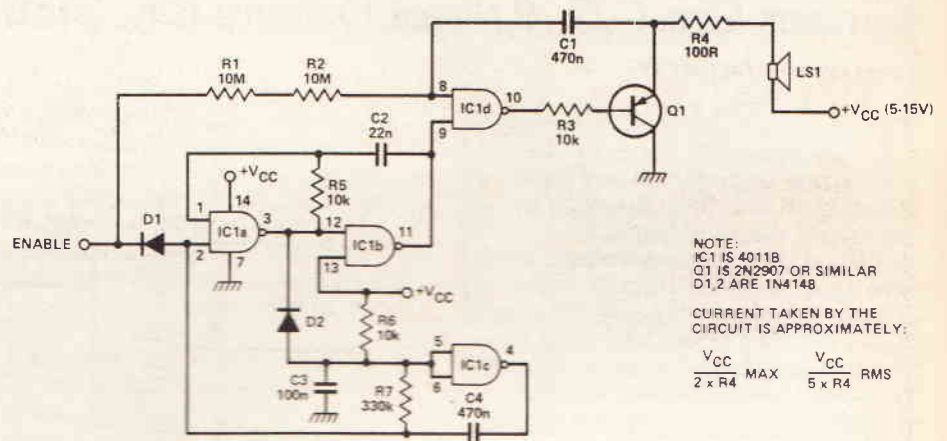
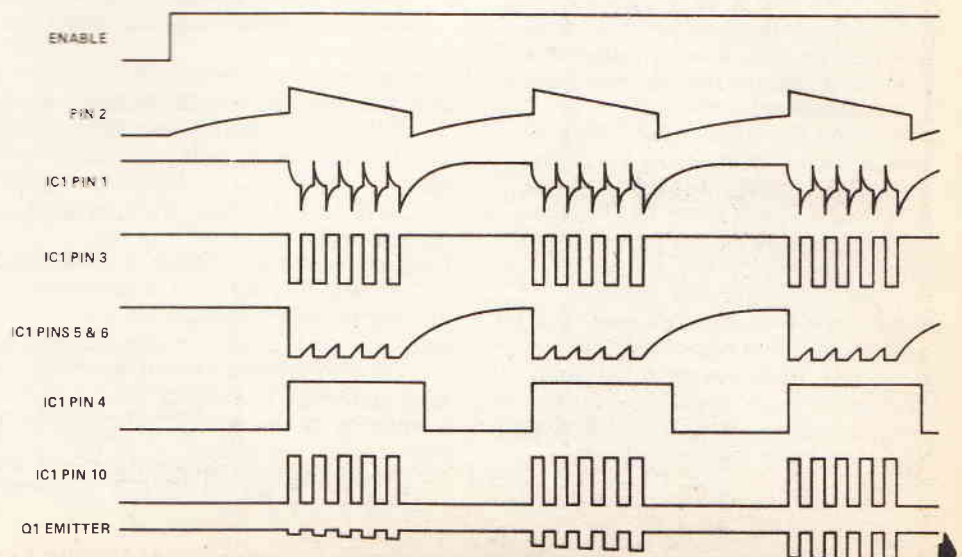


Fig. 1 (above) Circuit diagram of the Humane Alarm.

Fig. 2 (below) Timing diagram.



PARTS LIST

Resistors (all $\frac{1}{4}$ W 5%)
 R1, 2 10M
 R3, 5, 6 10k
 R4 100R (nominal)
 R7 330k

Capacitors
 C1 470n ceramic
 C2 22n ceramic
 C3 100n ceramic
 C4 470n ceramic

Semiconductors
 IC1 CD4011AE
 Q1 2N2907 (or similar)
 D1, 2 1N4148 (or similar)

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 LS1 8R miniature loudspeaker
 PCB

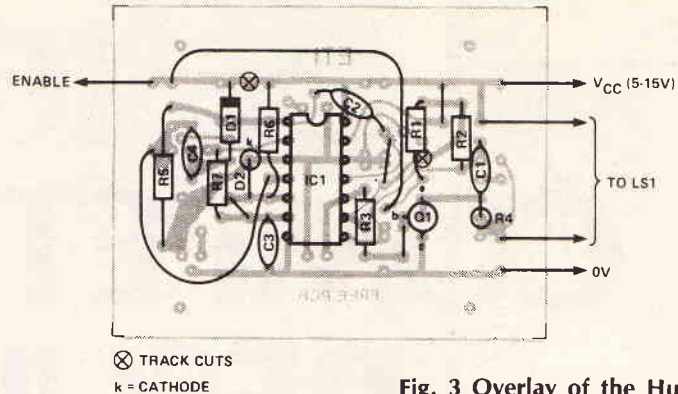


Fig. 3 Overlay of the Humane Alarm.

across R3 and LS1 increases with time giving increasing volume.

IC1a-c generate a pulsed-tone waveform. IC1a, IC1b, R5 and C2 form a conventional gated astable which generates the alarm tone. IC1a, IC1c, R7 and C4 form the pulse astable which determines how long the tone astable runs for each cycle. D2, C3 and R6 ensure that the faster running tone astable does

not interfere with the operation of the pulse astable. While the tone astable is running, pins 5 and 6 need to be kept low. C3 tries to charge up through R6 but is discharged through D2 every time pin 3 goes low. When the pulse astable switches the tone astable off, C3 is free to charge up through R6 until pin 4 goes low and starts a new cycle. When ENABLE is low both astables are disabled by pulling

pin 1 low via D1. Careful study of the 'host' alarm clock PSU will be required to ensure that the ENABLE signal swings between 0V and Vcc.

If the alarm circuit is to be run off the alarm clock PSU take care not to draw any more current than the existing alarm takes. Formulae for the approximate current taken by the circuit are shown on the circuit diagram.

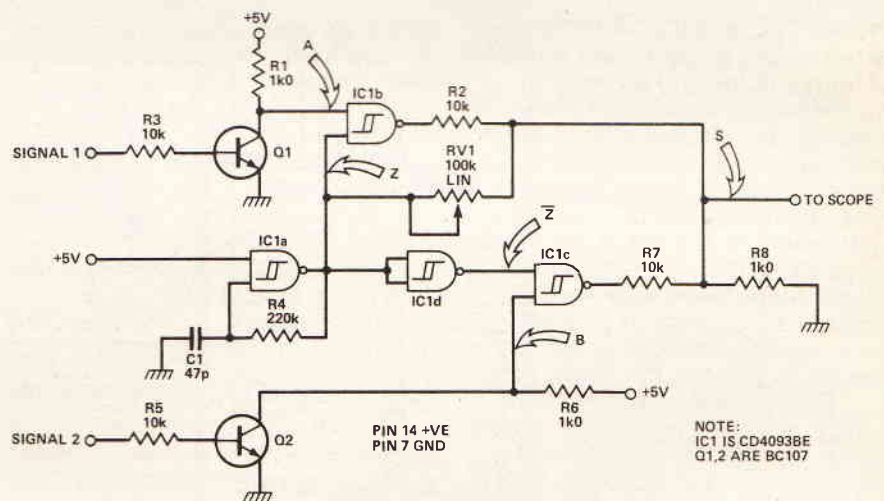
Runner Up: C.G. Bell, of Daigety Bay, Dunfirmline, for this dual trace adaptor.

The circuit employed here generates two traces on the scope upon which any logic input signal is added. Referring to the circuit diagram, Signal 1 is displayed on the upper voltage level and Signal 2 on the bottom. If the display is looked at closely the two traces are seen to be 'stitched' together by a high frequency square wave, but because of the scope's persistence it appears as two normal scan lines.

IC1a provides a relatively high frequency square wave (approx. 100 kHz) which is fed to one input on gates IC1b and IC1c. However before the pulse reaches IC1c it is inverted by gate IC1d to provide a switching action. For the two inputs to be displayed with good resolution the logic input frequency should be no more than a $\frac{1}{4}$ of the astable frequency. Q1 and Q2 are wired as inverter gates to give the correct polarity of the input signals when they reach the scope.

the potentiometer wired between the switching input of IC1b and point S has two important functions: (i) to ensure a variable degree of trace separation. (ii) to provide a 'summing' function which adds the input signals to their traces.

To get a clearer idea of how the resistor network RV1, R2, R7 and R8 works, refer to the timing diagram



and the resulting scope output.

Working from the inverted inputs at A and B, points to note are:

(i) if A or B is high their outputs switch between 1 and 0 at the frequency of the astable;

(ii) any low on A or B produces an output which is high for the duration of the logic pulse;

(iii) RV1 is switched, at its input end, between 1 and 0 at the frequency of the astable which is in phase with the output of IC1c.

Assuming no signal input, making A and B high, resistors R2 and R7 are switched between source and ground at 100 kHz.

However, the switching of R7 is always the complement of R2. RV1 is in phase with the switching of R7

PARTS LIST

Resistors (all $\frac{1}{4}$ W 5%)

R1, 6, 8 1k0

R2, 3, 5, 7 10k

R4 220k

Potentiometer

RV1 100k lin

Capacitor

C1 47p ceramic

Semiconductors

IC1 CD4093BE

Q1, 2 BC107

Miscellaneous

14 pin DIL socket for IC1; input and output sockets to suit

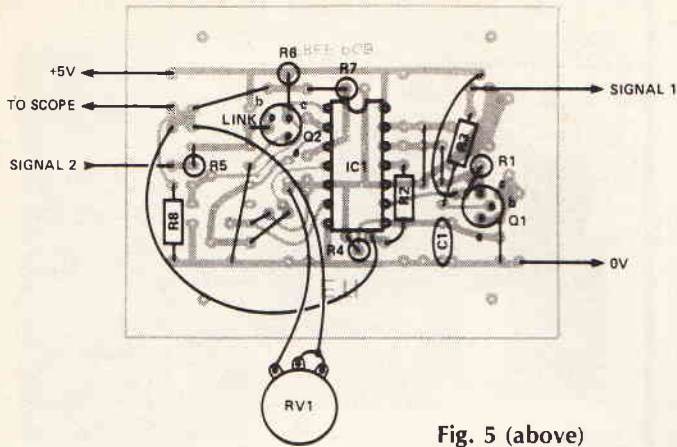
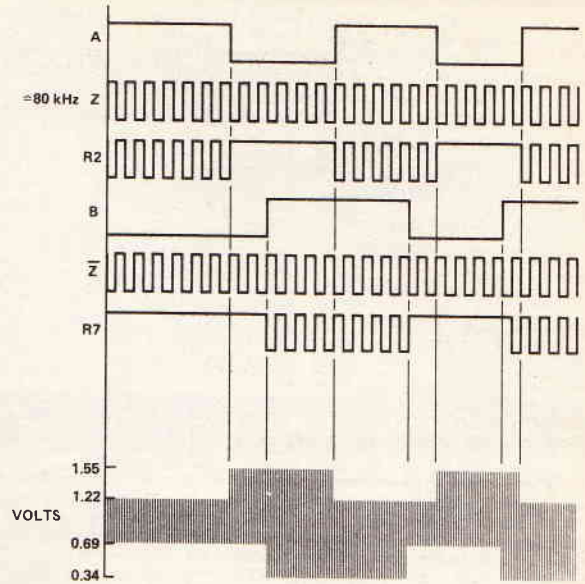


Fig. 5 (above)
Component overlay of
the dual trace adaptor.

and so in this input condition always parallels R7: the result of this is that two resistor configurations are generated alternately for 1/2f seconds each.

The two voltage levels generated form the basic trace lines upon which positive signal excursions can be added. So if Signal 1 goes high and Signal 2 remains low, R2 goes high for the

Fig. 6 (right) Waveform diagram of the dual trace adaptor.



duration of the logic signal but R7 and RV1 are still paralleled and switching between 1 and 0 at the astable frequency. This generates one new resistor configuration which adds 0.344V (RV1 set to 4k Ω)

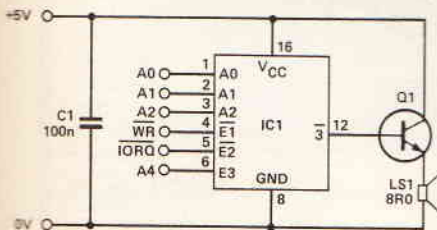
on to the top trace.

If Signal 2 goes high the bottom trace is raised in similar fashion to a level of approx. 0.69V because RV1 now parallels R8 to ground.

Runner Up: S.D. Solle of REculver, Kent, with the ZX Sound Board.

Sound boards for the ZX81 have been around for some time, however, being in the region of £25 they seem rather extravagant extras. This sound board uses few components, is thus cheap and easy to build, and all manner of sounds can be produced through a simple BASIC program.

The 74LS138 is a one-of-eight decoder, and if the lowest three bits



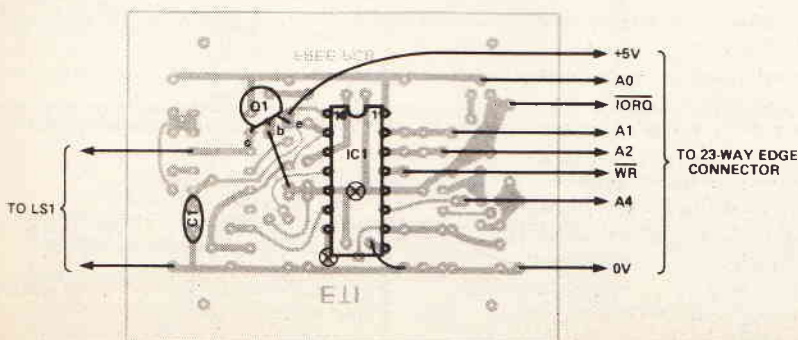
NOTE:
IC1 IS 74LS138
Q1 IS AC126

of the ZX address bus (A0, A1 and A2) are used as the three input lines, and A4, IORQ and WR are used as the enable lines, then by POKEing port 11 (not used by the computer) an electrical pulse can be amplified from data output 3 by Q1. The 100nF capacitor is used to smooth the current to IC1.

Construction is very simple, the PCB being modified only very slightly. However, it is necessary to mount IC1 upside down in its socket, that is pin 1 is where pin 16 should be and vice-versa. Be very careful when bending the pins (best done with miniature pliers) as they are likely to snap if bent more than once.

The edge connector is available through Watford Electronics. The connections to the edge connector are shown on page 167 of the Sinclair manual.

Fig. 7 (above) and Fig. 8 (below)
Circuit diagram and overlay of the
sound board.



PARTS LIST

C1	100n ceramic
Q1	AC126
IC1	74LS138
Miscellaneous	
	8R loudspeaker
	16 pin DIL socket
	23 way edge connector (see buylines)

BASIC LISTING

```

10 REM: "Y — = ?GOSGOSUB?
5 COPY??ASN??RND??RND"
20 PRINT "INPUT COARSE TUNE
(0-255)"
30 INPUT C
40 PRINT "INPUT FINE TUNE
(0-255)"
50 INPUT F
60 PRINT "INPUT LENGTH
(0-255)"
70 INPUT L
80 POKE 16527, C
90 POKE 16526, F
100 POKE 16519, L
110 RAND USR(16514)
120 GOTO 20

```

Type in the above listing, then, before running type in the following direct commands:

```

POKE 16521,186
POKE 16524,73
POKE 16527,2
POKE 16528,188
POKE 16530,136
POKE 16533,195
POKE 16534,143

```

You can now run the program, in FAST mode. (It will not work in SLOW.)

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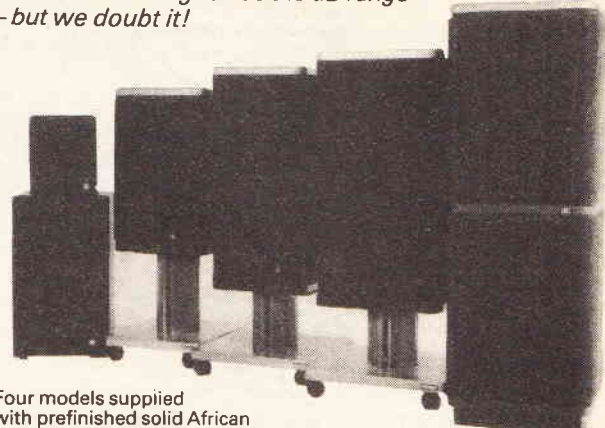
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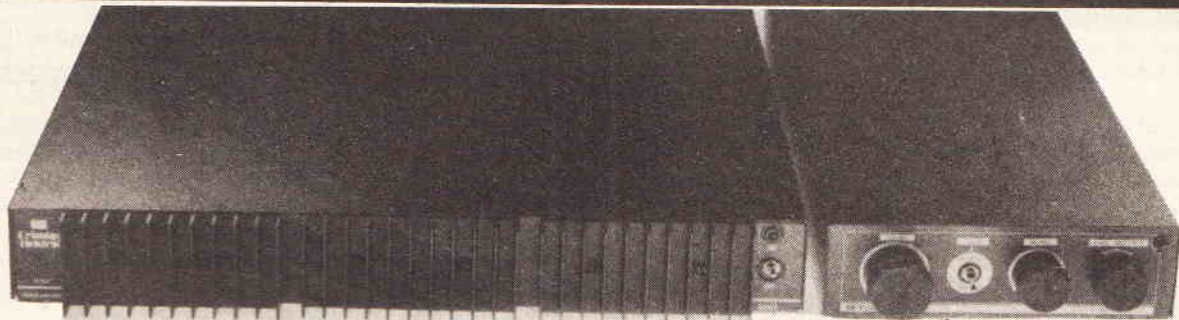
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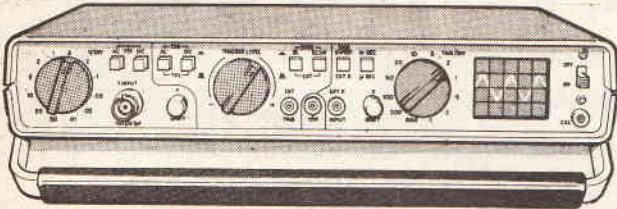


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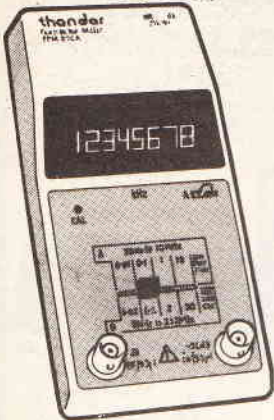
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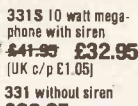
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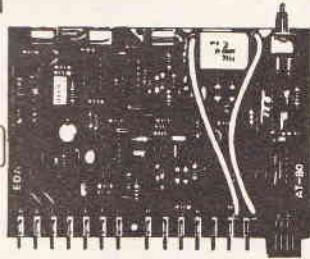
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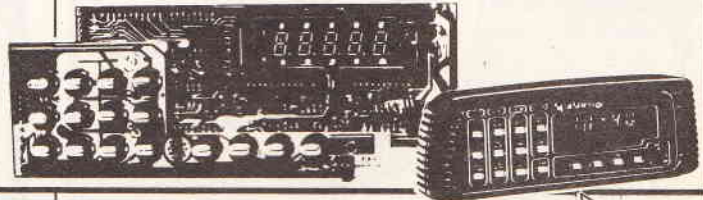
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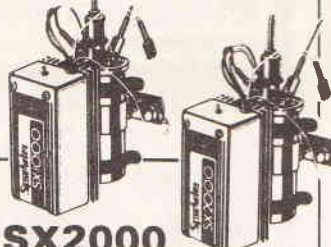
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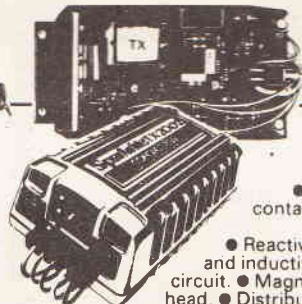


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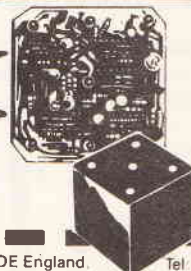


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CONFIGURATIONS

This month Ian Sinclair turns his attention to some of the many circuits that can be used to make waves: could this be a sine of the times?

When you first start to take an interest in circuit configurations, one of the first things that strikes you is the huge variety of sine wave oscillators, many of them known by names that go right back into the mists of time. When you look at these circuits more closely, however, what strikes you is not how different they are but how similar — and that's our starting point for this month.

An oscillator consists of an amplifier with a positive feedback loop and some circuit which has a time constant or is resonant to some frequency. Using this definition, we can include multivibrators among our oscillators, and rightly so, but since we dealt with multivibrators in Configurations Part 4 (November 82 ETI), we'll confine ourselves to sine wave oscillators in this part.

The Shrinking Sine

At times, the amplifier portion seems almost superfluous, because a resonant circuit, which is the most familiar way of forcing an oscillator to operate at some fixed frequency and give a sine wave, is a circuit which will, by itself, oscillate quite happily! The circuit of Fig. 1 will, for example, produce an oscillation when the base of the transistor is briefly pulsed positive. The peak emitter voltage of the transistor during this pulse charges the capacitor, and when the transistor cuts off again, the capacitor discharges through the inductor, setting up an oscillating current which in turn causes a sine wave voltage to appear across the circuit.

This wave decays, however, as Fig. 2 shows, because the coil has resistance and any resistance in a circuit will

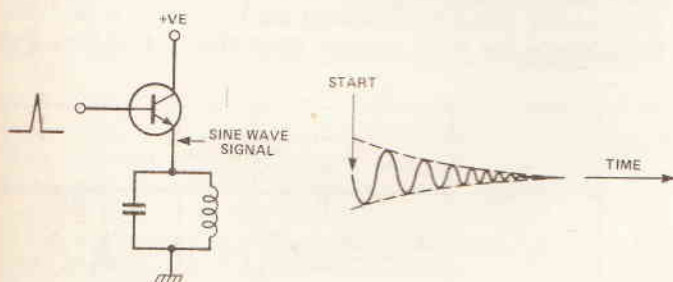


Fig. 1 (Left) A ringing circuit, using a resonant circuit in the emitter of a transistor which is normally cut off, but which can be pulsed briefly into conduction.

Fig. 2 (Right) The form of the 'ringing' wave — this is a sine wave which decays to zero amplitude. If the circuit resistance is very low, the decay may take a 'long' time, meaning that many cycles of wave will be executed before the amplitude becomes zero.

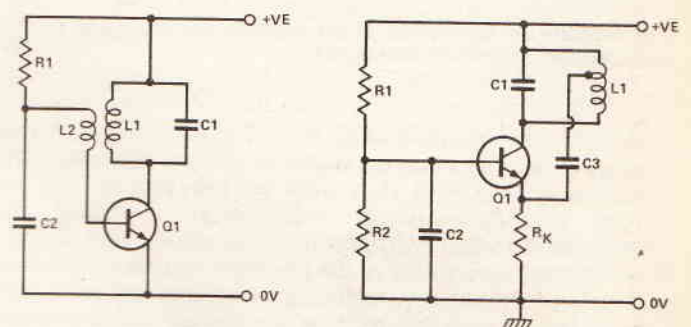


Fig. 3 (Left) A simple two-winding oscillator. This is easy to construct, but not so easy to adjust for a pure sine wave.

Fig. 4 (Right) The Hartley oscillator in one of its many forms. The positive feedback loop is from the collector circuit to the emitter.

dissipate energy (as heat) when a current flows through it. That's why an amplifier is needed — just to replace the energy that is lost in the resistance of the coil! Sine wave oscillators that make use of LC resonant circuits do not need a high-gain amplifier, and too much gain will, in fact, distort the waveform, changing it from a pure sine into something more like a square wave. Any oscillator that makes use of the LC resonant circuit must therefore include some means of controlling the gain of the amplifier, because a really well-shaped sine wave will be obtained only when the amplifier gain is just enough to sustain oscillation, and no more. There's another reason: a circuit which includes positive feedback is never very stable, so that the oscillator must include some method of limiting — preventing the amplitude of the oscillation from growing until the tips of the wave start to square off. That's one thing which can be done most easily when the gain of the amplifier is low, because the gain will drop as the transistor approaches the cut-off or the bottomed conditions, and if the gain is low to start with, this drop should be enough to limit the amplitude of oscillation with only a small amount of distortion of the waveform.

Winding You Up

With these words on general principles out of the way, then, we can take a look at some oscillator configurations. Let's start with the simplest one — the two-winding transformer type as shown in Fig. 3. The three building-blocks of amplifier, feedback loop and resonant circuit are obvious, but it's by no means the easiest type to obtain a pure sine wave from. The reason is that the bias of the transistor has to be set by the value of R1, and the gain must be set by the design of L2 — a few turns spaced some distance from L1. There's no quick and easy way of

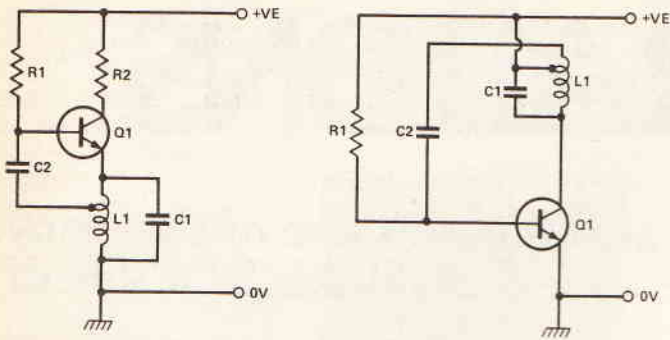


Fig. 5 (Left) Another form of the Hartley oscillator, with feedback from the emitter to the base.

Fig. 6 (Right) A third form of the Hartley circuit, using the coil tapping to invert the signal.

calculating the number of turns and spacing of L2, so that design invariably ends up with cut-and-try methods. The usual technique is to start with too many turns, get the circuit oscillating (which may mean reversing the connections to L2 if you got them the wrong way round), then removing turns for as long as the circuit will continue to oscillate, and finally, restoring a turn or a half-turn. This has to be done to ensure that the circuit will start each time it is switched on.

Much better waveshapes can be obtained with less effort by using the traditional Hartley and Colpitts oscillators that are so beloved of radio hams. One version of the Hartley oscillator is shown in Fig. 4 — this uses feedback from a tapping on the coil to the emitter terminal. This oscillator can give well-shaped sine waves,

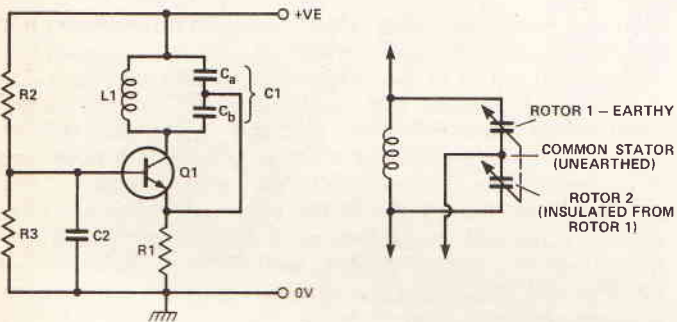


Fig. 7 (Left) The basic Colpitts oscillator.

Fig. 8 (Right) A variable tuning Colpitts can make use of a variable two-gang capacitor of specialised construction.

and seldom needs adjustment. The rule of thumb is to use a coil tapped at about 10% to 20% of its total turns from the 'cold' end (the end connected to the supply), a resistance of around 330R for R_e , and design the bias components R1 and R2 so that the oscillation is a sine wave and is self-starting. The decoupling of the base is essential if the oscillator is to be used as shown; alternatively the base can be driven from a low-impedance source which will cause the output from the resonant circuit to be amplitude modulated.

Figure 5 shows another version of the circuit, in which the tapped coil is in the emitter circuit, feeding back to the base this time, and so leaving the collector free to deliver the waveform. The output wave at the collector is not a pure sine wave, however, so that this output is useful mainly when the output is to be squared to generate

harmonics, or if a resonant circuit is to be included in the collector circuit. A wave of better sine shape can be taken from the emitter. Figure 6 shows another variant of the Hartley circuit which uses the tapped coil in the collector circuit — in this example, the tapping is connected to the supply voltage so that the remainder of the coil phase-inverts the signal to feed the base.

The Colpitts oscillator uses a very similar circuit to the Hartley, but with a single coil winding, untapped. The tapping is arranged by using two capacitors connected across the coil, as shown in Fig. 7, which shows the tuned-collector version of the circuit. The combination of the capacitors in series is the tuning capacitance for the inductor, and the ratio of the values should be arranged so that C_a is around $5C_b$ (or more) to give the required signal

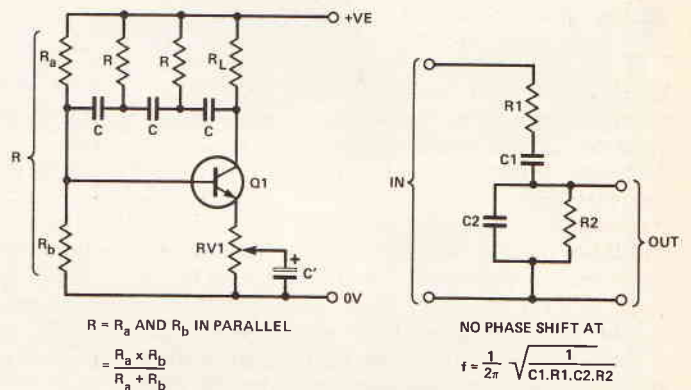


Fig. 9 (Left) The phase-shift oscillator in its simplest form.

Fig. 10 (Right) The Wien bridge circuit, originally devised for measurement purposes.

division ratio. The Colpitts configuration has the advantage that only a two-terminal coil is needed, but the capacitor dividing chain is a nuisance, particularly if frequency has to be varied by using variable capacitors — one solution is the type of twin ganged capacitor shown in Fig. 8.

Since it's possible to make RF oscillators from every conceivable arrangement of amplifier, resonant circuit and positive feedback loop, there are dozens of RF sine wave oscillator circuits, some of them (like the Hartley and the Colpitts designs) stretching back to the 20s and 30s. What keeps the most popular ones alive is that they give

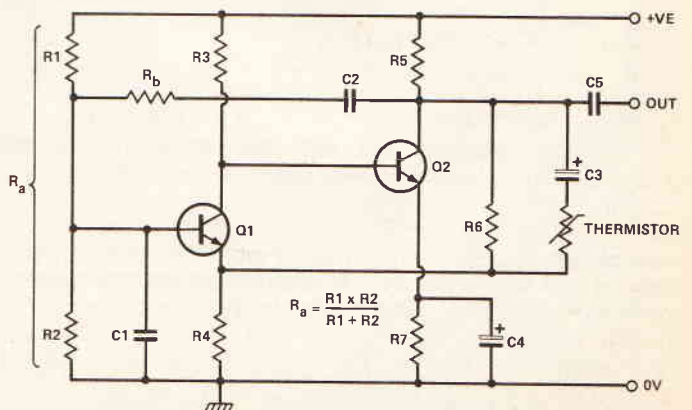


Fig. 11 A Wien bridge circuit circuit, using a thermistor to stabilise amplitude.

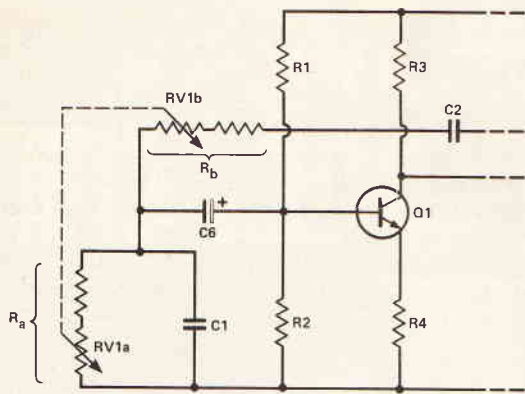


Fig. 12 Frequency variation on a Wien oscillator using ganged potentiometers.

good sine waves, with small frequency drift. There are many other designs which have simply dropped out of use because they could not fulfil the ever-increasingly stringent requirements for frequency stability, so please don't write in with what you think is an original RF oscillator circuit — it's a thousand to one that someone will have patented it in nineteen oatcake and it will have dropped out of use for good reason!

Descending Into Difficulty

At the lower end of the frequency scale, sine wave oscillators which use resonant circuits start to run into component problems. The inductors need iron cores, causing non-linearity, and have very low Q figures (ratio of reactance to resistance), which also permits poorly-shaped

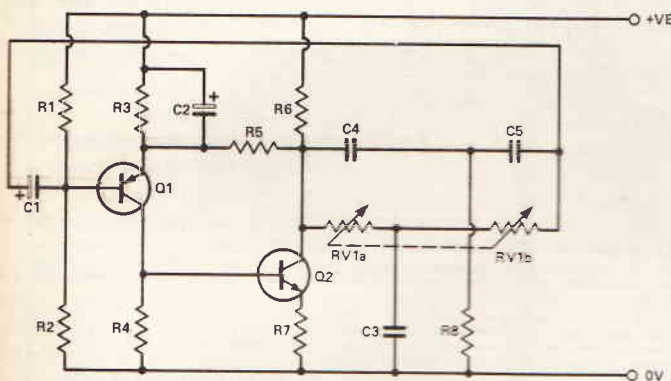


Fig. 13 The twin-T network used in an oscillator circuit.

waveforms. Capacitors tend to be more leaky because of their large capacitance values, and the sheer size of the resonance circuit can be very unwieldy. This leads to the use of RC oscillators for low frequency applications, and to the design of much more complicated oscillator circuits. The problem is that there are no truly resonant RC circuits that are in any way comparable with LC circuits. There are many RC circuits which have minimum or maximum attenuation or phase shift at a 'resonant' frequency, but their selectivity, in terms of the change of frequency is very poor compared to the LC circuit. For this reason, RC oscillators will never give a pure sine wave unless the gain of the amplifier stage is very closely controlled — hence the circuit complications.

The 'classic' RC oscillator circuit is the phase-shift oscillator of Fig. 9. The three RC time constants should be approximately equal, and each should cause a 60° phase

shift at the desired oscillating frequency. The set of three then causes a 180° phase shift overall, which is the requirement for oscillation if the gain is sufficient overall. A fair amount of gain will be needed in this circuit at all. Gain is adjusted by using RV1, which varies the small amount of negative feedback, and this should be set for the best sine wave shape, which will be when the circuit is just oscillating. This may not be the setting for obtaining reliable starting when the circuit is switched on, however.

For purposes where a high-quality sine wave is needed, and particularly if variation of frequency is wanted, more elaborate circuits are used, of which the Wien Bridge and the Twin-T are typical. The Wien bridge circuit itself is shown in Fig. 10 — its peculiar property is that it has zero phase shift at its 'resonant' frequency as shown in the formula. This configuration can be used in a positive feedback loop to ensure that the feedback is in the correct phase only at the correct frequency, but close control of the gain will be needed if the waveform is to remain of good sine shape.

Getting A Bead On It

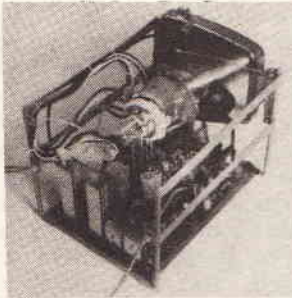
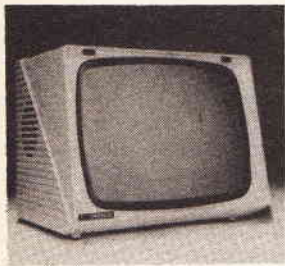
The conventional way of achieving this on modern RC oscillators is by the use of a subminiature thermistor with negative temperature coefficient. A bead thermistor is used, which will be heated by a signal current of a milliamp or less, and this component is included in a negative feedback loop which controls the gain of the complete amplifier section. When the signal current flowing through the thermistor is high, the thermistor resistance decreases and the increased feedback causes the gain of the amplifier to be reduced. The opposite process occurs if the signal current is too small. The thermistor therefore takes over the task of controlling the gain of the amplifier, allowing us to concentrate our efforts on designing the rest of the circuit.

A typical Wien bridge oscillator circuit is illustrated in Fig. 11. A direct-coupled two-transistor circuit is used, and the gain is controlled by the loop which feeds signal from the collector of Q2 to the emitter of Q1. This loop consists of a fixed resistor R6 and the combination of capacitor and thermistor in parallel with it; the values must be chosen so that the overall gain is fairly low. The Wien bridge network of $R_3/C1/R_4/C2$ is connected between the collector of Q2 and the base of Q1 (the positive feedback loop).

Variable frequency operation can be carried out by varying either the resistors of the Wien network or the capacitors, but it is not enough to alter just one component value. Most amateur circuits (see Fig. 12) use small value fixed resistors, plus a ganged potentiometer in series, to make up R_a and R_b ; R1 and R2 have high values, so their effect is negligible. Commercial Wien bridge circuits tend to use a FET for Q1, and to carry out frequency variation by using a ganged capacitor for C1 and C2. This gives a larger sweep of frequency, so that fewer ranges are needed, but requires very large resistor values, since the variable capacitors are only 500pF in value. Resistors of many megohms are needed if low frequencies are to be generated, hence the need for the FET at the front end. Commercial Wien bridge circuits can cope with a frequency range of 10 Hz to over 1 MHz in three or four switched ranges.

Finally, Fig. 13 shows a typical circuit using a twin-T network but omitting the complications of the thermistor amplitude control. The twin-T has, for some reason, never been so widely used in this country as in the USA — it seems to be the old Bootstrap v Miller timebase attitude all over again!

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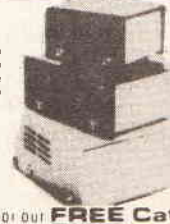
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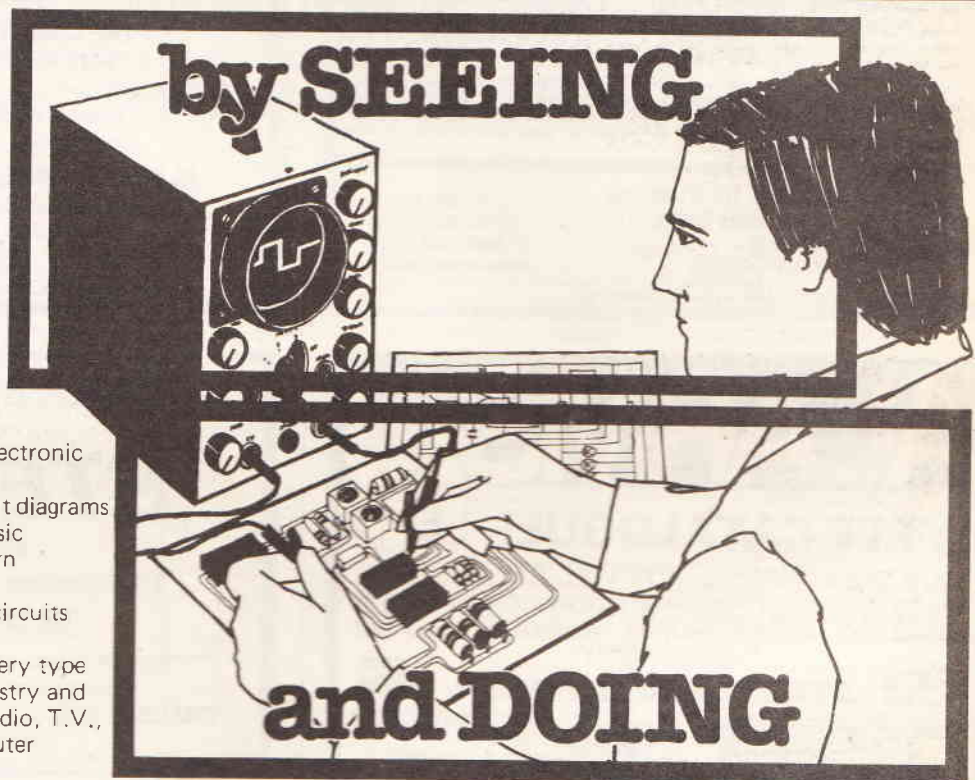
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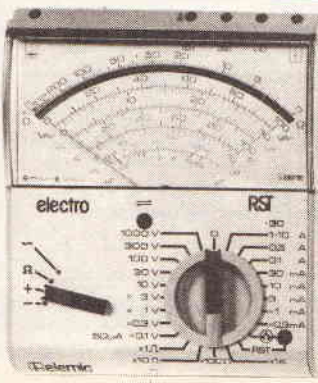
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FOUR MINI-MICRO PROJECTS

Confused by the multitudes of microcomputers on the market, or just dissatisfied by what they offer? Readers who are often brew their own, so here's a collection of circuits to help enhance your system. Designs by Martin Postranecky.

Computer System Reset Generator

In custom (ie home) built computer systems and peripherals it is advantageous to generate a SYSTEM RESET pulse which does not lose or corrupt data already stored or in 'transit'. This circuit accepts a variety of reset inputs (from simple push-to-earth switches, any number of which can be connected to point A using the 1N4148 diodes) and generates its own 'power-on' reset pulse.

When any reset pulse is received, via the D1, D2 . . . Dn 'OR' gate, both halves of the IC3 timer are triggered. If the SYSTEM BUSY is *not* asserted (ie the 2Clear input is held 'low') the 2Q output is 'high' and the reset output 1Q passes via IC2b to the SYSTEM RESET output.

If, on the other hand, the SYSTEM BUSY is asserted when a reset input is received, the 1Q output will be blocked by the 2Q line until either the busy signal ends (to prevent any data in I/O transit being lost) — or, if the busy line remains 'high' due to a fault, until timeout pulse 2Q ends. Set the timeout components (C2, R5) so that the interval exceeds safely any expected busy interval. Set the RESET interval (C3, R4) to give the required length of pulse longer than the timeout period.

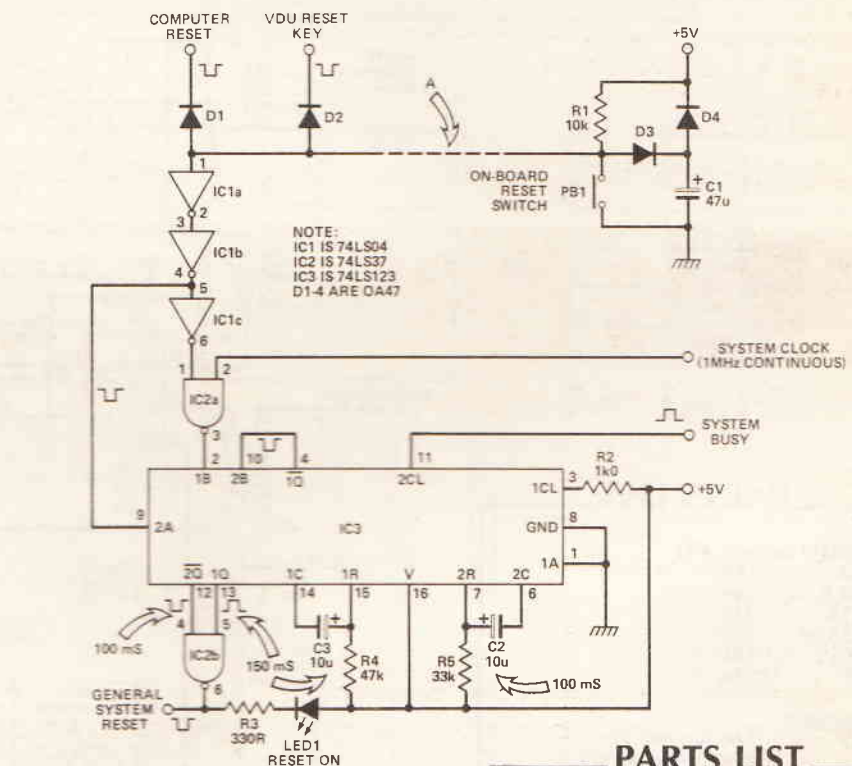


Fig. 1 Circuit diagram for the computer reset generator.

The CLOCK line (any continuous system clock will do) and IC2a provide a permanent RESET if any reset switch is held down LED1 gives a visual indication of the RESET function.

PARTS LIST

Resistors (all 1/4W, 5%)

R1	10k
R2	1k0
R3	330R
R4	47k
R5	33k

Capacitors

C1	47u 16 V Electrolytic
C2,3	10u 16 V Electrolytic

Semiconductors

IC1	74LS04
IC2	74LS37
IC3	74LS123
D1-4	OA47
LED1	any red LED

Time-out Generator And System Failure Alarm

This circuit provides an audible warning of a master clock and/or derived clock failure. It also generates its own time-out reset pulse (which can be applied to the previous circuit at the point A). The two clock lines tested (I suggest the continuous MASTER CLOCK and some derived clock pulse train far down the circuit chain — eg the RAM clock) are biased by R1, R2 and R3, R4 so that pulses via C1 and C2 continuously re-trigger the second timer in IC4. If any interruption occurs in either clock

line longer than that set by C4, R6 (preset this safely longer than any normally expected period between the clock pulse trains), the $2\bar{Q}$ line will return high causing IC5a to change its outputs and trigger the alarm.

The SYSTEM BUSY line going low will trigger the other half of the timer. If after a preset interval (C3, R5) the busy line is still asserted low the output $1\bar{Q}$ of IC4 will clock IC5a and change the $2\bar{Q}$ and $2\bar{Q}$ outputs. In addition to triggering the alarm a TIME-OUT RESET is generated via IC1b. (This could be applied to the RESET GENERATOR circuit making

a virtually self-correcting system). IC1b prevents the self-preset system operating in the case of the clock failure as this will usually indicate a more serious hardware fault, ie a short).

The alarm used is a two tone 555-based sound generator requiring 15 V for adequate volume. This has been used to distinguish between the clock and/or timeout failure (high tone) and the high temperature warning described in the fourth circuit (low tone). The output from IC2d enables the 555, while IC2e controls the tone by switching Q1.

PARTS LIST

Resistors (all $\frac{1}{4}W$, 5%)

R1,2	1k5
R3-6,9,10	1k0
R7,14	33k
R8,15,16	10k
R11,13	15k
R12	56k

Capacitors

C1,2	1n0 ceramic
C3	47u 16 V electrolytic
C4	22u 16 V electrolytic
C5	33n ceramic

Semiconductors

IC1	74LS32
IC2	74LS06
IC3	74LS08
IC4	74LS123
IC5	74LS74
IC6	555

Miscellaneous

TX1	PB-2720
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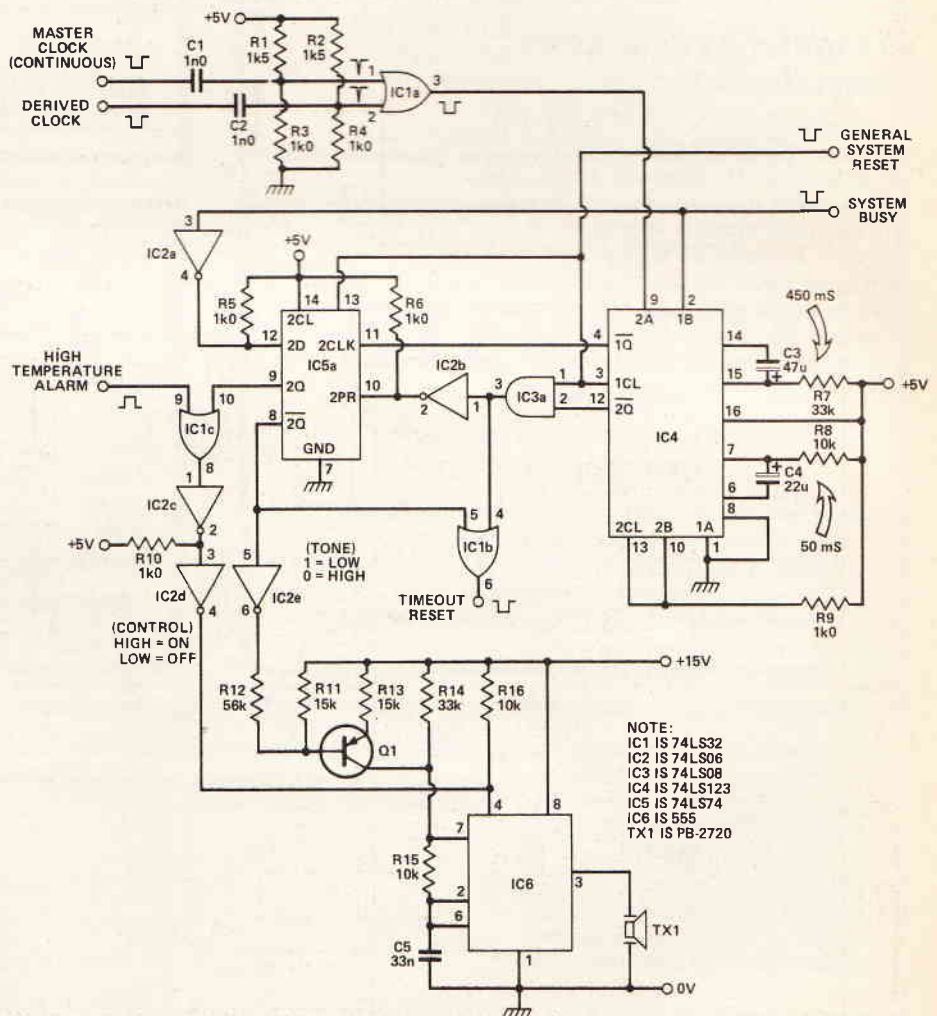


Fig. 2 The circuitry for the time-out generator and system failure alarm.

Supply Voltage Check Scan and DVM Display

This simple scanning circuit is used to check the status of the multitude of DC supply lines in a typical computer/peripherals system. A continuous clock input is divided by IC1 (more 7493s can be used if only

fast clocks are available) and decoded by IC2.)

The various supply voltages are divided down by the resistor networks R2-R9 and R10-R17 to provide safe levels for the analogue multiplexer IC3, a CMOS 4051B, which passes the selected supply line voltage to the standard DVM

circuit. In this case the Intersil ICL 7107 single chip voltmeter is used together with four 7-segment LEDs to provide an accurate visual check on the DC supply lines.

The last input is used to display (in °C) the temperature reading taken by the sensor described in the next section.

PARTS LIST

Resistors (all 1/4W, 5%)

R1-9	1k0
R10-17	5k6
R18	270R
R19	1k5
R20	470k
R21	180k
R22	100k

Potentiometers

PR1	220k miniature horizontal preset
PR2	2k2 miniature horizontal preset
PR3	470k miniature horizontal preset

Capacitors

C1,9,11	47u 16 V electrolytic
C2,4,8,10	100n polycarbonate
C3	100p ceramic
C5	10n ceramic
C6	47n ceramic
C7	220n polycarbonate

Semiconductors

IC1,2	74LS90
IC3	4051B
IC4	7107
DISP1-4	common anode seven-segment displays, one half and three full

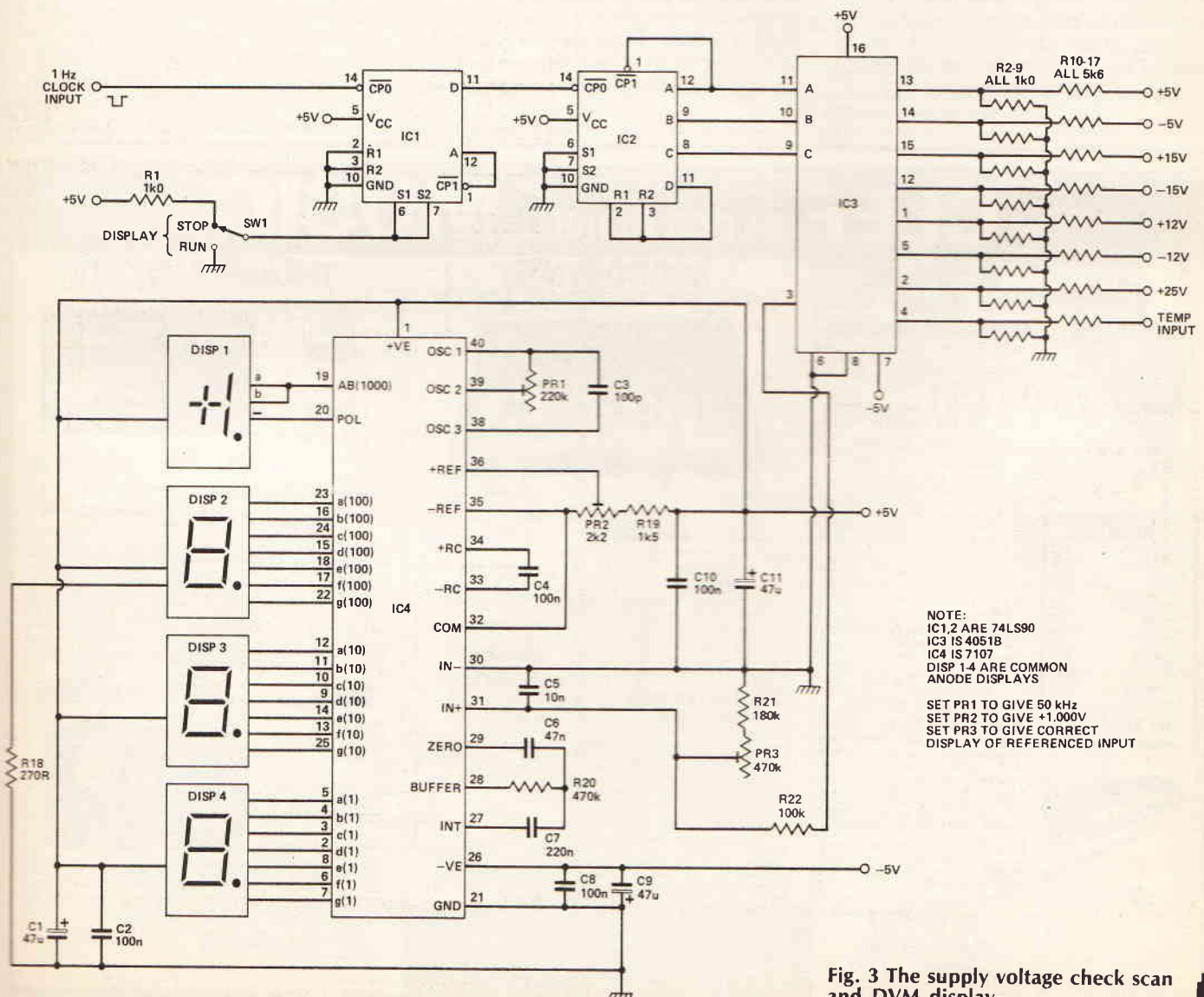


Fig. 3 The supply voltage check scan and DVM display.

PROJECT: Micro Add-ons

PARTS LIST

Resistors (all 1/4W, 5%)

R1	8k2
R2,4	1k0
R3	22k

Potentiometers

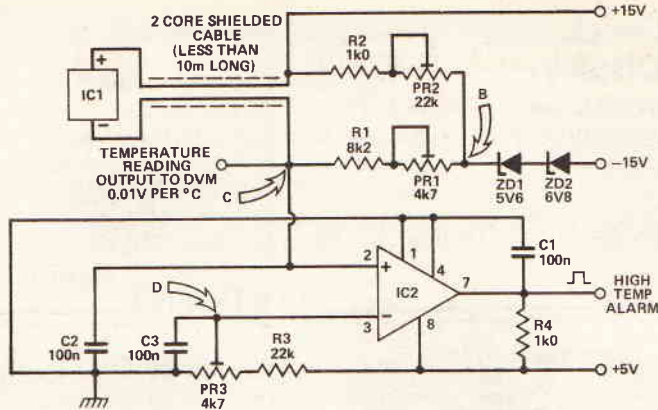
PR1,3	4k7 miniature horizontal preset
PR2	22k miniature horizontal preset

Capacitors

C1,2	100n ceramic or polycarbonate
------	-------------------------------

Semiconductors

IC1	AD590
IC2	LM311
ZD1	5V6 400 mW zener
ZD2	6V8 400 mW zener



NOTE:
 IC1 IS AD590
 IC2 IS LM311
 ZD1 IS BXV88C5V6
 ZD2 IS BXV88C6V8
 SET PR1 FOR B = -2.73V
 SET PR2 FOR C = 0.00V
 WITH SENSOR AT 0.00° C
 SET PR3 FOR TEMP ALARM
 POINT (0.65V FOR 65° C)

Fig. 4 Circuit diagram for the temperature sensor and alarm.

Computer System Temperature Sensor And Alarm

Analog Devices' AD590 temperature sensor is used to provide an output in degrees Centigrade of the temperature inside the computer console. Zener diodes ZD1, 2 and preset PR1 provide the conversion voltage of -2.732 V needed to

change the degrees K to degrees C. PR2 is used to zero the AD590 sensor linear output at some point of its scale (-50° to +150° C). I suggest the 0.00 V output should be set with the sensor in a beaker of a crushed melting ice. The sensor output is best displayed on a digital voltmeter (0.01 V per degree C) or on the specialised DVM chip (see

previous circuit).

A voltage comparator (IC1) is used to compare the temperature sensor output with a value preset by PR3 and trigger the high temperature alarm when this value (65°-70° C for most TTL and CMOS) is exceeded. This alarm output can be connected to the alarm buzzer as described in the second circuit.

ETI

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Letters for this page should be addressed to Read/Write at our Charing Cross Road address.

Dear Sirs,

With regards to the Earth Leakage Circuit Breaker article (*Electronics Today International* Vol. 11 No. 12 December 1982), may we, as manufacturers of ELCB socket outlets, offer the following cautionary advice.

In the article the following recommendation is given for the selection of the relay, "... so it's best to use a relay that is capable of switching the full 13 amp maximum that you will ever draw from a socket".

This statement we feel could be dangerously misleading, as under fault conditions very high currents can occur. For example a typical domestic 13 amp fuse will pass approximately 150 amps for a period of 30 ms, and 200 amps for a period of 10 ms.

Our extensive testing of compact relays for this application revealed that short time let through currents of these magnitudes are in excess of relay switching duty capabilities, and that resultant contact welding is a very real possibility.

For this reason our earth leakage sockets incorporate a circuit breaker as the switching element, which possesses switching capabilities well in excess of the demands made by a 13 amp fuse.

Yours faithfully,
for Dorman Smith Britmac Limited, Preston.
E. Johnston,
Project Leader.

In the light of the above comments, we'd like to recommend two courses of action to builders and users of our ELCB design:

- 1) Use the best quality relay you can, and, if you ever accidentally apply a short circuit to the output terminals, afterwards check, using the test button, that the relay does still release and check visually for damage to the relay contacts;
- 2) Make sure that all appliances have appropriate fuses (you should have done this anyway). This means that for most hand and garden tools, a 5 A fuse should be used.

Dear Sirs,

It is with much regret that I am writing to you to point out a lethal error in your article on mains potential and safety in your December issue. I am most annoyed that you have made this mistake as many newcomers may read it and be misled.

ERROR

IF A FAULT OCCURS IN A PIECE OF MAINS OPERATED EQUIPMENT ANY EXTERNAL METAL PARTS MAY BE PLACED AT EARTH POTENTIAL: as you know this should read MAINS POTENTIAL.

Please rectify this fault in your next issue.

W. Moore,
Ashton in Wakefield.
PS I hope you are not dead yet.

Thank you for your wish at the end of the letter — no, we aren't yet dead, but, at the time of writing, we do have the office Christmas party to come!

Seriously, we too are pretty annoyed about the mistake; we hope that everyone who built the project spotted it, as it is rather an obvious blunder.

Dear Sir,

Having just completed the "Touch Dimmer" from *Electronics Digest*, Volume 2, No. 2, Autumn 1981, I am disappointed to find that a buzz is present which does not allow me to use the unit in the place where I had originally intended it to go. I would be grateful if you would give me some advice in isolating and eliminating this noise.

Yours faithfully,
Christopher Jones,
Solihull.

No you're not reading the wrong magazine; this isn't *Electronics Digest*, but the Editor's office for ED is not one million miles from the ETI editor's office, and this letter gives us the opportunity to pass on a useful hint.

In general, buzzes in light dimmer circuits come from the suppression components, and in particular from the RF choke (inductor, to those of a more

recent electronic vintage). One solution we've used is to set the choke coils in an epoxy adhesive, such as Araldite. Other types of adhesive should not be used, as they might catch fire, and even epoxy adhesive should not be used if the choke shows any tendency to get hot in use.

Sir,

I write in response to the letter from Mr A. Worsley published in the November issue.

It is a sad fact that when an inventor makes an invention, self appointed critics crawl out of the woodwork, eager to discredit the inventor and/or the contribution made by the invention and to offer the world their own highly colourful advice to the inventor. I am certain that your readers will readily recognise the 'what you should have done' brigade.

Mr. Worsley was, in fact, one of a number of subjects upon whom I tried various pieces of test equipment back in 1978/9 and, as with all the subjects, I explained certain structural and operational features of the devices, under the normal bond of confidence as must exist between a researcher and his subject. The devices explained to Mr. Worsley were each capable of performing a single function in my overall technique. Since Mr. Worsley has never seen a dream-machine designed and approved by me, I leave it up to your readers to form their own opinions on the value of his observations.

If I may now reply to Mark Botham's letter in the previous issue. The dream machine has been the subject of continuous development since 1979 and, in its present form, is capable of performing a number of functions to assist an untrained subject. The device is now being tested by selected subjects in the Hearne Research Organization. The Organization has been set up specifically to allow the public access to dream techniques and electronic aids such as the dream machine, and to guide individuals to develop their respective talents in the art of dreaming. Any readers interested in learning more of the Organization should write to me at the address below.

Yours faithfully,
Keith Hearne (B.Sc., M.Sc., Ph.D.),
Hearne Research Organization,
PO Box 84,
Hull HU1 2EL

Dear Sir,

Following up a comment that you made in Read/Write, October 82 issue: "We will do a design for a sound processing preamp if there is sufficient demand from readers". This letter is simply to register my interest in such a project, and a couple of thoughts, which due to my limited knowledge in this field may not be relevant. However, I think I'm correct in saying that the basic operation of the Carver holographic amp is to feed to the right hand speaker not only its usual signal but also a signal that will cancel the left hand signal when it reaches the right ear, and vice-versa; this is necessarily repeated over several stages. It is then delivering to the ears the same sounds as they would hear were they wearing headphones.

My interest is in the reverse situation. Having listened to normal and binaural stereo signals on stereo headphones I wondered whether something could be done about the artificial quality of the former mode of listening (ie normal stereo signals, designed to give their best approximation of realism when fed through speakers, being delivered separately to each ear). Though this is fine when listening to many multi-tracked studio recordings, it totally defeats the object of recordings which attempt to recreate the acoustics of a live performance. Perhaps a realism approaching that of good binaural material could also be achieved when listening to a normal stereo signal on headphones if the headphones tricked the ears into thinking they were listening to speakers — that is, the right earpiece (and therefore ear) received not only its normal signal but also a processed signal representing what the right ear would hear from the left speaker when listening to speakers (and vice-versa). This seems to be the same principle as the Carver holographic amp, but with some inverted signals. Perhaps a sound processing preamp design could also be made to cope with headphones, with a little extra complexity.

My interest arises from the fact that I'm currently assembling a hi-fi system for headphone listening — one reason being to avoid annoying people around me with excessive volume.

Yours sincerely,
Christopher J. Travis,
Hitchin.

Watch this magazine!

Dear Mr Bradshaw,

Thank you very much for the exposure given to our Viewdata modem (and nuts) in the October issue of ETI. As a regular reader of the magazine, I was naturally pleased to see our product in your 'News' section, complete with the ETI flavour of write-up. I felt that the least we could do was to explain to you what the nuts mean in our advertising.

We design and manufacture from Reading a series of Modems, Multiplexors and Port Selectors. Once assembled, they all look the same (plain, plastic boxes). As they are just as 'plain' as competitive devices, we have chosen to market each range of product with a fruit (or nut). For instance:—
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b) Multiplexors — 'Still squeezing data through the old fashioned way? — Concentrate it's cheaper' — so we use oranges.

c) Line Drivers — 'Is the cost of high speed modems driving you bananas?' — hence bananas.
d) Port Selectors — 'Port costs taking a slice out of your budget?' — (see brochure on melons).
Enclosed is a selection of other brochures to show how we have used fruit in advertising. I hope you can now see the connection between our modems and nuts.

Thanking you. I remain,
Yours sincerely,
Douglas S. Staples,
Southern Area Sales Manager,
Microm Borer.

Dear Editor,

Many thanks for forwarding on the latest issue of ETI. My point relates to the article on the new Oric-1 which appeared on page 11.

The Tangerine comment about ULAs is incorrect. The ULAs for both the ZX81 and the Spectrum were completely designed by Sinclair Research and then custom-built for us by Ferranti.

Hope this will set the record straight.

With best wishes,
Yours sincerely,
Bill Nichols,
Sinclair Research Limited
23 Motcomb Street,
London SW1X 8LB.

Sinclair Computers: ULA designed by Sinclair

Dear Sir,

I have just read a letter in Read/Write (ETI October 82) from Gareth Lee regarding the Expander circuit published in your '100 Circuits' feature, and I thought my own experiences with this circuit may be of some interest, particularly to Mr Lee.

I built the circuit for use with my mobile disco and it's used as an expander only. Firstly it is possible to control the expansion ratio crudely by wiring a stereo pot of about 50k between the output and straight-through signal; remember the signal has undergone a 180° phase shift and will have to be inverted again before this control will work. I found it best to do this with an op-amp on the output of the IC with its gain set at five because at audio levels (775 mV in my case) the unit attenuates. It should be possible to alter the gain of the IC by altering the feedback resistor, and using the op-amp to buffer and invert the straight-through signal.

The noise from the IC is not excessive and on my amp is about the same level as that on the phono input.

A possible improvement that may improve the units' appeal to the hi-fi enthusiast would be to split up the audio spectrum into three parts and build separate compander circuits to deal with each part in a similar way to the dbx 38X unit. The circuit is certainly a lot cheaper than a dbx; now how about a circuit for a boom box (Sub harmonic synthesizer) like the dbx 100 unit.

Yours sincerely,
Simon Cooke,
Manchester.



ETI

ETI FEBRUARY 1983

ETI PCB SERVICE

Up until now PCBs were always the hardest component to obtain for a project. Of course you could make your own, but why bother anymore?

Now you can buy your boards straight from the designers — us! As of this issue all (non-copyright) PCBs will be available automatically from the ETI PCB Service. Each board is produced from the same master used to build our prototypes, so you can be sure it's accurate, and will be finished to the high standard you would expect from ETI.

In addition to the PCBs for this month's projects, we are making available some of the more popular designs from our recent past. See the list below for details. Please note that **NO OTHER BOARDS ARE AVAILABLE**. If it's not listed, we don't have it!

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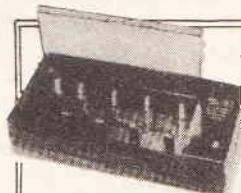
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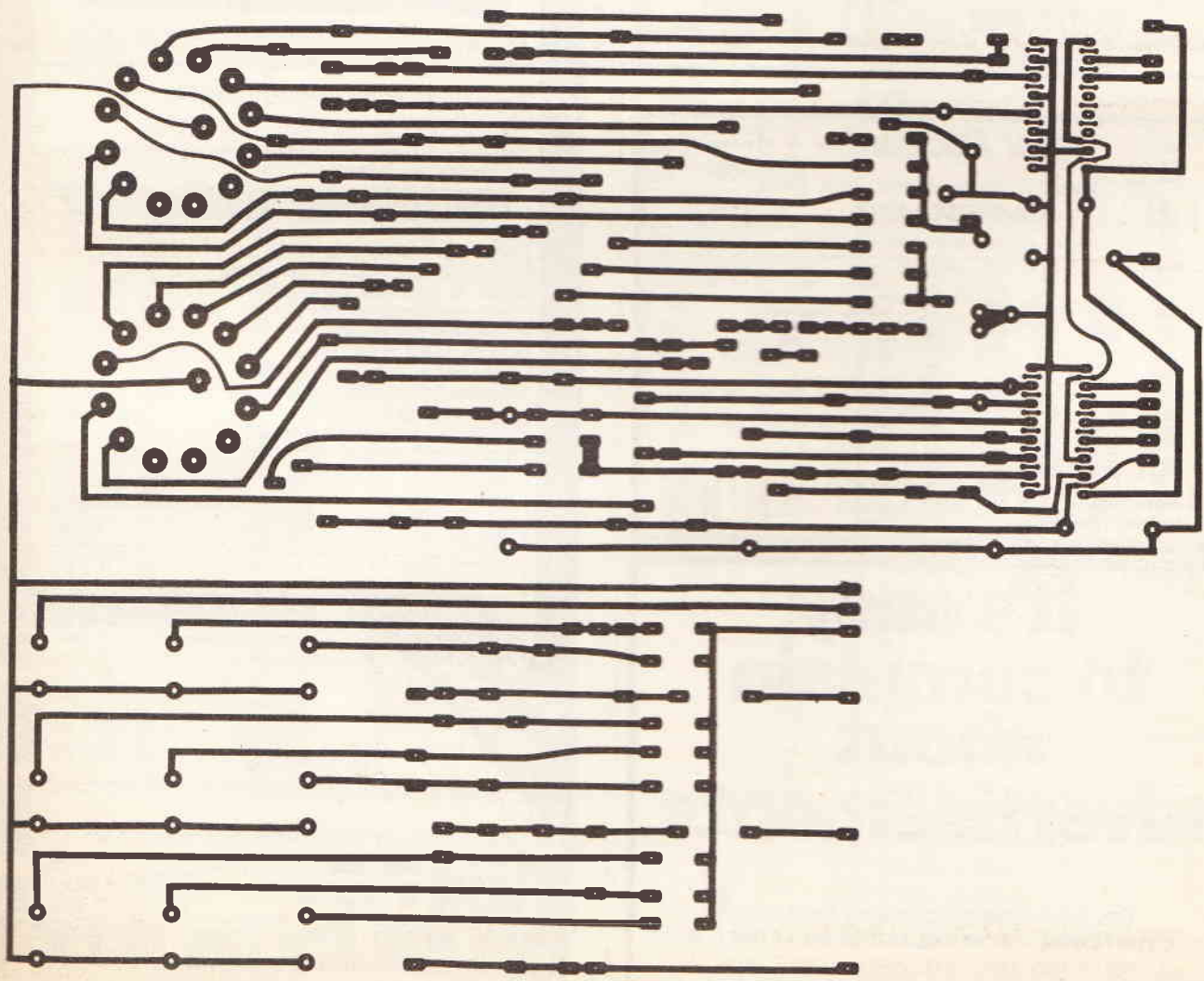
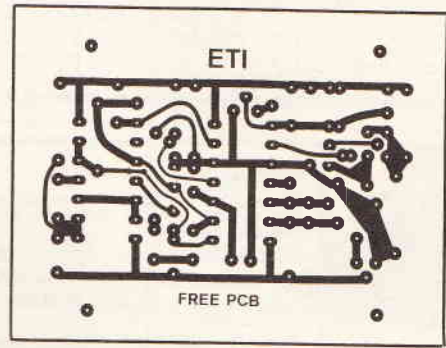
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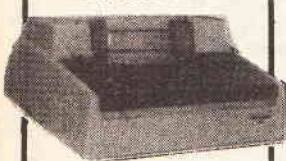
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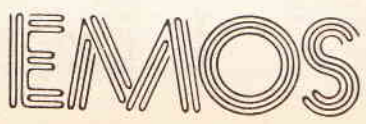
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3 ohm, 5 x 3in, 7 x 4in, £2.50; 8 x 5in, 6 1/2in, £3.8in, £4.50; 10in, £5.80; 2in, 2 1/2in, £2.00; 3in, 5in, 5 x 3in, 6 x 4in, 7 x 4in, £2.50; 6 1/2in; 8in x 5in £3.8in; £3; 10in, £5; 12in, £6. 1 1/2 ohm, 3in, 5 x 3 1/2in, 6 x 4in, 5in, £2.50; 6 1/2, 8 x 5in, £3. 25 ohm, 3in, 5 x 3in, 7 x 4in, £2.50; 120 ohm, 3 1/2in, dia, £1.50.

BATTERY ELIMINATOR MAINS TO 9 VOLT DC
Stabilised output, 9 volt 400 m.a. UK made with terminals. Overload cut out, 5 x 3 1/2 x 2 1/2in. Transformer Rectifier Unit. Suitable Radios, Cassettes. £4.50. Post 50p.

LOW VOLTAGE ELECTROLYTICS

1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 200mF 15V 10p.
500mF 12V 15p; 25V 20p; 50V 30p;
1000mF 12V 50p; 25V 35p; 50V 50p; 1200mF/76V 80p.
2200mF 6V 25p; 25V 42p; 40V 50p; 2000mF 100V £1.20.
2500mF 50V 70p; 3000mF 25V 85p; 50V 85p.
3300mF 63V £1.20; 4700mF 53V £1.20; 2700mF 76V £1.
4700mF 40V 85p; 1000mF 100V £1.

HIGH VOLTAGE ELECTROLYTICS

8/450V	45p	8 + 8/450V	75p	50 + 50/300V	50p
16/350V	45p	8 + 16/450V	75p	32 + 32 + 32/325V	75p
32/350V	75p	20 + 20/450V	75p	100 + 100/275V	85p
50/350V	80p	32 + 32/350V	85p	150 + 200/275V	70p
50/450V	95p	32 + 32/500V	£1.80	220/450V	95p

TRIMMERS 30pF, 50pF 10p, 100pF, 150pF 15p, 500pF 30p.
CONDENSERS VARIOUS, 1pF to 0.01mF 350V 5p.
400V-0.001 to 0.05 5p; 0.1 5p; 0.25 25p; 0.47 35p; 1.5 45p; 2.2mF 50p.
1000V 0.1mF 25p; 0.22mF 30p; 0.47mF 60p; 1750V 0.22mF 50p.
WAFER SWITCHES. 1 pole 12V, 2 pole 6W, 3 pole 4W, 4 pole 3W, 2 pole 2W, 4 pole 2W 80p ea.
TWIN GANGS 120pF £1.500 - 200pF £1.
SINGLE SOLID DIELECTRIC 100pF, 500pF £1.50.
GEARED TWIN GANGS 25pF 95p; 365 + 365 + 25 + 25pF £1.
SLOW MOTION DRIVE 6:1 90p. REVERSE VERNIER 60p.
VERNIER DIALS 36mm £2.25, 60mm £2.75.
SPINDLE EXTENDERS 85p, COUPLERS 85p.
NEON PANEL INDICATORS 280V. Red 1 1/2 x 1 1/2 45p. Round at 40p.
RESISTORS. 100 to 10M. 1W, 1W, 20% 2p, 2W 10p.
HIGH STABILITY. 1W 2% 10 ohms to 1 meg. 10p
Ditto 5%. Preferred values 10 ohms to 10 meg. 3p.
WIRE-WOUND. 10 ohm to 10K 5 watt 20p.
BLANK ALUMINIUM CHASSIS. 6 x 4 - £1.45; 8 x 6 - £1.80
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16 x 10 - £3.20. All 2 1/2in. 18 swg. ANGLE ALLI. 6 x 1 1/2 x 3 1/2in. 25p.
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14 x 3 - 75p; 10 x 7 - 95p; 12 x 8 - £1.10; 12 x 5 - 75p;
16 x 6 - £1.10; 14 x 9 - £1.45; 12 x 12 - £1.60; 16 x 10 - £1.75.
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9V 250mA	£1.50	20-40-60V 1A	£4.00
9V 3A	£3.50	25-0-25V 2A	£4.50
9-0-9V 50ma	£1.50	28V 1A Twice	£5.00
10-0-10V 2A	£3.00	30V 1 1/2A	£3.50
10-30-40V	£3.50	30V 5A and	
12V 100ma	£2.00	17-0-17V 2A	£4.50
12V 3A	£3.50	38V 2A	£4.00
12-0-12V, 2A	£3.50	34-28-0-28-34V 6A	£12.00
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Hebot II is a turtle-type robot which takes programming of the two dimensional world of the VDU into the real three dimensional world. Given a DC supply of 9-15V it can perform a bewildering number of moves under computer control — forwards, backwards, left and right — with each wheel independently controlled. It has blinking eyes, bleeps with a choice of two tones and has a solenoid operated pen to mark its progress. Touch sensors coupled to its shell return data about its environment, to the computer for it to calculate a move or exploratory action. Hebot II connects directly to a VDU port or alternatively with the universal interface board to the expansion bus of a ZX81 or other computer.

Robotic experience is becoming an essential subject as computing. MICROGRASP provides the lowest cost means of acquiring that experience but despite its ultra low price the robot has considerable versatility. There are 5 axes each using a servo motor and there is feedback from each of the arm movements. Control is by any computer with an expansion bus — the ZX81 being particularly suitable. Servicing is achieved with hardware on the interface board to keep programming simple and the robot is operated under BASIC commands with no computer specific software required. The interface board is memory mapped using only 64 bytes at any of 1024 switch selectable locations.



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(Electronics Today International December issue on CORTEX)

Example prices and specifications

Genesis S101
Base: 19.5" x 11" x 7.5"
Lifting capacity: 1500gm
Arm lift: 6.6"
Weight: 28Kg
4 axis model in kit form **£390**
5 axis model in kit form **£445**
3 axis model Ready Built **£790**

Genesis P101
Base: 19.5" x 11" x 7.5"
Lifting capacity: 2000gm
Arm lengths between axes: 14.0"
Weight: 34Kg
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6 axis model in kit form **£595**
6 axis model Ready Built **£950**

Complete Systems as shown in Photograph above

Genesis S101
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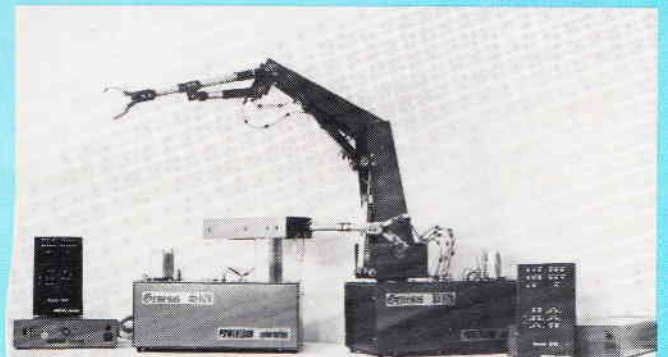
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