AN ARGUS SPECIALIST PUBLICATION

electronics today INTERNATIONAL

MARCH 1985 99p

LEAD THE WAY!

Build our amp/speaker combo unit for lead, bass or keyboards

PLUS

Single Board Controller – based on the Microtan

Voltage Controlled Digital Oscillator – add extra synth waveforms cheaply

New Series – what the text books don't tell you about components

...AUDIO.... ...MUSIC....RADIO....ROBOTICS.

TAKE COMPLETE CONTROL OF YOUR MUSIC with the MCS-1

professional quality MIDI-controlled sampling unit

Once again, Powertran and E&MM combine to bring you versatility and top quality from a product out of the realms of fantasy and within the reach of the active musician.

The MCS-1 will take *any* sound, store it and play it back from a keyboard (either MIDI or lv/octave). Pitch bend or vibrato can be added and infinite sustain is possible thanks to a sophisticated, looping system.

All the usual delay line features (Vibrato, Phasing, Flanging, ADT, Echo) are available with delays of up to 32 secs. A special interface enables sampled sounds to be stored digitally on a floppy disc via a BBC microcomputer.

The MCS-1 gives you many of the effects created by top professional units such as the Fairlight or Emulator. But the MCS-1 doesn't come with a 5-figure price tag. And, if you're prepared to invest your time, it's almost cheap!

Specification

Memory Size: Variable from 8 bytes to 64K bytes.

Storage time at 32 KHz sampling rate: 2 seconds.

Storage time at 8 KHz sampling rate: 8 seconds.

Longest replay time (for special effects): 32 seconds.

Converters, ADC & DAC: 8 bit companding. Dynamic range: 72 dB.

Audio Bandwidth: Variable from 12 KHz to 300 Hz.

Internal 4 pole tracking filters for anti-aliasing and recovery.

Programmable wide range sinewave sweep generator.

MIDI control range: 5 octaves.

+1/V/octave control range: 2 octaves with optional transpose of a further 5 octaves.

Digital Delay Line

Introduced in 1982, Powertran's DDL has brought digital quality effects to thousands of musicians. Still available in kit form at only £179.00 + VAT.

KIT £499 + VAT

BUILT £699 + VAT

Write or phone now to place an order
Powertran Cybernetics Limited,
Portway Industrial Estate,
Andover, Hants SP10 3ET.
Telephone: 0264 64455

VISA

Access

POWERTRAN cybernetics ltd

electronics today INTERNATIONAL

MARCH 1985 VOL 14 NO 3

Dave Bradshaw: Editor
Phil Walker: Project Editor
Ian Pitt: Assistant Editor
Jerry Fowler: Technical Illustrator
Paul Stanyer: Ad. Manager
Kerry Fowler: Copy Control
Jim Connell: Chairman

PUBLISHED BY:
Argus Specialist Publications Ltd.,
1 Golden Square, London W1R 3AB.
DISTRIBUTED BY:
Argus Press Sales & Distribution Ltd.,
12-18 Paul Street, London EC2A 4JS
(British Isles)
PRINTED BY:
The Garden City Press Ltd.
COVERS DESIGNED BY:
MM Design & Print.
COVERS PRINTED BY:
Alabaster Passmore.

OVERSEAS EDITIONS and their EDITORS
AUSTRALIA — Roger Harrison
CANADA — Halvor Moorshead
GERMANY — Udo Wittig
HOLLAND — Anton Kriegsman

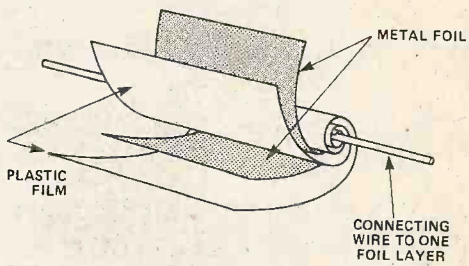
ABC Member of the Audit Bureau of Circulation

Electronics Today is normally published on the first Friday in the month preceding cover date.

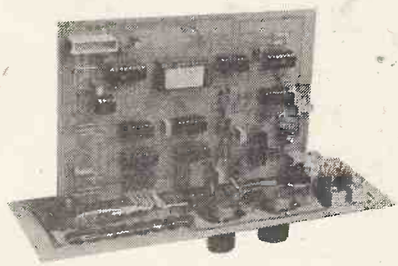
☐ Subscription Rates. UK £15.00 including postage. For further details and Airmail rates etc, see the Readers' Services page.

EDITORIAL AND ADVERTISEMENT OFFICE
1 Golden Square, London W1R 3AB. Telephone 01-437 0626. Telex 8811896.

FEATURES



PROJECTS



INFORMATION

SWITCHES
TOGGLE: 2A, 250V
SPST 35p DPDP 48p

SUB-MIN TOGGLE

SPST on/off	58p
SPDT c/over	64p
SPDT centre off	85p
SPDT biased both ways	105p
DPDT 6 tags	80p
DPDT centre off	88p
DPDT biased both ways	145p
DPDT 3 positions on/on/on	185p
4-pole 2 way	220p

SLIDE 250V:

DPDT 1A	14p
DPDT 1A c/off	15p
DPDT ½A	13p

PUSHBUTTON 6A with 10mm Button

SPDT latching	150p
DPDT latching	200p
SPDT moment	150p
DPDT moment	200p

Mini Non Locking

Push to Make	15p
Push to Break	25p

DIGITAST Switch
Assorted Colours
75p each

GAS/SMOKE DETECTORS
TGS812 or TGS813
£6 each

DIP SWITCHES
(SPST) 4 way 65p; 6 way 80p; 8 way 85p; 10 way 125p (SPDT) 4 way 190p

ROTARY SWITCHES
(Adjustable Stop type)
1 pole/2 to 12 way; 2 pole/2 to 6 way; 3 pole/2 to 4 way; 4 pole/2 to 3 way 48p

ROTARY: Mains DP 250V 4 Amp on/off 68p

ROTARY: (Mak-a-switch)
Make a multiway switch. Shafting assembly has adjustable stop. Accommodates up to 6 wafers (max. 6 pole/12 way + DP switch). Mechanism only 90p

WAFERS: (make before break) to fit the above switch mechanism. 1 pole/12 way; 2 pole/6 way; 3 pole/4 way; 4 pole/3 way; 6p/2 Way 65p
Mains DP 4A Switch to fit 45p
Spacers 4p. Screen 6p.

ROCKER SWITCHES

ROCKER: 5A/250V SPST	28p
ROCKER: 10A/250V SPDT	38p
ROCKER: 10A/250V DPDT c/off	95p
ROCKER: 10A/250V DPST with neon	85p

THUMBWHEEL Mini front mounting switches

Decade Switch Module	275p
B.C.D. Switch Module	298p
Mounting Cheeks (per pair)	75p

JUMPER LEADS (Ribbon Cable Assembly)

Length	14 pin	16 pin	24 pin	40 pin
Single ended DIP (Header Plug) Jumper				
24 inches	145p	185p	240p	380p
Double ended DIP (Header Plug) Jumper				
6 inches	185p	205p	300p	485p
12 inches	198p	215p	315p	480p
24 inches	210p	235p	345p	540p
36 inches	290p	370p	480p	525p

JUMPER LEADS (Ribbon Cable Assembly)
IDC Female Header Socket Jumper Leads 36"

	20 pin	26 pin	34 pin	40 pin
Single ended	160p	200p	280p	300p
Double ended	290p	370p	480p	525p

VEROBOARD 0.1in

2½ x 3¾	95p
2½ x 5	110p
3¾ x 3¾	110p
3¾ x 5	125p
3¾ x 17	420p
4¾ x 17	590p
Pkt of 100 pins	55p
Spot face cutter	150p
Pin insertion tool	185p

VQ Board	195p
DIP Board	395p
Vero Strip	95p

PROTO DECs

Veroblock	480p
S-Dec	395p
Eurobreadboard	590p
Bimboard 1	575p
Superstrip SS2	1350p

VERO WIRING PEN

+ spool	380p
Spare spool	75p
Combs	8p

DALO ETCH RESIST PEN
Plus spare tip 100p

FERRIC CHLORIDE
1 lb bag Anhydrous
195p + 50p p&p

ULTRASONIC TRANSDUCER
40KHz 475 pr

COPPER CLAD BOARDS

	Fibre glass	Single-sided	Double sided
	6" x 6"	100p	125p
	6" x 12"	175p	225p

DIL SOCKETS

	Low Prof	Wire Wrap
8 pin	8p	25p
14 pin	10p	35p
16 pin	10p	42p
18 pin	16p	52p
20 pin	20p	60p
22 pin	22p	65p
24 pin	25p	70p
28 pin	28p	80p
40 pin	30p	90p

EDGE CONNECTORS

2x6 way	—	111p
2x12 way	—	160p
2x15 way	—	165p
2x18 way	210p	175p
2x22 way	215p	250p
2x23 way	175p	—
2x25 way	285p	275p
2x28 way	190p	—
2x30 way	310p	—
2x36 way	380p	—
2x40 way	380p	—

SIL SOCKET 0.1" Pitch 20 way 65p

ANTEX SOLDERING IRONS

C15W	525p	CS17W	545p
C18W	550p	XS25W	570p
Spare Bits	85p	Elements	230p
Iron Stand	175p	Heat Shunt	30p

IDC CONNECTORS

	PCB with Pins Strt	Plugs latch Pins Angle	Female Header Plug	Female Card Edge Conct
10 way	90p	99p	85p	120p
16 way	130p	150p	110p	—
20 way	145p	166p	125p	195p
26 way	175p	200p	150p	240p
34 way	205p	236p	160p	320p
40 way	220p	250p	180p	340p
50 way	235p	270p	200p	395p
60 way	—	—	230p	495p

EURO CONNECTORS

Gold Flashed Contacts	Female Strt. Pins	Socket Angle Pins	Male Strt. Pins	Plug Angle Pins
DIN41617 31 way	170p	—	—	175p
DIN41612 2 x 32 A + B	275p	·	220p	285p
DIN41612 2 x 32 A + C	295p	·	240p	300p
DIN41612 3 x 32 A + B + C	360p	385p	280p	395p

DIL PLUG (Header)

	Solder	IDC
14 pin	40p	90p
16 pin	48p	105p
24 pin	88p	178p
28 pin	290p	295p
40 pin	250p	255p

RIBBON CABLE
price per foot

	Grey	Color
10 way	15p	28p
16 way	25p	40p
20 way	30p	50p
24 way	40p	65p
28 way	55p	80p
34 way	60p	85p
40 way	70p	90p
50 way	100p	135p
64 way	120p	160p

ZIF TEXTOOL DIL SOCKETS

24 pin	575p
28 pin	695p
40 pin	845p

'D' CONNECTORS

	9 way	15 way	25 way	37 way
Male	55p	80p	120p	150p
	110p	175p	225p	300p
	100p	100p	160p	250p
Female	90p	125p	180p	275p
	150p	200p	260p	390p
	100p	125p	195p	355p
Covers	75p	70p	70p	85p

IDC 25 way 'D' Plug 385p; Socket 450p

25 way 'D' CONNECTOR (RS232)
Jumper Lead Cable Assembly

18" long, Single end. Male	475p
18" long, Single end. Female	510p
36" long, Double Ended. M/M	995p
36" long, Double Ended. F/F	£10
36" long, Double Ended. M/F	995p

AMPHENOL PLUGS

	IDC	Solder
24 way IEEE	465p	460p
36 way Centronix	450p	475p
24 way Female	480p	450p

PANEL METERS
FSD
60 x 46 x 35mm
0–50μA
0–100μA
0–500μA
0–1mA
0–5mA
0–10mA
0–50mA
0–100mA
0–500mA
0aA
0.2A
0.25V
0.50V AC
0.300V AC
"S"
"VU" 490p each

CRYSTALS

32.768KHz	100
100KHz	545
200KHz	370
455KH	370
1MHz	275
1.008M	275
1.28MHz	450
1.6MHz	395
1.8MHz	545
1.8432M	250
2.0MHz	225
2.4576M	200
3.12MHz	240
3.278M	150
3.5794M	98
3.6864M	300
4.0MHz	150
4.032MHz	290
4.19430M	200
4.433619M	100
4.608MHz	200
4.80MHz	200
5.0MHz	160
5.185MHz	300
5.24288M	390
6.0MHz	140
6.144MHz	150
6.5536MHz	225
7.0MHz	150
7.168MHz	250
7.7328MHz	250
7.68MHz	200
8.0MHx	150
8.089333M	395
8.86723M	220
9.00MHz	200
10.0MHz	175
10.24MHz	200
10.5MHz	250
10.7MHz	150
12.0MHz	175
12.528M	300
14.31814M	170
15.0MHz	240
16.0MHz	220
18.0MHz	180
18.432M	150
19.968MHz	150
20.0MHz	200
24.0MHz	170
24.930MHz	325
26.69M	150
27.648M	170
27.145M	180
38.6667M	240
48.0MHz	240
100.0MHz	295
116.0MHz	300

RELAYS
Miniature, enclosed, PCB mount.

SINGLE POLE Changeover
RL-91 205R Coil, 12V DC, (10V5 to 19.5V), 10A at 30V DC or 250V AC 195p

DOUBLE POLE Changeover, 6A 30V DC or 250V AC
RL-100 53R Coil, 6V DC (5V4 to 9V9) 190p
RL6-111 205R Coil, 12V DC (10V7 to 19V5) 195p
RL6-114 740R Coil, 24V DC (22V to 37V) 200p

ASTEC UHF MODULATORS

Standard 6MHz	375p
Wideband 8MHz	550p

BUZZERS
miniature, solid-state 6V; 9V & 12V 70p
PIEZO TRANSDUCERS PB2720 70p

LOUDSPEAKERS

Miniature, 0.3W- 8Ω 2", 2¼", 2½", 3"	80p
2½" 40Ω 64Ω or 80Ω	80p
6" x 4" 8Ω	200p
7" x 5" 8Ω	225p
8" x 5" 8Ω	250p

MONITORS

- ZENITH — 12" Green, Hi-Resolution Popular **£68**
- MICROVITEC 1431. 14" Colour RGB input. Connecting cable incl. **£165**
- MICROVITEC 1451. 14" Medium resolution **£265**
- KAGA 12". Med-res. RGB Colour. Has flicker-free characters. Ideal for BBC, Apple, VIC, etc **£195** (car £7)
- KAGA 12". As above but Hi-Resolution **£259** (car £7)
- Connecting Lead for KAGA **£5**

Carriage £7 Securicor

BROTHER HR15 PRINTER
A high quality Daisy Wheel printer at the price of a Dot Matrix printer.
Price £339 (car. £7)

TRANSFORMERS
3-0-3V; 6-0-6V; 9-0-9V; 12-0-12V; 15-0-15V @ 100mA 130p
pcb mounting. Miniature, Split Bobbin
3VA: 2x6V-0.25A; 2x9V-0.15A; 2x12V-0.12A; 2x15V-0.1A 235p
6VA: 2x6V-0.5A; 2x9V-0.3A; 2x12V-0.25A; 2x15V-0.2A 280p
Standard Split Bobbin type:
6VA: 2x6V-0.5A; 2x9V-0.4A; 2x12V-0.3A; 2x15V-0.25A 250p
12VA: 2x4.5V-1.3A; 2x5V-1A; 2x9V-0.6A; 2x12V-0.5A; 2x15V-0.4A; 2x20V-0.3A 345p (35p p&p)
24VA: 2x6V-1.5A; 2x9V-1.2A; 2x12V-1A; 2x15V-0.8A; 2x20V-0.6A 385p (60p p&p)
50VA: 2x6V-4A; 2x9V-2.5A; 2x12V-2A; 2x15V-1.5A; 2x20V-1.2A; 2x25V-1A; 2x30V-0.8A 520p (60p p&p)
Specially wound for Multirail computer PSUs
50VA: Outputs +5V/5A; +12V, +25V, -5V, -12V at 1A 620p (60p p&p)
100VA: 2x12V-4A; 2x15V-3A; 2x20V-2.5A; 2x25V-2A; 2x30V-1.5A; 2x50V-1A 965p (75p)

P&P charge to be added over and above our normal postal charge

VOLTAGE REGULATORS
1A TO220 Plastic Casing

	+ ve		– ve	
5V	7805	50p	7905	50p
12V	7812	50p	7908	60p
15V	7815	45p	7912	50p
18V	7818	45p	7915	50p
24V	7824	50p	7918	50p
			7924	50p

100mA TO92 Plastic package

5V	78LO5	30p	79LO5	50p
6V	78LO6	30p	—	—
8V	78LO8	30p	—	—
12V	78L12	30p	79L12	50p
15V	78L15	50p	79L15	60p

ICL7660	248p	TAA550	50p
RC4194	375p	TDA1412	150p
RC4195	160p	78H05 + 5V/5V	550p
LM309K	135p	78H12+12V/5A	640p
LM317K	250p	78HG + 5V to + 25V 5A	585p
LM317KP	450p		
LM323K	450p	79HG – 2.25V to –24V; 5A	685p
LM337	175p		
LM723 Var	30p	78S40	225p
78S40	225p		

SOLDERCON PINS
Ideal for making SIL or DIL Sockets

100 pins	45p
500 pins	195p

ALUM BOXES

3 x 2 x 1"	85p
4 x 2½ x 2"	100p
4 x 2½ x 2½"	103p
4 x 4 x 2"	105p
4 x 4 x 2½"	120p
5 x 4 x 1½"	99p
5 x 4 x 2½"	120p
5 x 2¾ x 1½"	90p
5 x 2¾ x 2½"	130p
6 x 4 x 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 3"	280p
12 x 8 x 3"	295p

CMOS

4000	20	4072	25	4536	275
4001	25	4073	26	4538	80
4002	25	4075	25	4539	90
4006	75	4076	68	4541	95
4007	25	4077	25	4543	70
4008	60	4078	25	4544	150
4009	45	4081	25	4548	40
4010	60	4082	25	4549	400
4011	25	4085	60	4553	245
4012	25	4086	60	4554	180
4013	60	4089	125	4555	35
4014	60	4093	37	4556	55
4015	60	4094	70	4557	250
4016	40	4095	95	4558	120
4017	60	4096	100	4559	395
4018	60	4097	275	4560	180
4019	58	4098	80	4561	104
4020	90	4099	110	4562	350
4042	43	4160	95	4566	165
4021	58	4161	96	4568	250
4022	67	4162	98	4569	175
4023	30	4163	96	4572	45
4024	50	4174	96	4580	255
4025	22	4175	105	4581	125
4026	90	4194	105	4582	99
4027	43	4408	850	4583	100
4028	45	4409	850	4584	60
4029	75	4410	725	4585	70
4030	35	4411	750	4597	330
4031	130	4412	805	4599	155
4032	70	4415	590	40085	90
4033	130	4419	280	40097	45
4034	146	4422	770	40098	42
4035	70	4435	850	40100	215
4036	275	4440	900	40101	130
4037	115	4450	360	40102	140
4038	75	4451	350	40103	412
4039	280	4490	450	40104	120
4040	60	4500	395	40105	220
4041	57	4501	38	40106	60
4042	50	4502	60	40107	55
4043	42	4503	40	40108	325
4044	50	4504	99	40109	100
4045	110	4505	385	40110	235
4046	60	4506	100	40114	240
4047	60	4507	45	40161	194
4048	55	4508	130	40163	75
4049	38	4510	55	40174	75
4050	35	4511	55	40175	75
4051	70	4512	55	40181	220
4052	80	4513	150	40182	80
4053	60	4514	115	40192	75
4054	85	4515	115	40193	95
4055	85	4516	55	40194	70
4056	85	4517	275	40195	75
4057	1000	4518	48	40244	196
4059	435	4519	32	40245	196
4060	68	4520	53	40257	196
4061	500	4521	115	40373	220
4062	986	4522	125	40374	220
4063	85	4526	60	45106	586
4066	45	4527	65		
4067	245	4528	68		
4068	25	4529	150		
4069	25	4530	90		
4070	25	4531	130		
4071	25	4532	65		
		4534	400		

OPTO ELECTRONICS

LEDs with clips

TIL209	10
TIL211 GRN	14
TIL212 Yel.	14
TIL220 2" Red	12
2" Green, Yellow or Amber	14
0.2" Bi colour Red/Green	100p
Green/Yellow	115p
0.2" Tri colour Red/Green/Yellow	85
Hi-Brightness Red	58
High-Bri Green or Yel	68
Flashing red 0.2" red	55
Square LEDs. Red, Green, Yellow	30
Rectangle Stackable LEDs Red, Green or Yellow	18
Triangular LEDs Red	18
Green or yellow	22
LD271 Infra Red	48
SFH205 Detector	118
TIL32 Infra Red	52
TIL78 Detector	55
TIL38	50
TIL100	75
BARGRAPH. Red 10 segments	275

ISOLATORS

IL74	145
ILD74	145
ILQ74	275
TIL111/2/4	70
ILCT6 Darlington	135
TIL117	125
4N33 Photo Darlington	136

7 Segment Displays

TIL312 .3" CA	120
TIL313 .3" CC	120
TIL321 .5" CA	140
TIL322 .5" CC	140
TIL729/730	140
DL704 .3" CC	125
DL707 .3" CA	125
FND357 Red	120
FND500	130
.3" Green CA	150
.6" Green CA	215
.3" ± 1 Red CA	150
.3" ± 1 Green CA	150
LCD 3½ Digits	496
LCD 4 Digits	530
LCD 6 Digits	625

OPTO

OCP71	120
ORP12	85
ORP61	86
BPX25	250
BPW21	320
TIL139	225
Reflective Switch	225
SLOTTED Optical Switch similar to RS Comp.'s	295

COMPUTER CORNER

- QL RGB MONITOR, Medium resolution £239
- EPSON RX80 Printer £229
- EPSON RX80 F/T Printer £245
- EPSON FX80 Printer £318
- EPSON FX100 Printer £435
- KAGA/TAXAN KP810 Printer £235
- KAGA/TAXAN KP910 Printer £339
- SEIKOSHA GP100A Printer £339
- BROTHER HR15 Daisywheel £339

Cable for above printers to interface with BBC Micro £7

- TEX EPROM ERASER — Erases up to 25 Eproms. Has a built-in safety switch £30
- SPARE 'UV' Lamp Bulb £8
- C12 Computer CASSETTES in Library cases 36p
- 8½" & 9½" Fan Fold paper (1000 sheets) .... £7 (Carr. 150p)

(Securicor Carriage charge on printers is £7)

CALL IN AT OUR SHOP FOR A DEMONSTRATION ON ANY OF THE ABOVE ITEMS. BE SATISFIED BEFORE YOU BUY OR WRITE IN FOR OUR DESCRIPTIVE MICRO PERIPHERALS LEAFLET.

DISC DRIVES

(CUMANA)
DRIVES CASED with PSU & CABLES

- **CS100** — Single Cased with PSU, 40 track, 5¼" S/S 100K £119
- **CD200** — Twin Cased with PSU, 40 Track, 5¼" S/S 200K £165
- **CS200** — Epson Single Cased with own PSU D/S, 40 Track, 5¼" 200K £175
- **CD400** — Epson Twin Cased with own PSU D/S, 40 track, 5¼" 400K £339

MITSUBISHI 5¼" SLIM LINE DISC DRIVES

- Double Sided, Double Density, Track Density 96 TPI, Track to track access time 3msec.
- **MITSUBISHI Single Slimline**, 5¼" Cased with PSU. DSDD. 1 Megabyte (400 K with BBC) £199
- **MITSUBISHI Twin Slimline**, 5¼" Cased with PSU. DSODD. 2 Megabyte. (800 K with BBC) £425

5¼" DISKETTES (Lifetime Warranty)

- **10 3M Diskettes Single side Double density** £14
- **10 3M Diskettes Double side Double density** £23

N.B Carriage on Drives £7 securicor

SPECTRUM 32K UPGRADE

Upgrade your 16K Spectrum to full 48K with our RAM Upgrade Kit. Very simple to fit. Fitting instructions supplied.

£22

BBC MICRO WORDPROCESSING PACKAGE

A complete wordprocessing package (which can be heavily modified to your requirements, maintaining large discount). We supply everything you need to get a BBC Micro running as a word-processor. Please call in for a demonstration.

Example Package:
BBC Micro, with DFS Interface, Wordwise, Twin 400K TEC Disc Drives, 12" High-res green monitor, Brother HR15 Daisywheel printer, Beebcalc & Database software on Disc, 10 3M Discs, 500 sheets of paper, 4way mains trailing socket, manuals and all cables.

Only: £1,119

BBC & MICROCOMPUTER & ACCESSORIES

BBC Model B **Only £3@5**

We stock the full range of BBC Micro peripherals, Hardware & Software like, Disc Drives (Top quality Cumana & Mitsubishi), Diskettes, Printers, printer, Paper, Interface Cable, Dust Covers, Cassette Recorder & Cassettes, Monitors, Connectors (Ready made Cables, Plugs & Sockets), Plotter (Graphic Tablet) EPROM Programmer, Light-pen Kit, Joysticks, Sideways ROM Board, EPROM Eraser, Machinecode ROM. The highly sophisticated Watford's 16K BEEB DFS, WORDWISE, BEEB-CALC, Software (Educational Application & Games), BOOKs, etc, etc, Please send SAE for our description leaflet.

DIGEST

System on a Chip? Well, Perhaps

Rapid Recall has just announced a new Intel software-on-silicon product which features a full BASIC interpreter in ROM on a single chip.

Known as the 8052 AH-BASIC, this 40-pin device is specifically designed for process control, measurement and instrumentation applications. It consists of an 8052 AH micro-controller with a full-feature BASIC interpreter resident in the 8K bytes of available ROM. The interpreter allows 8052 AH users to write programs in BASIC instead of assembly language.

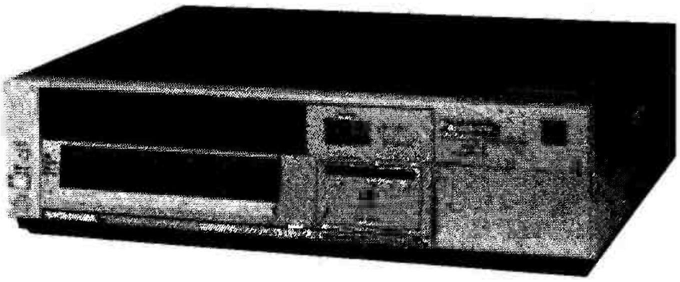
MCS BASIC-52 contains all the standard BASIC commands and functions, including BCD floating point arithmetic and transcendental operations. It also has many unique features to perform tasks that usually require assembly language programming. Bit-wise logic operators (such as AND, OR and EXCLUSIVE-OR) are supported, as is hexadecimal arithmetic.

Additionally, almost all of the 8052 AH's special function registers can be accessed with MCS BASIC-52, allowing the user to set the timer or interrupt modes within the constructs of a BASIC program. MCS BASIC-52 also has a built-in 5msec real time clock which can be enabled, disabled and used to generate interrupts. Interrupts can be handled either by BASIC or assembly language.

A powerful feature of MCS BASIC-52 is that it generates all the timing necessary to program any standard EPROM or E²PROM with the user's application program. All that is required to implement this feature is a transistor, a gate and two passive components. Very little external hardware is required to construct small systems.

Unlike most other BASIC interpreters, MCS BASIC-52 allows programs to reside in both RAM and EPROM/E²PROM. With the additional facility that up to 255 programs may reside in EPROM/E²PROM. Programs can also be transferred from EPROM/E²PROM to RAM for editing purposes.

An interrupted language, MCS BASIC-52 allows the user to develop a program interactively without the tiresome processes required by assemblers and compilers. Its design permits a programmer to develop resident high-level language software using the 8052 AH micro-controller. Rapid Recall Limited, Rapid House, Denmark Street, High Wycombe, Bucks, HP11 2ER, tel 0494 26271.



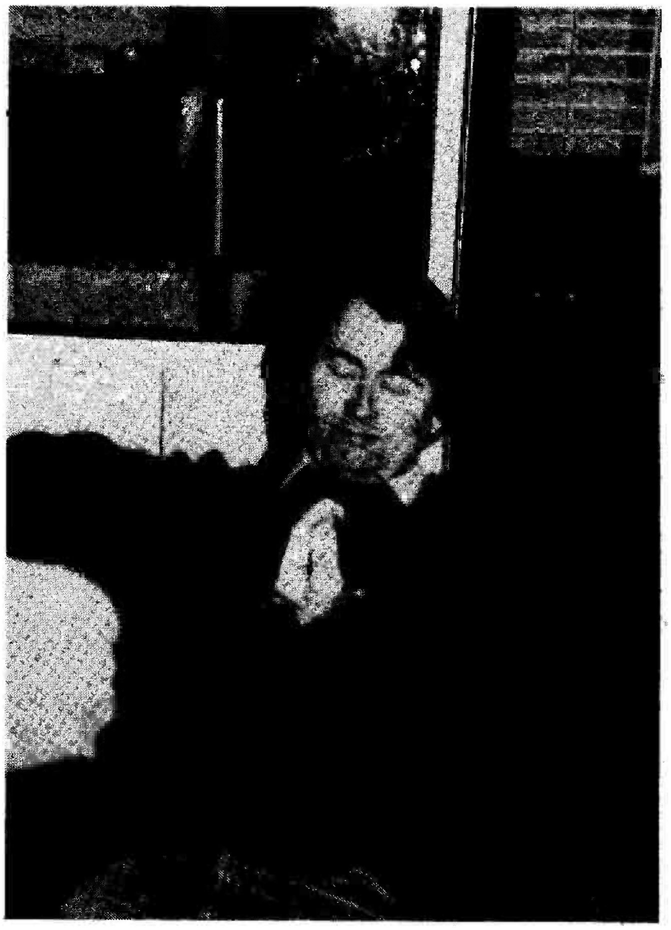
Time Lapse VCR

The Video Systems department of Panasonic Industrial have introduced a video cassette recorder which provides all the features normally found on such machines but in addition has the facility to produce time lapse recordings. The machine can be used with a conventional TV set or as part of a closed circuit television system for use in security/surveillance, education and information applications.

The AG-6010 is a VHS machine which can make recordings of up to three hours in the normal way or over a continuous period of 18, 36 or 72 hours in time lapse mode. The three-head design is described as microprocessor controlled and provides a wide range of functions including still, slow, frame shift, reverse play and high speed forward or reverse search. A built-in timer allows time and date to be superimposed upon the recorded images and timed recordings can be stopped and started within a 24-hour period. Other features include automatic repeat recording, automatic recording after a power failure and alarm recording at normal speed. It is designed to complement Panasonic's range of CCTV products, including the mini CCTV system which allows up to three low-cost cameras to be used with a 9" monitor which has a built in sequential decoder.

The AG-6010 is now available through Panasonic's CCTV dealer network and the recommended retail cost is £1295.00 plus VAT. Panasonic UK Ltd, 300-318 Bath Road, Slough, Berkshire SL1 6JB, tel 0753-34522.

● By the 1st of January 1986 almost every company in the country will be required to display the new, EEC approved safety signs. As a reminder, the British Safety Council have produced a full colour poster which features a sculpted figure not unlike the present occupant of 10, Downing Street. The wording on the poster reads "How dare you ignore the new safety signs". Readers wishing to acquire a copy for correction/contemplation/worship/to throw darts at should write to the council at 62-64 Chancellors Road, London W6 9RS, tel 01-741 1231.



'Walker In Manchester' Shock

Pictured above in classic pose — praying that he won't get any more technical enquiries — is erstwhile ETI Project Editor Phil Walker. Unconfirmed reports suggest that he is now in the Manchester area, scene of many previous exploits (no, of course we're not going to tell you; use your imagination).

Sensitive Mancunians are advised to approach with care as this man's jokes have been known to stun at twenty paces. Those encountering him should approach with care and, if verbally assaulted, utter the terrible cry 'technical enquiry'. That should send him packing!

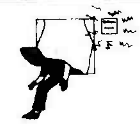
P.S. Sorry, Phil. And best of luck in your new job.

ELECTRONIC SIREN KIT

Produces an extremely loud piercing swept frequency tone from a 9-15V supply. Enable input for easy connection to alarm circuits. Includes 5in. Horn Speaker. £7.90

Mini Siren
As above, but with a small speaker (instead of horn speaker) for internal use. Complete with box £4.30

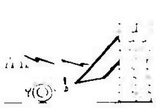
SECURITY PRODUCTS



Protect your home and property and save by building your own burglar alarm system

Stair Mat 23 × 7 in (950 120) £1.70
Floor Mat 29 × 16 in (950 125) £2.60
Tamper-proof connecting block (950 110) £0.30
Door/Window Contacts. Flush mounting, 4 wire, Magnet switch Per Pair. (950 140) £1.05
Window Tape 0.5" wide. 50m. (950 145) £2.50
Window Tape Terminations Per pair. (950 150) £0.36
Key-operated Switch. 1.5A 250V SPST Heavy chrome metal. (350 128) £4.50
Passive Infra-Red Detector
Detects intruder's body heat. Range 10 metres. 12V DC. n/o & n/c contact. (950 135) £40.00
Alarm Control Unit. 4 input circuits, 2 instant and 2 delayed. Adjustable entry, exit and alarm times. Built and tested. Full instructions supplied. Size: 180 × 130 × 30mm. Supply: 12V DC. (950 160) £26.00
Ultrasonic Burglar Alarm. Self-contained mains or battery powered unit complete with horn and AC adaptor. Imputs for pressure mats and other sensors together with exit/entry delays enable this unit to be used as a complete system. **£45.00 + p&p £2.20**
8W Horn Speaker. 5.5 ins. 8 ohm. Ideal for sirens, etc. 2.5m lead and 3.5mm jack plug. (403 148) £6.15

IR GARAGE DOOR CONTROLLER KIT



For controlling motorised garage doors and switching garage and drive lights on off up to a range of 40 ft. Lots of applications like controlling lights and TVs, etc. in the home. Ideal for aged or disabled persons, this coded kit comprises of a mains powered infra red receiver with a normally open relay output plus two latched transistor outputs, battery powered transmitter and opto isolated solid state mains switch.

XK103 £25.00
XK105 Extra transmitters £10.50

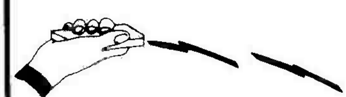
PANTEC KITS

PN2	FM Micro Transmitter	£7.50
PN3	Stabilised Power Supply	£13.70
PN5	2 × 10w Stereo Amplifier	£14.50
PN6	2 × 40w Stereo Amplifier	£24.95
PN7	Pushbutton Stereo Preamp	£12.80
PN8	Tone & Volume Control	£13.60
PN11	3w FM Transmitter	£11.95
PN13	Single Channel FM Transmitter	£9.80
PN14	Receiver for above	£15.50

TOP QUALITY . . . TOP SERVICE BOTTOM PRICES!

For FREE CATALOGUE send 9" × 6" SAE – contains full list of stock range all at very competitive prices. Cash with order (except account customers). Access or Barclaycard telephone orders welcome. Add 75p p&p + 15% VAT to all UK orders. Overseas customers add £2.75 p&p Europe, £6.50 elsewhere. Giro No. 529314002. Goods by return subject to availability. Shop open 9am – 5pm (Mon-Fri). 10am – 4pm Sat). ALL PRICES EXCLUDE VAT

INFRA-RED REMOTE CONTROL KITS



These kits are designed to enable infra-red remote control to be incorporated into virtually any application from switching car locks or alarms to controlling Hi-Fi or TV. The application will determine the interface circuitry between the receiver and the controlled device. General instructions and applications are supplied. The kits are coded and provide a high degree of security and noise immunity.

MK 18 Transmitter Kit – for use with MK11/MK12 receivers. Requires PP3 battery. Size: 8 × 2 × 13cms. Range approx 60 ft. £6.80

Keyboards for MK18
MK9 4-way for use with MK12 £1.90
MK10 16-way for use with MK12 £5.40
MK13 11-way for use with MK11 £4.35

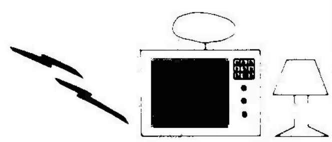
MK11 Receiver Kit – mains powered. Provides 10 latched plus 3 analogue outputs ideal for controlling audio amplifiers, TV or lighting where control of light brightness is required. £13.50

MK14 AC Power Controller Kit for (phase) controlling AC loads from MK11 analogue outputs, eg lamp dimming. £5.20

MK19 Stereo Amplifier Controller Kit – for remote control of bass, treble and volume (or balance) by MKII. Includes a one of 10 decoder remote channel or input selection. May be connected between the pre-amp and power amp of almost any audio system. £10.70

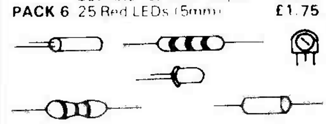
MK12 Receiver Kit – mains powered with 16 latched or momentary outputs. Latched version is for applications requiring one output on at a time, eg TV channel selection. Momentary type gives an output only during transmission. Lines may be latched as required. Size: 9 × 4 × 2cms. £13.50

MK15 Dual Latched Solid State Relay – for switching mains loads such as lamps, TVs, etc. from the outputs of the MK12 (momentary). 15 items may be switched independently using 8 MK15s. Triacs (not supplied) switch at mains zero to reduce interference. £4.50

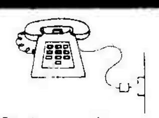


COMPONENT PACKS

PACK 1 650 Resistors 47R 10M 10 per value £4.00
PACK 2 40 × 16V Electrolytics 10-1000µF 5 per value £3.25
PACK 3 60 × Polyester Capacitors 0.01 1µF 250V 5 values £5.55
PACK 4 45 Presets 100R 1M £3.00
PACK 5 30 × Low Profile IC Sockets 8, 14 & 16 pin £2.40
PACK 6 25 Red LEDs (5mm) £1.75



BT STYLE PHONE CONNECTORS



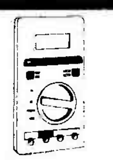
Line Jack Units
Master Unit (first line unit) has bell capacitor and surge arrester. Flush or surface mounting. Screw connectors.

Master (flush)	(960 110)	£3.00
Master (surface)	(960 112)	£3.00
Master (mini surface)	(960 113)	£3.50
Secondary (flush)	(960 114)	£2.65
Secondary (surface)	(960 116)	£2.65
Secondary (mini surf)	(960 117)	£3.00
Dual outlet adaptor	(960 118)	£4.20
4 way line cord with plug to spade terminals	(960 120)	£2.00
4 way line cord	(960 130)	**£0.20 per m**

LCD DIGITAL MULTIMETERS

LOW COST! 10M ohm. 3½ digit 0.4 in display. Auto zero and polarity, low batt indication, overload protection. Includes test leads, battery, spare fuse, manual, carrying case.
AC Volts: 0 – 200 – 500.
DC Volts: 0-2-20-200-1000.
DC Current: 0-20m-200mA.
Resistance: 0-2k-20k-200k-2M.
Size: 138 × 86 × 36mm.
(405 202) £25.95

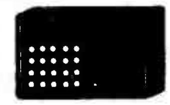
Professional 10M, 0.5 in, 3½ digit. Overrange and low battery indication. Overload protection: Includes leads, spare fuse, battery, manual and case. Transistor Checker. Size: 175 × 93 × 42mm.
AC Volts: 0-200-750.
DC Volts: 0-200m-2-20-200-1000.
DC Current: 0-20u-2m-20m-200mA. 0-10A.
Ohms: 0-200-2k-20k-200k-2M. 0-20M.
(405 204) £33.50



Auto Ranging. 3½ digit 10mm display. Continuity buzzer, low battery, overload and range indication. 10A internal shunt for AC/DC current measurement. Carrying case supplied.
AC Volts: 0-2-20-200-600.
DC Volts: 0-0.2-2-20-200-1000
AC Current: 0-200mA. 0-10A.
DC Current: 0-200mA/0-10A.
Resistance: 0-200-2k-20k-200k. 0-2M.
Size: 160 × 85 × 29mm.
(405 206) £44.85

High Sensitivity Temperature Probe. For use with a multimeter to measure temperatures from −50°C to +250°C. Accuracy: 1.5°C@25°C, 2°C@100°C. Response time (in water), 5 seconds. Includes case, calibrated scale and instructions. (405 220) £8.50

MICROPROCESSOR TIMER KIT



Designed to control 4 outputs independently switching on and off at preset times over a 7-day cycle. LED display of time and day, easily programmed via 20-way keyboard. Ideal for central heating control (including different switching times for weekends). Battery back-up circuit. Includes box. 18 time settings.

CT6000K £39.00
XK114. Relay Kit for CT6000 includes PCB, connectors and one relay. Will accept up to 4 relays. 3A/240V c/o contacts £3.90
701 115 Additional Relays £1.65

ELECTRONIC LOCK KIT

With hundreds of uses indoors, garages, car anti-theft devices, electronic equipment, etc. Only the correct easily changed four-digit code will open it! Requires a 5-15V DC supply. Output 750mA. Fits into standard electrical wall box.
Complete kit (except front panel)
XK101 £11.50
Electric Lock Mechanism for use with existing door locks and the above kit. (Requires relay.) 12V AC/DC coil. (701 150) £14.95

HOME LIGHTING KITS

These kits are designed to replace a standard wall switch to control up to 300w of lighting

TDR300K	Remote Controlled Light Dimmer	£14.95
MK6	Transmitter for above	£4.50
TD300K	Touch Dimmer	£7.75
TS300K	Touch Switch	£7.75
TDE/K	2-way extension for above kits	£2.50
LD300K	Rotary controlled Light Dimmer	£3.95

DISCO LIGHTING KITS

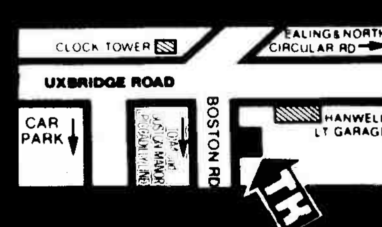
DL1000K This value-for money 4-way chaser features bi-directional sequence and dimming. 1kW per channel. **£15.95**
DLZ1000K – A lower cost uni-directional version of the above. Zero switching to reduce interference. **£8.95**
Optional opto input allowing audio 'beat', light response **(DLA/1)** **70p**
DL3000K 3-channel sound to light kit features zero voltage switching, automatic level control and built-in microphone. 1kW per channel. **£12.95**

DVM/ULTRA SENSITIVE THERMOMETER KIT

Based on the ICL 7126 and a 3½ digit liquid crystal display, this kit will form the basis of a digital multimeter (only a few additional resistors and switches are required – details supplied), or a sensitive digital thermometer (−50°C to +150°C) reading 0.1°C. The kit has a sensitivity of 200mV for a full-scale leading automatic polarity and overload indication. Typical battery life of 2 years (PP3). £15.50

TK ELECTRONICS
11-13 Boston Road London W7 3SJ

ORDERS 01-567 8910
ENQUIRIES 01-579 9794
01-579 2842 TECHNICAL AFTER 3pm

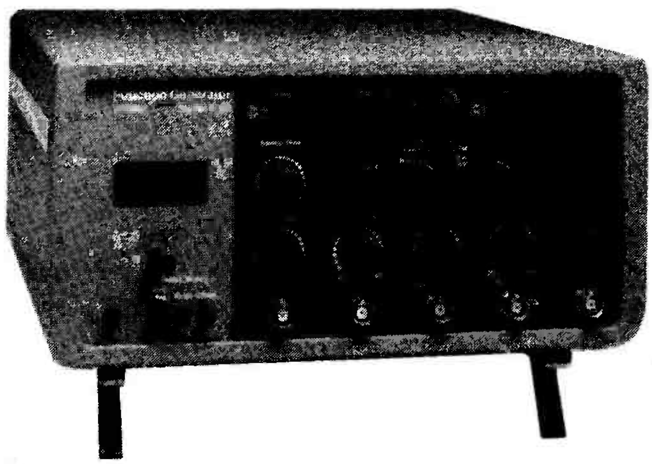


12 MHz AM/FM Sweep Function Generator

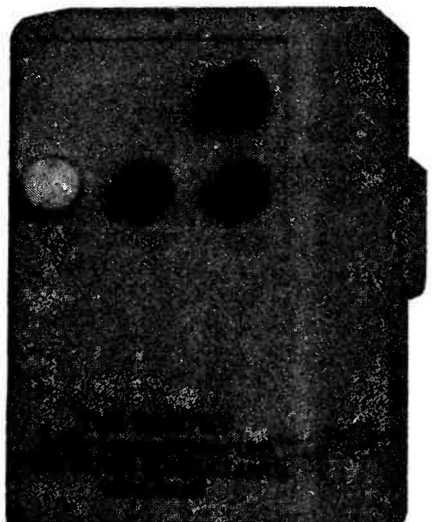
The series 8120 multipurpose function generator from Global Specialties Corporation provides sine, triangle, square, and pulse wave forms with variable amplitude, symmetry and offset over a frequency range of 1mHz to 12MHz. Frequencies can be amplitude or frequency modulated with an internal 1kHz sine signal or with an external signal or in a combination of both internal and external signal.

The output can be continuous, gated or triggered either by an external switch or a front panel manual switch. The start phase of the output signal is continuously adjustable from −90° to +90°. When used as a sweep generator, the series 8120 has an internal ramp with variable duration to provide a recurring linear sweep over a 100:1 frequency range or a 1000:1 range using an external signal.

Other features include an output amplitude to 30V peak-to-peak, an attenuation and amplitude control to 80dB, a 20% to 80% variable symmetry and a DC/offset voltage adjustable from −7.5 to +7.5V into 50R. A 3-digit LED display gives an automatic and convenient read-out of the frequency, output peak-to-peak voltage, output offset DC level and sweep stop frequency. This facility eliminates the need for external instruments such as oscilloscopes, digital multimeters, and counters, to monitor the output of the function generator.



The 8120 series comprises ten different models, each weighing approximately 4.5kg and having an ambient operating temperature range of 0° to 40°C. Prices range from £680.00 to £1,115.00 exclusive of VAT and postage. Global Specialties Corporation, Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AQ, tel 0799-21682.



Hiccough Monitor

Could a hicough in the mains cause chaos with your micro or other gear? The answer is 'yes', but the problems only start there, because it's often impossible to tell what actually has caused the failure or latch-up, especially if you're testing out something new.

Enter Mektronic Consultants with 'The Sentry' mains monitor. You could use it just to indicate when a mains transient has occurred, so that, when your micro has gone down and taken 300 hours of diligent machine code graphics programming with it, at least you will know it wasn't your fault. Alternatively, you could use 'The Sentry' to check the available supplies at your location to see which is cleanest. And by noticing what happens when a supply transient is generated, you could eventually isolate which items are causing the transients.

It plugs into a standard 13A socket and provides an indication if a transient is detected. It will indicate three levels of transient: slight, moderate and severe, and once a transient is detected the indicator lamp remains lit until the unit is reset. 'The Sentinel' costs £48.50 including P&P but excluding VAT (an extra £7.28) from Mektronic Consultants, Linden House, 116 Rectory Lane, Prestwich, Manchester M25 5DB, tel 061-798 0803.

TI Turn Their Hand To Diesel

As temperatures plunge well below freezing point, drivers of diesel-engined vehicles are finding that they can start up, but that their engines are running roughly, and frequently stalling two or three minutes down the road.

In sub-zero conditions, diesel engines suffer the problem of fuel "waxing", in which the paraffin crystallises. The engine will then usually run until the wax reaches the filter, which clogs up and leads to stalling.

Truckers associations advise owners to garage their vehicles overnight, and to use diesel fuel heaters or fuel additives. But many do not have garages or even sheltered parking places, and the fuel mixtures available in any but the coldest countries cannot cope with such extremes.

In February 1984, the Materials and Controls Division of Texas Instruments launched an easy-to-use, semiconducting ceramic device which prevents the waxing of diesel fuel. This diesel fuel heater, known as the 30RT, uses ceramic elements as a heat source. Packaged in a highly-efficient heat exchanger, it is typically mounted between the filter head and the filter itself, or alternatively in the fuel line.

The 30RT, in combination with an ambient temperature thermostat, switches on if the temperature falls below zero. The self-regulating nature of the ceramic means that it cannot overheat, and can be used on applications from 12-24V DC without any deterioration in performance.

Since the 30RT's introduction, many car, truck and filter makers have been evaluating it this winter or fitting it to their products. For example, it has recently been introduced on BMW's 300 series diesel models. Agricultural machinery maker International Harvester has been fitting 30RTs on its machines this winter, as has Fleetguard the truck maker on its Cummins-engined vehicles.

However, at present the average driver is still having to contend with waxing problems because the automotive industry typically takes at least a year to complete its evaluation of new products, such as the 30RT. By next winter, however, this device should be moving down from the luxury end of car ranges. It will also become available through the retrofit/DIY after-market, helping to reduce the hazards of winter driving for many more motorists. In the meantime, the major UK filter manufacturer is presently adapting its range to provide compatibility with the 30RT. Texas Instruments Ltd, Manton Lane, Bedford, MK41 7PA, tel 0234 63211.

● Rapid Recall are making available a pamphlet written by two Digital Equipment Corporation engineers which outlines the more common microprocessor benchmarking techniques. The 8-page A4 pamphlet also describes the various areas of system performance and proposes a performance measuring system, and copies can be obtained free of charge from Rapid Recall, Rapid House, Denmark Street, High Wycombe, Buckinghamshire HP11 2ER, tel 0494-26271.

● **British Telecom opened their first high-street shop at Southend on January 3rd. You can go in there, choose a new telephone, pay your bill . . . and two more shops will be opening in Newcastle and Plymouth later this year.**

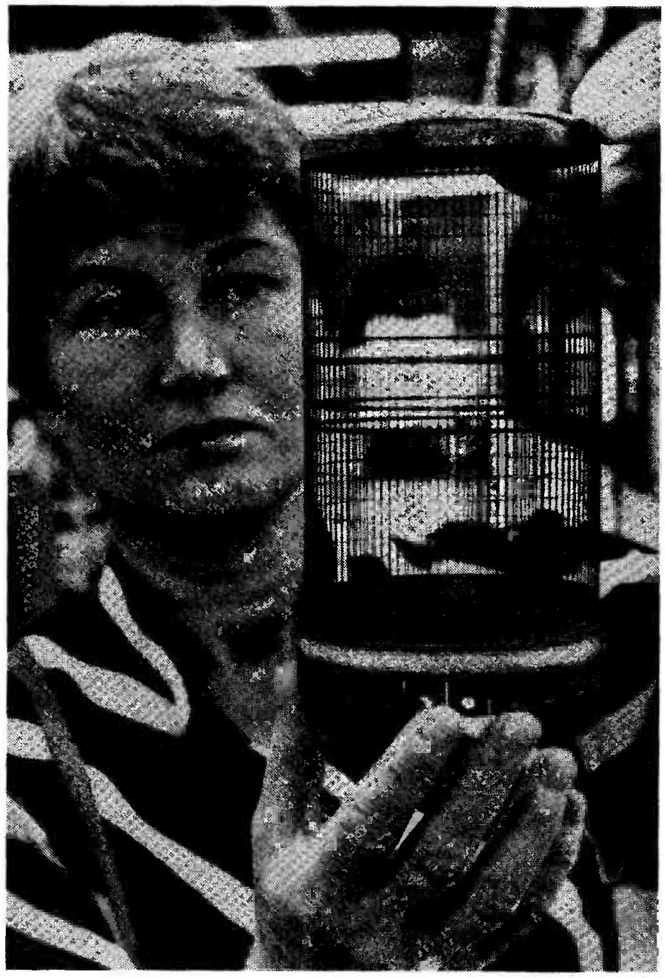
● *Decospray have developed a process which allows molten zinc to be applied to the surfaces of plastic enclosures without deforming or weakening them. The coating provides a high level of shielding against radio frequency interference and will allow plastics to be used in many applications which currently demand the screening properties of a metal enclosure. For more information contact C.C. Hammond at Decospray Ltd, Eastmore Street, Woolwich Road, Charlton, London SE7 8NA, tel 01-858 5128.*

● The British Standards Institution has published the following documents under the common title 'Harmonised system of quality assessment for electronic components':- BS9925 Inductor and transformer cores for telecommunications, part 0, geometric specification (£22.80); BS9925 part 01.0 Sectional specification of magnetic oxide cores for inductor applications (£16.20); BS CECC 11100 Sectional specification of display storage tubes (£16.20); BS CECC 1700 Generic specification of mercury wetted make contact units (£16.20); BS CECC 18000 Generic specification of dry reed change-over contact units, mechanically biased (£16.20); BS CECC 30400 Sectional specification of fixed metallised polyethylene-terephthalate film dielectric capacitors for direct current (£8.00); BS CECC 75100 Sectional specification of two part and edge socket connectors for printed board application (£22.80). All of these standards are available at 50% discount to members from the Sales Department, BSI, Linford Wood, Milton Keynes MK14 6LE.

Who's A Pretty Pyrographite Then?

High technology has been applied to some pretty mundane products but as far as we know no-one is yet using a laser to produce bird cages. The device shown is, in fact, the screen grid of a 100kW vapour-condensation cooled tetrode for medium and short wave radio transmitters. Manufactured by Siemens at their electronics tubes plant in Berlin, the grid was produced from a hollow cylinder of pyrographite using a laser as a precision cutting tool. The features are said to be remarkably smooth when compared with those of sand-blasted grids, and the material has excellent dimensional stability. In operation it will be loaded with as much as 24W per square centimetre and will run at temperatures as high as 2000 K.

Siemens Ltd, Siemens House, Windmill Road, Sunbury-on-Thames, Middlesex TW16 7HS, tel 09327-85691.



The Year To Go Bust

Last year, 1984, was the worst year on record for business failures in the electrical industry, according to the latest survey by Dun & Bradstreet Limited, the business information company. During the year company liquidations in the industry amounted to 793, an increase of 4.9 per cent over 1983 and representing 5.8 per cent of the total liquidations in England and Wales.

48.4 per cent of liquidations were recorded in London and the South East. A further 16.5 per cent occurred in the North West. Bankruptcies among firms, partnerships and individuals rose 19.8 per cent to 121 during the year.

In England and Wales as a whole, total company liquidations in 1984 reached 13,647 — an increase of 9.5 per cent on 1983. Bankruptcies among individuals, firms and partnerships rose to 8,035 during 1984 representing an increase of 17.8 per cent over the previous year.

Let's just hope that 1985 is better for us all.

Motor Control Chip

Plessey Semiconductors has introduced the TDA 2088, a bipolar phase control integrated circuit optimised for current feedback applications but which can also be used in the open loop mode.

The new circuit, now available from the company and its distributors, has been designed primarily for AC universal motor speed control in applications such as power drills and domestic appliances (foodmixers, etc). A high level of system integration has resulted in low external component count, thus ensuring a low cost solution to such applications.

Powered direct from the AC mains or a DC line, the TDA 2088 features an on-chip series regulator. This produces a smooth, low current (−5V) supply for the internal analogue control functions which may be used to power ancillary circuitry usually associated with this type of control system.

Voltage and current synchronisation inputs ensure that the triac firing pulse is at precisely the right moment under any load conditions. The negative triac firing pulse (a drive polarity preferred by most triac manufacturers) has a minimum guaranteed drive current of 100 mA with a typical current of 125 mA which ensures reliable firing of triacs capable of handling up to 40 Amps.

The TDA 2088 phase controller also produces a well-defined control voltage/phase angle relationship by using the international −5V reference circuit as the charging voltage for both the pulse timing ramp capacitor and as the reference voltage for the speed input potentiometer.

Compensation of motor speed with varying load is achieved by sensing motor current. The circuit design allows simple optimisation of control loop parameters.

Currently available in a 14 pin plastic dual-in-line (DIL) package it is planned to supply the TDA 2088 in a SO 14 package. Further information will be provided by Plessey Semiconductors Limited, Cheney Manor, Swindon SN2 2QW, tel 0793 36251.

BI-PAK BARGAINS

HIGH QUALITY MODULES FOR STEREO, MONO & OTHER AUDIO EQUIPMENT

Audio Amplifiers

O/No.	POWER O/P R.M.S.	MAX SUP. VOLTAGE	PRICE
AL 30A	10 Watts	30V	£4.95
AL 60	25 Watts	30-50V	£5.92
AL 80	35 Watts	40-60V	£8.75
AL 120	50 Watts	50-70V	£15.22
AL 250	125 Watts	50-80V	£20.60

Stabilised Power Supplies —

Output current 2.5 Amps

O/No.	AC Input	Price
SPM 120/45	40-48V	£8.05
SPM 120/55	50-55V	£8.05
SPM 120/65	60-65V	£8.05

Mono Pre-Amplifiers – Operating Vtg. 40-65V

O/No.		Price
MM 100	Suitable for Disco Mixer	£14.75
MM 100G	Suitable for Guitar Pre-Amp Mixer	£14.75

Magnetic Cartridge Pre-Amplifier
O/No. MPA30. Sup Vtg. 20-30V Price £4.29

Monographic Equaliser
GE 100 MKII 10 Channel OUR PRICE ONLY £20.00

Full Specifications and Data available on request. Please send self-addressed envelope.

OPTO 7-Segment Displays

Brand new 1st Quality

LITRONIX DL 707R 14-pin

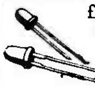
Red 0.3" Common Anode Display 0-9 with right hand decimal point. TTL compatible. 5v DC Supply. Data supplied.

	5 pieces	£3	(60p each)
IN	10 pieces	£5	(50p each)
PACKS	50 pieces	£20	(40p each)
OF	100 pieces	£35	(35p each)
	1,000 pieces	£300	(30p each)

THE MORE YOU BUY THE LESS YOU PAY

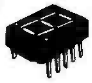
BI-PAK'S OPTO SPECIAL

A selection of large and small sized LED's in various shapes, sizes & colours, together with 7 Segment Displays both anode & cathode plus photo transistors emitters and detectors. Cadmium Cell ORP12 and Germ. photo transistor OCP71 included. In all a total of 25 Opto pieces valued over £12 Normal Price



Order No. VP57

Our Super Value Price Just £5.00



DIGITAL VOLT METER MODULE

3 × 7 segment displays Bass Circuit. 0-2v ± instructions provided to extend voltage & current ranges. Operating voltage 9/12v. Typ Power Consumption 50mA.

O/No. VP99 **Once only price** £9.95

SINGLE SIDED FIBREGLASS BOARD

Order No	Pieces	Size	Sq. Ins.	Price
FB1	4	9 × 2¾"	100	£1.50
FB2	3	11 × 3"	100	£1.50
FB3	4	13 × 3"	156	£2.00

DOUBLE SIDED FIBREGLASS BOARD

Order No	Pieces	Size	Sq. Ins.	Price
FB4	2	14 × 4"	110	£2.00

EDGE CONNECTORS

2 × 5 way .1 Pitch Edge Connector (Gold) (O/No. AMP163279 2) **£1.20 each. £50 per 50 off**

PICK-UP COIL

Large telephone pick-up coil for high sensitivity. Suction pad to stick to telephone. 90cm lead to 3.5 jack plug. Connects direct to cassette recorder. Dims: 32mm(dia) × 17mm(body) 36mm(dia) sucker. O/No. VP87 **£1.00**

VALUE PACKS

Pak No	Qty	Description	Price
VP1	300	Assorted Resistors Mixed Types	£1.00
VP2	300	Carbon Resistors ¼-½ Watt Pre-Formed	£1.00
VP3	200	⅛ Watt Min Carbon Resistors Mixed	£1.00
VP4	150	½ Watt Resistors 100 ohm-1M Mixed	£1.00
VP5	200	Assorted Capacitors All Types	£1.00
VP6	200	Ceramic Caps Miniature - Mixed	£1.00
VP7	100	Mixed Ceramics Disc. 1pf – 56pf	£1.00
VP8	100	Mixed Ceramic Disc. 68pf – .015pf	£1.00
VP9	100	Assorted Polyester/Polystyrene Caps	£1.00
VP10	60	C280 Type Caps Metal Foil Mixed	£1.00
VP11	50	Electrolytics – All Sorts	£1.00
VP12	60	Bead Type Polystyrene Min Caps	£1.00
VP13	50	Silver Mica Caps Ass. 5.6pf – 150pf	£1.00
VP14	50	Silver Mica Caps Ass. 180pf – 4700pf	£1.00
VP15	25	.01uF 250v Min. layer metallised Polyester Capacitors	£1.00
VP16	50	Wirewound Res. 9W (avg) Ass. 1 ohm – 12K	£1.00
VP17	50	Metres PVC Covered Single Strand Wire Mixed Colours	£1.00
VP18	30	Metres PVC Covered Multi Strand Wire Mixed Colours	£1.00
VP19	40	Metres PVC Single/Multi Strand Hook-Up Wire Mixed	£1.00
VP20	6	Rocker Switches 5 Amp 240v	£1.00
VP21	15	2in. high bright RED LEDs in plastic encapsulation–Large area light source	£1.00
VP22	200	Sq. Inches Total, Copper Clad Board Mixed Sizes	£1.00
VP23	20	Assorted Slider Pots. Mixed Values	£1.00
VP24	10	Slider Pots. 40 mm 22K 5 × Log. 5 × Lin	£1.00
VP25	10	Slider Pots. 40 mm 47K 5 × Log. 5 × Lin	£1.00
VP26	15	Small .125" Red LED's	£1.00
VP27	15	Large .2" Red LED'S	£1.00
VP28	10	Rectangular .2" RED LED'S	£1.00
VP29	30	Ass. Zener Diodes 250mW – 2W Mixed Vlts. Coded	£1.00
VP30	10	Ass. 10W Zener Diodes Mixed Vlts. Coded	£1.00
VP31	10	5 Amp SCR's TO-66 50-400v Coded	£1.00
VP32	20	3 Amp SCR's TO-66 Up To 400v Uncoded	£1.00
VP33	200	Sil. Diodes Switching Like IN4148 DO-35	£1.00
VP34	200	Sil. Diodes Gen. Purpose Like OA200/BAX13/16	£1.00
VP35	50	1 Amp IN4000 Series Sil. Diodes Uncoded All Good	£1.00
VP37	8	Black Instrument Type Knobs With Pointer ¼" Std	£1.00
VP42	10	Black Heatsinks To Fit TO-3, TO-220 Ready Drilled	£1.00
VP43	4	Power-Fin Heatsinks 2 × 10-3 2 × TO-66 Size	£1.00
VP45	50	BC107/8 Type NPN Transistors Good Gen. Purpose Uncoded	£1.00
VP46	50	BC177/8 Type PNP Transistors Good Gen. Purpose Uncoded	£1.00
VP47	10	Silicon Power Trans. Similar 2N3055 Uncoded	£1.00
VP140	50	Precision Resistors. 2-1% tol.	£1.00
VP141	40	1N4002 Sil. Rects. 1A 100v preformed pitch	£1.00
VP142	4	40A Power Rectifiers Silicon TO48 300PIV	£1.00
VP143	5	BY187 12KV Sil. Diodes in carriers 2.5mA	£1.00
VP144	4	100K 1in. Multi-turn pots ideal vari cap tuning	£1.00
VP145	10	Assorted pots. inc. Dual & Switched types	£1.00
VP146	25	Solid Tantalum Caps. Mixed Values	£1.00

OPTICALLY COUPLED MODULES

1 pair SD1/131 Consisting 1 × LS600 Silicon Light Sensor & 1× Matched Gallium Arsenide Light Source – Type TIL23, on ready mounted fibre glass board. Including Data. Ideal Alarm projects etc. O/No. VP147.

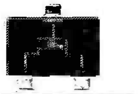
BI-PAK Price ONLY £0.60 pr.

LED DISPLAYS

VP130	6	RED 7 Seg. CC 14mm × 7.5mm RDP FND353	£2.00
VP131	4	GREEN 7 Seg. CA .6" LDP XAN6520	£2.00
VP132	5	RED 7 Seg. CC .6" LDP XAN6940	£2.00
VP133	6	RED Over-flow .6" 3 × CA 3 × CC 6630/50	£2.00
VP134	5	GREEN Over-flow .6" CA XAN6530	£2.00
VP135	5	RED 7 Seg. CA .3" XAN3061	£2.00
VP136	3	DUAL RED 7 Seg. .5" CA DL527 DPR	£2.00
VP137	3	DUAL RED 7 Seg. .51" CA DL727 DPR	£2.00
VP138	20	Assorted LED Displays – Our mix with Data	£5.00

RDP = Right Hand Decimal Point   CC = Common Cathode
LDP = Left Hand Decimal Point   CA = Common Anode

ANTENNA SWITCH 2 and 3 WAY



Co-axial switch for one transceiver to two antennae or one antenna to two transceivers. Dims: 86 × 55 × 32mm (Body). O/No. VP 113 **£4.50**

As above but 3-way. O/No. VP 114 **£4.75**

HIGH PASS FILTER/SUPPRESSOR

CB/TV. High pass filter. Reduces unwanted signals picked up by antenna. Dims: 45 × 25 × 17mm. O/No. VP 115 **45p**

LOW PASS FILTER

Designed to reduce harmonics on the VHS and TV band.
Cut-off frequency: 30MHz.
V.S.W.R.: Less than 1.2 to 1.
Insertion loss: –0.2dB @ 27MHz.
Impedance: 50 ohms.
Dims: 80 × 55 × 40mm.
O/No. VP 116 **£2.75**

IC BARGAINS

40 Assorted TTL CMOS INTEGRATED CIRCUITS 74 Series & CD4000 Series – All new Gates. Flip-Flops – MSI etc. GREAT VALUE Data Book & Sheets included. 40 Pieces (Our Mix) **£4.00** O/No. UP40

TRANSISTOR PACKS

VP150	20	BC183B Sil. Trans. NPN 30v 200mA Hfe240+ TO92	£1.00
VP151	25	BC171B Sil. Trans. NPN 45v 100mA Hfe240+ TO92	£1.00
VP152	15	TIS90 Sil. Trans. NPN 40v 400mA Hfe100+ TO92	£1.00
VP153	15	TIS91 Sil. Trans. PNP 40v 400mA Hfe100+ TO92	£1.00
VP154	15	MPSA56 Sil. Trans. PNP 80v 800mA Hfe50+ TO92	£1.00
VP155	20	BF595 Sil. Trans. NPN eqvt. BF184 H.F. TO92	£1.00
VP156	20	BF495 Sil. Trans. NPN eqvt. BF173 H.F. TO92	£1.00
VP157	15	ZTX500 Series Sil. Trans. PNP Plastic	£1.00
VP158	15	ZTX107 Sil. Trans. NPN eqvt. BC107 Plastic	£1.00
VP159	15	ZTX108 Sil. Trans. NPN eqvt. BC108 Plastic	£1.00
VP160	20	E5024 Sil. Trans. PNP eqvt. BC214L TO92	£1.00
VP161	25	BC183L Sil. Trans. NPN 30v 200mA TO92	£1.00
VP162	5	SJE5451 Sil. Power Trans. NPN 80v 4A Hfe20+	£1.00
VP163	2	NPN/PNP pairs Sil. Power Trans. like SJE5451	£1.00
VP164	4	2N6289 Sil. Power Trans. NPN 40v 40w 7A Hfe30+	£1.00
VP165	6	BFT33 NPN Sil. Trans. 80v 5A Hfe50-200 TO39	£1.00
VP166	5	BFT34 NPN Sil. Trans. 100v 5A Hfe50-200 TO39	£1.00
VP167	1	BUY69C NPN TO3 VCB 500 10A 100w Hfe15+	£1.00
VP168	10	BC478 eqvt. BCY71 PNP Sil. Trans. TO18	£1.00
VP169	10	BXS21 eqvt. BC394 NPN Sil. Trans. 80v 50mA TO18	£1.00
VP170	10	Assorted Power Trans. NPN/PNP Coded & Data	£1.00
VP171	10	BF355 NPN TO-39 Sil. Trans. eqvt. BF258 225v 100mA	£1.00
VP172	10	SM1502 PNP TO39 Sil. Trans. 100v 100mA Hfe100+	£1.00

TRANSISTORS

100 Silicon NPN Transistors. All Perfect. Coded Mixed. Types With Data And Eqvt. Sheet No Rejects. Fantasic Value. O/No. BP38 **£3.00**

100 Silicon PNP Transistors. All Perfect Coded. Mixed. Types With Data and Eqvt. Sheet. No Rejects. Real Value. O/No. 8P39 **£3.00**

The best known Power Transmitter in the world 2N3055 NPN 115W. Our Bi-Pak Special Offer Price.

10 off	50 off	100 off
£3.50	£16.00	£30.00

BD312 COMPLIMENTARY PNP POWER TRANSISTORS TO 2N3055. Equivalent MJ2955 BD312 TO3. **Special Price £0.70 each. 10 off £6.50**

SEMICONDUCTORS FROM AROUND THE WORLD

100 A collection of Transistors, Diodes, Rectifiers & Bridges, SCRs, Triacs, I.C.s & Opto's all of which are current every day useable devices. Guaranteed Value Over £10 Normal Retail Price. Data etc. in every pack. Order No. VP56

Our Price £4.00

TRANSISTOR CLEARANCE

100 All Sorts Transistors. A mixed bag NPN-PNP Silicon & Germ. Mainly Uncoded You To Sort Pack includes instructions for making Simple Transistor Tester, Super Value. Order No. VP60. **£1.00**

150 De-soldered Silicon Transistors from boards 10mm leads all good. O/No. VP173 **£1.00**

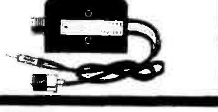
TECASBOTY

THE ELECTRONIC COMPONENTS AND SEMICONDUCTOR BARGAIN OF THE YEAR!

This collection of Components and Semiconductors for the hobbyist is probably the most value-packed selection ever offered, it consists of Resistors, carbon and wirewound of various values. Capacitors: All types, sorts and sizes including electrolytics. Potentiometers – single, dual, slider and preset. Switches, Fuses, Heatsinks, Wire, P.C.B. Board, Plugs, Sockets etc., PLUS a selection of Semiconductors for everyday use in popular Hobby Projects. These include: SCR's, Diodes, Rectifiers, Triacs & Bridges as well as a first class mix of Transistors and I.C.'s. In all, we estimate the value of this in current retail catalogues to be over £25! So, help yourself to a great surprise and order a Box TODAY – ONLY at BI-PAK. Remember, stocks are limited so hurry! You can call us on 0920 3182/3442 and order with your Barclaycard or Access Card – 24hr Answerphone Service NOW. Order No. VP 85. **just £7.00**

ANTENNA COUPLER

Transceiver/car radio antenna coupler. With co-axial cables. One co-axial terminates in antenna plug and the other in PL259 plug. Dims: 67 × 46 × 30mm.
O/No. VP 117 **£2.00**



PRECISION MORSE KEYS

Well designed beginners key. Fully adjustable. Dims: Base 82mm × 45mm. O/No. VP 122. **£1.85**

ELECTRONIC SIREN 12v DC

Red plastic case with adjustable fixing bracket. Emits high-pitched wailing note of varying pitch – 100 cycles per minute.
Dims: 90mm(dia) 60mm(depth)
Power: 12v DC
Our Price: £5.50

POWER SUPPLY

OUR PRICE £3.75

Power supply fits directly into 13 amp socket. Fused for safety. Polarity reversing socket. Voltage switch. Lead with multi plug input – 240v AC 50Hz Output –3 4.5 6 7.5 9 & 12v DC. Rating 300ma MW88.

TAPE RECORDER SWITCH

Unit to control motor of tape recorder. 1.8m cord and 2.5mm plug attached. On/Off switch. Dims: 55 × 20 × 20mm.
O/No. VP 127 **£1.00**

(LEARN A LINGO) PILLOW SPEAKER

Slim under pillow unit. 80ohms 2" speaker. 1.5m lead with 3.5mm mono jack plug. Black. Dims: 65(dia) × 17mm. O/No. VP 88 **£1.25**

BI-PAK

Send your orders to Dept ETI BI-PAK PO BOX 6 WARE, HERTS
SHOP AT 3 BALDOCK ST. WARE, HERTS
TERMS CASH WITH ORDER, SAME DAY DESPATCH, ACCESS, BARCLAYCARD ALSO ACCEPTED. TEL. (0920) 3182, GIRO 388 7006
ADD 15% VAT AND £1.00 PER ORDER POSTAGE AND PACKING

Use your credit card. Ring us on Ware 3182 NOW and get your order even faster. Goods normally sent 2nd Class Mail.
Remember you must add VAT at 15% to your order.
Total Postage add £1.00 per Total order.

New 726 Information Technology Scheme

A new City and Guilds Information Technology scheme (726) was launched on 18 January. C&G say that this scheme represents a double breakthrough: it takes an entirely new approach to educational and training methods as well as a uniquely broad consideration of vocational training in the rapidly developing and changing field of Information Technology.

The 726 series is intended to provide for very flexible study or training methods; it is entirely pupil paced, and the criterion referenced assessment is designed to ensure that successful candidates demonstrate an ability to do the job competently.

The approach is modular, but there are a limited number of modules and each is nationally devised so that employers will be able to assimilate and assess the content of each as well as deciding which combinations might best meet the needs of their workforce. Modules will relate to and Guilds. This means that centhe three subject disciplines of: programming and software; electronics and hardware; and computer applications and operation. Module levels are defined as either introductory, elementary, intermediate or advanced. These levels relate to the subject matter and are not necessarily indicative of ability. C&G say that many of the modules will be equally suitable for a very wide range of candidates; some will ideally suit YTS trainees and others will be pitched at supervisory and management personnel.

The scheme may be offered by any centre approved by the City tres could be set up in schools, F.E. colleges, industrial premises, ITeC's or Skills Centres, etc — anywhere where the necessary hardware, training personnel and accommodation can be provided.

The scheme is initially released at the Introductory and Elementary levels, but Intermediate and Advanced level modules will be available very soon. Scheme notes are now available and further information can be obtained from: Section 18, City and Guilds of London Institute, 46, Britannia Street, London WC1X 9RG, tel 01-278 2468.

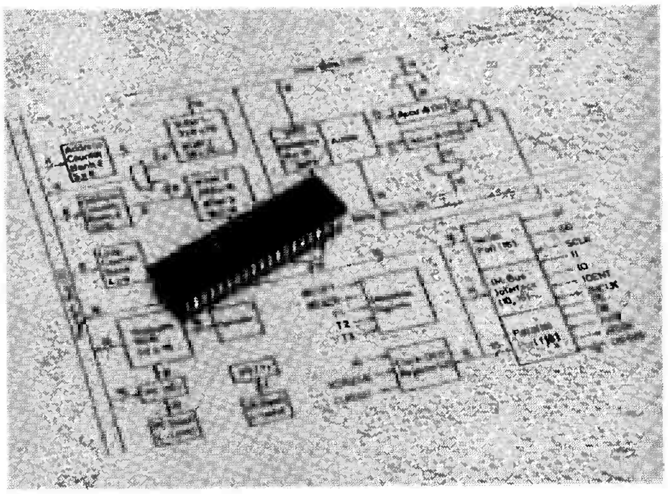
Digital Signal Processor For Audio Applications

ITT Semiconductors have produced a digital signal processor chip which can be used instead of analogue devices in many audio-frequency applications. The advantages of using digital processing include higher noise immunity, true phase-linearity and freedom from component drift problems caused by temperature and ageing.

The UDP101 CMOS chip is based on the Harvard architecture, and comes in a 40-pin plastic package. Two data buses and pipelining are used for speed of execution, and the basic instruction cycle time is 100 nanoseconds which makes it suitable for use in a wide variety of audio processing applications. The basic arithmetic operation is multiply and add using twos complement with a results resolution of 31 bits. The data and instruction word-length is 16 bits and the internal memory comprises 1K 16-bit words of program ROM, 72 words of data ROM, and 440 words of data RAM. Subroutines can be nested at up to four levels.

Three separate I/O facilities are available: fast serial at rates up to 5 Mbits/second, slow serial I/O for communication with slave peripherals through the chip's IM bus interface, and a 16-bit parallel interface that's compatible with popular microprocessors, including the 68000.

The UDP101 operates on a single 5V supply and consumes about 80 mW. A ROMless version (UDP101-EC) is available for development. Software tools include a cross assembler and simulator written in FORTRAN 77.



The device's bandwidth allows a wide range of applications. In the telecommunications field it could be used in DTMF receivers, modems, vocoders, scramblers and echo-cancelling systems, and in the consumer field it's suitable for audio processing in a variety of TV, hi-fi and radio applications. General industrial uses include speech recognition.

For further information contact Georgina Cole at ITT Semiconductors, 145-147 Ewell Road, Surbiton, Surrey KT6 6AW, tel 01-390 6578.

Light And Colour Principles

A new volume — 'Light and Colour Principles' — has been published by the IBA as No. 22 in the series of occasional engineering texts under the general title of 'IBA Technical Review'.

Our sources say that this fully-illustrated 60-page book provides not only a clear introduction to aspects of photometry and colorimetry essential to the understanding and engineering of colour television but also describes the recent development by IBA engineers of new, microcomputer-based spectrometric equipment and its practical application to the analysis and optimisation of television cameras and monitors.

Contributions include: "The Measurement of Light" by Professor R.W.G. Hunt (City University, London, formerly Kodak Research Laboratories) and P.J. Darby (IBA).

"Colorimetry" by Professor R.W.G. Hunt.

"Colorimetry in Television" by P.J. Darby.

"Computer-operated Spectrophotometric Analysis of Cameras (COSAC)" by P.A. King (IBA) and P.J. Marshall (HTV, formerly IBA).

"Computer-operated Spectrophotometric Analysis of Monitors (COSAM)" by P.A. King and P.J. Marshall.

In an introduction, J.B. Sewter, IBA's Assistant Director of Engineering (Network and Development), points out that the IBA has overall responsibility for the maintenance of high technical standards in Independent Broadcasting. Its engineers are much concerned with the technical performance of studio centres although the equipping and operation of such centres and the creative content of the programmes is the concern of the individual programme companies. During recent years broadcasters have achieved a more widespread understanding of colorimetry and its importance to television. The availability of microcomputers now makes it possible to process multiple measurements and the complex calculations needed to analyse and optimise cameras and monitor display. Together with improvements in optical components this had led to the development of a transportable IBA test rig capable of a wide range of colorimetric measurements.

The early sections provide clear, unambiguous definitions of units based on the latest CIE and CIELUV 76 recommendations. These volumes are intended only for engineers and students directly involved in the field of broadcasting. Subject to availability of limited stocks, single copies may be obtained without charge. Complimentary copies are also available, on request, to technical libraries and educational centres in the UK and overseas. IBA Technical Review No 22, 'Light and Colour Principles', technical editor Dr. Henry Palmer is published by IBA London. Enquiries to IBA Engineering Information Services, Crawley Court, Winchester, Hampshire, SO21 2QA, telephone Winchester (0962) 822444. **ETI**

01-208 1177 TECHNOMATIC LTD 01-208 1177

BBC Micro Computer System

ACORN COMPUTER SYSTEMS
BBC Model B Special offer.......**£320** (a) BBC
Model B+Econet............**£389** (a)
BBC Model B+DFS............**£409** (a)
BBC Model B+DFS +Econet............**£450** (a)

UPGRADE KITS
A to B Upgrade Kit............**£75** (c)
DFS Kit............**£95** (c)
Econet Kit............**£45** (c)
Speech Kit............**£47** (c)

ACORN ADD-ON PRODUCTS
Z80 2nd Processor............**£352** (a)
6502 2nd Processor............**£175** (b)
Teltext Adaptor............**£190** (b)
IEEE Interface £282............**£282** (b)
Prestel Adaptor............**£99** (b)

RH Light pen............**£39.50** (c)

BBC FIRMWARE
1.2 Operating System............**£7.50** (d)
Basic II ROM............**£22.50** (d)
View Word Processor ROM............**£48.00** (c)
Wordwise Word Processor ROM............**£34.00** (d)
BCPL ROM/Disc............**£86.00** (b)
Disc Doctor/Gremlin Debug ROM **£28** (d)
EXMON/TOOL KIT ROM............**£28 ea** (d)
Printmaster (FX80)/Graphics ROM............**£28 ea** (d)
ULTRACALC spreadsheet ROM **£69 ea** (c)

COMMUNICATION ROM
Termi Emulator............**£28** (d)
Communicator............**£59** (d)
Commstar............**£229** (d)

TORCH UNICON products including the IBM Computible GRADUATE in stock
For detailed specification on any of the BBC Firmware/Peripherals listed here or information on our complete range please write to us.

DISC DRIVES

These are fully cases and wired drives with slim line mechanisms of high quality, Shuggart A400 standard interface. Drives supplied with cables manuals and formatting disc suitable for the BBC computer. TEAC 80 track drives are supplied with 40/80 track switching as standard. All drives can operate in single or dual density format.

1 x 100K 40T SS:TS55A............**£100**(b)
1 x 200K 40/80TSS:TS55E............**£140**(b)
1 x 400K 40/80TDS:TS55F............**£145**(a)
2 x 100K 40T SS:TD55A with psu......**£250**(a)
2 x 200K 40/80T SS:TD55E TEAC with psu............**£325**(a)
2 x 400K 40/80T DS: TD55MP with psu............**£380**(a)
2 x 400K 40/80TDS:TD55M Mitsubishi with psu............**£360**(a)
CS55A with psu............**£125**(b)
CS55E with psu............**£150**(b)
CS55F with psu............**£169**(b)

3M 5¼" FLOPPY DISCS

High quality discs that offer a reliable error free performance for life. Each disc is individually tested and guaranteed for life. Ten discs are supplied in a sturdy cardboard box.

40T SS DD **£15 (c)** 40T DS DD **£18 (c)**
80T SS DD **£22 (c)** 80T DS DD **£24 (c)**

DRIVE ACCESSORIES

FLOPPICLENE Disc Head Cleaning Kit with 20 disposable cleaning discs ensures continued optimum performance of the drives............**£14.50** (c)
Single Disc Cable .... **£6** (d) 10 Disc Library Case............**£1.80**(c)
30/40 Disc Lockable Box............**£14** (c)
Dual Disc Cable............**£8.50** (d)
30 Disc Case............**£6** (c)
70/80 Disc Lockable Box............**£19** (c)

PRINTERS

EPSON
RX80FT **£225** (a) FX80 **£315** (a) FX 100 **£435** (a)

KAGA TAXAN
KP 810 (80col) **£255** (a) KP910 (156col) **£359** (a)
JUKI 6100 **£340** (a) **BROTHER** HR15 **£340** (a)

ACCESSORIES
32K Internal Buffer Parallel **£75** (b)

EPSON
Serial Interface: 8143 **£28** (c); 8148 with 2K **£57** (c)
Paper Roll Holder **£17** (d); FX80 Tractor Attachment **£37** (c)
Ribbons: FX/RX/MX80 **£5** (d) FX/RX/MX100 **£10** (d)
RX/FX80 Dust Cover **£4.50** (d)

KAGA TAXAN
RS232 with 2K Buffer **£85** (c) KP810/910 Ribbon **£6.00** (d)

JUKI 6100
RS232 with 2K Buffer **£65** (c) Ribbon **£2.50** (d)
Tractor Attachment **£99** (a) Sheet Feeder **£199** (a)
BBC Parallel Lead **£7** (d) Serial Lead **£7** (d)
2000 Sheets Fanfold Paper with extra fine perforation
9.5" x 11" **£13** (b) 14.5" x 11" **£18** (b)
Self Adhesive Labels 2¾" x 17/16"
Single Row **£5.25**/1000 (d) Triple Row **£5**/1000 (d)

MONITORS

MICROVITEC 14" RGB:
1431 Standard Resolution............**£165 (a)**
1451 Medium Resolution............**£240 (a)**
1441 Hi Resolution............**£399 (a)**
1431 AP Std Res PAL/AUDIO............**£210 (a)**
1451 AP Med Res PAL/AUDIO............**£280 (a)**
1451 DQ3 Med Res for QL............**£239 (a)**
Above monitors are now available in plastic or metal cases, please specify your requirement.
KAGA Super Hi Res Vision III RGB............**£340 (a)**
Hi Res Vision II............**£240 (a)**
MONOCHROME MONITORS 12":
Kaga Green KX1201 G Hi Res............**£99 (a)**
Kaga Amber KX1201 A Hi Res............**£105 (a)**
Sanyo Green DM8112CX Hi Res............**£90 (a)**
Swivel Stand for Kaga Monochrome............**£21 (c)**
All monitors are supplied with leads suitable for the BBC Computer. Spare leads available.

MODEMS

— All modems listed below are BT approved

MIRACLE WS2000:
The ultimate world standard modem coverall all common BELL and CCITT standards up to 1200 Baud. Allows communication with virtually any computer system in the world. The optional AUTO DIAL and AUTO ANSWER boards enhance the considerable facilities already provided on the modem. Mains powered **£129(b)**. Auto Dial Board/Auto Answer Board **£30(c)** each. Software lead **£4.50.**

TELEMOD 2:
Complies with CCITT V233 1200/75 Duplex and 1200/1200 Half Duplex standards that allow communications with VIEWDATA services like PRESTEL, MICRONET etc. as well as user to user communications. Mains powered **£64(b).**

BUZZ BOX:
This pocket sized modem complies with V21 300/300 Baud and provides an ideal solution for communications between users, with main frame computers and bulletin boards at a very economic cost. Battery or mains operated, **£52(c).** Mains adaptor **£8(d).**

BBC to Modem data lead **£7.**

ATTENTION

All prices in this double page advertisement are subject to change without notice
ALL PRICES EXCLUDE VAT
Please add carriage 50p unless indicated as follows:
(a) £8 (b) £2.50 (c) £1.50 (d) £1.00

SPECIAL OFFER

2764-25............**£4.9**
27128-25............**£1**
27128-30............**£1**
6264-15............**£2**
6262LP-15............**£3**
6264-12............**£3**

GANG OF EIGHT
INTELLIGENT FAST EPROM COPIER

Copies up to eight eproms at a time and accepts all single rail eproms up to 27256. Can reduce programming time by 80% by using manufacturer's suggested algorithms. Fixed Vpp of 21 & 25 volts and variable Vpp factory set at 12.5 volts. LCD display with alpha moving message. **£395(b).**

SOFTY II

This low cost intelligent eprom programmer can program 2716, 2516, 2532, 2732, and with an adaptor, 2564 and 2764. Displays 512 byte page on TV — has a serial and parallel I/O routines. Can be used as an emulator, cassette interface.
Softy II............**£195(b)**
Adaptor for 2764/2564. **£25.00(c)**

UV ERASERS

All erasers with built in safety switch and mains indicator.
UV1B erases up to 6 eproms at a time.... **£47(c)**
UV1T as above but with a timer............ **£59(c)**
UV140 erases up to 14 eproms at a time. **£61(b)**
UV141 as above but with a timer............ **£79(b)**

CONNECTOR SYSTEMS

I.D. CONNECTORS
(Speedblock Type)

No of ways	Header Plug	Receptacle	Edge Conn.
10	90p	85p	120p
20	145p	125p	195p
26	175p	150p	240p
34	200p	160p	320p
40	220p	190p	340p
50	235p	200p	390p

D CONNECTORS
No of Ways

	9	15	25	37
MALE:				
Ang.Pins	120	180	230	350
Solder	60	85	125	170
IDC	175	275	325	-
FEMALE:				
St Pin	100	140	210	380
Ang.pins	160	210	275	440
Solder	90	130	195	290
IDC	195	325	375	-
St Hood	90	95	100	120
Screw Lock	130	150	175	-

TEXTOOL ZIF
SOCKETS 24-pin £5.75
28-pin £8.00 40-pin £9.75

EDGE CONNECTORS

	0.1"	0.156"
2 x 6-way (commodore)	—	300p
2 x 10-way	150p	—
2 x 12-way (vic 20)	—	350p
2 x 18-way	—	140p
2 x 23-way (ZX81)	175p	220p
2 x 25-way	225p	220p
2 x 28-way (Spectrum)	200p	—
2 x 36-way	250p	—
1 x 43-way	260p	—
2 x 22-way	190p	—
2 x 43-way	395p	—
1 x 77 way	400p	500p
2 x 50-way(S100conn)	600p	—

EURO CONNECTORS

DIN 41612		
2 x 32 way St Pin	230p	275p
2 x 32 way Ang Pin	275p	320p
3 x 32 way St Pin	260p	300p
3 x 32 way Ang Pin	375p	400p
IDC Skt A + B	275p	
IDC Skt A + C	350p	

For 2 x 32 way please specify spacing (A + B, A + C).

AMPHENOL CONNECTORS
36 way plug Centronics (solder) 500p (IDC) 475p
36 way skt Centronics (solder) 550p (IDC) 500p
24 way plug IEEE (solder) 475p (IDC) 475p
24 way skt IEEE (solder) 500p (IDC) 500p
PCB Mtg Skt Ang Pin
24 way 700p 36 way 750p

GENDER CHANGERS
25 way D type
Male to Male............**£10**
Male to Female............**£10**
Female to Female............**£10**

RS 232 JUMPERS
(25 way D)

24" Single end Male	£5.00
24" Single end Female	£5.25
24" Female Female	£10.00
24" Male Male	£9.50
24" Male Female	£9.50

DIL SWITCHES
4-way **90p** 6-way **105p**
8-way **120p** 10-way **150p**

TELEPHONE CONNECTORS

4 way plug	**110p**
6 way plug	**180p**
6 way rt.ang.skt	**160p**
Flexible cable	
4 way	**50p/m**
6 way	**72p/m**

RIBBON CABLE
(grey/metre)

10-way	40p	34-way	160p
16-way	60p	40-way	180p
20-way	85p	50-way	200p
26-way	120p	64-way	280p

DIL HEADERS

	Solder	IDC
14 pin	40p	100p
16 pin	50p	110p
18 pin	60p	-
20 pin	75p	-
24 pin	100p	150p
28 pin	200p	-
40 pin	200p	225p

MISC CONNS
21 pin Scart Connector **200p**
8 pin Video Connector **200p**

VOLTAGE CONTRO OSCILLATOR

Tired of the same old sounds from your synth? Bring a new variety to its waveforms with the VCDO! Design by Richard Thorp, development by Simon Bailey.

A conventional VCO can produce several waveforms, rich in harmonics, which may be filtered in order to alter the timbres. This is quite satisfactory for a wide range of musical requirements but the small range of waveforms available (usually sawtooth, square and triangle) and the coarse effects of analogue filters mean that it is impossible to produce many of the delicate, natural sounds which are so characteristic of modern digital synthesis. This module adds some exciting new possibilities to existing synthesisers by combining the flexibility of analogue voltage control with the clarity and realism of digitally generated waveforms.

As a unit, the voltage-controlled digital oscillator (VCDO) may be regarded as an ordinary VCO, but with a far greater range of waveforms. The design is fully compatible with existing synthesiser systems (1V/octave frequency control, 10V peak-to-peak output, linear and exponential modulation inputs) and offers the versatility of 32 different waveforms covering a wide variety of sound textures. A particular waveform can be selected either with push-button switches using a simple incremental system or by a combination of a push-button switch and suitable electronic pulses to the input provided. The module has a wide frequency range (approximately 30Hz to 10kHz) which allows it to be used as either an audio or modulation source.

Design

The VCDO works on a very simple principle. The 32 waveforms are encoded in a 2716 EPROM. Each waveform is represented as a series of 64 8-bit numbers (a wavetable). A binary counter is made to run at a frequency generated by a VCO and to count through the waveform data. A DAC converts each item of data into an analogue voltage.

The VCO is based on the familiar CEM 3340 from Curtis Electromusic Specialties. In this case, the frequency range has been shifted upwards by altering the timing components. Accurate calibration of the oscillator is

HOW IT WORKS

IC1 is a CEM 3340, which with the addition of a few external resistors and capacitors functions as a high quality VCO, featuring accurate exponential and linear control of frequency. Three output waveforms are provided (triangle, sawtooth and pulse), but in this application only the pulse output is required, which is available at pin 4. A positive-going control voltage to pin 5 allow adjustment of the duty cycle of the pulse wave from approximately 0% to 100%. Frequency control is by means of timing capacitor C4 (10pF in this application) and multiple voltage control via resistors R8-11 to pin 15, which is a virtual earth summing node. Additionally, pin 13 may be employed as a linear frequency control input, providing the facility of linear frequency modulation. The VCO is configured such that it may be calibrated for an accurate +1V/octave response using presets RV1 and RV3. Provision has also been made for connection to an external VC clock via SK4 which, if permanently connected, allows the removal of the CEM 3340 and associated circuitry.

The pulse output is suitably attenuated to 5V by R17/ZD1 and is further processed by a Schmitt trigger (1/6 of IC2). Squaring of the pulse output is necessary as at extremely high frequencies an unacceptable amount of slewing is present, which inhibits operation of the next circuit block, a frequency doubler. The frequency doubling circuitry configured around IC3a and IC3b is included to provide an extra octave range. It functions by separately differentiating both edges of the square wave — C6/R18 differentiate negative edges and C7/R19 differentiate positive edges. The output of IC3b is then a series of narrow pulses corresponding to both edges of the original square wave clock signal.

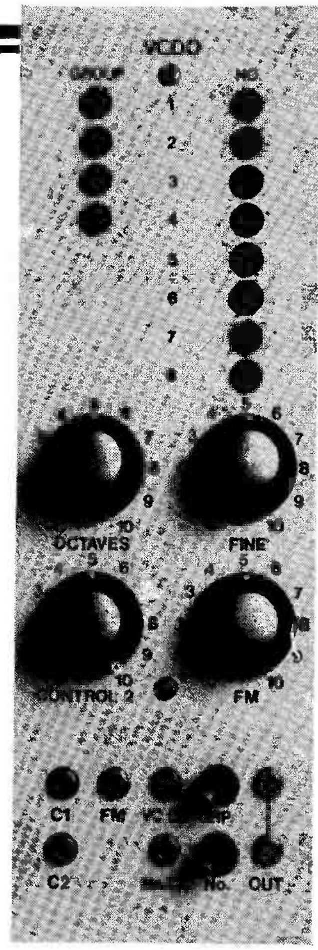
Ripple counter IC4 steps through the lower six address bits of IC 9, a 2716 EPROM suitably programmed with wavetables. The data outputs at pins 9-17 of the 2716 go directly to IC10, which is a high speed multiplying digital-to-analogue converter (DAC 0800). The data is thus converted to an analogue voltage which is buffered by IC 11. The same IC also scales the output to 10V peak-to-peak.

Ripple counter IC 7 and IC 8 are used to select the required waveform Number and Group respectively. Their clock inputs (pin 1) are fed by IC 3c and IC 3d which invert and debounce the switches SW1 and SW2. Additionally, an external input is provided so that a suitable waveform or pulse train may be used to advance the waveform Number in a particular Group. ZD2/R20 are included to limit an incoming externally generated pulse to +5V. R24 and C10 form a power-on reset network to take the reset inputs of the select counters high at switch-on in order to start at waveform Number 1 in Group 1.

IC 5 and IC 6 are BCD to decimal converters and LED drivers, displaying two decimal equivalents present on the upper five address lines of the 2716. Thus the two highest address lines A_9 and A_{10} are decoded to light one of four green LEDs representing the waveform Group whilst control lines A_6 to A_8 light one of eight red LEDs representing the waveform Number.

Power supply requirements to the VCDO are +/—15V at approximately 40mA per rail and a separate +5V rail at 500mA.

LLED DIGITAL

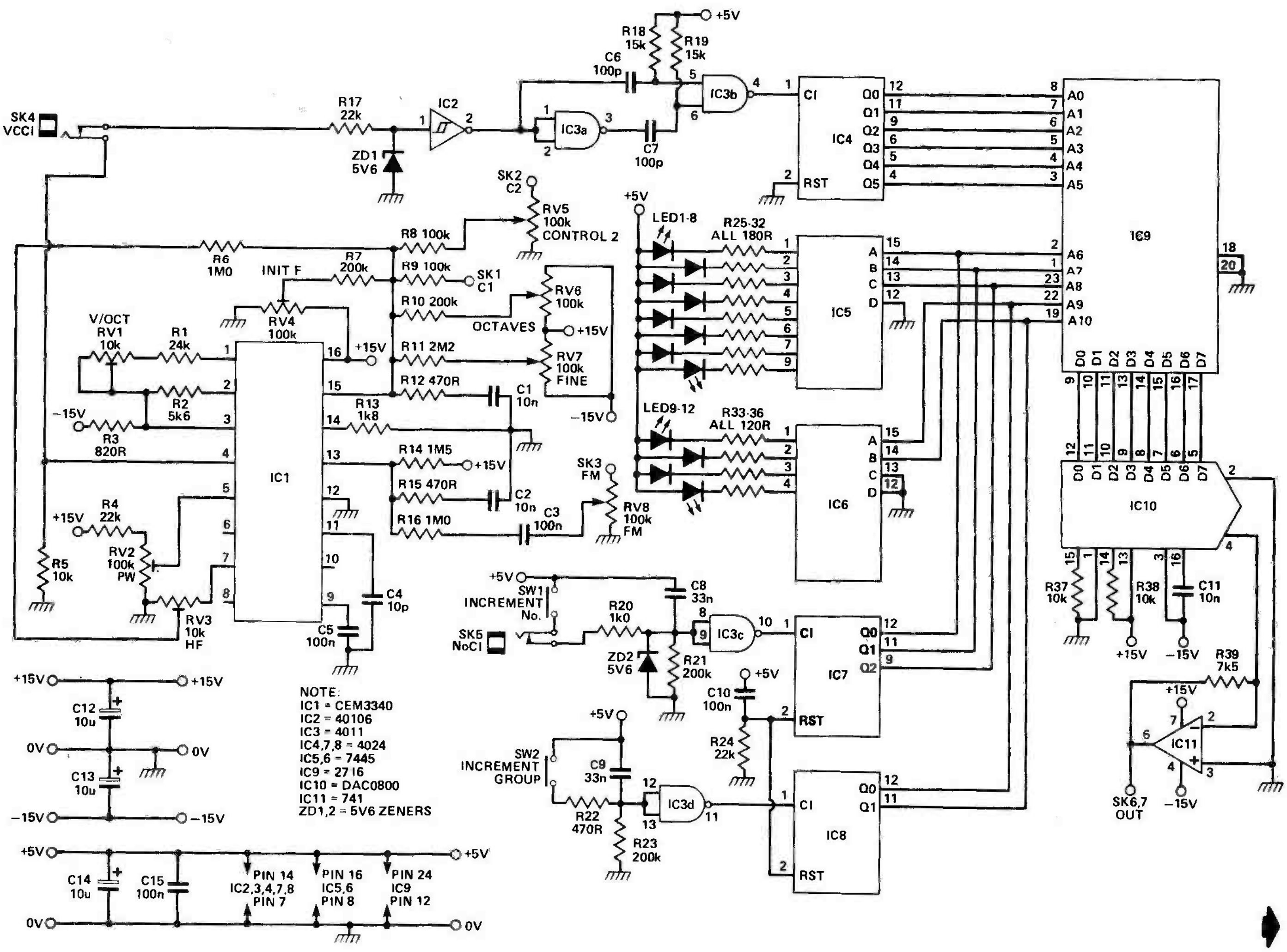


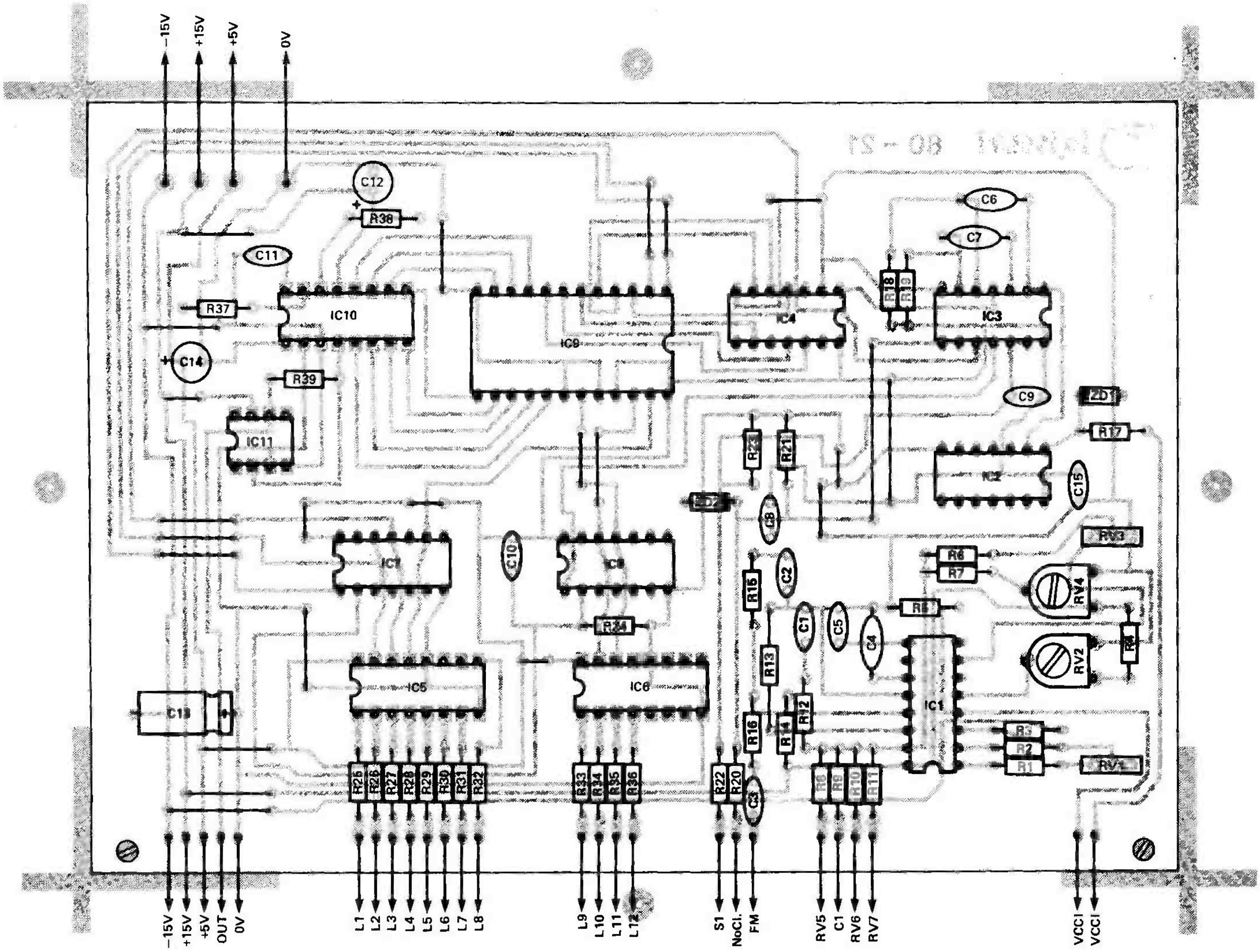
achieved by means of four presets. Coarse and fine frequency controls are available as well as depth controls for exponential and linear modulation (Control 2 and FM).

The pulse output of the 3340 is used as the clock for the waveform generation circuitry. After being cut down to 5V and passed through a Schmitt trigger to improve the shape, it is doubled in frequency by edge differentiation to give an extra octave range. Subsequently, a binary counter is incremented by the pulses and this steps through the 6 least significant address lines of the EPROM. A simple DAC and buffer convert the data outputs into voltages between 0 and +10V.

The remaining circuitry is concerned with the waveform selection. Two push-buttons are debounced and used to clock a pair of binary counters. One controls the 2 most significant address lines of the 2716 and thus splits it into 4 groups designated Groups 1 to 4. The other counter controls a further 3 address lines and thus can select one of eight waveforms. The combination of two counters means that any particular waveform is quickly accessible. Inserting a jack plug into the waveform select (No. CI.) input enables electronic control of the incrementation, opening up the possibility of timbral modulation and sequencing etc.

Indication of the waveform selected is by means of 4 green LEDs and 8 red LEDs, representing wave Group and wave Number respectively. These are driven by BCD-to-decimal converter/drivers which monitor the address lines. A simple RC network ensures that Group 1, Waveform 1 (a sine wave) is selected at switch-on.





PARTS LIST

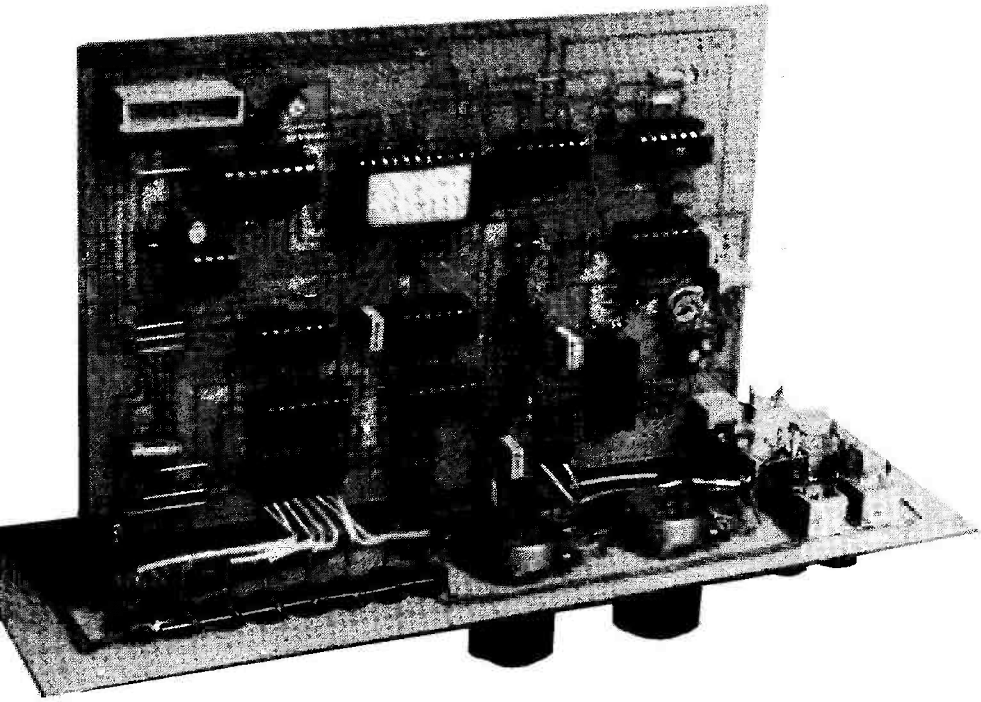
RESISTORS (¼W, 5% unless otherwise stated)		C3,5,10,15	100n min polyester
R1	24k 1%	C4	10p polystyrene
R2	5k6 1%	C6,7	100p polystyrene
R3	820R	C8,9	33n min polyester
R4,17,24	22k	C12,14	10u 35V radial electrolytic
R5	10k	C13	10u 25V axial electrolytic
R6,16	1M0 1%		
R7,10	200k 1%		
R8,9	100k 1%	**SEMICONDUCTORS**	
R11	2M2	IC1	CEM 3340
R12,15,22	470R	IC2	40106
R13	1k8 1%	IC3	4011
R14	1M5 1%	IC4,7,8	4024
R18,19	15k	IC5,6	7445
R20	1k0	IC9	2716
R21,23	200k	IC10	DAC0800
R25-32	180R (8 off)	IC11	741
R33-36	120R (4 off)	LED1-8	5mm red LED
R37,38	10k 1%	LED9-12	5mm green LED
R39	7k5	ZD1,2	5V6 400mW zener
RV1,3	10k min multiturn		
RV2	10k horiz preset	**MISCELLANEOUS**	
RV4	100k horiz Cermet preset		
RV5-8	100k lin rotary pots		
CAPACITORS			
C1,2,11	10n min polyester		

MISCELLANEOUS
SW1,2 momentary push-button switches, SK1-7 3.5mm min jack sockets (SK4,5 with break contacts), DIL Sockets (1 x 8 pin, 5 x 14 pin, 4 x 16 pin, 1 x 24 pin); PCB; wire, solder, knobs, etc.

Construction

There are a number of wire links to be made on the board and these should be inserted first. The rest of the components should then be fitted onto the PCB in order of increasing height (i.e. zener diodes, resistors, IC sockets, presets and capacitors). Note the orientation of the electrolytic capacitors and ensure that all the ICs are inserted as shown on the component overlay as they do not all have the same orientation. The use of a PCB solvent cleaner to remove residual flux is recommended.

Off the board, there are 12 LEDs, four potentiometers, seven jack sockets and two push-button switches to be wired up. These components may be mounted on a front panel as shown or in any other format that individual constructors may wish to use. The actual connections to be made are readily ascertained by using the circuit diagram and component overlay together.



The PCB has a space for a four pin CHIRI-type connector which may be used for the power supply connections rather than hardwiring them to the board.

Calibration

Once construction is complete and the unit has been carefully checked, set all presets to mid-position and power up. Calibration of the VCO circuitry is by way of four presets and is carried out as follows.

Firstly, RV2 is adjusted so that the unit operates over a frequency range from approximately 30Hz up to 30kHz. The correct setting of RV2 is likely to be slightly anti-clockwise from mid-way and can be recognised when the frequency may be increased (e.g. by RV6) without any noticeable sudden jumps.

The two multiturn presets, RV1 and RV3, are used to achieve a precise 1 volt/octave CV to frequency relationship and may be calibrated in a number of ways. The most convenient method is to use a previously calibrated keyboard, but failing this a variable voltage source which can be increased by precisely one volt may be used. Also required is some means of checking the output frequency. The simplest way is to take the output through an amplifier and speaker and to calibrate it by ear, providing the ear concerned has had some musical training. Alternatively, a frequency meter or oscilloscope may be used to visually display the frequency.

Proceed with the calibration as follows: firstly, adjust RV3 so that its wiper is at the earth end of the track. With the oscillator set at some point on the range 150 to 500 Hz (set by RV4/6/7), check that when the control voltage input at C1 is increased by exactly 1V, the output frequency increases by one octave (ie, doubles). If not, adjust RV1 until it is. Repeat this check over the range 150 to 500 Hz.

Next, readjust the initial frequency to about 5kHz. Adjust RV3 until increasing the control voltage at C1 produces the required doubling of frequency.

Once these two adjustments have been done, the unit should track accurately over its entire range. Obviously, it is important that you should be able to measure the increase in the input control voltage accurately.

The final step in the calibration sequence is to adjust RV4 to give a convenient initial frequency when no inputs are connected, which to a large degree is a matter of personal taste. It may, for example, be set to 65.4Hz, which is the lowest note on a four octave C-C keyboard.

In Use

The VCDO kit (see Buylines) is supplied with a pre-programmed EPROM containing the data for 32 64-byte waveforms. Organised in 4 groups, these are as follows:-

1. Starting as a sine wave, this group progresses with the addition of extra harmonics in varying quantities, though none above the sixth are added.
2. The waveforms of this group contain some higher harmonics, and as a result sound brighter.
3. With lots of high harmonics and subdued lower harmonics and fundamental, these waveforms sound characteristically sharp and metallic.
4. This group contains some of the basic waveforms to be found on a conventional VCO (sawtooth, square, triangle, pulse etc.) plus one or two more unusual waveforms.

With suitable filtering and envelope shaping, a wide variety of sounds can be produced, both imitative and innovative. On the imitation side, Groups 1 and 2 can provide some very good church organs as well as xylophone, electric piano etc. Group 3 is ideally suited for bells, gongs, chimes and so on. Group 4 enables you to use the VCDO for conventional synthesis but it also includes some unusual waveforms unavailable on a standard VCO. As might be expected, the use of several VCDOs in a polyphonic system sounds especially impressive.

One or two unusual modes of operation yield some novel effects. Use of a linear FM patch produces sounds similar to those obtained from the recently popularised FM synthesisers. The waveform select input provides the possibility of cycling through any particular group, which can be quite dramatic when free-running or in time with the EG trigger from a sequencer/arpeggiator.

Additionally, the VCDO can operate as a modulation source. However, the output is stepped, and if being used as a frequency modulator for a VCO, for example, some form of filtering should be used in order to "smooth out" the waveform. This would be unnecessary for amplitude modulation.

ETI

BUYLINES

A complete kit for the Voltage Controlled Digital Oscillator including all components noted in the parts list and a suitably programmed EPROM is available from Digisound Limited, 14/16 Queen Street, Blackpool, Lancs. FY1 1PQ for £47.75 inclusive of P&P and VAT. A front panel as featured is available for £3.80 fully inclusive.

TERMS OF BUSINESS

- ★ All prices exclude V.A.T. and carriage. Please add carriage to order total before adding V.A.T.
- ★ Carriage charges extra on all orders as follows:

Components	£0.75
Books/Data/Software	£2.00
Printers, Monitors, Disc drives, etc.	£4.50

- ★ Strictly cash with order or credit card (Access or VISA) only.
- ★ Delivery is normally from stock but please allow up to 28 days.
- ★ Any query or complaint regarding an order should be made in writing within 7 days of receipt of the order. No telephone queries will be entertained.
- ★ Goods incorrectly ordered cannot be accepted for replacement without our prior agreement. Due to high processing costs, a minimum of 15% handling charge may be levied on any returns or cancelled orders.
- ★ We will issue a full immediate refund, if requested, for out of stock items.
- ★ All items carry full manufacturers warranty.
- ★ A V.A.T. receipt will be supplied with all orders.
- ★ Prices quoted are correct at the time of going to press but we reserve the right to effect changes without prior notice.

Hi-Tech

HI-TECH COMPONENTS,

6502 FAMILY

6502	3.50
6502A	4.95
6520	2.25
6520A	2.45
6522	3.40
6522A	4.45
6532	5.45
6532A	5.95
6551	5.95

6800 FAMILY

6800	2.15
6802	2.70
6803C	8.40
6809E	6.25
6809P	6.25
6810	1.70
6821	1.70
6840	3.70
6845	6.45
6850	1.70
6862	3.75
6875	4.95
68B00	4.30
68B09	9.95
68B10	1.88
68B21	3.70
68B40	6.60
68B50	1.58
68B54	7.95

6805 FAMILY

MC1468052P	12.60
MC146818P	7.20
MC146823P	8.80
MC68705KT3	75.00
MC68705R3L	40.00
MC68705U3L	36.00

68000 FAMILY

MC68000G10	50.00
MC68000L8	50.00
MC68008L8	45.00
MC68230L8	19.50
MC68451L8	67.00
MC68901P	75.00

TI 9900 FAMILY

TMS9901-95	4.50
TMS9902	4.50
TMS9918	35.00
TMS9927	11.60
TMS9928	13.00
TMS9929	13.00
TMS9937	6.70
TMS9980	17.20
TMS9995	13.70

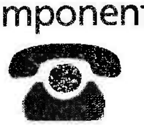
8086 FAMILY

8086	29.50
8088-2	22.50
8216	0.75
8237A-5	23.50
8251A	7.50
8253-5	7.50
8255A-5	7.00
8259A	6.60
8272	35.00
8284A	9.50
80C86	46.65
80C88	46.65
82C52	15.68
82C54	19.04
82C55A2	12.98
82C59A	15.22
82C82	6.26
82C84A	8.94
82C88	16.80

Z80 FAMILY

Z80ACPU	1.99
Z80ACTC	1.99
Z80ADMA	7.95
Z80APIO	1.99
Z80ASIO-0	6.70
Z80ASIO-1	7.95
Z80ASIO-2	7.95
Z80BCPU	5.95
Z80BCTC	5.95
Z80BPIO	5.95
Z80BSIO-0	19.95
Z80BSIO-1	19.95
Z80BSIO-2	19.95
Z80SIO-0	6.00
Z80SIO-1	6.00
Z80SIO-2	6.00

Hi-Tech
components



0379 4131

MEMORIES — EPROM

2532-300ns	4.95
2532-450ns	3.95
2564-300ns	6.95
2708-450ns	3.95
2716-450ns	3.50
2716-3 RAIL	7.95
2732-350ns	4.95
2732-450ns	4.45
2764-200ns	7.95
2764-250ns	5.15
2764-300ns	4.75
27C64-250ns	10.95
27C64-300ns	10.45
27128-250ns	19.00
27128-300ns	16.00

MEMORIES RAM

4116-150ns	1.28
4116-200ns	1.20
4164-150ns	4.45
4416-200ns	4.70
4532-200ns	2.45
4564-150ns	4.45
8118-100ns	1.95
81256-150ns	25.00
8416-200ns	6.00
8416-LP-200ns	6.40
8417-200ns	6.00
8417-LP-200ns	6.40

MEMORIES — RAM *ZERO POWER ZKXB CMOS*

MK48Z02B-150ns	32.00
MK48Z02B-200ns	24.00
MK48Z02B-250ns	23.00

BIPOLAR PROMS

TBP18S030N	1.54
TBP18SA030	1.38
TBP24S10N	2.06
TBP24S41N	6.68
TBP24S81N	5.50
TBP24SA10N	1.40
TBP24SA41N	4.40
TBP28L22N	3.10
TBP28LA22N	4.14
TBP28S166N	19.00
TBP28S42N	4.50
TBP28S46N	4.50
TBP28S86N	5.00
TBP28SA42N	4.50
TBP28SA46N	4.50
TBP28SA86N	8.62
AM27S13PVC	3.74
AM27S19PC	1.92
AM27S191DC	15.00
AM27S25DC	15.00
AM27S29DC	6.46
AM27S35DC	22.00

MEMORIES E2 PROM

X2804AP-300ns	14.95
X2804AP-350ns	13.45
X2804AP-450ns	12.75
X2816AP-300ns	29.95
X2816AP-350ns	25.00
X2816AP-450ns	22.50

LINEAR/INT. DEV.

4702	8.90
HCi-55564-5 (Speech Synthesis)	10.66
AM7910DC	34.88
AM7911DC	34.88
25LS2518PC	3.60
25LS2521PC	3.28
25LS2538PC	2.72
25LS2539PC	2.72
26LS31PC	2.62
26LS32PC	2.62
6402	6.40
75107BN	0.69
75110AN	0.86
75150P	0.86
75154N	1.05
75159	2.30
75160AN	2.60
75161AN	2.82
75162AN	4.08
75172NG	1.96
75173N	1.44
75174	2.82
75175	1.96
75182	0.50
75183	0.50
75188	0.86
75189	0.86
75451BP	0.22
75452BP	0.29
75453BP	0.22
75454BP	0.22
75468N	0.88
75491N	0.31
75492N	0.41
AY-3-1015	3.50
AY-3—1270	9.40
AY-3-8910	6.40
AY-5-3600	8.84
DP8304	4.50
L203	0.99
LF398	3.80
LM301AN	0.30
LM308AN	0.94
LM308N	0.56
LM311N	0.60
LM317MT	0.80
LM317T	1.06
LM319N	3.30
LM324N	0.50
LM337T	1.20
LM339	0.48
LM339N	0.48
LM348N	0.64
LM350T	3.12
LM358N	0.60
LM3900	0.68
LM393N	0.48
LM725CN	3.00
741CP	0.16
LM747CN	0.60
LM748CN	0.30
MC1413P	0.80
MC1416	0.80
MC14411	10.10
MC14412	14.20
MC1458CPI	0.35
MC1495L	6.30
MC1496P	0.70
MC1723P	0.40
MC3242A	6.30
MC3302P	0.48
MC3340P	2.36
MC3357P	1.90
MC3423PL	0.81
MC3441AP	2.90
MC3446AP	2.90
MC3447P	4.30
MC3448A	3.99
MC3470P	6.44
MC3480	7.76
MC3487	1.80
NE555P	0.25
NE556CP	0.65
RO32513-L	9.40
RO32513-U	9.40
TL010-CP	0.44
TL061-CLP	0.28
TL062-CP	0.47
TL064-CN	0.95
TL066-CP	0.28
TL071-CP	0.28
TL072-CP	0.56
TL074-CN	1.10
TL081-CP	0.29
TL082-CP	0.49
TL084-CN	1.02
TL091-CP	0.39
TL092-CP	0.72
TL094-CN	1.30
TL487-CP	0.59
TL489-CP	0.59
TL494-CN	1.99
TL496-CP	0.59
TL507-CP	1.22
ZN450-E	6.08
ZN451-E	7.40
ZN451-KIT	29.95

F.D. CONTROLLERS

8272	35.00
FD1771P	30.00
FD1791	15.50
FD1791-02	11.00
FD1793	18.40
FD1793-02	11.00
FD1795	25.00
FD1797	21.00
WD1691	14.00
WD2143	12.00

DATA CONVERTERS

ZN425E-8	3.76
ZN425J-8	8.00
ZN426E-8	1.90
ZN427E-8	6.68
ZN427J-8	12.50
ZN428E-8	5.10
ZN428J-8	9.70
ZN429E-8	1.60
ZN432CJ-10	20.79
ZN432E-10	13.00
ZN433CJ-10	25.00
ZN434	0.98
ZN435	4.38
ZN436E	1.26
ZN440	55.00
ZN441	46.80
ZN447	7.80
ZN448E	6.66
ZN448J	12.48
ZN449	2.72
ZNA134J	22.50
ZNA234E	9.40

VOLTAGE REF.

ZN404	0.50
ZN423	0.98
ZN458	0.92
ZN458A	0.92
ZN458B	1.12
ZNREF 025	1.90
ZNREF 040	1.90
ZNREF 050	1.90
ZNREF 062	1.90
ZNREF 100	3.05

BUFFERS

81LS96	0.80
81LS97	0.80
81LS98	0.80
8T26A	0.80
8T28	0.80
8T28A	0.80
8T95	0.80
8T97A	0.80
8T98	0.80

OPTOISOLATORS

4N25	0.75
4N26	0.75
4N33	0.90

UHF MODULATORS

UM1111	2.95
UM-1233	3.45

VOLTAGE REG.

7805	0.75
7812	0.75
7815	0.75
78H05SC	7.50
78H12ASC	8.95
78HGASC	9.95
78L05	0.30
78L12	0.30
78L15	0.30
78S40DM	7.50
78S40PC	3.00
7905	0.95
7912	0.95
7915	0.95
LM309K	0.95
LM317K	2.45
LN323K	4.95
LM338K	4.50

FAIRCHILD FAST

74F00PC	0.60
74F04PC	0.60
74F08PC	0.65
74F109PC	0.65
74F11PC	0.52
74F138PC	0.52
74F138PC	1.26
74F139PC	1.26
74F151	1.26
74F153	1.26
74F157	1.30
74F158	1.17
74F161	2.34
74F164	1.68
74F175	1.82
74F181	3.90
74F189	5.10
74F190	3.20
74F191	3.20
74F194	1.68
74F20PC	0.52
74F240	3.16
74F241	2.42
74F243	2.80
74F244	2.96
74F245	6.08
74F251	1.26
74F253	1.26
74F257	1.26
74F258	1.34
74F280	1.74
74F283	1.74
74F32PC	0.52
74F352	1.26
74F353	1.26
74F373	3.16
74F374	3.16
74F379	1.83
74F381	6.62
74F382	4.22
74F398	3.16
74F399	2.70
74F521	2.76
74F533	3.16
74F534	3.16
74F537	6.02
74F538	4.38
74F539	4.38
74F64PC	0.52
74F74PC	0.58
74F86PC	0.77

HIGH SPEED CMOS

74HC00N	0.42
74HC02N	0.42
74HC03N	0.64
74HC04N	0.44
74HC08N	0.42
74HC107N	0.78
74HC109N	0.50
74HC10N	0.64
74HC112N	0.86
74HC113N	0.86
74HC132N	1.28
74HC137N	1.81
74HC138N	1.20
74HC139N	0.78
74HC151N	1.16
74HC153N	0.90
74HC157N	1.02
74HC158N	1.02
74HC160N	0.90
74HC161N	0.90
74HC162N	1.51
74HC163N	1.51
74HC164N	0.95
74HC165N	2.24
74HC173N	1.35
74HC174N	0.80
74HC175N	0.78
74HC194N	1.28
74HC195N	1.28
74HC20N	0.40
74HC237N	1.80
74HC240N	1.38
74HC241N	1.34
74HC242N	2.24
74HC243N	2.24
74HC244N	1.32
74HC251N	1.03
74HC253N	1.03
74HC257N	1.03
74HC266N	0.92
74HC273N	2.24
74HC27N	0.80
74HC280N	3.26
74HC32	0.40
74HC373N	2.40
74HC374N	2.40
74HC393N	1.78
74HC4002	0.64
74HC4017	1.16
74HC4020	1.46
74HC4024	1.20
74HC4040	1.46
74HC4060	1.46
74HC4075	0.64
74HC42N	0.90
74HC4511	2.51
74HC4514	3.76
74HC4538	2.36
74HC4543	3.04
74HC51N	0.64
74HC533N	2.40
74HC534N	2.40
74HC589N	1.72
74HC58N	0.64
74HC595N	1.84
74HC597N	1.72
74HC73N	0.84
74HC74N	0.84
74HC75N	0.92
74HC76N	0.64
74HC85N	2.02
74HC86N	0.80
74HCU04N	0.80

TTL

74LS00	0.17
74LS01	0.17
74LS02	0.17
74LS03	0.17
74LS04	0.25
74LS05	0.25
74LS08	0.17
74LS09	0.25
74LS10	0.17
74LS109	0.27
74LS11	0.17
74LS112	0.54
74LS113	0.27
74LS114	0.44
74LS12	0.25
74LS122	0.42
74LS123	0.53
74LS124	2.30
74LS125	0.49
74LS126	0.29
74LS13	0.17
74LS132	0.73
74LS136	0.46
74LS138	0.77
74LS139	0.77
74LS14	0.28
74LS145	1.23
74LS148	1.50
74LS15	0.25
74LS151	0.36
74LS153	0.36
74LS155	0.24
74LS156	0.77
74LS157	0.24
74LS158	0.62
74LS160	0.80
74LS161	0.34
74LS162	0.80
74LS163	0.80
74LS164	1.10
74LS165	0.61
74LS166	1.95
74LS173	0.63
74LS174	1.30
74LS175	0.96
74LS181	2.09
74LS190	0.98
74LS191	0.75
74LS192	0.36
74LS193	1.10
74LS194	0.28
74LS195	0.78
74LS196	1.10
74LS197	1.10
74LS20	0.17
74LS21	0.17
74LS22	0.17
74LS221	0.62
74LS240	1.40
74LS241	0.48
74LS242	1.36
74LS243	1.36
74LS244	1.40
74LS245	1.95
74LS248	0.39
74LS249	1.16
74LS251	0.78
74LS253	0.25
74LS257	0.78
74LS258	0.27
74LS259	0.42
74LS26	0.30
74LS261	2.60
74LS266	0.19
74LS27	0.17
74LS273	1.35
74LS279	0.77
74LS28	0.17
74LS283	1.00
74LS290	0.29
74LS293	0.29
74LS30	0.17
74LS32	0.25
74LS33	0.17
74LS365	0.33
74LS366	0.33
74LS367	0.34
74LS368	0.36
74LS37	0.17
74LS373	1.50
74LS374	0.52
74LS375	0.26
74LS377	0.46
74LS378	1.22
74LS379	1.50
74LS38	0.25
74LS386	0.50
74LS390	1.10
74LS393	0.52
74LS40	0.25
74LS42	0.25
74LS47	0.30
74LS48	0.35
74LS49	0.34
74LS51	0.17
74LS54	0.17
74LS55	0.17
74LS670	2.30
74LS73	0.30
74LS74	0.35
74LS75	0.28
74LS76	0.17
74LS78	0.19
74LS83	0.28
74LS85	0.39
74LS86	0.42
74LS90	0.21
74LS91	1.30
74LS92	0.22
74LS93	0.21
74LS95	0.77

CMOS 4000 Series

4000	0.16
4001	0.15
4002	0.16
4006	0.55
4007	0.16
4008	0.50
4009	0.25
4010	0.25
4011	0.19
4012	0.16
4013	0.29
4014	0.40
4015	0.50
4016	0.29
4017	0.40
4018	0.40
4019	0.30
4020	0.41
4021	0.56
4022	0.42
4023	0.23
4024	0.40
4025	0.16
4026	0.74
4027	0.52
4028	0.34
4031	0.93
4033	2.40
4034	1.00
4035	0.54
4040	0.41
4041	0.36
4042	0.40
4043	0.41
4044	0.43
4045	2.00
4046	0.55
4047	0.50
4048	0.40
4049	0.50
4050	0.29
4051	0.40
4052	0.48
4053	0.50
4054	1.30
4055	0.72
4060	0.50
4063	0.60
4066	0.50
4068	0.16
4069	0.23
4070	0.23
4071	0.23
4072	0.23
4073	0.23
4075	0.46
4076	0.48
4077	0.23
4078	0.25
4081	0.23
4082	0.25
4085	0.66
4086	0.40
4093	0.23
4099	0.50
4502	0.55
4507	0.47
4508	0.96
4510	0.45
4511	0.50
4512	0.40
4514	1.00
4515	1.84
4516	0.45
4518	0.40
4519	0.25
4520	0.64
4521	1.32
4522	0.84
4526	0.52
4527	0.52
4528	0.48
4532	0.68
4541	0.82
4543	0.60
4553	2.00
4555	0.36
4556	0.44
4585	0.48

CRYSTALS

A111B	1MHz	4.50
A112A	1.008MHz	2.70
A113A	1.8432MHz	3.50
A116A	2.4576MHz	2.00
A120B	4MHz	1.25
A132A	6MHz	1.30
A140A	8MHz	1.25
A169A	3.6864MHz	2.00
A173A	9.8304MHz	2.75
A182A	19.6608MHz	2.50

DIL SKTS TIN

		1+	100+
07070802	8 PIN	0.07	0.05
07071402	14 PIN	0.09	0.07
07071602	16 PIN	0.09	0.07
07071802	18 PIN	0.15	0.10
07072002	20 PIN	0.19	0.14
07072202	22 PIN	0.21	0.15
07072402	24 PIN	0.24	0.16
07072802	28 PIN	0.26	0.17
07074002	40 PIN	0.29	0.18

DIL SKTS GOLD

06060802	8 PIN	0.16
06061402	14 PIN	0.20
06061602	16 PIN	0.21
06061802	18 PIN	0.22
06062002	20 PIN	0.28
06062202	22 PIN	0.32
06062402	24 PIN	0.42
06062802	28 PIN	0.46
06064002	40 PIN	0.66

DIL SKTS W/WRAP TURNED PIN

9090802	8 PIN	0.36
9091402	14 PIN	0.75
9091602	16 PIN	0.85
9091802	18 PIN	0.96
9092002	20 PIN	1.08
9092202	22 PIN	1.18
9092402	24 PIN	1.28
9092802	28 PIN	1.50
9094002	40 PIN	1.70

ZIF SOCKETS

08082402	24 PIN	5.70
08082802	28 PIN	6.90
08084002	40 PIN	8.25

components

GILRAY ROAD, DISS, NORFOLK. TEL: 0379 4131

INSULATION DISPLACEMENT CONNECTOR SYSTEM

HEADERS

	SHROUDED 90°	OPEN 90°	OPEN — STRAIGHT PINS
10 way	0.86	0.65	0.47
14 way	1.22	0.83	0.59
16 way	1.34	0.92	0.65
20 way	1.36	1.13	0.77
26 way	1.70	1.40	0.95
34 way	2.04	1.78	1.19
40 way	2.28	2.07	1.37
50 way	2.70	2.54	1.67
60 way	3.20	3.02	1.96

SOCKETS

10 way	0.88
14 way	1.06
16 way	1.16
20 way	1.38
26 way	1.66
34 way	1.94
40 way	2.08
50 way	2.78
60 way	3.34

CARD EDGE

10 way	1.84
20 way	3.14
26 way	3.80
34 way	4.90
40 way	5.52
50 way	6.68
60 way	8.06

DIP PLUGS

14 way	0.92
16 way	1.06
24 way	1.60
40 way	2.40

TRANS. CONNS.

10 way	0.86
16 way	1.17
20 way	1.37
26 way	1.67
34 way	1.87
40 way	2.23

D-TYPE SOCKETS

9 way	1.47
15 way	2.02
25 way	2.90
37 way	3.97

D-TYPE PLUGS

9 way	1.38
15 way	1.85
25 way	2.52
37 way	3.34

CABLE ASSEMBLIES

IDC JUMPERS SINGLE ENDED

36" cable	IDC socket
10 way	1.72
14 way	2.07
16 way	2.22
20 way	3.14
26 way	3.75
34 way	3.98
40 way	4.23
50 way	5.36
60 way	6.36

DIP JUMPERS

Single Ended

	— 24" cable
14 pin	1.73
16 pin	1.90
24 pin	2.73
40 pin	3.96

Double Ended

	6" cable	12" cable	18" cable
14	2.74	2.84	2.94
16	3.03	3.14	3.25
24	4.18	4.36	4.55
40	5.89	6.18	6.47

DISC DRIVE CONNECTING CABLES

34 way card edge to 34 way card edge 1M	11.30
34 way card edge to 2 × 34 way card edge 1.5M	18.00
34 way card edge to 34 way IDC SKT (BBC) 1M	8.50
34 way card edge to 2 × 34 way IDC KT (BBC) 1.5M	14.50
BBC Power Cable — Single Drive	3.50
BBC Power Cable — Dual Drive	4.75

RIBBON CABLE (PRICED PER FOOT)

	GREY	RAINBOW
9	0.16	0.25
10	0.16	0.25
14	0.21	0.35
15	0.22	0.37
16	0.23	0.39
20	0.28	0.48
25	0.34	0.60
26	0.35	0.62
34	0.45	0.80
40	0.52	0.92
50	0.64	1.14
60	0.76	1.35

BBC MICRO CONNECTORS

DIN PLUG 7 PIN	0.40
DIN PLUG 6 PIN	0.40
DIN PLUG 5 PIN 180°	0.40
DIN PLUG 5 PIN DOMINOE	0.40
POWER PLUG (36" CABLE)	3.00
ANALOGUE INPUT PLUG	2.25
5 WAY DIN SKT 180°	0.90
5 WAY DIN SKT DOMINOE	0.90
6 WAY DIN SKT	0.90
7 WAY DIN SKT	0.90
15 WAY DIN SKT	2.15

Connecting cables for personal computers

A comprehensive range of high quality interconnecting cables for popular micro computers. All cables utilise high quality connectors and are individually tested to ensure trouble free use.

Part number	Description	Computer	
Video cables			
CON100	Phono plug to phono plug (2M)		1.20
CON101	Phono plug to BNC plug (2M)		2.95
CON102	BNC plug to BNC plug (2M)		3.95
CON107	6 pin DIN to open end (1M)	BBC	1.05
CON108	6 pin DIN to 6 pin DIN (1M)	BBC	1.50
CON119	Phono plug to coax plug		1.35
CON160	DIN plug to 2 phono plugs	Dragon	1.20

Cassette recorder cables

CON109	7 pin DIN to open end	BBC	1.25
CON110	7 pin DIN to 2 × 3.5mm + 1 × 2.5mm J/plug	BBC	2.50
CON111	7 pin DIN to 5 pin DIN + 2.5mm J/plug	BBC	2.50
CON118	5 pin DIN to 2 × 3.5mm J/plugs	Spectrum/ZX	2.50
CON117	5 pin DIN to 2 × 3.5mm + 1 × 2.5mm J/plug	Dragon	2.50

Parallel printer cables

CON130	36 way plug to 36 way plug (2M)	Sirius/Apricot	18.00
CON131	36 way plug to 36 way plug (5M)	Sirius/Apricot	26.50
CON132	36 way plug to 36 way socket (2M)		18.00
CON133	36 way plug to 36 way socket (5M)		26.50
CON144	36 way plug to 25 way male D type (2M)	IBM/TI PC	19.00
CON145	36 way plug to 25 way male D type (5M)	IBM/TI PC	27.50
CON134	36 way plug to 25 way male D type (2M)	RML/Apple	19.00
CON135	36 way plug to 25 way Male D type (5M)	RML/Apple	27.50
CON142	36 way plug to 20 way IDC socket (2M)	Dragon	13.95
CON139	36 way plug to 26 way IDC socket (2M)	BBC	9.95
CON140	36 way plug to 26 way IDC socket (5M)	BBC	22.95
CON141	36 way plug to 34 way card edge (2M)	TRS80 Lev 1	18.50
CON143	36 way plug to 34 way IDC socket (2M)	TRS80 Lev.2/ Memotech	10.95

RS232 Cables

CON106	25 way male D type to 5 pin DIN	BBC	5.85
CON128	'Universal' RS232 cable (pins 1-8, 20 connected and 20 jumpered as required) 2M		15.95
CON164	'Universal' RS232 cable as above but 5M		20.95
CON120	25 way male to male 1-25 connected (2M)		16.95
CON121	25 way male to male 1-25 connected (5M)		22.50
CON122	25 way male to male 1-25 connected (10M)		32.50
CON123	25 way male to male 1-25 connected (30M)		68.00
CON124	25 way male to female 1-25 connected (2M)		15.45
CON125	25 way male to female 1-25 connected (5M)		21.00
CON126	25 way male to female 1-25 connected (10M)		31.00
CON127	25 way male to female 1-25 connected (30M)		66.50
CON129	25 way male to 9 way male	Spectrum	15.95
CON162	25 way male to 9 way male	Mackintosh	15.95
CON163	25 way male to 5 pin DIN	RML 480Z	14.95

PART NO.	DESCRIPTION	MAIL ORDER PRICE
BBC MICROS AND ACCESSORIES		
ANB01	BBC Model B Micro	£325.00
ANB02	BBC Model B Micro with Econet I/F	£385.00
ANB03	BBC Model B Micro with Disc I/F	£406.00
ANB04	BBC Model B Micro with Disc & Econet	£445.00
ANB21	DNFS ROM	£17.91
ANB23	Disc Interface Kit (Excl DNFS ROM)	£84.00
ANB14	Speech Interface	£40.00
ANK01	IEEE488 Interface Adaptor	£283.00
ANB22	Econet I/F Kits	£35.00
BBC 45	2 BBC Joysticks	£8.00
STAND	Monitor Stand	£7.50
SRE1	Sideways ROM Expansion Board for BBC Micro	£25.95
BBC DISC DRIVES		
HC1	Single 100k 40 track single sided	£75.00
HC1S	Single 100k (expandable to dual) 40 track	£90.00
HC1D	Dual (2 × 100k) 40 track single sided	£160.00
BBC44	Single 400k 80 track double sided	£156.50
BBC44S	Single 400k (expandable to dual) 40/80 track switchable double sided	£180.00
BBC44SW	Single 400k 40/80 track switchable double sided	£159.00
BBC44D	Dual (2 × 400k) 40/80 track switchable double sided	£310.00
MECHANISMS		
	100k single sided Alps	£70.00
	400k double sided Epson	£140.00
FLOPPY DISCS		
MD-1C/B	Nashua single sided, single density 40 track (10 discs)	£12.00
MD-1DC/B	Nashua single sided, double density 40 track (10 discs)	£13.00
MD-2DC/B	Nashua double sided, double density 40 track (10 discs)	£15.50
MD-2FC/B	Nashua double sided, quad density 80 track (10 discs)	£17.85
SPECIAL OFFER		
BBC40TD	BASF double sided, double density 40 track (10 discs)	£14.00
DISC STORAGE BOXES		
MDT25/3	3½" Flip 'N' file Micro disc box (cap. 25)	£7.75
DT25/5	5¼" Flip 'N' file lockable disc box (cap. 25)	£18.77
DT60/5	5¼" Standard lockable disc box (cap 60)	£10.65
MONITORS		
9MON	9 inch green screen high resolution NEC high quality monitor	£125.00
12MON	12 inch green screen high resolution NEC high quality monitor	£135.00
1431	Microvitec 14" RGB colour monitor	£175.00
1441	Microvitec 14" RGB colour monitor high resolution	£410.00
1451	Microvitec 14" RGB colour monitor medium resolution	£295.00
1431/AP/MS	Microvitec 1431 PAL & RGB inputs and sound facility	£225.00
EPSON COMPUTERS AND ACCESSORIES		
PX-8	Epson portable computer (incl. CP/M and s/w) 64k	£798.00
PX-8/120	120k RAM	£998.00
CX-21	Acoustic coupler	£160.00
PF/10	Disc drive for PX-8	£360.00
P40	Thermal printer for PX-8 and HX-20	£86.91
HX-20	Epson portable computer	£411.00
MATRIX PRINTERS		
RX80	Epson RX80 100cps matrix printer	£204.00
RX80F/T	Epson RX80F/T 100 cps matrix printer friction or tractor feed	£231.00
FX80	Epson FX80 150cps matrix printer	£328.50
MT80SP	Mannesmann Tally MT80 matrix printer friction or tractor feed with film ribbon and tear off facility	£217.00
LETTER QUALITY PRINTERS		
HR5	Brother HR5 Thermal printer A/C mains or battery	£130.00
HR15	Brother HR15 Daisy wheel printer (13cps)	£326.00
HR25	Brother HR25 Daisy wheel printer (23cps)	£550.00
UCHIDA	Uchida DWX305 Daisy wheel printer (20cps)	£227.00
PRINTER SUPPLIES		
11241P160	11×9½ 1 part plain listing paper (2,000)	£12.56
11241P2CI	11×9½ 2 part (otc) plain listing paper (1,000)	£15.93
11241P3CI	11×9½ 3 part (otc) plain listing paper (700)	£17.86
11370R160	11×14½ 1 part ruled listing paper (2,000)	£16.20
11370R2NC	11×14½ 2 part (ncr) ruled listing paper (1,000)	£22.50
11370R2CI	11×14½ 2 part (otc) ruled listing paper (1,000)	£15.00
12235P160S	12×9½ 1 part plain listing paper with side perfs (2,000)	£12.00
HR1R	Brother HR1 ribbon	£2.20
RIB119	Diablo Hytype II Multistrike film ribbon	£1.75
GP205	Diablo Hytype II fabric ribbon	£2.50
MX80	Epson MX80, RX80, FX80, fabric ribbon	£3.00
MT80	Mannesmann Tally MT80 film ribbon	£6.50
RIB117	Uchida DWX305 multistrike film ribbon	£2.75
HR5R	Brother HR5 ribbon	£2.20
HR15R	Brother HR15 multistrike ribbon	£4.00
HR25R	Brother HR25 multistrike ribbon	£4.00
	Brother daisy wheels	£14.00
	Uchida/Qume daisywheels	£4.00
LAB089361C	3½×1 7/16 Labels — 1 wide (8,000)	£20.00
LAB089361S	3½ 1 7/16 Labels — 1 wide (2,000)	£13.00
LAB070363F	2¾ 1 7/16 Labels — 3 wide (1/10") (2,000)	£8.00

THE ETI "SONNETI" COMBO

This month sees the departure of ETI Project Editor Phil Walker, who will shortly be returning to the electronics industry complete with his undisputed talents and indecipherable puns. But not before he's told us about the Sonneti, a combo unit guaranteed to turn anybody's farewell performance into the start of a new career.

The ETI Sonneti is an instrument amplifier suitable for use with lead guitar, bass guitar or keyboards. It doesn't have too many frills but it is capable of turning in a good performance without unnecessary fuss. The pre-amplifier and power supply have been designed to permit the simple addition of an echo unit or similar effect, and whilst distortion-type effects are not specifically catered for there is no reason why they should not be included if desired.

The aim was to keep things as simple as possible, and to this end we have used a commercially-available combo cabinet and a ready-built power amplifier module. There is nothing to stop ambitious constructors building their own cabinets, but it was not felt to be worthwhile designing and building a power amplifier for so basic an application.

We used a Crimson Elektrik CE1008 module, mostly because we happened to have one lying around, but there are many other modules on the market which would be suitable. The CE1008 is capable of 100W into an 8 ohm load when fed from a ±45V supply and quite adequate power for the present purpose when supplied with ±25V. The output power can be increased by raising the supply voltage but the pre-amp regulator arrangements will have to be modified if more than ±35V is used.

The power supply is a straightforward centre-tapped transformer feeding a bridge rectifier to give the split-rail supply. The transformer secondary voltage is 18-0-18 to give the ±25V required and with a rating of 80VA is under very little strain. For 100W you would need 30-0-30V at around 120 to 150VA and C21 and 22 would have to be 63V types. You would also need pre-regulators for the pre-amp power supply to drop it down to about ±30V — a simple resistor, transistor and zener diode arrangement would do.

The pre-amp section is

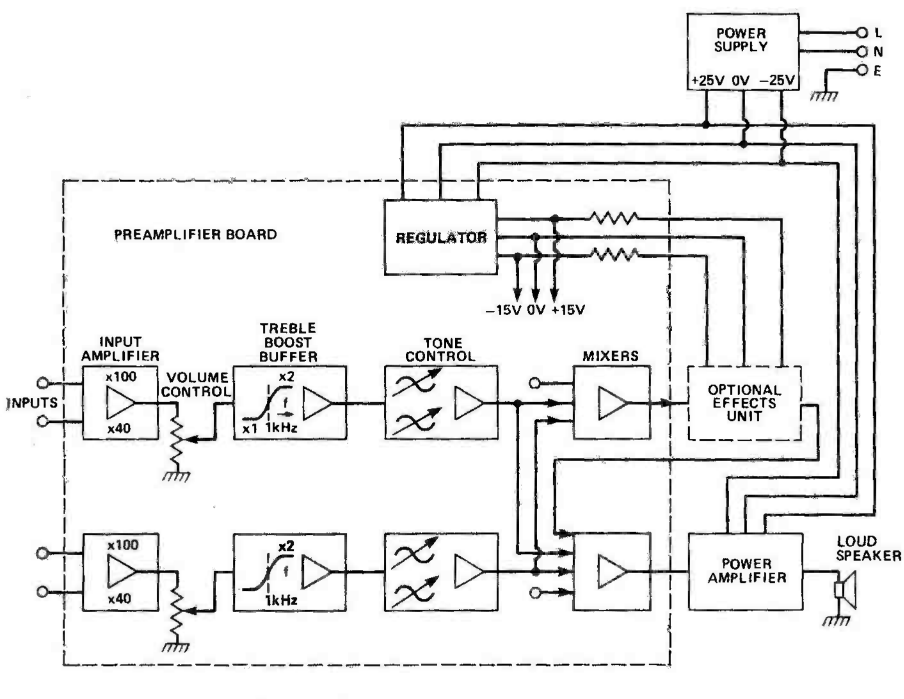


Fig.1 Block diagram of the combo unit.

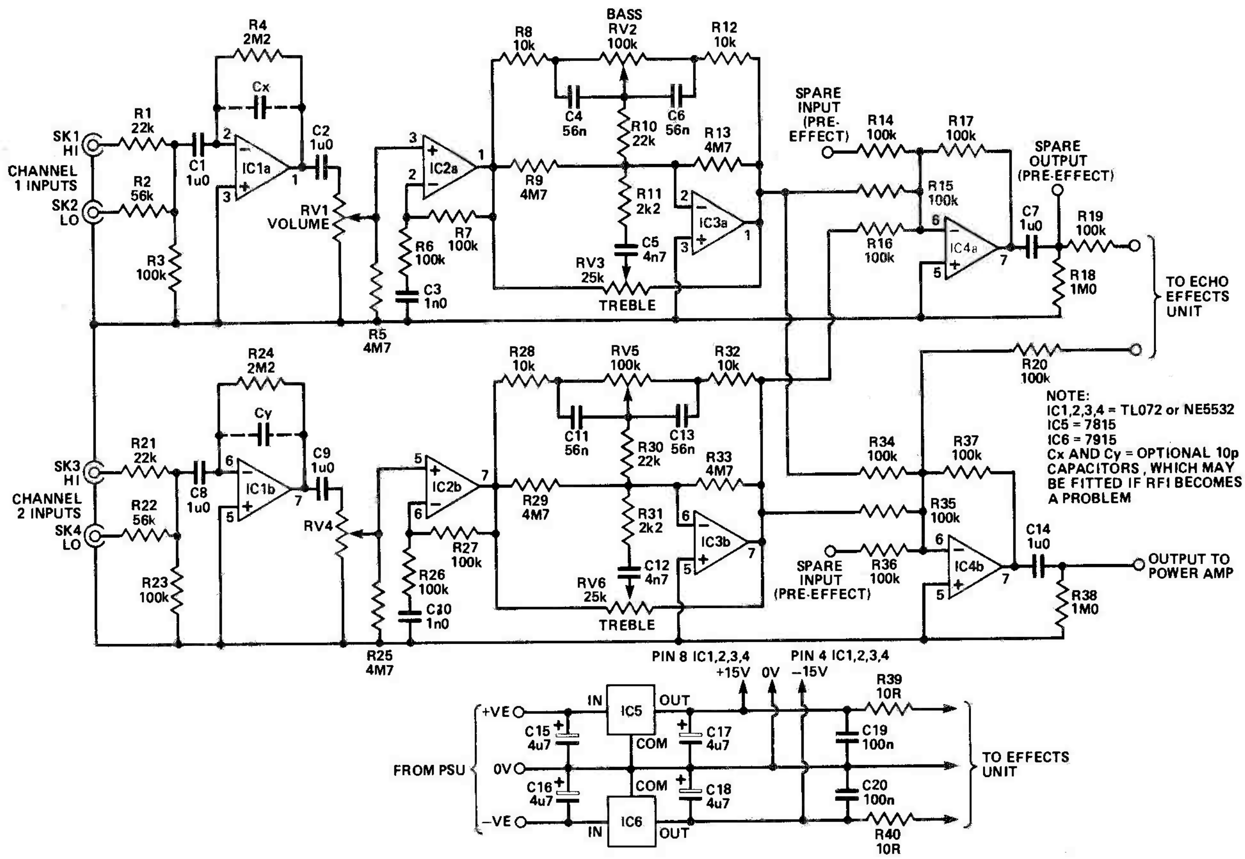


Fig.2 Circuit diagram of the preamplifiers and regulators.

designed as two identical channels each with hi and lo level inputs and volume, treble and bass controls. Both channels feed into the two mixer stages, one of which is designed to feed an echo or similar effects unit while the other drives the power amplifier input. This latter stage also has an input for a return signal from the optional effects unit, a configuration which reduces the possibility of electrical feedback through the effects unit. The preamplifiers are designed to give sensitivities of around 4 and 10mV on the hi and lo inputs respectively.

When this project was first assembled and tested using the author's guitar the sound produced was very muddy and "plonky". The guitar was known to produce a very wide range of sounds when used with commercial amplifiers, so the frequency response of the whole unit was tested and found to be flat to about 40kHz. It was decided to change the circuitry around IC2 to give a boost to the higher frequencies. Some component values in the tone control section were adjusted to improve the treble and expand its control range, and the final circuit gives a very good sound.

HOW IT WORKS

The preamplifier is the only part of this project which needs much explanation. It consists of two virtually identical channels. The inputs are connected via R1 and 2 and C1 to the input of IC1a. The values of R1 and R2 are such that the R1 input is about 2.5 times more sensitive than the other. The value of R4 connected as a negative feedback element round IC1a sets its gain to 100 from R1 input and 40 from the R2 input.

The output from this stage is coupled via C2 to the volume control RV1. From here the signal passes to IC2a which is configured such that it has a gain of 1 at low frequencies and 2 at high frequencies, the change in gain occurring between about 800 and 1600Hz.

The output from IC2a is a convenient low impedance drive for the tone control stage which follows. This is a familiar feedback configuration which is fairly simple but gives adequate results. Extra resistors have been incorporated in this and the previous stages so that the inputs to the op-amps will always have a DC path for their bias current should a potentiometer wiper become open circuit. This should prevent any alarming noises resulting from dirty contacts. The resistor R3 at the input prevents static build-up.

The outputs from the tone control stage of each channel are applied to the inputs of two mixer stages. The output of one of these is intended to drive an echo or similar special effect circuit while the output of the other mixer drives the power amplifier. This second mixer has an extra input to take the return signal from the effects unit.

The power amplifier can be considered as a single, rather expensive, component. All that needs to be done is to supply suitable voltages and signal input and take the output to a loudspeaker. The specified module is capable of supplying 100W into an 8 ohm load but in this application the maximum output is somewhat less since the power supply voltage is only about 50 volts in total. The resulting output will be around 30 to 35 watts but could be raised by using a higher voltage transformer with appropriate modifications to associated components.

The power supply is a straightforward split rail configuration which gives about 25-0-25V from the 18-0-18V transformer. This is smoothed by C21 and 22 and applied to the power amplifier module. Integrated regulators IC5 and IC6 reduce this to the ±15V required by the preamplifier and small capacitors connected across the supplies ensure stability and reduce the impedance at high frequencies. The regulated supply is made available to the effects card via the same connector which carries the effects input and output, and the 10R resistors R39 and R40 reduce the level of any noise produced on the card.

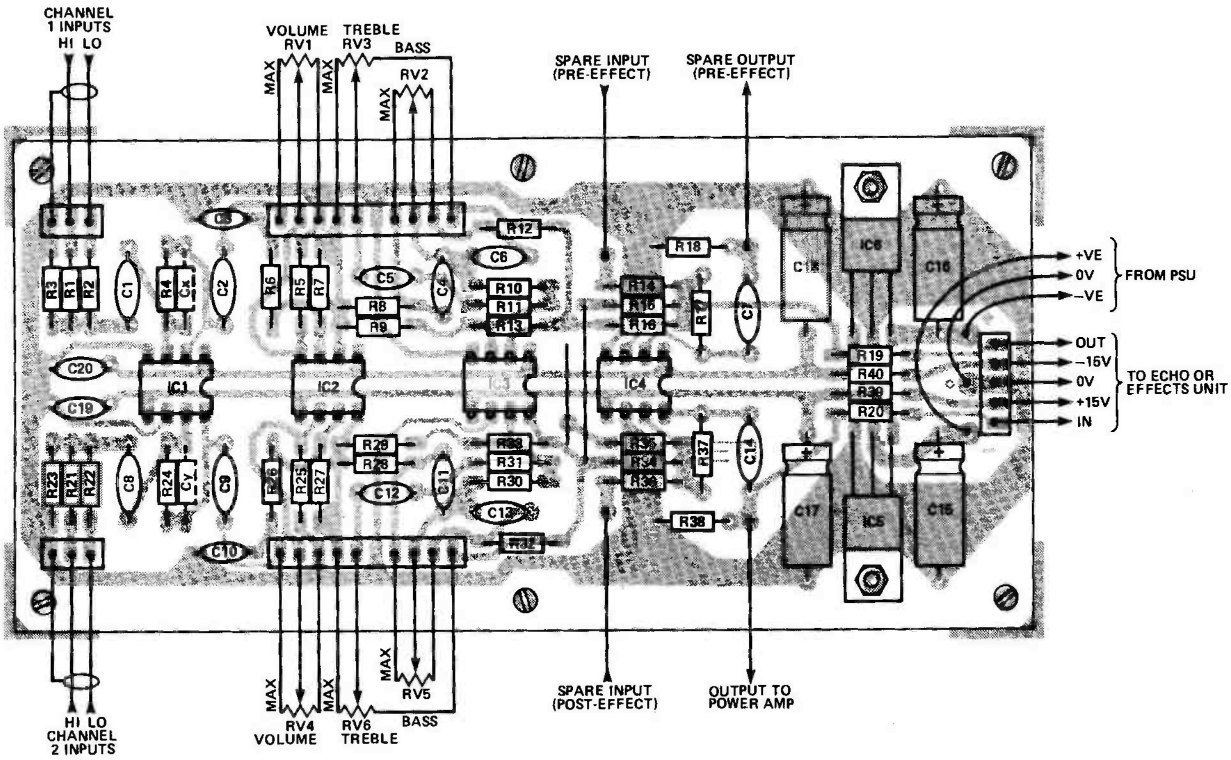
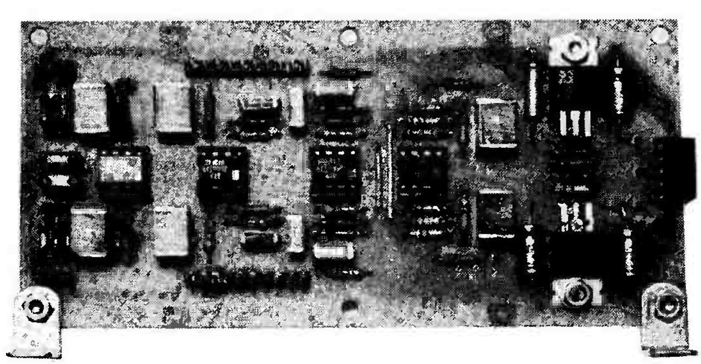


Fig.3 Component overlay of the preamplifier and regulator board.

PARTS LIST

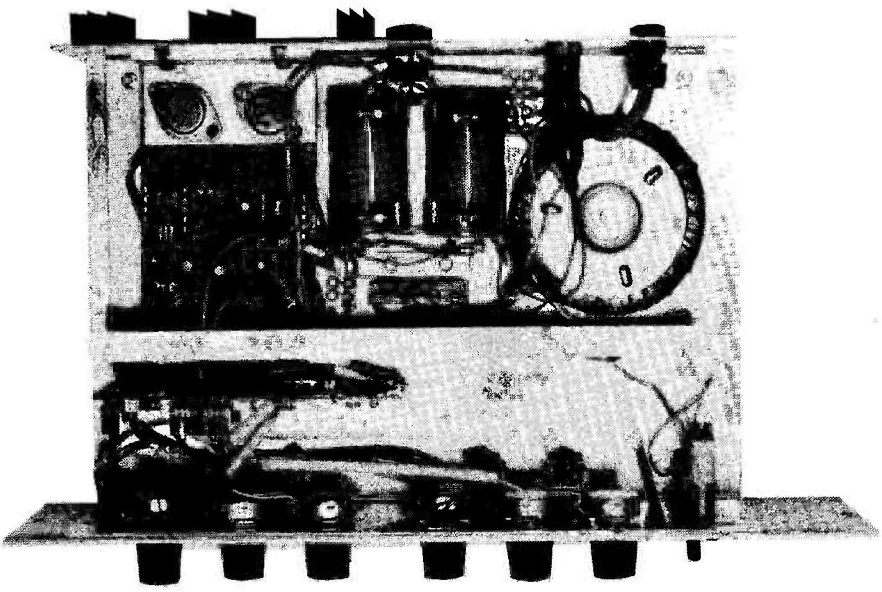
RESISTORS (¼W carbon film 5%)	
R1,10,21,30	22k
R2,22	56k
R3,6,7,14,15,16,17, 20,23,26,27,34,35, 36,37	100k
R4,24	2M2
R5,9,13,25,29,33	4M7
R8,12,28,32	10k
R11,31	2k2
R18,38	1M0
R19	100R
R39,40	10R
RV1,4	100k logarithmic potentiometer
RV2,5	100k linear potentiometer
RV3,6	25k linear potentiometer
CAPACITORS (layer type PCB mount polyester unless stated)	
C1,2,7,8,9,14	1µ0 100V
C3,10	1n0 250V
C4,6,11,13	56n 250V
C5,12	4n7 250V
C15,16	4µ7 63V axial electrolytic
C17,18	4µ7 25V axial electrolytic
C19,20	100n 100V
C21,22	4700µ 40V can electrolytic
SEMICONDUCTORS	
IC1-4	TL072 or NE5532 — see text
IC5	7815
IC6	7915
BR1	200V 6A bridge rectifier
MISCELLANEOUS	
FS1	1A anti-surge 20mm fuse and holder
LP1	240V neon indicator, panel-mounting
LS1	8R, 85W, 12" McKenzie C1285GP or similar
SK1-4	¼" chassis-mounting jack sockets
SW1	DPST mains toggle switch
T1	0-18 + 0-18V, 80VA toroidal transformer

PCB; Crimson Elektrik CE1008 amplifier module or similar; two heatsinks, Maplin type FL42V or equivalent; PCB connectors if desired — 2 × 3 way, 2 × 10 way and 1 × 5 way plug and socket pairs; 4 × 8 pin DIL sockets; six knobs; Newrad N819 or similar aluminium case; sheet aluminium for sub-chassis/screen, preamplifier screen and dummy front panel; ready-built combo cabinet or wood, cloth, etc to build; clamps for C21 and 22; strain relief bush for mains cable; two grommets for wires passing through internal screen; grommet for loudspeaker cable or ¼" jack socket and plug; brackets, nuts, bolts, solder tags, wire, etc.



Construction

The preamplifier PCB should be assembled first. The board has been designed so that PCB-type connectors can be used for the wiring to the potentiometers, input sockets and the optional effects card, and if you plan to use this system you should begin construction by soldering the appropriate connector halves to the PCB.



Plugs should be used for the potentiometer and input socket connections but the wiring to the effects card includes the supply rails and a socket should therefore be used so that there is no risk of bare pins being accidentally short-circuited. If you do not wish to use connectors simply poke the wires through the holes and solder in the usual way when the rest of the board has been assembled. If you intend using sockets for the ICs these should also be soldered into position before the rest of the components are installed.

Continue assembly by installing the two wire links and the solder pins and then the resistors and capacitors, taking particular care with the electrolytic capacitors C15-18 which may be damaged if they are not wired the correct way around. Pads are provided on the PCB for two 10p capacitors, Cx and Cy, in the feedback loops around IC1a and b. These will reduce the risk of radio frequency interference (RFI) and need only be installed if you have good reason to expect RFI problems. It is easy enough to add them later if you encounter problems when the unit is finished.

The last items to be soldered into position are the ICs. We used TL072 dual op-amps for ICs 1-4 but the more expensive NE5532 could be used if you require lower noise. A reasonable compromise would be to use an NE5532 in the IC1 position and TL072s in the other positions. If you use sockets it will be easy to swop ICs over to compare the performance of different types.

The amplifier is built into an aluminium box which is a little smaller than the slot at the top of the combo cabinet. An enlarged front panel, cut to suit the recess on the front of the cabinet, is attached to the amplifier box by means of the potentiometer securing nuts, the jack socket bushes and two small screws. The complete unit is then held in place by two self-tapping screws which pass through either end of the panel and into the wooden uprights of the cabinet.

The internal layout of the amplifier is shown in Fig. 4. The power supply and the power amplifier module are mounted on a sub-chassis which is bent up at the front so as to form a screen between these components and the preamplifier. The advantages of using the sub-chassis are that it reduces the number of holes required in the bottom of the case and that this section can be built and wired up before being bolted into place. If you can't find anything that will serve as both sub-chassis and screen you could simply mount the components onto the bottom of the case and then use a piece of aluminium supported on brackets as the screen.

The preamplifier board is mounted vertically on two right-angle brackets immediately behind the front panel. This allows the input sockets and control potentiometers to be connected up using very short lengths of cable. By positioning the preamplifier board to one side, sufficient space is left to accommodate an effects board at a later date. A second screen is placed between the preamplifier and input circuitry and the mains switch and indicator at the far end of the panel. A small piece of thin aluminium is sufficient, bent at a right angle and held in place by the toggle switch.

Two heatsinks are bolted onto the rear of the case in line with the aluminium bracket on the power amplifier module. If the Newrad NB19 case is used as in our prototype, the heatsinks will project slightly beyond the back of the cabinet when the amplifier is slotted into place. This helps ensure a good flow of air for cooling but might be considered undesirable. Using a slightly shallower box will reduce or remove the projection, and if you can find one made from heavy gauge aluminium or bend one up yourself you might find that you don't need the heatsinks anyway. Whichever method you use, don't forget to smear some heatsink compound between the surfaces before assembly.

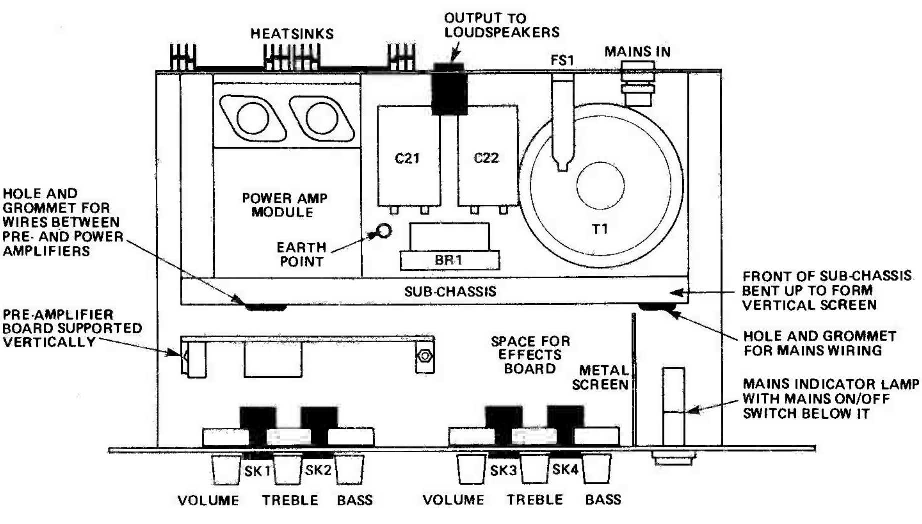


Fig.4 Layout of the major components within the amplifier case.

The wiring should present no problems provided the arrangement shown in Fig. 5 is followed closely. All of the earths are returned to one point so as to prevent the formation of hum loops, and care should be taken to ensure that no earth connection is inadvertently made elsewhere. The ¼" jack sockets which are generally available have no connection between the earth tag and the mounting bush, but if for any reason you decide to use different sockets you should make sure that they are insulated from the panel.

Twin screened cable should be used for the connections to the volume controls and the input sockets, and single screened cable for the signal connection between the pre- and power amplifiers. The rest of the wiring, including the tone control connections, can all be made using un-screened wire. The short connections between the reservoir capacitors, the bridge rectifier and the earthing tag and the link between the earth connections on each pair of input sockets can all be made using tinned copper wire of a suitably heavy gauge.

The leads are brought out from the loudspeaker enclosure through a small hole in the bottom of the amplifier space. Rather than attach the leads permanently to the amplifier, we left a length hanging from the back of the cabinet, fitted it with a jack plug and provided a corresponding socket on the back of the amplifier. This allows the amplifier to be removed easily from the combo and used on its own.

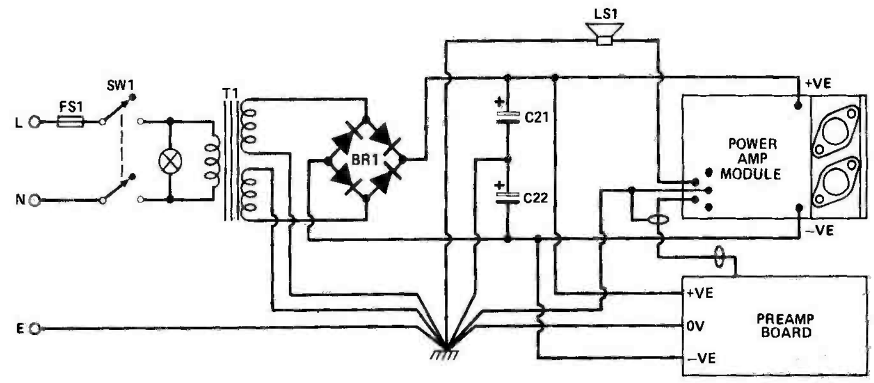
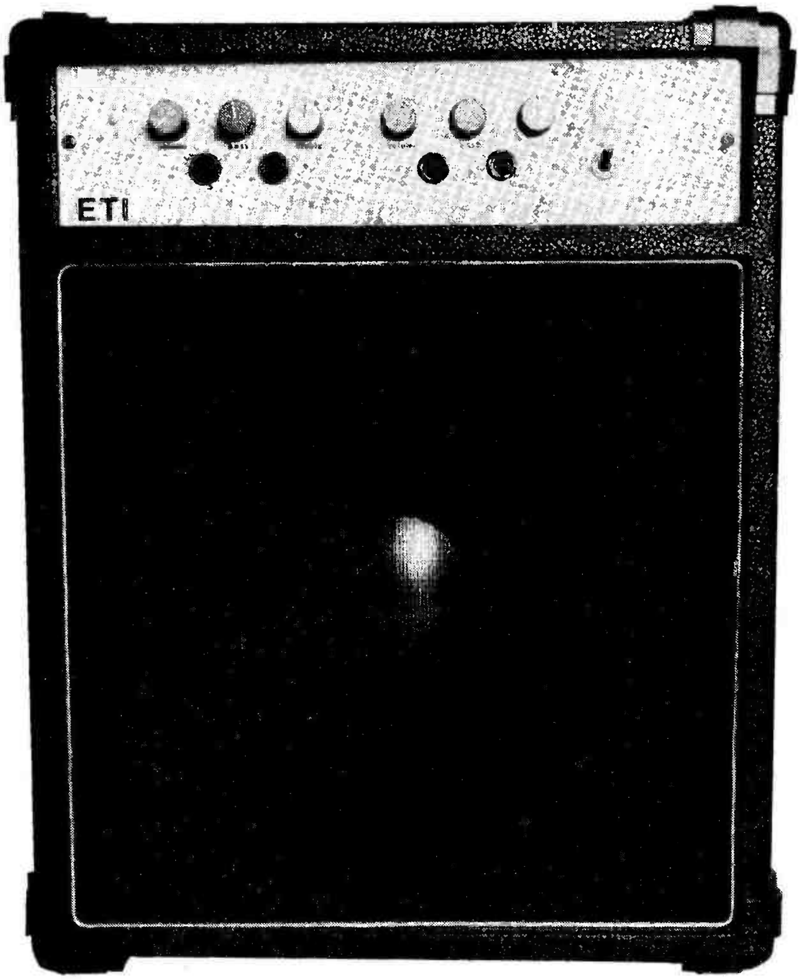


Fig.5 Wiring diagram. Note that all the earth connections are brought to one point.

BUYLINES

The cabinet we used was supplied by Wilmslow Audio, 35-39 Church Street, Wilmslow, Cheshire SK9 1AS, and they also stock a loudspeaker which is suitable but has a higher power rating than is needed for this project. The most recent prices we have are £35.75 inclusive for the cabinet and £32.45 for the C12 100GP loudspeaker, but we suggest you check with them before ordering; their telephone number is 0625-529599. We obtained the McKenzie loudspeaker used in the prototype from B.K. Electronics and you will find the price and other information you need in their advertisement elsewhere in this magazine. Crimson Elektrik amplifier modules are available from Bradley Marshall at their shop in London's Edgware Road, from Wilsmlow Audio at the address above, or direct from the manufacturers at their Phoenix Works, 500 King Street, Longton, Stoke-on-Trent ST2 1EZ, tel 0782-330520. The most recent price we have for the CE1008 is £27.50 inclusive but again we recommend that you check this before ordering. The metal case for the amplifier was obtained from Newrad whose address and telephone number you will find in their advertisement. The only other items likely to cause any problems are the aluminium panels. If you live in the London area you could try H.L. Smith in the Edgware Road who will supply aluminium panels cut and bent to customer's requirements for a small charge. If you live elsewhere you will have to try local hardware shops or salvage some scrap aluminium and brush up your metal-bashing skills. The PCB is available from our PCB Service.



A CCD-delay line effects board for this project is currently under development, and we hope to bring you constructional details of it in a month or two. It will of course, require controls, so readers who intend building it are advised to postpone painting and lettering the front panel until it is published.

ETI

OMP POWER AMPLIFIER MODULES

★ PRICES INCLUDE V.A.T. ★ PROMPT DELIVERIES ★ FRIENDLY SERVICE ★ LARGE S.A.E. 28p STAMP FOR CURRENT LIST

OMP POWER AMPLIFIER MODULES

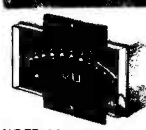
Now enjoy a world-wide reputation for quality, reliability and performance at a realistic price. Four models available to suit the needs of the professional and hobby market, i.e., Industry, Leisure, Instrumental and Hi-Fi, etc. When comparing prices, NOTE all models include Toroidal power supply, Integral heat sink, Glass fibre P.C.B., and Drive circuits to power compatible Vu meter. Open and short circuit proof. **Supplied ready built and tested.**

OMP100 Mk II Bi-Polar Output power 110 watts R.M.S. into 4 ohms, Frequency Response 15Hz - 30KHz —3dB, T.H.D. 0.01%, S.N.R. —118dB, Sens. for Max. output 500mV at 10K, Size 360 × 115 × 72mm. PRICE £32.99 + £2.50 P&P.

OMP/MF100 Mos-Fet Output power 110 watts R.M.S. into 4 ohms, Frequency Response 1Hz - 100KHz —3dB, Damping Factor 80, Slew Rate 45V/uS, T.H.D. Typical 0.002%, Input Sensitivity 500mV, S.N.R. —125dB. Size 300 × 123 × 60mm. PRICE £39.99 + £2.50 P&P.

OMP/MF200 Mos-Fet Output power 200 watts R.M.S. into 4 ohms, Frequency Response 1Hz - 100KHz —3dB, Damping Factor 250, Slew Rate 50V/uS, T.H.D. Typical 0.001%, Input Sensitivity 500mV, S.N.R. —130dB, Size 300 × 150 × 100mm. PRICE £62.99 + £3.50 P&P.

OMP/MF300 Mos-Fet Output power 300 watts R.M.S. into 4 ohms, Frequency Response 1Hz - 100KHz —3dB, Damping Factor 350, Slew Rate 60V/uS, T.H.D. Typical 0.0008%, Input Sensitivity 500mV, S.N.R. —130dB, Size 330 × 147 × 102mm. PRICE £79.99 + £4.50 P&P.



Vu METER Compatible with our four amplifiers detailed above. A very accurate visual display employing 11 L.E.D. diodes (7 green, 4 red) plus an additional on/off indicator. Sophisticated logic control circuits for very fast rise and decay times. Tough moulded plastic case, with tinted acrylic front. Size 84 × 27 × 45mm. PRICE £8.50 + 50p P&P.

NOTE: Mos-Fets are supplied as standard (100KHz bandwidth & Input Sensitivity 500mV). If required, P.A. version (50KHz bandwidth & Input Sensitivity 775mV). Order — Standard or P.A.

19" RACK CASED MOS-FET STEREO AMPLIFIERS with twin power supplies and L.E.D. Vu meters plus X.L.R. connectors.
Three models (Ratings RMS into 4 ohms)
MF200 (100 + 100w) £169.00
MF400 (200 + 200w) £228.85
MF600 (300 + 300w) £274.85
Securicor Delivery £10.00

BURGLAR ALARM

Better to be '**Alarmed**' then terrified.
Thandar's famous 'Minder' Burglar Alarm System. Superior microwave principle. Supplied as three units, complete with interconnection cable. **FULLY GUARANTEED.**

IDEAL for Workshops, Factories, Offices, Home, etc. Supplied ready built.

Control Unit — Houses microwave radar unit, range up to 15 metres adjustable by sensitivity control. Three position, key operated facia switch — off — test — armed. 30 second exit and entry delay.
Indoor alarm — Electronic swept freq. siren. 104dB output.
Outdoor Alarm — Electronic swept freq. siren. 98dB output. Housed in a tamper-proof heavy duty metal case.
Both the control unit and outdoor alarm contain rechargeable batteries which provide full protection during mains failure. Power requirement 200/260 Volt AC 50/60Hz. Expandable with door sensors, panic buttons etc. Complete with instructions.

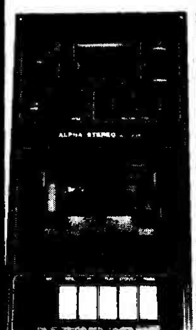
SAVE £148.00 Usual Price £228.85
BKE's PRICE £79.99 + £4.00 P&P
? Why buy a collection of self-assembly boards!

OMP LINNET LOUDSPEAKERS

The very best in quality and value. Made specially to suit todays need for compactness with high sound output levels. Finished in hard wearing black vynide with protective corners, grille and carry handle. All models 8 ohms. Full Range 45Hz - 20KHz.
OMP 12/100 watts 20" × 15" × 12" £125.00 per pair
OMP 10/200 watts 18" × 15" × 11" £145.00 per pair
OMP 12/300 watts 20" × 15" × 11" £169.00 per pair

Delivery: Securicor £8.00 per pair

STEREO CASSETTE DECK



STEREO CASSETTE DECK Ideal for installing into Disco and Hi-Fi cabinet/Consoles. Surface mounting (Horizontal). Supplied as one unit with all electronics including mains power supply.
★ Metal top panel Black finish
★ Piano type keys including pause
★ Normal/Chrome tape switch
★ Twin Vu Meters
★ 3 Digit counter
★ Slider Record Level control
Size 171 × 317 mm Depth 110 mm
PRICE £35.99 + £3.00 P&P

1 K-WATT SLIDE DIMMER

★ Control loads up to 1Kw
★ Compact Size 4⅗" × 1" × 2½"
★ Easy snap in fixing through panel/cabinet cut out
★ Insulated plastic case
★ Full wave control using 8 amp triac
★ Conforms to BS800
★ Suitable for both resistance and inductive loads. Innumerable applications in industry, the home, and disco's, theatres etc.
PRICE £12.99 + 75p P&P (Any quantity).

LOUDSPEAKERS

5 to 15 INCH Up to 300 WATTS R.M.S. All speakers 8 ohm Impedence.

Cabinet fixing in stock. S.A.E. for details.

POWER RANGE
8" 50 WATT R.M.S. Hi-Fi/Disco.
20 oz. magnet. 1½" ally voice coil. Ground ally fixing escutcheon. Res. Freq. 40Hz. Freq. Resp. to 6KHz. Sens. 92dB. PRICE £9.90 Available with black grille £10.90. P&P £1.50 ea.
12" 100 WATT R.M.S. Hi-Fi/Disco
50 oz. magnet. 2" ally voice coil. Ground ally fixing escutcheon. Die-cast chassis. White cone. Res. Freq. 25Hz. Freq. Resp. to 4KHz. Sens. 95dB. PRICE £26.00 + £3.00 P&P ea.
15" 100 WATT R.M.S. Hi-Fi/Disco
50 oz. magnet. 2" ally voice coil. Ground ally fixing escutcheon. Die-cast chassis. White cone. Res. Freq. 20Hz. Freq. Resp. to 2.5KHz. Sens. 97dB. PRICE £34.00 + £3.00 P&P ea.

McKENZIE
12" 85 WATT R.M.S. C1285GP Lead guitar/keyboard/Disco.
2" ally voice coil. Ally centre dome. Res. Freq. 45Hz. Freq. Resp. to 6.5KHz. Sens. 98dB. PRICE £24.99 + £3.00 P&P ea.
12" 85 WATT R.M.S. C1285TC P.A./Disco 2" ally voice coil. Twin cone.
Res. Freq. 45Hz. Freq. Resp. to 14KHz. PRICE £24.99 + £3.00 P&P ea.
15" 150 WATT R.M.S. C15 Bass Guitar/Disco.
3" ally voice coil. Die-cast chassis. Res. Freq. 40Hz. Freq. Resp. to 4KHz. PRICE £49.99 + £4.00 P&P ea.

WEM
5" 70 WATT R.M.S. Multiple Array Disco etc.
1" voice coil. Res. Freq. 52Hz. Freq. Resp. to 5KHz. Sens. 89dB. PRICE £20.00 + £1.50 P&P ea.
8" 150 WATT R.M.S. Multiple Array Disco etc.
1" voice coil. Res. Freq. 48Hz. Freq. Resp. to 5KHz. Sens. 92dB. PRICE £27.00 + £1.50 P&P ea.
10" 300 WATT R.M.S. Disco/Sound re-enforcement etc.
1½" voice coil. Res. Freq. 35Hz. Freq. Resp. to 4KHz. Sens. 92dB. PRICE £30.00 + £2.00 P&P ea.
12" 300 WATT R.M.S. Disco/Sound re-enforcement etc.
1½" voice coil. Res. Freq. 35Hz. Freq. Resp. to 4KHz. Sens. 94dB. PRICE £38.00 + £3.00 P&P ea.

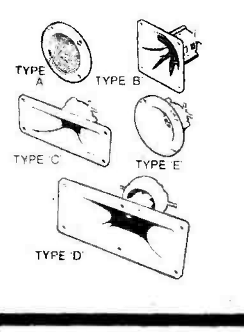
SOUNDLAB (Full Range Twin Cone)
5" 60 WATT R.M.S. Hi-Fi/Multiple Array Disco etc.
1" voice coil. Res. Freq. 63Hz. Freq. Resp. to 20KHz. Sens. 86dB. PRICE £8.99 + £1.00 P&P ea.
6½" 60 WATT R.M.S. Hi-Fi/Multiple Array Disco etc.
1" voice coil. Res. Freq. 56Hz. Freq. Resp. to 20KHz. Sens. 89dB. PRICE £9.99 + £1.50 P&P ea.
8" 60 WATT R.M.S. Hi-Fi/Multiple Array Disco etc.
1¼" voice coil. Res. Freq. 38Hz. Freq. Resp. to 20KHz. Sens. 89dB. PRICE £11.99 + £1.50 P&P ea.

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 (Hz) ● 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 £33.60 each. - £3.00 P&P ea.
ADC Q4 mag. cartridge for above. **Price £4.99 ea.** P&P 50p.

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 £4.90 each** + 40p P&P.
TYPE 'B' (KSN1005A) 3½" super horn. For general purpose speakers, disco and P.A. systems etc. **Price £5.49 each** + 40p P&P.
TYPE 'C' (KSN6016A) 2" × 5" wide dispersion horn. For quality Hi-fi systems and quality discos etc. **Price £6.49 each** + 40p P&P.
TYPE 'D' (KSN1025A) 2" × 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 £8.99 each** + 40p P&P.
TYPE 'E' (KSN1038A) 3¾" horn tweeter with attractive silver finish trim. Suitable for Hi-fi monitor systems etc. **Price £5.49 each** + 40p P&P.
LEVEL CONTROL Combines on a recessed mounting plate, level control and cabinet input jack socket. 85 × 85 mm. **Price £3.99** + 40p P&P.

PANTEC

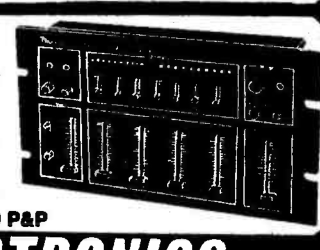
HOBBY KITS. Proven designs including glass fibre printed circuit board and high quality components complete with instructions.

FM MICROTRANSMITTER (BUG) 90/105MHz with very sensitive microphone. Range 100/300 metres. 57 × 46 × 14mm (9 volt) **Price: £8.62** + 75p P&P.
3 WATT FM TRANSMITTER 3 WATT 85/115MHz varicap controlled professional performance. Range up to 3 miles 35 × 84 × 12mm (12 volt) **Price: £13.74** + 75p P&P.
SINGLE CHANNEL RADIO CONTROLLED TRANSMITTER/RECEIVER 27MHz. Range up to 500 metres. Double coded modulation. Receiver output operates relay with 2amp/240 volt contacts. Ideal for many applications. Receiver 90 × 70 × 22mm (9/12 volt). **Price: £17.82.** Transmitter 80 × 50 × 15mm (9/12 volt). **Price: £11.27** P&P + 75p each. S.A.E. for complete list.

3 watt FM Transmitter

STEREO DISCO MIXER

STEREO DISCO MIXER with 7 band graphic equaliser and 10 segment L.E.D. Vu Meters. Many outstanding features.
5 Inputs with individual fader controls:—
2 Mag. turntable, 2 Aux. plus Mic. with talk-over switch. Headphone monitor. Master output control with Hi-Low outputs. Compatible with our OMP Power Amplifiers.
Size: 360 x 200 x 120 mm. Supply 240V/50Hz AC.



PRICE £118.00 + £3.00 P&P

VISA

POSTAL CHARGES PER ORDER £1.00 minimum. OFFICIAL ORDERS WELCOME, SCHOOLS, COLLEGES, GOVERNMENT BODIES, ETC. PRICES INCLUSIVE OF V.A.T. SALES COUNTER VISA/ACCESS/C.O.D. ACCEPTED.

Access

B. K. ELECTRONICS

UNIT 5, COMET WAY, SOUTHEND-ON-SEA, ESSEX. SS2 6TR TEL: 0702-527572

COMPUTER WAREHOUSE

1000's OF BARGAINS FOR CALLERS

THE 'ALADDIN'S' CAVE OF COMPUTER AND ELECTRONIC EQUIPMENT

RECHARGEABLE BATTERIES

Dry Fit Maintenance FREE by Sonnenschein. **A300 07191315** 12v 3 AH same as **RS 591-770 NEW £13.95**. **A300 07191202** 6-0-6 1.8 AH same as **RS 591-382 EX EQUIP £4.99** Miniature PCB mount 3.6v 100 Mah as **RS 591-477 NEW £1.00** **SAFT VR2C** 1.2v "C" size **NICADS** in 18 cell ex equipment pack. Good condition – easily split to single cells **£10.50 + pp £1.90**

HOT LINE DATA BASE

DISTEL©

THE **ORIGINAL FREE OF CHARGE** dial up data base 1000's of stock items and one off bargains. **ON LINE NOW** – 300 baud, full duplex CCITT tones, 8 bit word, no parity.

01-679 1888

COMPUTER 'CAB'

All in one quality computer cabinet with integral switched mode PSU, Mains filtering, and twin fan cooling. Originally made for the famous **DEC PDP8** computer system costing thousands of pounds. Made to run 24 hours per day the PSU is fully screened and will deliver a massive +5v DC at 17 amps, +15v DC at 1 amp and -15v DC at 5 amps. The complete unit is fully enclosed with removable top lid, filtering, trip switch, 'Power' and 'Run' LEDs mounted on Ali front panel, rear cable entries, etc. etc. Units are in good but used condition – supplied for 240v operation complete with full circuit and tech. man. **Give your system that professional finish** for only £49.95 + Carr. Dim. 19" wide 16" deep 10.5" high. Useable area 16"w 10.5"h 11.5"d.
Also available **LESS PSU**, with FANS etc. Internal dim. 19"w. 16"d. 10.5"h. ***£19.95***. Carriage & insurance £9.50.

EX-STOCK INTEGRATED CIRCUITS

2732 ex equip £3.25, 27128 – 250ns **NEW £12.00**. 6116-200 £4.50, 6116-250 £3.95, 6264LP-150 £22.00, 4164-200 £3.50, 4864-150 £4.00, 4116-300 £1.20, 2114 £1.75, 6800 £2.50, 6821 £1.00, 68A09 £8.00, 68B09 £10.00, 68B09E £14.50, D8085AH-2 £12.00, D8086 £20.00, Z80A £2.99.

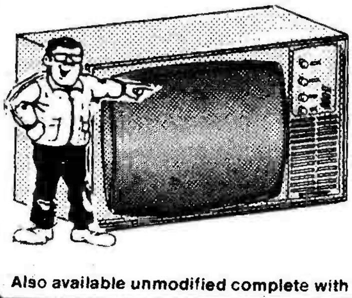
MAINS FILTERS

Cure those unnerving hang ups and data glitches caused by mains interference.
SD5A As recommended by **ZX81** news letter, matchbox size up to 1000 watt load ***£5.95***
L2127 compact completely cased unit with 3 pin fitted socket Up to 750 watts ***£9.99***

COOLING FANS

Keep your hot parts COOL and RELIABLE with our range of **BRAND NEW** professional cooling fans.
ETRI 99XUOI Dim. 92 x 92 x 25 mm. Miniature 240 v equipment fan complete with finger guard. **£9.95**.
GOULD JB-3AR Dim. 3" x 3" x 2.5" compact very quiet running 240 v operation. **NEW £6.95**
BUHLER 69.11.22. 8-16 v DC micro miniature reversible fan. Uses a brushless servo motor for extremely high air flow, almost silent running and guaranteed 10,000 hr life. Measures only 62 x 62 x 22 mm. Current cost £32.00. **OUR PRICE ONLY £12.95 complete with data.**
MUFFIN-CENTAUR standard 4" x 4" x 1.25" fan supplied tested EX EQUIPMENT 240 v at £6.25 or 110 v at £4.95 or BRAND NEW 240 v at £10.50. 1000's of other fans Ex Stock. Call for Details. Post & Packing on all fans £1.60

PRICE BARRIER SHATTERED ON 16" RGB CASED COLOUR MONITORS



A scoop purchase from a major London Hotel enables us to offer this special converted **DECCA 100 COLOUR** video TV at a super low price of **£99.00!!** Low enough to suit any budget!! Solid state modular construction, 16" high definition PIL tube, which eliminates convergence problems and our own special modification results in 80 + column text definition and picture quality not seen on monitors costing three times as much!! In fact we guarantee you will be delighted with this product, the quality has to be seen to be believed. Supplied complete and ready to plug direct to a **BBC MICRO COMPUTER** or any other system with a TTL RGB output. Other features include internal audio amp and speaker, compact dimensions only. 52cm W x 34 H x 24 D, auto degaussing circuit, attractive teak finished case, 30 day guarantee.

ONLY £99.00 + *£10.00 CARR.*

Also available unmodified complete with mod data (Mod costs less than £12.00) *£80.00.*

EPROM COPIERS

The amazing **SOFTY 2**. The "Complete Tool-kit" for copying, writing, modifying and listing EPROMS of the 2516, 2716, 2532, 2732 range. Many other functions include integral keyboard, cassette interface, serial and parallel data i/o, UHF modulator, ZIF socket etc. ***ONLY £195.00 + PP £2.50.***

"GANG OF EIGHT" intelligent Z80 controlled gang programmer for ALL single 5v rail EPROMS upto 27128. Will copy 8 27128 in typ. ONLY 3 MINUTES!! Internal LCD display and checking routines for IDIOT PROOF operation. ***ONLY £395.00 + PP £3.00.***

"GANG OF EIGHT PLUS" same spec. as above but with additional RS232 serial interface for down line loading data from computer etc. ***ONLY £445.00 + PP £3.00.***

Data sheets on request.

SPECIAL 300 BAUD MODEM OFFER

Another **GIGANTIC** purchase of these **EX BRITISH TELECOM, BRAND NEW** or little used 2B data modems allows US to make the **FINAL REDUCTION**, and for **YOU** to join the exciting world of data communications at an **UNHEARD OF PRICE OF ONLY £29.95**. Made to the highest **POST OFFICE APPROVED** spec at a cost of hundreds of pounds each, the 2B has all the standard requirements for data base, business or hobby communications. All this and more!!

- 300 baud full duplex
- Full remote control
- CCITT tone standards
- Supplied with full data
- Modular construction
- Direct isolated connection
- CALL, ANSWER and AUTO modes
- Standard RS232 serial interface
- Built in test switching
- 240v Mains operation
- 1 year full guarantee
- Just 2 wires to comms. line

NOW ONLY £29.95

Order now – while stocks last. Carriage and Ins. £10.00

BUDGET RANGE VIDEO MONITORS

At a price YOU can afford, our range of **EX EQUIPMENT** video monitors defy competition!! All are for 240v working with standard composite video input. Units are pre tested and set for up to 80 col use on BBC micro. Even where MINOR screen burns MAY exist – normal data displays are unaffected.

1000's SOLD TO DATE

12" KGM 320-321, high bandwidth input, will display up to 132 columns x 25 lines. Housed in attractive fully enclosed brushed alloy case. **B/W** only ***£32.95*** **GREEN** screen ***£39.95***
24" KGM large screen black & white monitor fully enclosed in light alloy case. Ideal schools, shops, clubs etc. ***ONLY £55.00*** Carriage £10.00

SAVE £250 SUPER PRINTER SCOOP

BRAND NEW CENTRONICS 739-2

ONLY £199

The "Do Everything Printer" at a price that will **NEVER** be repeated. Standard **CENTRONICS** parallel interface for direct connection to **BBC, ORIC, DRAGON** etc. Superb print quality with full pin addressable graphics and 4 type fonts plus **HIGH DEFINITION** internal **PROPORTIONAL SPACED MODE** for **WORD PROCESSOR** applications. 80-132 columns, single sheet, sprocket or roll paper handling plus much more. Available **ONLY** from **DISPLAY ELECTRONICS** at the ridiculous price of ***ONLY £199.00*** + VAT Complete with full manual etc. Limited quantity – Hurry while stocks last. Options. Interface cable (specify) for BBC, ORIC, DRAGON or CENTRONICS 36 way plg £12.50. Spare ribbon £3.50 each BBC graphics screen dump utility program £8.60. Carriage and Ins. £10.00 + VAT

DATA MODEMS

Join the communications revolution with our super range of **DATA MODEMS** with prices and types to suit all applications and budgets!!
Most modems are **EX BRITISH TELECOM** and are made to the highest standard for continuous use and reliability. RS232 interfaces are standard to all our modems, so will connect to ANY micro etc. with an RS232 serial interface.

DATEL 2B see **SPECIAL OFFER** centre of this ad.
MODEM 13A, 300 baud. Compact unit only 2" high and same size as telephone base. Standard CCITT tones, CALL mode only. Tested with data. ***ONLY £45.00 + PP £4.50.***
MODEM 20-1, 75-1200 baud. Compact unit for use as subscriber end to PRESTEL, MICRONET or TELECOM GOLD. Tested with data. ***£39.95 + PP £6.50.***
MODEM 20-2, same as 20-1 but 1200-75 baud ***£99.00.***
TRANSDATA 307A, 300 baud acoustic coupler. Brand new with RS232 interface. ***£95.00 + PP £4.50.***
DACOM DSL2123 Multi Standard Modem, switchable CCITT or USA BELL 103 standard. V21 300-300, V23 75-1200, V23 1200-75 or 1200-1200 half duplex. Auto answer via MODEM or CPU. CALL or ANSWER modes plus LED status indication. Dim 2.5" x 8.5" x 9". **BRAND NEW fully guaranteed** ***ONLY £268.00 + PP £4.50.***
DATEL 2412 Made by SE LABS for BT this two part unit is for synchronous data links at 1200 or 2400 baud using 2780/3780 protocol. Many features include Auto answer, 2 or 4 wire working etc. etc. **COST OVER £800.** ***OUR PRICE £185.00.***
DATEL 4800, RACAL MPS4800 high speed good condition ***£285.00 CARR £10.00***

HUNDREDS OF PRINTERS EX STOCK FROM £49.00.

Call Sales Office for Details.

1 only large **CALCOMP 1036** AO 3 pen drum plotter and offline 915 magtape controller. Good working order. ***£2500.00.***

DISK DRIVE SPECIALS

SIEMENS FDD-100-5 5¼" 40 track single sided. Ex new equipment tested, guaranteed working. Complete with data ***£75.00***
SHUGART SA400 5¼" 35 track, single sided, Ex equipment, guaranteed working ***£55.00***
SHUGART SA800, SA850 8" drives plus spares EX Stock call for prices.
Hard disk drives.
Large quantities of HARD DISK drives currently EX STOCK including:

DRE series 30 mb Front Load for DEC, NOVA etc	***FROM £295.00***
DIABLO 44/DRE 4000 A, B 5+5 mb cartridge drive	***FROM £995.00***
CDC HAWK 5+5 mb cartridge drive as new condition	***FROM £795.00***
CDC 9762 80 mb DEC RM03 compatible	***FROM £2900.00***
PERTEC D3422 5+5 cartridge drive	***FROM £495.00***

Large quantities of spares and controllers available for S100, DEC, HONEYWELL, DATA GENERAL. Call sales office for details.
IN HOUSE disk drive refurbishing service – call for competitive quotations!!

ADD VAT TO ALL PRICES

EX STOCK DEC CORNER

PDP 1140 System comprising of CPU, 124K memory + MMU 16 line RS232 interface, RP02 40 MB hard disk drive, TU10 9 track 800 BPI Mag tape drive, dual rack system, VT52 VDU etc. etc. Tested and running ***£3750.00***

BA11-MB 3.5" Box, PSU, LTC	£385.00
DH11-AD 16 x RS232 DMA interface	£2100.00
DLV11-J 4 x EIA interface	£310.00
DUP11 Sych. Serial data i/o	£650.00
DQ200 Dilog – multi RK controller	***£495.00***
DZ11-B 8 line RS232 mux board	£650.00
LA36 Decwriter EIA or 20 ma loop	£270.00
LAXX-NW LA180 RS232 serial interface and buffer option	£130.00
LAX34-AL LA34 tractor feed	£85.00
MS11-JP Unibus 32 kb Ram	£80.00
MS11-LB Unibus 128 kb Ram	£450.00
MS11-LD Unibus 256 kb Ram	£850.00
MSC4804 Qbus (Equiv MSV11-L) 256 kb	£499.00
PDP11/05 Cpu, Ram, i/o, etc.	£450.00
PDP11/40 Cpu, 124k MMU	£1850.00
RT11 ver. 3B documentation kit	£70.00
RK05-J 2.5 Mb disk drives	£650.00
KL8JA PDP 8 async i/o	£175.00
MI8E PDP 8 Bootstrap option	£75.00
VT50 VDU and Keyboard – current loop	£175.00
VT52 VDU with RS232 interface	***£250.00***

1000's of **EX STOCK** spares for **DEC PDP8, PDP8A, PDP11** systems & peripherals. Call for details. All types of Computer equipment and spares wanted for **PROMPT CASH PAYMENT.**

All prices quoted are for U.K. Mainland, paid cash with order in Pounds Sterling PLUS VAT. Minimum order value ***£2.00.*** Minimum Credit Card order ***£10.00.*** Minimum BONA FIDE account orders from Government Depts., Schools, Universities and established companies ***£20.00.*** Where post and packing not indicated please ADD £1.00 + VAT. Warehouse open Mon-Fri 9.30-5.30. Sat 10.30-5.30. We reserve the right to change prices and specifications without notice. Trade, Bulk and Export

DISPLAY ELECTRONICS

32 Biggin Way, Upper Norwood, London SE19 3XF
Telephone 01-679 4414 Telex 27924

THE REAL COMPONENTS

In this short(ish) series, John Linsley Hood will be looking at a range of components and their unwelcome characteristics.

It is becoming popular, among the lugubrious 'things aren't what they used to be' fraternity, to complain that Electronics Engineers are degenerating into technicians who merely connect 'black boxes' together, without any particular concern about what is in them or how they are made. But hasn't this always been true, to some extent, and isn't it also true of most other technical or engineering occupations?

In practice, everyone who uses bits and pieces provided by other people will be more concerned about how these are used, and how well they will work in that use, than about what they are. One doesn't expect an architect to be an expert in the manufacture of glass in order to be able to design windows, so why expect an electronics engineer to know just what is inside an 'op-amp IC' or a 'MSI CMOS gate'? Perhaps the mere fact that he can understand the jargon is an adequate qualification.

However, having set up the argument, I now want to nibble away at its foundations by saying that an architect who knows the relative qualities and costs of a borosilicate and a lead glass will be a better architect for this knowledge, and the mechanical engineer who knows the difference between EN20 and EN36 in steels will also be a more effective engineer because of that understanding.

So — how about our own bits and pieces, like the humble resistor and capacitor?

For a long time now, electronics engineers who have worked at the limits of this field, in very low noise systems, or at very high frequencies, or where high discrimination is needed between adjacent signals, have needed to be very fussy about component quality. Thanks to their efforts we now have some superb components at our disposal, whose qualities have come more into popular view because of the activities of the 'Ultra-Hi-Fi' buffs, who are very much sold on the need to use the most exotic things they can lay their hands on. But are these always as good for our purposes as the 'U-H-F' brigade would have us think. Let us have a look.

Resistors

These are made in a variety of kinds, and their purpose is to cause a voltage drop when current flows through them (remember V=IxR.). They will get hot if the current or voltage is high enough (heat, in watts = VxI or I^2R.). With transistor circuitry, the dissipation will usually be pretty small, so the ¼ watt resistors are usually quite adequate, and will fit more tidily onto a printed circuit board. However, if one is in doubt, it is easy enough to check, using the formulas above, and a pocket calculator to ease the strain on the brain.

Wire Wound Types

For higher powers, it is most common to use 'wire-wound' resistors (which range from a watt or two as far upwards as one has the strength to carry them). These are, as their name suggests, made by winding wire around a suitable fire-proof former, and joining a connector wire (or terminal, if they are big ones) on to the end, as I've sketched in Fig. 1. Obviously, if they are likely

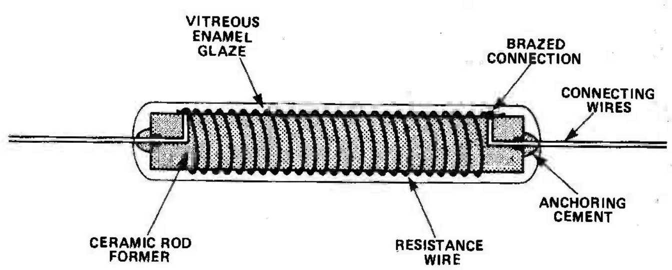


Fig. 1 A good quality wire-wound resistor (2–25W).

to get hot, and we want them to have the same resistance value when they are hot as when they are cold, the wire must have a low temperature coefficient of resistance. This usually means that they are wound from 'Eureka' or 'Constantan' wire. This a copper-nickel alloy, whose resistance doesn't change very much as it gets hot.

The snag with wire-wound resistors is that they have inductance, and the higher the value, and the more turns of wire that have to be wound round the former to get that resistance, the bigger the inductance will be. It is possible to make 'non-inductive' resistors by winding the wire in a zig-zag manner, so that there are just as many turns wound anti-clockwise, as there are wound in a clockwise rotation, but these are pretty rare.

A further point which has to be watched is that the former shouldn't expand as it warms up and stretch the wire wound round it, which would cause its resistance to increase — as in a strain gauge. Also, the wire has to be protected, to prevent it tarnishing or corroding, which would make it thinner. A layer of some heat-resistant vitreous enamel is usually fired on for this purpose, in the better WW resistors.

Apart from these snags, this is a pretty good type of resistor, which usually behaves in a nearly ideal manner.

Metal Glaze Types

These are made by firing onto a ceramic former a pottery type glaze, containing metallic salts, which make it

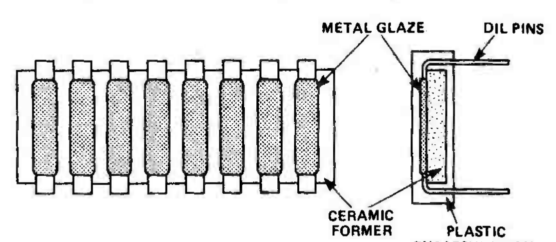


Fig. 2 Plastic encapsulated DIL metal glaze resistor array.

conductive. With proper composition these can have a low temperature coefficient, and can be made as non-inductive high-wattage replacements for WW types. However, you are most likely to find them as the single or dual-in-line devices I have sketched in Fig. 2, where they are plastic moulded like ICs, though some of these are carbon-film varieties.

Carbon Rod Types

These are the real grand-daddies of small power electronics resistors. They were around when I was a kid, and that was a good few years ago!

Their method of manufacture is to extrude a rod of mixed clay and graphite, in a combination which it is hoped will give the right sort of value. This is then chopped up into lengths, dried, fired in a kiln, and an end connection made by spraying it with metal, onto which a wire or other fixing can be soldered. I have shown the general scheme in Fig. 3. After the process is completed, the resistor will be impregnated with wax, and painted to say what value it is (for the time being).

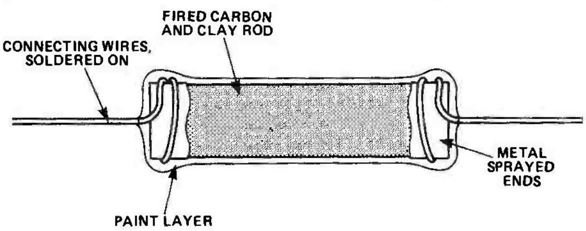


Fig. 3 Carbon rod-type resistor (½W–2W).

There are a lot of problems with these resistors, the first of which is that no-one really knows what sort of value is likely to happen after the firing process, and no two resistor rods are going to be the same anyway. The manufacturers got around this problem by automatic sorting machines, which measured the resistance value, and dropped the resistor into the appropriate box. A consequence of this was that if one wanted a 10k 20% tolerance resistor, it might be 8k or it might be 12k, but the only value it certainly wouldn't be is 10k, because these would have been sorted out for the 5% tolerance cut!

Another snag, which I recall from my early days in messing around with valves and 'steam' radios, was that if the resistor got a bit hot in use, when it cooled down again, it would have a different value. These are not now thought to be very good resistor types to use, unless one isn't very fussy, since they have a pretty poor noise figure — more about that later.

Carbon Film Types

These were the first of the really high quality low wattage resistors to be made, and for quite a long time commanded a premium price. They are made by depositing a thin layer of graphite on to the surface of a smooth ceramic rod, affixing end caps, which are usually crimped into position, as shown in Fig. 4, and then feeding them into an automatic machine, which measures their resistance, and then grinds a spiral groove through the film with a diamond cutter wheel, until the value has reached the required level, when the rod is dropped in to a collection chute.

The accuracy of these is as high as the accuracy of setting of the machine which made them, and it is quite common these days to find that a ± 5% carbon film resistor is, on measurement, within 1% of the quoted value. As with other types, the resistor will be given a coat of a hard protective lacquer, usually epoxy based, prior to the paint rings which denote its value being applied.

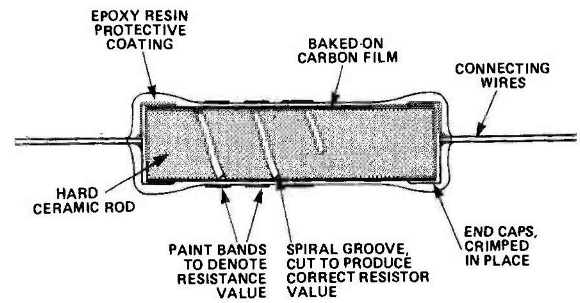


Fig. 4 Miniature carbon film high stability resistor (⅛W–2W).

Metal Oxide Types

These are usually made by firing a layer of thin oxide, which allows a low temperature coefficient, on to a 'Pyrex' glass rod former. Grooves are then ground, in spiral form, as in the carbon film types, to give the correct final value. They are then finished as the carbon film ones, though with rather more care. These were the first resistor types, I recall, to get the prestigious BS9000 approval, and, to my mind, are still the 'Rolls-Royce' of these components.

Metal Film Types

These are much like the carbon film ones except that a thin film of vacuum evaporated resistor alloy metal has been deposited on the surface, instead of a thin carbon layer. They are a bit more robust than carbon film types, and are available to very close tolerances.

Cermet Types

This is really just another name for 'metal glaze', though it is mainly used when this kind of resistor layer is going to be used in a potentiometer.

Some General Snags

Apart from the problems of inductance, temperature coefficient and instability of resistor value, mentioned above, there is also the snag about noise. This is partly a characteristic which is inherent in resistors, as the clouds of electrons inside them mill around, like crowds in a tube station at going-home time. Because, statistically, there will at any given moment be more going in one direction than in the other, and vice-versa, the net result is a 'noise' voltage which appears across the resistor, and is proportional to the square-root of the resistor value. As the temperature increases, the crowds of electrons become more agitated, and mill about more, so the noise voltage increases. So, in very low noise circuits, it is necessary to keep the resistance values as low as possible.

However, in addition to this, there is also the problem of 'excess noise', which is a function of the way the resistor is made, and the composition of the materials, and is due to a variety of causes, from the trapping of electrons by impurity 'holes' to spurious electrochemical potentials, or to piezo-electric or tribo-electric effects. Our old friend the carbon rod resistor is the worst offender here.

An additional problem which would worry an audio amplifier designer, is the voltage dependence of resistance. By this I mean the sort of change in resistance value which can occur as a function of the voltage applied across it — regardless of its change in temperature. This can generate odd harmonics in the signal waveform.

The final problem is that of assymetry in resistance, due to slight rectification effects. Happily this is rare.

Looking at these problems, which is the best resistor to use. Well, apart from inductance, the wire-wound ones are very snag free. Next, in descending order of goodness come the metal oxide or metal film, the carbon film the metal glaze, and a long way behind, the carbon rod types.

Capacitors

These are best divided into 'polar' (ie, electrolytic) and 'non-polar' (ie plastic film or ceramic) types. The polar ones are those which will give a lot of capacitance in a small space, but need, generally, to be connected the right way round or they become either medium value resistors, or miniature canons, depending on the voltage and current available. More fun to watch from the other side of a stout window, in someone else's amplifier.

Plastic Film Dielectric Types

The plastic film dielectric types — they used to be made from waxed paper, but happily no longer, except in some exotic polychlorinated biphenyl impregnated systems, for power use — are not fussy about which way round they are connected, but tend to be a bit bulky and dear if one wants much in the way of microfarads. These will normally use polystyrene, polyester, polycarbonate or polypropylene films as the insulating dielectric between the two 'plates' to which one makes the electrical connections.

The best kind of 'plate' in a plastic film capacitor is a thin foil of high conductivity aluminium. Two of these will normally be wound up in a 'swiss roll' fashion, sandwiched between a pair of strips of plastic film, as I have shown in Fig. 5. One or more conducting wires or

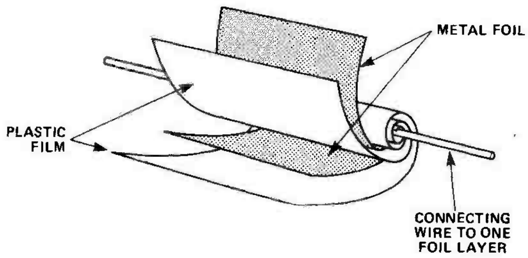


Fig. 5 The construction of 'film-foil' capacitors.

strips will then be led out of the body before it is wound, or perhaps while it is being wound, to make contact with the foils, and in the case of a polystyrene film capacitor, for example, the whole lot is then heated in an oven to make the plastic shrink and fuse, to give the shape shown in Fig. 6. Note at this point that one end will be identified, often with red dye, to tell you which is the outside layer of foil. If this is earthed, perhaps, it will screen the inner one.

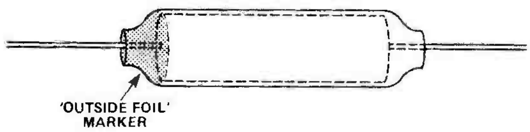


Fig. 6 Finished 'film-foil' capacitor.

If one applies too high a voltage, the insulating film will puncture, and the capacitor will become 'short circuited'. This snag is avoided by using a vacuum evaporated, thin, layer of aluminium, on both sides of the film dielectric, as the conducting 'plate'. If the dielectric breaks down, in this case, the discharge of the capacitor through the pin-hole will blast away the evaporated metal layer around the puncture, and the capacitor will 'self heal'. The price which is paid for this, is that the metal plate, being much thinner, hasn't got as good a conductivity, so an attempt to keep the internal resistance of the capacitor low is made by sputtering or spraying metal all over the exposed ends of the evaporated layer, as I have sketched in Fig. 7.

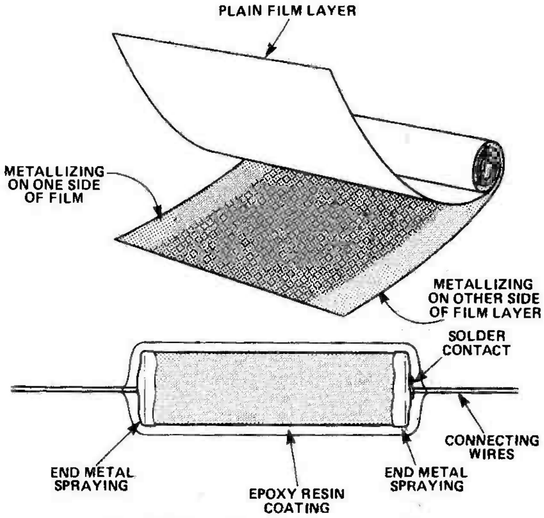


Fig. 7 'Metallised film' capacitor.

Because the evaporated metal 'plate' is so much thinner than a foil plate, these capacitor types give a bigger capacitance for the same physical size, and with the very thin film polycarbonate types, quite high capacitances, up to, say, 10uF, can be obtained in relatively small packages. The most common capacitor of this type is the 'polyester' one, usually based on a 'mylar' or 'melinex' polyethylene terephthalate film. This is thin because it is stretched in both directions, like the soap film in a bubble.

Ceramic Capacitors

Ceramic dielectric capacitors take advantage of the fact that some fired materials, like titanium dioxide, barium titanate, or barium titanate-zirconate, can have dielectric constants anywhere between 90 and 45,000, as compared with 2.2–4 for plastic films. Since the capacitance of a capacitor (its ability to store charge) depends directly on the dielectric constant of the insulation (the formula is $C(uf)=0.225AK/D$, where A is the area of each plate, in sq. in., K is the dielectric constant and D is the separation between the plates), the higher the dielectric constant the more uFs in a given size.

Well, what's the snag? It is that the dielectric constant of these ceramic materials is wildly temperature dependent. The capacitor will usually have its characteristics printed on the side; for example, N750 means a temperature coefficient which is negative, and to the tune of 750 parts per million, per degree centigrade. Similarly, P100 is positive (ie., the capacitance increases with temperature) to the tune of 100 ppm°C. NPO means that it doesn't change at all, but you'll only find these in values up to about 100pF. The large capacitance, small size ones, like the pea sized 0.1uF/60V types, will all be N750 or maybe even N4500. Also, when they say '0.1uF' they mean somewhere in the range of 0.25uF–0.1uF!

Electrolytics

The electrolytic types, nowadays either aluminium or tantalum, rely on the formation of a thin continuous film of an insulating oxide layer on the 'anode', the +ve plate of the capacitor, as a result of electrolytic action occuring in the 'electrolyte'. Not only is the layer very thin, but it has a fairly high dielectric constant, and if the 'plates' are etched to give a high effective surface area too, very high capacitance values can be obtained in small packages. Also, since the oxide film is formed by the passage of current through the unit, it follows that if it punctures, it will soon heal again by growing itself a bit of replacement oxide where the hole was.

The big problems with the electrolytic types, apart from some other more exotic defects which I will leave to later, were that they leaked (all the time!), they had a fairly high internal inductance, because of the way the plates were wound, and in use, they tended to behave as though they had a small resistor always connected in series with them, especially at higher frequencies. The big advantage of tantalum electrolytics is that their internal leakage can be exceedingly small, and they can even survive a small reverse voltage, say up to 1.5V. Aluminium electrolytics will survive up to about only 0.5V.

Recent developments have led to some very low leakage aluminium electrolytics too, and a big effort has been made to produce low 'equivalent series resistance' (low ESR) aluminium types. These are not yet quite in the league of tantalums for µFs per ml, but they are catching up.

Snags

Some people (not me this time, I spent many years working on, and designing instruments to test, plastics films for capacitor dielectrics) consider the capacitor to be the weakest link in most electronics — especially Hi-Fi — and think that the ideal audio amp. would be one without capacitors. Certainly, they have a lot of problems.

Consider how a capacitor works. A layer of some insulating material has a metal plate on either side, schematically shown in Fig. 8a. When a voltage is applied, the dielectric polarises, and negative and positive charges effectively move towards the two charged plates, giving the 'charging current', as in Fig. 8b. If the applied voltage is reversed the charges will require to move towards the other plate, as in Fig.8c. The movement of these charges may, in reality, be occasioned by the physical rotation of a molecule with a lop-sided charge as part of its structure.

There may then be some frictional energy losses in its rotation, and the higher the frequency, the worse these may be. These are known as the 'dielectric losses' of the capacitor, or 'Tan δ', (an expression of the ratio, as an angle, between the capacitative and resistive parts of the capacitor). But maybe not all of the molecules reorient on the change of charge, this leads to what is known as stored charge, or 'hysteresis'. Or, again, what if the extent of polarisation is a bit non-linear with applied voltage. This would lead to the capacitance being voltage dependent, as well as being temperature and frequency dependent, which it will be anyway.

Voltage dependence of capacitance leads to the generation of harmonics in the current flow through the component, and is a well known trouble to power station engineers. Stored charge and hysteresis lead to lots of odd nasties. Internal series and leakage resistances lead to other problems, which the designer has to note. Finally, unlike resistors, capacitors don't usually have a precisely specified value: ±20% is usually a fair average, apart from polystyrene ones, which are quite precisely specified. Electrolytics may be anywhere between +100% and −25% in value. Fortunately, the actual value often doesn't matter all that much.

The stability of the capacitance value depends on a lot of factors. In the case of the plastic film types, it is mainly a question of the stability of the physical structure, though if there is a lot of self-healing, in metallised types, the available plate area will get less.

In electrolytics, the stability depends mainly on loss of electrolyte, and one should expect a steady and continuing decrease in capacitance with time. Advice here is to be generous in chosen values to begin with.

So — how does one choose the best capacitor for the job? The main moral is to use the biggest capacitor, physically, that you have room for. Usually small size implies a price which has to be paid somewhere. For HT supply decoupling, use a 'low ESR' type electrolytic, if one is available, and by-pass it by a suitable, low inductance non-polar type, say 0.22uF or 0.1uF. If you are really fussy, you can by-pass this by a smaller value (hence lower internal inductance) capacitor yet again, to make sure your HT lines offer as low an impedance to higher frequencies as they do to 50–60Hz.

In audio systems, choose the capacitor with the dielectric having the lowest dielectric loss, which will probably also be the one with the lowest hysteresis, since it implies either no charge movement, or little friction in this. Polypropylene is the best here, followed by polystyrene (a close second), polycarbonate, polyester, low k ceramics and high k ceramics. Finally, if it is essential to use an electrolytic at all in the signal path, use an aluminium electrolytic. Tantalums have a rather bad image, nowadays, in respect of sound clarity. Also, between capacitors having the same dielectric, metal foil plates are preferable to evaporated metal film ('metallised') types.

Also, be generous in respect of the voltage and, in power supplies, the ripple current ratings of your capacitors. Electrolytics may survive brief voltage overloads; foil types will not.

Nowadays, capacitors don't usually introduce much circuit noise, apart from the thermal noise associated with their effective impedance, but, remember, in an electrolytic, if there is current flow, that current will be discontinuous, and very noisy.

Next month, bipolar transistors. **ETI**

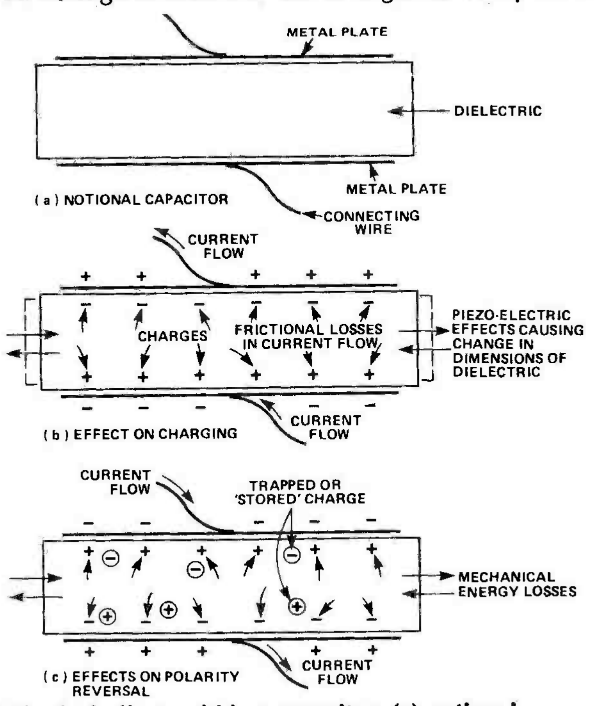
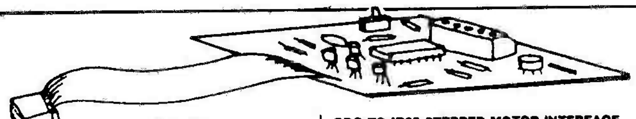


Fig. 8 Physical effects within a capacitor: (a) notional capacitor; (b) effect on charging; (c) effects on polarity reversal.

MAGENTA ETI KITS

Full kits include pcbs, hardware, cases (unless stated otherwise), IC sockets, wire, nuts & bolts. Article reprints extra 70p each.

SPECTRUM CENTRONICS INTERFACE Dec 84 less case and printer plug	£8.71
LOUDSPEAKER SQUEAKER Nov 84	£4.13
DIGITAL CONTROL PORT (SPECTRUM) I/O BOARD Nov 84 less case	£24.44
DIRECT READING CAPACITANCE METER Nov 84	£27.32
Kit less case & panel meter	£15.98
TEMPERATURE CONTROLLER Nov 84 less case	£5.99
MAINS FAILURE ALARM Nov 84	£8.20
KNITE LIGHT Nov 84	£12.93
SIMPLE ECHO UNIT (EZEKO) Oct 84	£25.98
DIGITAL CONTROL PORT (SPECTRUM) CONTROL/PSU BOARD OCt 84 less case	£25.57
SIREN UNIT Sept 84 less key switch	£14.82
DRY CELL CHARGER Sept 84	£13.79
INFRA RED ALARM July/Aug 84	£31.98
SIMPLE CMOS TESTER Aug 84	£22.95
WARLOCK BURGLAR ALARM July 84	£84.98
SPECTRUM JOYSTICK INTERFACE June 84	£12.98
AUTOMATIC SECURITY LIGHT SWITCH May 84	£21.57
ZX81 EPROM PROGRAMMER May 84	£32.23
MIDI DRUM SYNTH May 84	£20.98
MAINS BORNE REMOTE CONTROL (TRANSMITTER) May 84	£32.71
MAINS BORNE REMOTE CONTROL (RECEIVER) Apr 84	£28.84
STEREO POWER METER Mar 84	£57.48
Kit less case & panel meters	£33.98
MINI MYNAH (ZX81 & Spectrum) Feb 84 less case	£49.90
MINI DRUM SYNTH Nov 83	£11.87
FAST LIGHT PEN Nov 83 less cases	£24.92
RADIO CONTROL SERVO FAIL-SAFE less case Aug 83	£3.14
BALANCED INPUT PRE-AMP no case May 83	£11.99
COMPRESSOR/LIMITER no case May 83	£21.37
HIGH QUALITY PHONO AMPLIFIERS Feb 82	
MOVING COIL STAGE less case	£20.83
MOVING MAGNET STAGE less case	£20.48
WATCHDOG SECURITY ALARM less battery Aug 81	£49.48
HANDCLAP SYNTHESISER Aug 81	£35.98
LED JEWELLERY June 81. CROSS £3.25 STAR £10.91 SPIRAL	£8.68
GUITAR NOTE EXPANDER Apr 81	£19.82
INFRA RED ALARM Feb 81	£84.98
4 INPUT MIXER Dec 80	£23.98
MUSICAL DOORBELL Dec 80	£13.98
ULTRASONIC BURGLAR ALARM Aug 80	£31.50
CAPACITANCE METER Aug 80	£24.78
CLICK ELIMINATOR Apr 79	£67.70
Kit less case	£49.98



CATALOGUE

1985 CATALOGUE. Brief details of each kit, our books, & illustrations of our range of tools & components etc.

CATALOGUE & PRICE LIST — send £1 in stamps etc or add £1 to your order. Price list — 9 x 4 sae.

Catalogue FREE TO SCHOOLS/COLLEGES REQUESTED ON OFFICIAL LETTERHEAD.

BBC TO ID35 STEPPER MOTOR INTERFACE
PCB, driver IC, components, connectors & leads included. Demonstration software listings, circuit diagram, pcb layout & construction details given. Requires unregulated 12V dc power supply.

INTERFACE KIT (ref ETI)	£13.99
OPTIONAL POWER SUPPLY PARTS	£4.67
1035 STEPPER MOTOR	£13.50
BBC TRACKBALL CONTROLLER. 2" ball. 2 fire buttons. Analogue input port connector. Includes simple software	£17.98

MAGENTA ELECTRONICS LTD.
ET3, 135 Hunter St. Burton-on-Trent
Staffs. DE14 2ST. Mail Order Only
(0283) 65435. S.A.E. enquires.
Add 60p p&p to all orders. Prices include VAT. Access & Visa phone/post.

24 hr answerphone for credit card orders.
OVERSEAS: Payment must be sterling.
IRISH REPUBLIC + BFPO - UK PRICES
EUROPE: UK PRICES + 10%.
ELSEWHERE. WRITE FOR QUOTE.

OSCILLOSCOPES

COSSOR CDU 150. Dual Trace 35MHz Solid State. Portable. 8 x 10cm display. Complete with manual.......... **£200**

S.E. LABS SMIII. Dual Trace 18MHz Solid State. Portable AC or External DC Operation. 8 x 10cm display. Complete with manual.................... **£175**

EX-MINISTRY CT436. Dual beam 6MHz. Size 10 x 10 x 16ins. Complete with manual.................... **£75**

NEW PROBES AVAILABLE. Switched x 1; x 10.......................... **£11**

MARCONI AM SIGNAL GENERATOR TF144H/4. 10KHz - 72MHz
Stability 0.002%. Attenuated Output 2 microVolt - 2 Volts. Complete with manual.......................... £65

WAYNE KERR AUDIO SIGNAL GENERATOR SI21 10Hz - 120KHz
Attenuated 0 - 30V and 600 ohm Outputs. Complete with manual... **£40**

ADVANCE AUDIO SIGNAL GENERATOR J1 15Hz - 50KHz
20dB Attenuator. 600 ohm & 5 ohm Outputs. Complete with manual... **£30**

WAYNE KERR COMPONENT BRIDGE B521 (CT 373)
Resistance 1 milli-ohm - 1 Mohm
Capacitance 1 pf - 5 pf
L 1 microH - 500KH
Complete with manual........... **£35**

MARCONI VALVE VOLTMETER TF2600
Twelve ranges 1mV - 300 Volts FSD up to 10 MHz.
Complete with manual **£75**

ML - DC NANO-AMMETER & MICROVOLTMETER
100 nA - 30 mA; 100 microV - 30V.
Centre zero meter.
Unused.................. **£15** p&p £7

KINGSHILL STABILISED P.S.V. Model 500
0 - 60 Volts; 0 - 0.5 Amps. Current Limiting.
Metered. Size 8½ x 6 x 5½ins.
.... **£40** p&p £7

VARIAC 5AMP
Input 240V; Output 0 - 265V.
Cased — suitable for Bench use.
.... **£20** p&p £7

AVO TRANSISTOR TESTER Type TT169
Handheld. GO/NOGO for In-situ Testing. Complete with Leads & Instructions.................... **£20** p&p £3

CROYDON RESISTANCE BOX-MANGANIN
0.1 - 1111 Ohms (4 switches). Un-used.
.... **£25** p&p £7

METROHM — BATTERY MEGGER 500 VOLTS
Complete with Batteries and leads. In leather case............. **£40** p&p £5

AVO MULTIMETER TEST SET No1.
(Very similar to AVO 8X)
Complete with Batteries, Leads and Carrying Case............ **£80** p&p £7

AVO MULTIMETER MODEL 7
Complete with Batteries, Leads & Carrying Case.............. **£35.** p&p £7

AVO MULTIMINOR
Complete with Batteries, Leads & Carrying Case.............. **£22.50.** p&p £3

TANDON 5¼" FLOPPY DISC DRIVES ½ HEIGHT
Single Sided Double Density..... **£75**
Double Sided Double Density... **£100**
Brand New. Complete with Information p&p £5.

STEPPER MOTORS
Type 1. 200 Steps 4 Phase (5 wire) 12/24V 25 oz inch. 2¼" dia........... **£15**
Type 2. 6/12 Steps 3 Phase 12/24V. 1¾" dia. **£2** ea 5 for **£5.70**
Type 3. 24 Steps 4 wire 5V 3.3A 0-250rpm 0-200PPs 2¾" dia.... **£10 ea**
Type 4. 200 Steps 120V (3 wire) 25 oz inch. 2⅝" dia................. **£4 ea**
p&p and VAT extra

Also in stock NEW OSCILLOSCOPES, MULTIMETERS etc.

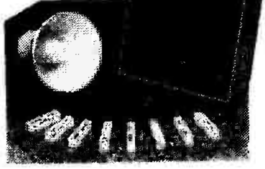
This IS A VERY SMALL SAMPLE OF STOCK, SAE Or Telephone for LISTS
Please check availability before ordering.
Carriage all units £10
VAT to be added to Total of Goods & Carriage

STEWARTS OF READING
110 Wykenham Road, Reading Berks RG6 1PL
Telephone: 0734 68041
Callers welcome 9 a.m. to 5.30 p.m. Monday to Saturday inclusive

Don't put it off any longer!

Protect your family and property with your know how and our security modules. Complete systems start from as little as £39.95

A COMPLETE SECURITY SYSTEM FOR ONLY £39.95 + V.A.T.



Control Unit	CA 1250
Enclosure	HW 1250
Key Switch & 2 keys	KS 3901
L.E.D.'s	LED 1
5½" Horn Speaker	HS 588
4 quality surface Magnetic Switches	MS 1025

With only a few hours of your time it is possible to assemble and install an effective security system to protect your family and property, at the amazingly low cost of £39.95 + V.A.T. No compromises have been made and no corners have been cut. The outstanding value results from volume production and direct supply. Assembly is straight forward with the detailed instructions provided. When installed you can enjoy the peace of mind that results from a secure home. Should you wish to increase the level of security, the system may be extended at any time with additional magnetic switches, pressure pads or ultrasonic sensors. Don't wait until it's too late - order today.
Order code CS 1370

CA 1250 - 2 zone alarm control unit with built in alarm & power supply	£19.95 + V.A.T.
HW 1250 Enclosure & Hardware Kit for above	£9.50 + V.A.T.
LED 1 - Set of 4 l.e.d.'s in chrome bezels + Push Switch to fit HW 1250	£2.15 + V.A.T.
KS 3901 - 3 position Key Switch	£3.43 + V.A.T.
HS 588 - 5½" Horn Speaker, ouput of 110dbs with CA 1250 or SL 157	£4.95 + V.A.T.
US 5063 - advanced Digital Ultrasonic Detector, high sensitivity, with false alarm suppression	£13.95 + V.A.T.
SC 5063 - Enclosure for US 5063	£2.95 + V.A.T.
IR 1470 - Infra-red system to provide 50' invisible beam, includes both transmitter and receiver	£25.61 + V.A.T.
SL 157 - Siren Module 12V	£2.95 + V.A.T.

Wide range of modules and accessories, etc. Send S.A.E. for details.

SELF-CONTAINED ULTRASONIC UNIT CK 5063

Requires no installation. Easily assembled using our professionally built and tested modules.

- Adjustable range up to 25 ft.
- Built-in entrance and exit delay
- Built-in timed alarm
- Key operated switch - Off, Test and Operate
- Provision for an extension speaker
- Fully self-contained
- Uses US 5063, PSL 1865 Key Switch 3901, 3" Speaker 3515

only £37.00 + V.A.T.

Now you can assemble a really effective intruder alarm at this low price using tried and tested Riscomp modulas. Supplied with full instructions, the kit contains everything necessary to provide an effective warning system for your house or flat. With a built-in LED indicator and test position the unit is easily set-up requiring no installation. It may simply be placed on a cupboard or desk. Movement within its range will then cause the built-in siren to produce a penetrating 900dbs of sound, or even 110dbs with an additional speaker. All parts included and supplied with full instructions for ease of assembly.
Size 200 x 180 x 70mm Order as CK 5063

Add 15% VAT to all prices
Add 70p post and packing to all orders
Units on demonstration
Shop hours 9.00 to 5.30 p.m
Closed Wednesday

Saturday 9.00 to 1.00 p.m
SAE with all enquiries
Order by telephone or post using your credit card

RISCOMP LIMITED
Dept ETI/25
21 Duke Street,
Princes Risborough,
Bucks. HP17 0AT
Princes Risborough (084 44) 6326

SINGLE BOARD CONTROLLER

Mike Bedford considers the new Single Board Controller from Microtan Computer Systems Ltd and describes some simple modifications which will allow it to be used as a low-cost control computer.

Despite the increasingly large number of home computers on the market there are still surprisingly few which are aimed at the electronics enthusiast. Most machines are entirely suitable for game playing and BASIC programming, having such facilities as medium resolution colour graphics and sound effects, but they do not lend themsleves to learning about the hardware or machine code programming. One product which has become known as a "hardware man's machine" is the Microtan 65, a number of add-ons for which have been featured in ETI. One drawback of the Microtan 65 is that the design is now somewhat dated, the single board having very little memory and being based upon the 6502 processor.

Out of the same stable has now come the Single Board Controller, which is being marketed by Microtanic Computer Systems Ltd. This board uses the same bus specification as the Microtan 65 and can therefore be interfaced with previous Tangerine peripheral boards, but it can also be configured to use the 6809, regarded by many as the most powerful 8 bit processor. Other suitable processors are the 6802 and the 6808 which are versions of the 6800 with on-chip clock and RAM, but in this article the discussion will be restricted to the 6502 and 6809. The controller can also take up to 56K of memory on the one board.

The controller is available either as a complete board, as a kit of parts or as a bare PCB, monitor EPROMs being available separately if this latter option is chosen. As such, the controller forms the basis of an attractive system for the more serious home computing enthusiast and especially those with a hardware bias.

The System

The single board controller has been artworked in such a way that it may take either a 6502 or 6809 processor, so the types of system which may be built around it fall into two categories. A 6502-based system will be similar in many ways to a system built around the original Microtan 65, although clock frequencies up to 1.5 MHz may be used which is twice the speed of the Microtan. The CBUG monitor will be used and will give all the usual facilities of display/modify memory, setting breakpoints, etc, plus a line assembler and disassembler. This system will also allow BASIC resident in EPROM to be added.

A 6809 based system may be run at 1MHz or 2MHz and will use a system monitor called TVBUG. Monitor facilities are similar to those in CBUG except that the line assembler/disassembler is not included but routines for booting from disc and writing MIKBUG compatible records via the serial port are. It should be noted that the single board does not include any video circuitry, so a minimum system must either include the VDU card marketed by MCS Ltd or alternatively some sort of computer terminal interfaced via the RS232 port.

*	BOOT 5 INCH DISC OPERATING SYSTEM
/	BOOT 8 INCH DISC OPERATING SYSTEM
~	USER FUNCTION
/	OPEN LAST ACCESSED MEMORY ADDRESS
B	DISPLAY/MODIFY BREAKPOINTS
C	COPY MEMORY BLOCK
D	DISPLAY MEMORY BLOCK
F	FILL MEMORY BLOCK
G	GO (EXECUTE PROGRAM)
J	JUMP TO SUBROUTINE
M	MODIFY MEMORY
N	SET NULL PAD COUNT
P	TOGGLE PRINTER OUTPUT
R	DISPLAY/MODIFY REGISTER
S	DISPLAY STACK CONTENTS
V	COMPARE MEMORY BLOCK
W	WARM START FLEX OPERATING SYSTEM
X	REMOVE BREAKPOINTS
b	BUILD S1-S9 TAPE BLOCK
l	LOAD TAPE
s	SAVE MEMORY AS TAPE FILE
v	VERIFY TAPE

Table 1. Commands available with CBUG (6502).

M	MEMORY MODIFY/EXAMINE
L	LIST MEMORY
G	GO (EXECUTE PROGRAM)
R	REGISTER MODIFY/EXAMINE
S	SINGLE STEP MODE
N	NORMAL (NON SINGLE STEP) MODE
P	PROCEED (IN SINGLE STEP MODE)
B	SET/CLEAR BREAKPOINTS
O	OFFSETT CALCULATION
C	COPY MEMORY BLOCK
BAS	BASIC COLD START
WAR	BASIC WARM START
D	DUMP TO CASSETTE TAPE
E	EXAMINE CASSETTE TAPE
F	FETCH FROM CASSETTE TAPE
T	TRANSLATE (SINGLE LINE ASSEMBLER)
I	DIS-ASSEMBLER

Table 2. Commands available with TVBUG (6809).

PARTS LIST

RESISTORS		
R1	220R	only for 20mA C/L
R2	220R	only for RS232
R3	4k7	only for RS232
R4	1k0	only for RS232
R5,11,12,14	4k7	
R6	120k	only for cassette interface
R7,8	10k	only for cassette interface
R9,13	470R	only for cassette interface
R10	10k	only for 20mA C/L
RP1	4k7 SIL pack	(7 commoned)
RP2	1k0 SIL pack	(7 commoned)
RP3	10k SIL pack	(4 separate resistors)
RP4	1k0 SIL pack	(4 separate resistors)
CAPACITORS		
C1,7-14	100n	
C2,15	10n	
C3	100p	
C4,6	47n	only for cassette interface
C5	100u	
DISCRETE SEMICONDUCTORS		
Tr1,3	BC184*	only for RS232
Tr2	BC184*	only for cassette interface
* NOTE BC184 HAS DIFFERENT PIN OUT TO BC184L		
D1	1N4001	only for serial I/O
D2	1N4001	
D3	1N4001	
XTAL 1	8.0MHz or 6.0MHz	8.0MHz for 1 or 2MHz operation 6.0MHz for 0.75 or 1.5MHz
XTAL 2	1.8432 MHz	only for serial I/O
INTEGRATED CIRCUITS		
B1	6522	Always fitted for use in computer.
B2	6522	For control applications one or two 6522s may be fitted depending on application. May be replaced by 6821s as described in text. For frequencies above 1MHz use 6522A/68B21.
C1	74LS393	
C2	874LS04	
C3	LM358N	Only for cassette interface
D1	6551	Only for serial I/O. For frequencies above 1 MHz use 6551A.
D2	6809	Either D2 or D3 should be selected.
D3	6502	For frequencies above 1MHz use 68B09/6502A.
D4	75150	only required for RS232
E2	74LS244	May be replaced by wire links for single
E3	74LS244	board control application (see text).
F3	74LS139	
G3	74LS00	
H3	74LS266	
J3	74LS12	
K3	74LS10	
L3	74LS08	
M3	74LS138	
N2	74LS245	Not required for single board applications.
N3	74S288	Memory mapping PROM. Must be programmed as described in text or obtained from MCS. An alternative for simple control application is described in the text.
E1,F1,F2,H1,H2 K1,K2,L1,L2		Memory fitted as required For 6502 computer system the minimum configuration is CBUG(2732) in E1, 6116 in F2. For 6809 computer system the minimum configuration is TVBUG(2732) in E1, 6116 in L1.
MISCELLANEOUS		
PCB; edge connector 2X32 way A+B DIN Euro-connector; IC sockets as required.		

From these minimal systems, which will allow 6502 or 6809 machine code programming and may well be adequate for those whose main interest is computer hardware, many upgrade paths are available. Hundreds of K of RAM or EPROM may be added in paged memory configuration. The addition of a disc controller and disc drives allows the FLEX or OS/9 operating system to be run on the 6809 board or TANDOS on the 6502 controller. Alternatively a Z80 card is available and allows the industry standard CP/M disc operating system to be run on systems with either processor. Other options include high resolution colour graphics, sound effects, serial and parallel I/O, EPROM programmers, real time clocks etc. Table 1 and Table 2 list the commands available under CBUG and TVBUG respectively.

The Board as a Controller

Some months ago, the author started to design a minimum configuration 6809 card to control the ETI Universal EPROM programmer in a stand-alone situation. It soon became clear that this was unnecessary because a board which would do this task at a reasonable cost was already available. Admittedly the 6502/6809 single board controller was not designed for this type of application, and it could be argued that it is a waste to use a board of this complexity for a pure control function.

This would be true if the board was only available fully built, but the fact that a bare board can be obtained and populated only as required for the particular application makes it quite suitable. The cost for control applications can be further reduced by some slight circuit modifications which remove the need for some of the more expensive components. For logic designs of reasonable complexity, the cost of a minimum configuration single board controller will be less than the component cost of a design using discrete TTL devices without even considering the time and expense of PCB artwork and manufacture.

The Circuit

The object of this section, How It Works and the constructional details is to open the board up to the electronics enthusiast. The documentation currently provided by MCS Ltd does not really do justice to the product, a circuit diagram having only just been released, and the one presented here is more comprehensive being the result of many hours tracing the circuit from a bare PCB.

The circuit consists of:

a) The processor, which may be either a 6502 or a 6809 running at a variety of clock frequencies.

b) 9 sockets which will take standard JEDEC packages, allowing 2K, 4K or 8K RAMs or EPROMs to be used depending on link selection.

c) One 6551 configured to provide TTL serial, 20mA current loop or RS232 I/O at various baud rates.

d) Two 6522 VIAs giving 40 bits of parallel I/O, 2 counter/timers and 2 shift registers, one of which controls a cassette interface. When used in a computer system these VIAs provide interfacing for a parallel keyboard and a Centronics printer. When used as a controller, a slight circuit modification allows the 6522s to be replaced by the less expensive 6821 PIAs.

e) A bipolar PROM controlling the memory mapping of the board.

f) Signal buffering and implementation of various TANBUS signals to allow the board to be used as part of a large system by means of a system motherboard.

Construction

It is not the intention of this article to duplicate the information supplied by MCS Ltd, and this will mainly cover those points not covered by the instructions which accompany the PCB or kit. The only point to make is that the task should cause no problems to anyone familiar with the fundamentals of electronic construction. This section will cover the programming of the address decoding PROM and the ways in which the board may be modified slightly to reduce the cost of a minimum configuration system for control applications.

MCS Ltd supply a number of memory mapping PROMs for various applications but do not give instructions on how to work out the programming required to achieve a specific mapping configuration. The 74S288 PROM has a capacity of 32 bytes and, in this application, each of these bytes controls the memory configuration of a 2K block of addressing space within the 64K map. In other words, the first byte affects 0-2K (0000-07FF), the second byte 2K-4K 0800-0FFF) etc.

74S288 PIN No.	74S288 BIT No.	FUNCTION
9	7	A Ø IN THIS BIT ENABLES MEMORY SOCKETS 1-8. THIS IS FURTHER DECODED BY BITS 4,5 & 6.
7	6	WHEREVER A Ø OCCURS IN BIT 7 A THREE BIT BINARY NUMBER SHOULD BE WRITTEN TO THESE BITS TO INDICATE WHICH OF THE EIGHT SOCKETS IS TO BE ADDRESSED. THE SOCKET NUMBER = 1 + THE THREE BIT NUMBER e.g. ØØØ ADDRESSES SOCKET No.1.
6	5	
5	4	
4	3	A Ø IN THIS BIT ENABLES MEMORY SOCKET No.Ø. THIS IS A SPECIAL SOCKET UNAFFECTED BY CLOCK ENABLE etc. AND IS USED FOR THE MONITOR EPROM.
3	2	WHEREVER A Ø OCCURS IN BIT 7 ONE OF THESE TWO BITS SHOULD BE SET TO INDICATE WHETHER THE MEMORY SOCKET SPECIFIED BY BITS 4,5 & 6 IS TO BE CONSIDERED AS RAM OR EPROM FOR BLOCK ENABLING AND MEMORY INHIBITING PURPOSES. BIT 2 = 1 FOR RAM BIT 1 = 1 FOR EPROM
2	1	
1	0	A1 IN THIS BIT ENABLES THE TOP HALF OF THE 2K BLOCK TO BE THE I/O AREA

Table 3. Memory mapping PROM bit designations.

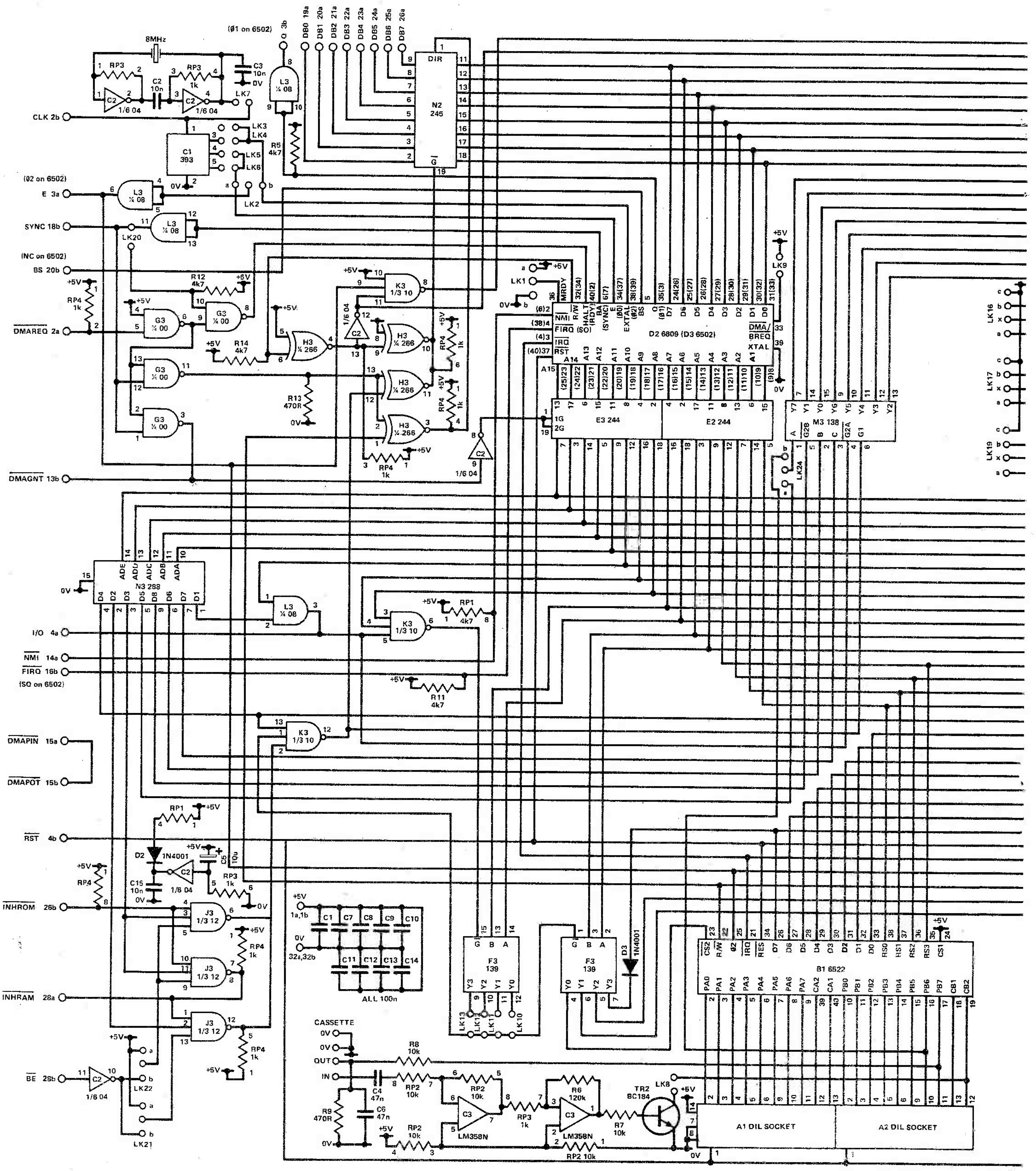
Table 3 shows the significance of each bit within these bytes, bit 0 in this illustration being the least significant and bit 7 the most significant. As an example, Table 4 shows the programming of the standard memory map PROM for a 6502 CBUG system. Looking at the bit 7 column it is clear that the sockets 1-8 are enabled for addresses 0000-2000 and C000-EFFF, these blocks being the only ones where a 0 is programmed. The columns for bits 4, 5 and 6 indicate that sockets 1, 2, 3, 4, 7 and 8 are configured for 2K devices as each of these sockets is addressed for only a single 2K block and sockets 5 and 6 are addressed for 2 blocks each and are therefore 4K devices. It can be seen that 0000-07FF addresses socket 1, 0800-0FFF — socket 2, 1000-17FF — socket 3 up to E800-EFFF — socket 8.

By looking at the bit 1 and 2 columns we can see that, of these 8 sockets, the first four have a 1 for bit 2 and are therefore RAMs and the second four have a 1 for bit 1 and are therefore EPROMs. The last two 2K blocks have a 0 in bit 3 which selects socket 0, the monitor EPROM which is obviously a 4K device, and to complete the map, a 1 in bit 0 for the block B800-BFFF indicates that the I/O area is in the top half of this block ie BC00-BFFF.

ADDRESS BLOCK	EPROM ADDRESS	DATA BITS 7	6	5	4	3	2	1	0	HEX
0000-07FF	00	0	0	0	0	1	1	0	0	0C
0800-0FFF	01	0	0	0	1	1	1	0	0	1C
1000-17FF	02	0	0	1	0	1	1	0	0	2C
1800-1FFF	03	0	0	1	1	1	1	0	0	3C
2000-27FF	04	1	0	0	0	1	0	0	0	88
2800-2FFF	05	1	0	0	0	1	0	0	0	88
3000-37FF	06	1	0	0	0	1	0	0	0	88
3800-3FFF	07	1	0	0	0	1	0	0	0	88
4000-47FF	08	1	0	0	0	1	0	0	0	88
4800-4FFF	09	1	0	0	0	1	0	0	0	88
5000-57FF	0A	1	0	0	0	1	0	0	0	88
5800-5FFF	0B	1	0	0	0	1	0	0	0	88
6000-67FF	0C	1	0	0	0	1	0	0	0	88
6800-6FFF	0D	1	0	0	0	1	0	0	0	88
7000-77FF	0E	1	0	0	0	1	0	0	0	88
7800-7FFF	0F	1	0	0	0	1	0	0	0	88
8000-87FF	10	1	0	0	0	1	0	0	0	88
8800-8FFF	11	1	0	0	0	1	0	0	0	88
9000-97FF	12	1	0	0	0	1	0	0	0	88
9800-9FFF	13	1	0	0	0	1	0	0	0	88
A000-A7FF	14	1	0	0	0	1	0	0	0	88
A800-AFFF	15	1	0	0	0	1	0	0	1	88
B000-B7FF	16	1	0	0	0	1	0	0	0	88
B800-BFFF	17	1	0	0	0	1	0	0	1	89
C000-C7FF	18	0	1	0	0	1	0	1	0	4A
C800-CFFF	19	0	1	0	0	1	0	1	0	4A
D000-D7FF	1A	0	1	0	1	1	0	1	0	5A
D800-DFFF	1B	0	1	0	1	1	0	1	0	5A
E000-E7FF	1C	0	1	1	0	1	0	1	0	6A
E800-EFFF	1D	0	1	1	1	1	0	1	0	7A
F000-F7FF	1E	1	0	0	0	0	0	1	0	82
F800-FFFF	1F	1	0	0	0	0	0	1	0	82

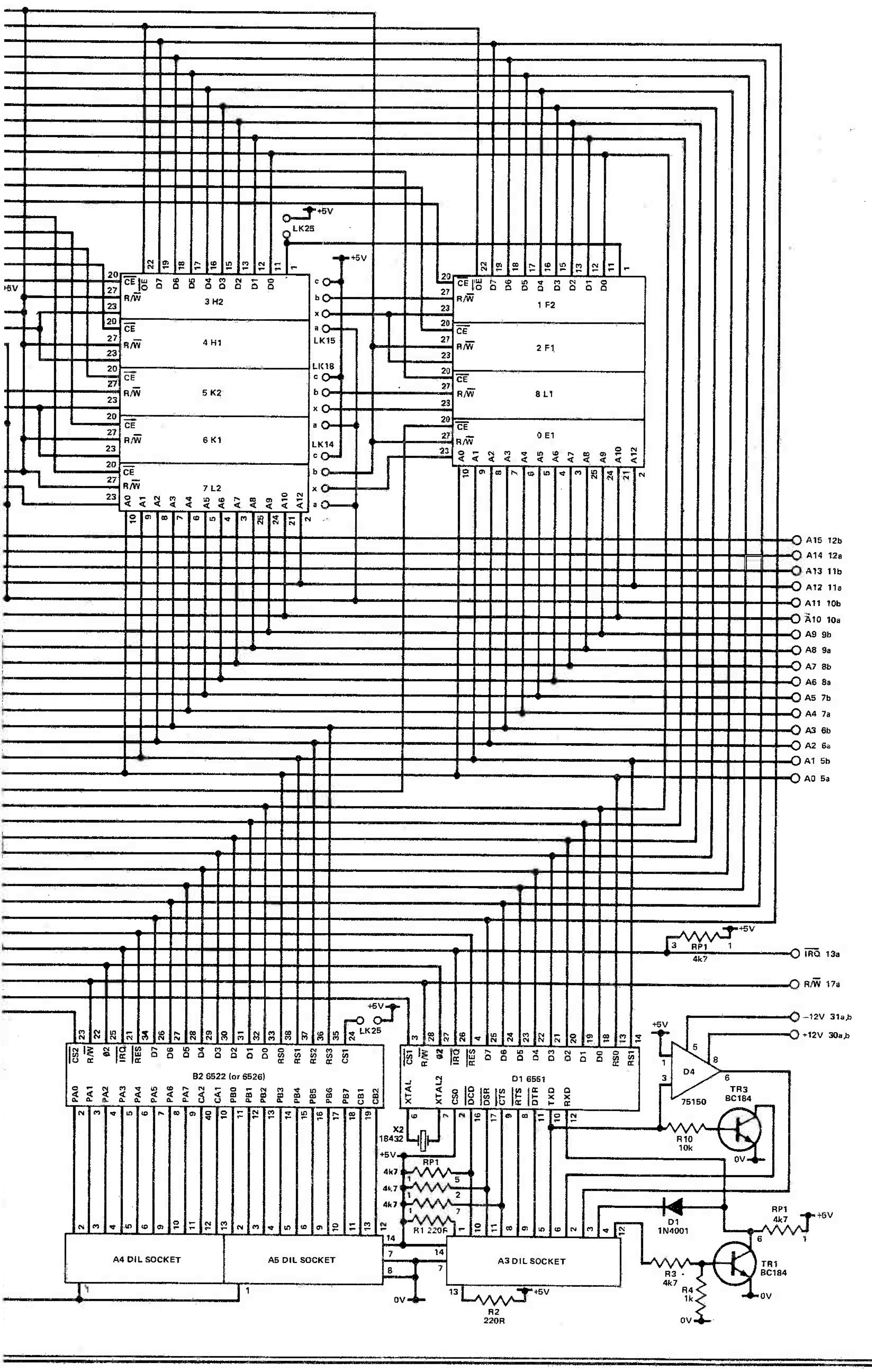
Table 4. Memory mapping PROM for 6502 CBUG configuration.

Fig. 1 Circuit diagram of the Single Board Controller. The numbers in brackets are the pin numbers of alternative devices, the 6502 which can be used instead of the 6809 and the 6526 instead of the 6522.



WORKS

The heart of the circuit is either D2, the 6809 processor or D3, a 6502 (6802 or 6808) processor, these two using slightly offset sockets. On the circuit diagram (Fig. 1) the two possible processors are shown as one block, the pin numbers and functions for the 6502 option being shown in brackets (where different from the corresponding 6809 functions) next to the 6809 pin numbers and functions. LK1 is used for enabling or disabling on chip RAM if the 6802/6808 is in use and LK9 allows a battery supply to be used with this same processor for power down data retention. The processor clock is provided by the circuitry around C1, a binary counter and its associated crystal oscillator. LK7 selects either the on-board crystal oscillator or an off-board master clock. LK3, LK4, LK5 and LK6 select the processor frequency and LK2 alters the clock configuration depending on the type of processor in use. The power-on reset circuit is the portion including one-sixth of C2, D2 and capacitors C5 and C15. Buffering of the address bus is provided for on-board and external use by E2 and E3 whereas N2 buffers the data bus for off board peripherals only. E1, F1, F2, H1, H2, K1, K2, L1 and L2 are sockets for JEDEC memory devices, the specific type of device in use being specified by links LK14-19, some of which control a single socket and some of which affect a pair of memory sockets. The chip select decoding of these memories comes from M3, a 3 to 8 line decoder which is used in conjunction with N3, a bipolar PROM which controls the memory mapping of the complete board. LK24 allows a 2 page memory configuration to be implemented on board, the page selection being controlled from B1, a 6522 VIA. The circuitry around J3 allows on board memory to be enabled or disabled via the external BE (block enable) signal which is generated on the system mother board and allows a paged memory configuration greater than 64K to be achieved. LK21 and LK22 allow this facility to be disabled for on-board EPROM or RAM respectively. The same circuitry is sensitive to the Tanbus Inhibit RAM and Inhibit ROM signals which other boards may generate under various circumstances to disable portions of on-board memory. B1 and B2 are the 6522 VIAs, connection to the outside world being made via the DIL sockets A1, A2, A4 and A5. Socket B2 can take a 6526 in place of the 6522; this device has time of day registers and requires a 50Hz clock which may be connected via LK25. The cassette interface is driven from B1 and the circuitry round C3, an LM358N op-amp. D1 is the 6551 UART, access to which is provided via DIL socket A3 and the circuitry around D4, T33 and Tr1 provides RS232 (transmitted and received data only — not modem control lines) and 20mA current loop signal levels. The address decoding for the I/O devices is provided by F3 while links LK10-13 allow four optional addresses for the on-board portion of the I/O area. The I/O area select signal is also made available to off-board devices via the edge connector. Provision is made for DMA, the circuitry comprising G3 and H3 taking DMA request and generating DMA granted.



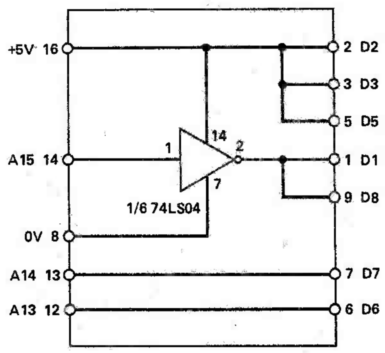


Fig. 2 The circuit which may be used for memory mapping instead of a PROM in control applications.

From the foregoing information it should be clear that virtually any memory map in 2K steps can be specified by the programming of the PROM. However, for a minimal configuration as used for control applications, a cost reduction can be made by replacing this component with a number of wire links and a simple TTL device which could be soldered onto a DIL header and inserted into the PROM socket. Figure 2 shows the circuit diagram of such an arrangement which gives a crude but effective memory map for many control applications. In this map the I/O area repeats sixteen times in 2K steps starting at 0400-07FF: socket 5 is addressed at 8000-9FFF, socket 6 at A000-BFFF, socket 7 at C000-DFFF and socket 8 at E000-FFFF. Obvously if 4K devices are used they will repeat twice within the 8K block and 2K devices will repeat four times. It should be noted that this configuration does not give RAM at address 0 and accordingly will be more practical for a 6809 application than for the 6503 which generally requires zero page memory at this address.

The memory mapping PROM does not dictate the mapping of the various I/O devices within the I/O area. This is partially fixed by the hardware and partially a function of LK10, LK11, LK12 and LK13, only one of which will be fitted. Table 5 shows the I/O memory map.

When used as the basis of a computer system the 6522 VIAs will be required as their facilities are made use of by the system software, but in many control applications all that is required is the parallel I/O capability so the less expensive 6821 PIAs could be used. Unfortunately the pin-outs of the two devices are not identical, which means that a few tracks need cutting and few wire links require adding to the back of the board. Figure 3 shows the details of this modification. The 6821 only occupies an addressing space of 4 compared to the 16 bytes of the 6522 which means that, once the modification has been carried out, the 6821 registers will be spaced at intervals of 4 bytes. This need present no problem so long as it is not overlooked when writing the firmware.

To achieve further cost reductions for control applications it is merely necessary to omit those components which are not required for the particular application. One RAM and one EPROM will obviously be required as will at least one of the 6522 VIAs (or 681 PIAs). If no RS232 facility is required then D1, D4, Tr1, Tr3, X2 and their associated passive components may be left out. If the cassette interface is not to be used C3 and Tr2 together with their passive components can be omitted. As a final cost reducing exercise, assuming that no other boards are to be connected to the bus, the address and data bus buffers may be omitted. The data bus buffer N2 may be simply left out, but the address bus buffers E2 and E3 will require linking across as they supply on-board as well as off-board devices. This linking is done by omitting the chips in question and linking each input to its corresponding output, as may be seen from the circuit diagram (ie pins 13 to 7, 17 to 3, etc).

ETI

LINK FITTED	6522 B1	START ADDRESS 6551 D1	6522 B2
LK10	I/O+00H+00H	I/O+00H+10H	I/O+00H+20H
LK11	I/O+40H+00H	I/O+40H+10H	I/O+40H+20H
LK12	I/O+80H+00H	I/O+80H+10H	I/O+80H+20H
LK13	I/O+C0H+00H	I/O+C0H+10H	I/O+C0H+20H

Table 5. Memory map of I/O area.

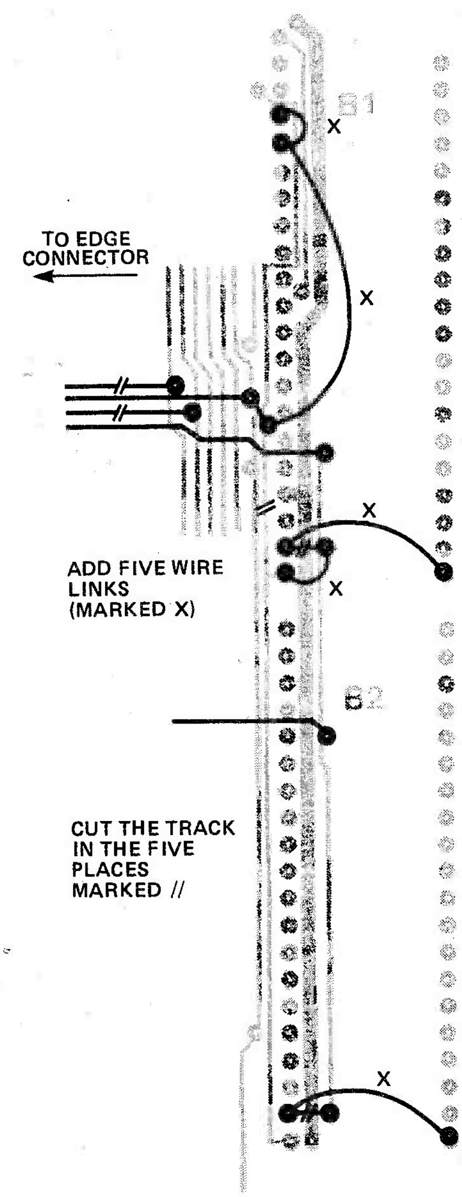


Fig. 3 PCB modification to enable 6821s to be used in place of 6522s.

BUYLINES

The PCB is not available from the ETI PCB service but may be obtained from Microtanic Computer Systems Ltd, 102, Lordship Lane, Dulwich, London SE22, tel 01-299 1419. MCS Ltd also supply complete kits of parts for various 6502 and 6809 configurations, ready built boards and pre-programmed memory mapping PROMs and monitor EPROMs. For those obtaining just the PCB from them there should be few problems finding the necessary components from standard sources.

DISTORTION METER

In the third and final part of this series, John Linsley Hood describes the construction and use of the instrument.

The THD meter is built on two main PCBs, one carrying the circuitry for the distortion meter itself and the millivoltmeter while the other carries the oscillator circuitry. A further PCB is required for the stabilised mains power supply or the dual-rail circuit if a single battery is to be used. No power supply circuitry is required if the distortion meter is to be operated directly from twin batteries. The mains power supply circuit is so standard that we have re-used an existing PCB rather than lay out a new one.

Assembly of the PCBs should present no problems if the overlay diagrams are followed carefully, and the only points to watch are the usual ones concerned with the orientation of ICs, electrolytic capacitors, diodes and any other polarity-conscious components. If you are planning to use IC sockets these should be soldered onto the boards first of all, followed by the resistors and capacitors and then the diodes. The ICs can then be inserted in their sockets when the soldering is complete. If you are not using sockets, solder the passive components into place first, then the diodes, etc, and last of all the ICs.

The choice of case will be largely determined by the method of powering you intend to employ. The single battery option will fit into a fairly small case, especially since there will be no problems of mains pick-up. The twin-battery option will require a slightly larger case but is otherwise as compact as the first type, while the mains-powered version will require extra space for the transformer plus enough clearance between this and the main circuitry to prevent the risk of hum pick-up. Whichever system you are using, it is advisable to choose a die-cast box rather than a pressed-steel or other metal one, and you should certainly not use a plastic box.

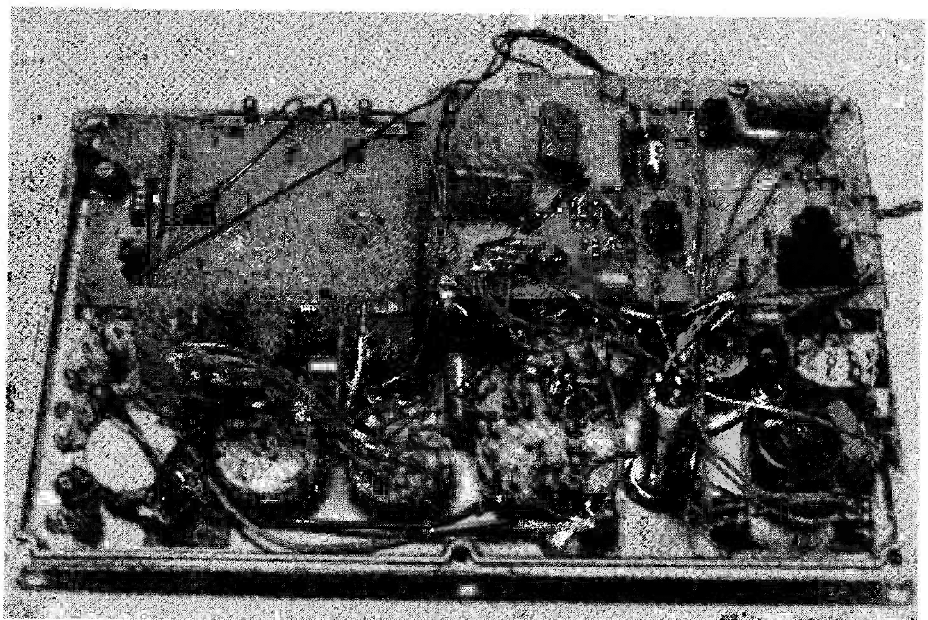
The PCBs are mounted below the front panel using stand-off pillars, and the total depth of the finished unit should be about two inches. This allows plenty of room for a metal screen and a mains power supply to be mounted in the base of a suitable box without making the completed instrument unduly deep. It is a good idea, however, to give yourself plenty of room even if you are not building the mains version. Too tight a construction may lead to capacitive coupling between various parts of the circuit and this will introduce a number of problems. One particular example is the effect of coupling the feedback signal from the millivoltmeter into the early stages of the THD meter circuit. This gives rise to a spurious crossover distortion effect which mysteriously vanishes when the instrument is nulled.

The input attenuator resistors can be mounted between the tags of the rotary switch. If you are using the specified values this

OOPS!

The formula for calculating the null frequency of a Wien network, given in the first part of this series on page 58 of the January issue, was incorrect. It should be

$$F_o = \frac{1}{2\pi\sqrt{C_1 C_2 R_3 R_4}}$$



Internal view of the prototype. A number of modifications have been incorporated in the final version, so don't try and follow this wiring too closely!

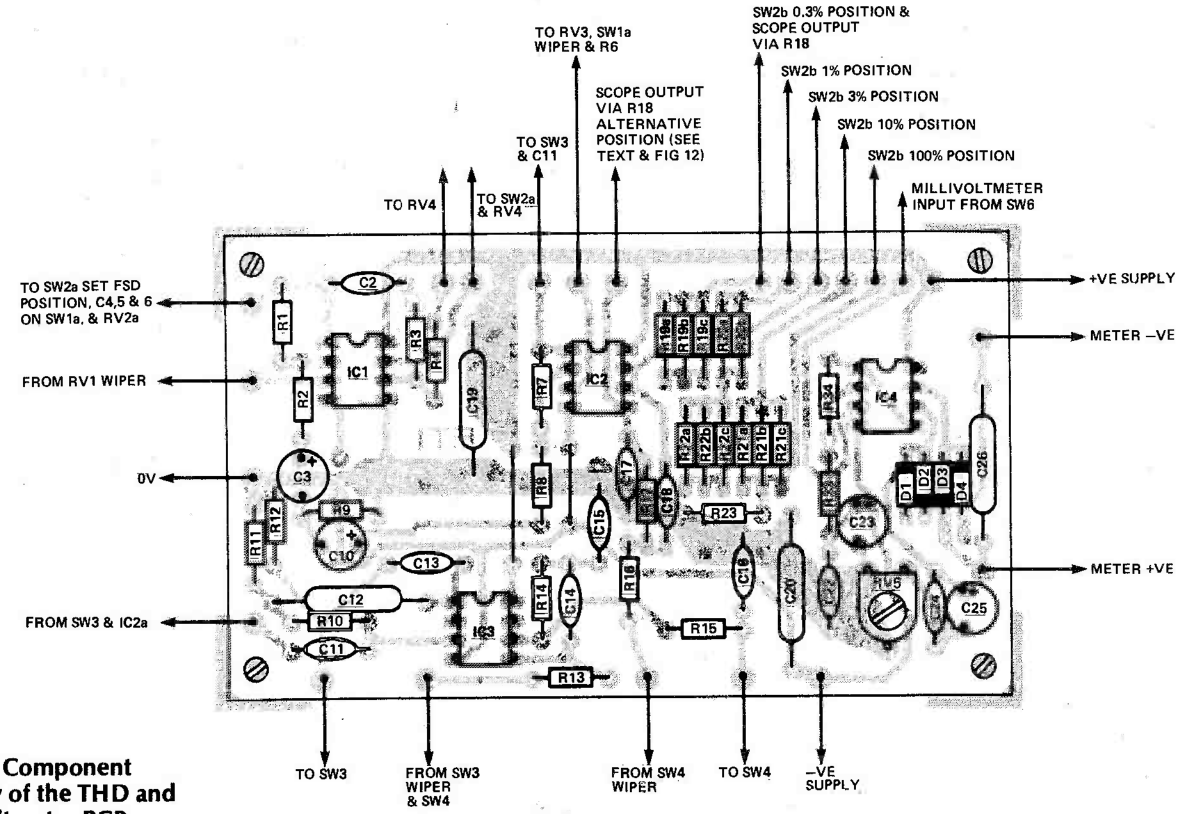


Fig. 13 Component overlay of the THD and millivoltmeter PCB.

PARTS LIST — THD METER AND MILLIVOLTMETER

RESISTORS (all ¼W carbon or metal film)	
R1	12k
R2	3k9
R3	5k6
R4	10k
R5	470R
R6	560R
R7, 15, 18	2k2
R8	220R
R9	47R
R10, 11, 12	6k8
R13	39k
R14, 33	2k7
R16, 17	3k3 (see text)
R19, 27	2k33 (see text)
R20, 28	666R (see text)
R21, 29	233R (see text)
R22	90R (see text)
R23, 32	10R (see text)
R24	66k6 (see text)
R25	23k3 (see text)
R26	6k66 (see text)
R30	66R6 (see text)
R31	23R (see text)
R32	10R (see text)
R34	68k
RV1	10k
RV2	10k dual gang
RV3	100R
RV4	2k2
RV5	2k7
CAPACITORS	
C1, 4, 7, 12, 19, 20, 21, 24, 26	470n
C2	1u0
C3	2u2 electrolytic
C5, 8, 13	47n
C6, 9	4n7
C10, 23, 25	47u electrolytic
C11	22n
C14, 15	3n3
C16	33n
C17	470p (see text)
C18	1n0 (see text)
C22	100n
SEMICONDUCTORS	
IC1 – 4	TL072
D1 – 4	1N4148
MISCELLANEOUS	
M1	100uA meter
SK1 – 3	co-axial socket, panel mounting
SW1	2 pole, 3 way rotary switch
SW2	2 pole, 6 way rotary switch
SW3, 4, 6	SPDT toggle switch
SW5	1 pole, 9 way rotary switch
PCB.	

arrangement is not too critical, but if, as discussed earlier, you decide to use higher values to increase the input impedance, you may find it necessary to screen the switch to prevent pick-up. Note that a number of other components are also mounted on or between switches and potentiometers rather than on the PCBs. These include R5, 6, and 18 and C1, C4-9 and C21. Because we have re-used an existing PCB rather than design one specifically for this project, R54 and R55 in the mains power supply must also be mounted off of the board.

Connecting up the PCBs and the various controls should present no problems provided you adopt a fairly methodical approach, but don't make the wiring any longer than you absolutely have to. This is particularly important with the mains wiring if you are building a mains-powered instrument.

When the unit has been completed and appears to be working correctly, the sensitivity of the basic meter amplifier should be adjusted to 10mV FSD. This is probably best done, if appropriate calibration gear is not available, by setting up a small mains transformer to give a 50Hz output in the range 5-20V, as measured by a multi-meter with an AC range. You can then adjust meter sensitivity by means of RV5, on an appropriate range setting, until it gives the same reading.

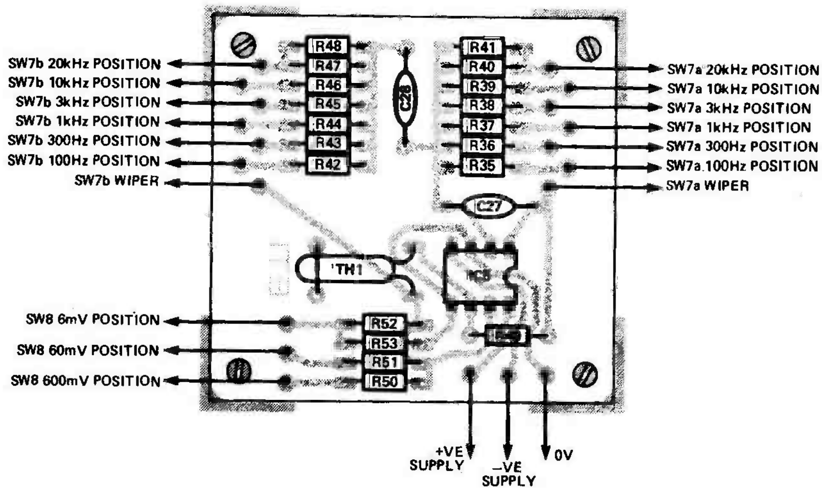


Fig. 14 Component overlay of the spot frequency oscillator PCB.

PARTS LIST — OSCILLATOR

RESISTORS (all ¼W carbon or metal film)		**CAPACITORS**	
		C27, 28	4n7
R35, 42	330k	**SEMICONDUCTORS**	
R36, 43	100k	IC5	TL072
R37, 44	33k		
R38, 45, 52	10k	**MISCELLANEOUS**	
R39, 46	3k3	SK4	co-axial socket, panel mounting
R40, 47	1k8		
R41, 48	27k	SW7	2 pole, 6 way rotary switch
R49	1k5		
R50	220R	SW8	1 pole, 3 way rotary switch
R51	22k		
R53	100R	TH1	RA53
RV6	2k5	PCB.	

PARTS LIST — MAINS PSU

RESISTORS		LED1	panel mounting LED
R54	470R		
R55	1k0	D5 – 8	1N4001
CAPACITORS		**MISCELLANEOUS**	
C29, 31	100u 16V electrolytic	SW9	mains toggle switch
C30, 32	1000u 25V electrolytic	T1	15-0-15V 3VA mains transformer, PCB mounting
SEMICONDUCTORS			
IC6	7815		
IC7	7915	PCB.	

Using The Distortion Meter

While the major application which will occur to the reader will undoubtedly be that of testing audio amplifiers, for example, to see whether the quiescent current setting of a transistor amplifier output stage is correct or to check that one is getting the results one should from a DIY unit, there are other uses.

There are three particular applications which are especially valuable. One is to check that the alignment of a pick-up cartridge on its arm is correct. For this one needs a test record with a track of 1kHz or 3kHz (the higher, the more difficult for the cartridge) recorded at, say, 5cms/sec. If the cartridge is properly aligned, the THD should be in the range 0.4 to 1.2%, depending on cartridge quality. A worn stylus will worsen these figures rapidly, especially at higher frequencies, so if one checks the 'off-record' THD from time to time, one can monitor the health of the stylus.

A second useful application is to check the correct recording and bias levels on a tape or cassette recorder. With the latter, on a reasonable machine, the THD should be of the order of 0.3% at −5VU. This will worsen with increasing signal level, becoming perhaps 3% just below the recording overload level, which will allow the overload level to be determined for a particular machine/tape combination. A reel-to-reel machine, at 7.5 ins/sec, should have THD levels of about half these values.

Since the bias level settings on a tape recorder are a compromise between flatness of frequency response and THD, the combination of oscillator, millivoltmeter and THD meter should allow one to check or reset

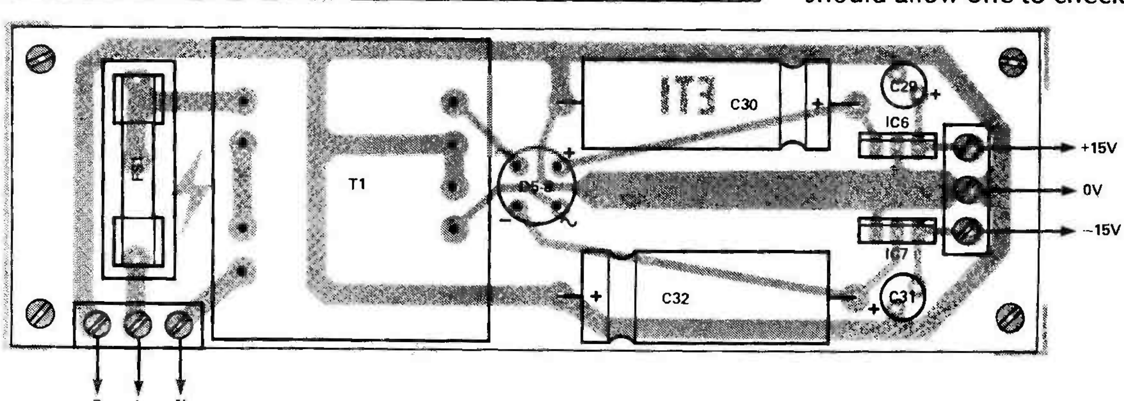


Fig. 15 Component overlay of the mains power supply PCB.

this level if it is not ideally chosen.

The final additional use for a THD meter is in setting up FM tuners. The THD of these depends on the alignment of the IF tuning coils and also upon the setting of the quadrature coil on the demodulator IC. By using the BBC test tones which are sometimes broadcast after the finish of programmes, the THD of the signal can be measured and optimised by adjustments to the controls.

I ought at this stage to sound a small note of warning in that one should be reasonably sure what one is doing before coil-twiddling inside an expensive and complicated commercial FM tuner. If it is a DIY job, one should be able to get back to square one if things go wrong.

In all of these applications, the method of operation is the same:-

1. Set the THD meter input sensitivity to zero, and switch out both of the filter stages.
2. Set the mV/THD switch to THD, and set the Mode switch to Set FSD.
3. Connect the input of the meter to the output of the system under test, and gradually increase the input sensitivity control until the output meter reads full scale.
4. Switch the mode switch to 100% and alter the setting of the Coarse tune (RV2a and 2b) and Trim (RV4) controls, at an appropriate choice of frequency range (set by SW1). Adjust until the best practicable notch is obtained with the mode settings adjusted to the 10% and 3% positions.
5. Progressively increase the sensitivity given by the mode switch setting until the highest practical value is obtained, with the fine tune (RV3) and trim pots adjusted alternately until no lower value of residual reading can be obtained. Although the use of a single gang pot as RV3 is practicable, it does mean that it is necessary to try trim settings on either side of the apparent minimum position before adjusting the fine tune pot.

If the constructor uses the completed instrument to assess the quality of the built-in oscillator, the THD values obtained should be similar to those shown in Table 1 for the prototype. This is a useful first test, serving both to confirm that all is well with the meter and also giving some practice in using the instrument.

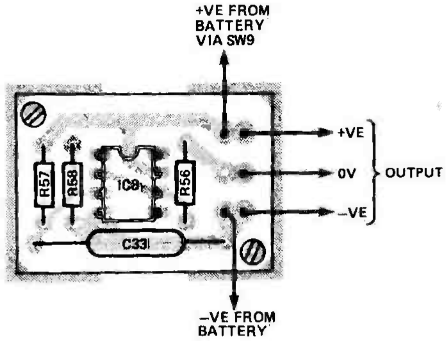


Fig. 16 Component overlay of the single battery supply PCB.

PARTS LIST — SINGLE BATTERY PSU

RESISTORS	
R56	100R
R57, 58	1M0
CAPACITOR	
C33	1u0
SEMICONDUCTOR	
IC8	TL071
MISCELLANEOUS	
SW9	SPST toggle switch

Interpreting The Results

In spite of all the publicity which attends the introduction of new, very high quality audio amplifiers, and in spite of the continuing efforts of designers — me included — to produce very low distortion systems, I think a lot of the effort devoted to getting more 0s after the decimal point is of small value to the user. Even with modern designs, in which most of the residual distortion will be due to crossover type defects which lead mainly to audibly unpleasant high-order harmonics, I do not believe it is possible to hear the difference between nil and 0.05%. For myself, I am convinced that if an amplifier doesn't sound well and the THD is less than 0.05%, the problem lies elsewhere, possibly in its transient response or maybe in incipient instability or overload hang-up effects.

I say this to save users from needless anxiety if, in testing a well loved unit, they find it has, say, 0.04% THD — or maybe even more. Most of that could be low order distortion which isn't audible, or even hum and noise. The corollary is also true, that an instrument with a lower THD limit of, say, 0.03% will still be a valuable aid in making sure that the domestic hardware isn't letting the side down!

ETI

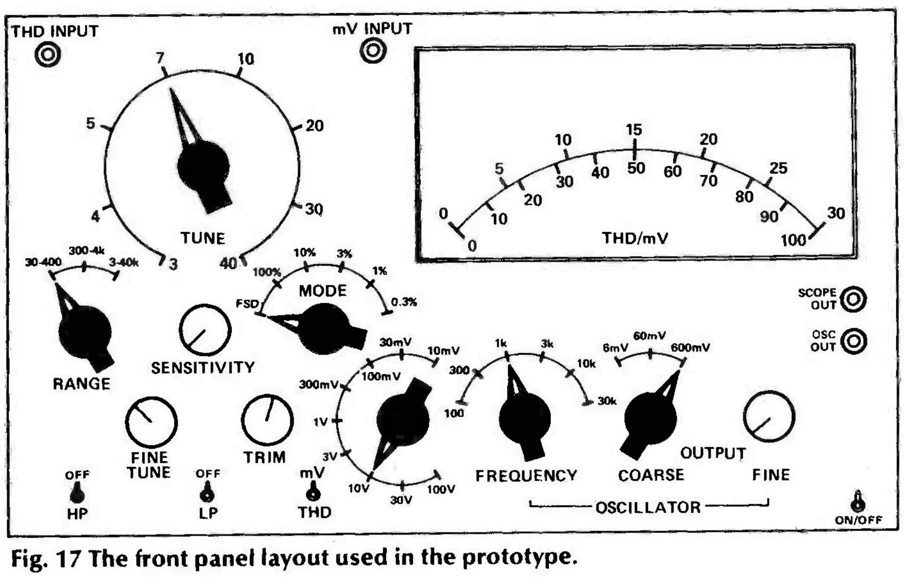


Fig. 17 The front panel layout used in the prototype.

RVM Audiotronic

Abbots Hill Chambers
1st Floor, Gower Street,
Derby DE1 1SD

Tel: Derby 0332/382433

Modules	Power RMS	Load	Volt Max	Size (mm)	Price
RVM150S	70-150W	4-8	±60	31x80x100	1+ **27.00**
					10+ **22.97**
					20+ **22.77**
RVM300S	120-300W	4-8	±65	31x102x136	1+ **37.80**
					10+ **32.13**
					20+ **30.24**
RVM400S	170-400W	4-8	±65	47x89x136	**47.05**
RVM700S	300-700W	2-8	±70	47x90x197	**70.10**
RVM700S Mounted on Heat Sink					**70.40**

MAIL ORDER ONLY

RVM RANGE OF POWER MOSFET AMPLIFIER MODULES.
These Power Mosfet Modules are very reliable, driving difficult loads is no problem. Application from hi power systems to studio to domestic hi-fi.
All of our modules are built and tested and carry a 2 year guarantee.
We also supply a range of heat sinks, specially recommended for RVM modules.

All prices include post & packing.
(Quantity discount available)

To order send cash with order, or cheque/postal order.
Delivery on our Modules and Heat Sink or same day dispatch when order is received with cash, allow 7 days with cheque or postal order.

hobbyboard

Printed Circuit Hardware & Component Catalogue

- ★ COPPER CLAD LAMINATES
- ★ PHOTO-RESIST LAMINATE & CHEMICALS
- ★ PRINTED CIRCUIT DRAUGHTING AIDS
- ★ VERO BOARD & PROTOTYPING SYSTEMS
- ★ CONNECTORS/CASES/GENERAL HARDWARE
- ★ SELECTION OF COMPONENTS
- ★ EDUCATIONAL COMPUTING
- ★ ELECTRONICS KITS

Send for your free catalogue to:

A FARNELL ELECTRONICS COMPANY

KELAN ENGINEERING LTD.
Circuit Products & Components Division.
27-29 Leadhall Lane, Harrogate.
North Yorkshire. HG2 9NJ.
Tel: (0423) 870938. ETI/3/85

NAME ....
ADDRESS ....
....
....

QUASAR

STEREO CASSETTE DECK

SPECIAL OFFER PRICE

From

RTVC

£29·95

INCLUDING VAT & CASE PLUS £2.75 P & P

For a special offer price of only **£29.95** we're offering you this super Quaser Cassette Deck Kit. Including tape transport mechanism, n, ready punched and back printed quality circuit board and all electronic parts i.e. semi-conducters, resistors, capacitors, hardware, top cover, printed scale, mains transformer and a self assembly simulated wood cabinet. You only supply solder and hook-up wire.

SPECIFICATIONS:

Case size 285x260x90mm approx. Mechanism with automatic stop and tape counter with reset button. Tape Speed: 4.76cm/sec (1 7/8 in/sec). Wow & Flutter: Typically 0.1%. Drive Motor: 12V d.c. with electrical governor. Play Torque: 40-75g/cm (DYNAMIC). Rewind & Fast Forward Torque: 60-140g/cm (STATIC). Rewind & Forward Time: Less than 100 sec. for C60 tapes. Bias/Erase Oscillator: Externally variable, frequency 60-100kHz. Output: (Adjustable) Up to 1 volt r.m.s. Mic. Sensitivity: 1mV @ 47k. DIN Sensitivity: 30mV @ 47k. Frequency Response; 30Hz-12.4kHz (−3dB). Signal to Noise Ratio. Noise reduction OFF-50dB. Noise reduction H.F. -56dB Noise reduction FLAT-70dB Cross Talk: Typically-50dB.

CALLERS WELCOME: 323 EDGWARE RD., LONDON W2.
– Open 6 days a week 9.00 – 5.30.
21 HIGH ST., ACTON LONDON W3 6NG
Tel: 01-992 8430 – Open 6 days a week 9.30 - 5.30
½ day closing Wednesdays

To: RT-VC, 21A High St., Acton, London W3 6NG

Please send me [ ] Kit/s
One deck kit costs £29.95 plus £2.75 p&p (£32.70)
I enclose PO/Cheque No .... Value ....
Name ....
Address ....
....

Access 'phone orders 01-992 8430
To: RT-VC, 21A High Street, Acton, London W3 6NG

PARAGRAPH EQUALISER

Are Barry Porter's paragraphs equal to the task of describing the construction of this innovative project? Read on and find out.

By now, it must be obvious that the ParaGraph need not be limited to the suggested ten frequency bands, but this number does seem to give the best opportunity of applying just about any required response characteristic. A suggested panel layout is shown in Fig. 14, based on standard 19" rack mounting dimensions, so there is a wide choice of suitable cabinets available.

Each filter stage is built onto a separate circuit board, which is attached to the front panel by the frequency and Q adjustment potentiometers. The board layout is shown in Fig. 11. The cut-out area allows different types of slide fader to be used and ensures that the rotary controls can be in line with the fader. Remember to purchase sliders which can be mounted by screws from the front, and use a dummy front panel if you don't want the screw heads to show.

The only components that differ between one filter board and another are the integrator capacitors, and plenty of space has been left for these. Instead of attempting to mount the various capacitor types and sizes in the normal way, small terminal pins should be pressed through the capacitor mounting holes, and the components soldered to these from the top of the board.

Once the boards have been assembled, they should be attached to the front panel making sure that they are in the correct order. The busses which carry the various common connections should be fed through the circled holes and continued to the circuit board that contains the main signal path components (Fig. 12). A suitable guage of tinned copper wire should be used for the busses and this may be insulated with short lengths of sleeving if it is felt that there is any danger of short circuits occurring.

OOPS!

There were a number of errors in the first part of this project published last month. On page 31, in the formula for resonant frequency which appears towards the bottom of the third column under the heading 'Principle Of Operation', the bottom line should read $2\pi R_f C$.

In Fig. 5, the input stage circuit diagram, pin 2 of IC1b should be taken from the wiper of RV1 only. The link shown between this pin and the junction of RV1/R8 should not be there. There are also two resistors marked R10 on the diagram: the lower one, in the −15V supply line, should be R11.

In Fig. 7, the main signal path circuit diagram, there are two capacitors marked C24: the one connected between ground and the junction of R28/C27 should be C29.

In Fig. 8, the state variable filter circuit diagram, the IC supply pin numbers are missing. The +15V supply via R39 connects to IC6 & 7 pin 7 and the −15V supply via R40 connects to IC6 & 7 pin 4.

In Fig. 9, the balanced output stage diagram, the numbering of pins 2 and 3 on IC11 is reversed; the + and − signs on the two pins are correct. The input to R41/C42 should be marked "FROM SW2b" and C42 should be 330n, not 330k. The 'SET OUTPUT SYMMETRY' preset between R54 and R55 should be marked RV5, not RV4.

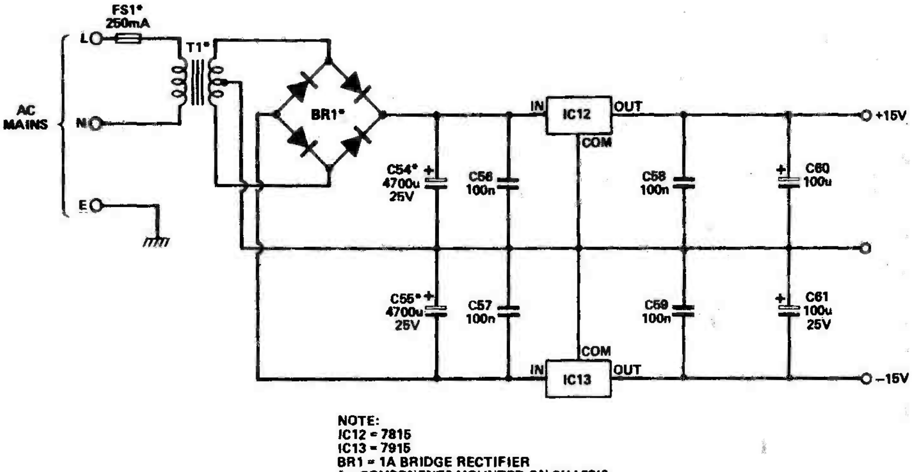
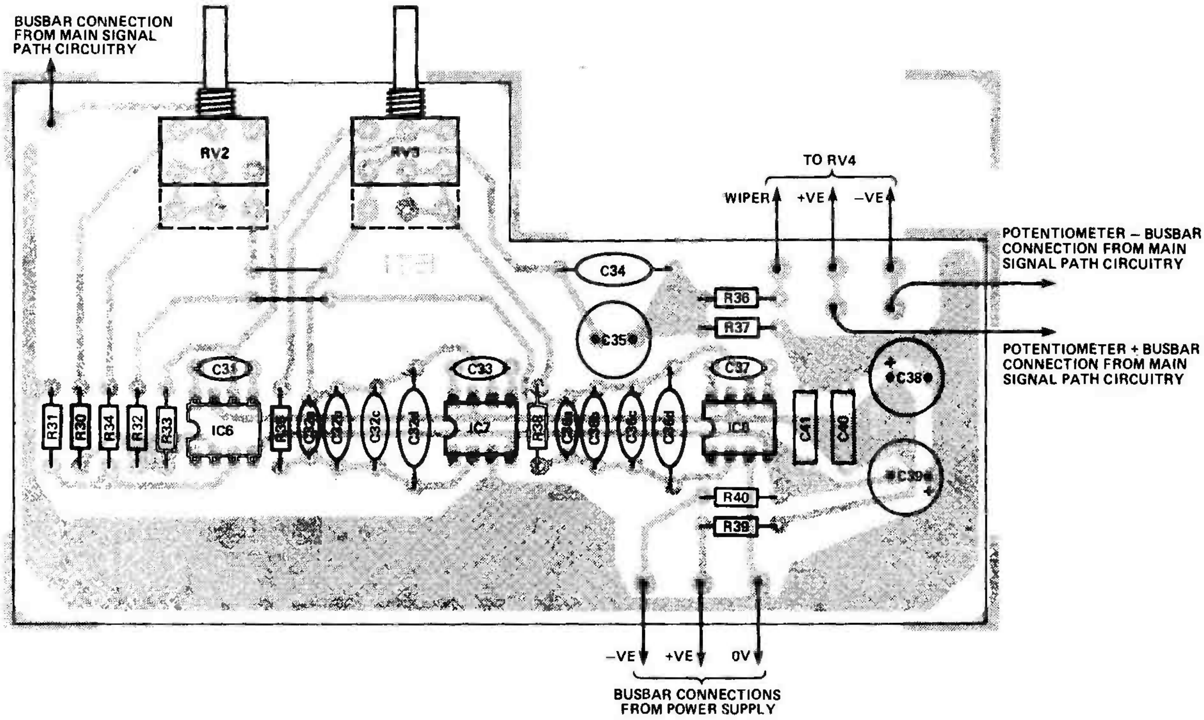


Fig. 10 Circuit diagram of the stabilised power supply.



PARTS LIST — FILTER BOARD

RESISTORS (all ¼W 1% metal film)

R30, 31, 34	10k
R32, 33	20k
R35, 38	11k
R36	4k3
R37	47k
R39, 40	10R
RV2	100k linear dual gang rotary potentiometer
RV3	22k linear dual gang rotary potentiometer
RV4	10k linear slider potentiometer

CAPACITORS

C31, 33, 37	22p polystyrene
C32, 36	see Table 1
C34	100n polycarbonate
C35	22u 16V non-polarised radial electrolytic
C38, 39	100u 25V radial electrolytic
C40, 41	100n polyester

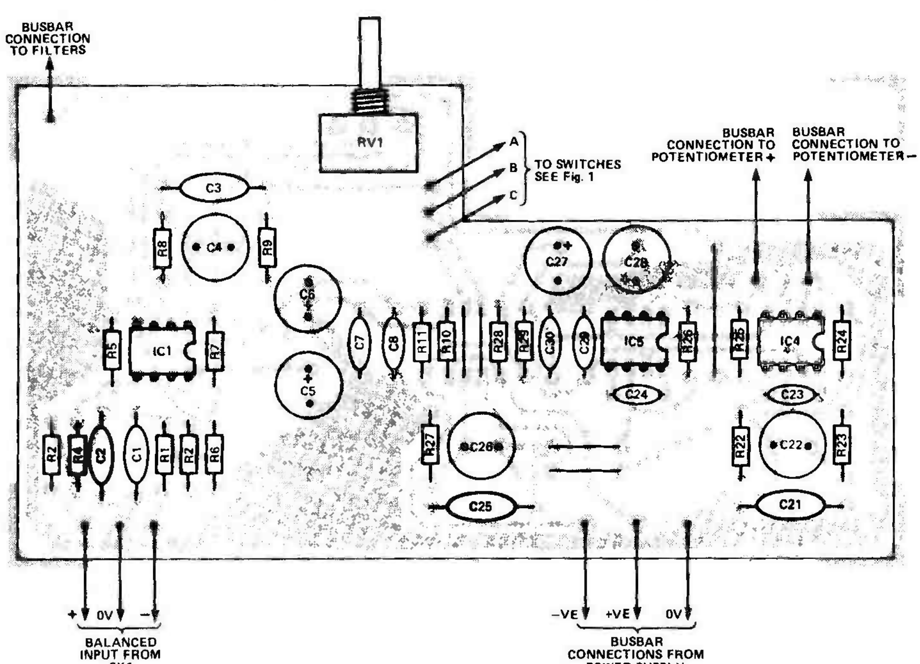
SEMICONDUCTORS

IC6, 7, 8	NE5534

MISCELLANEOUS

PCB; IC sockets if desired; terminal pins for C32 and C36.

Fig. 11 (above) Component overlay of the filter PCB. Note that you will need one filter board for each channel of the ParaGraph.



PARTS LIST — INPUT AND MAIN SIGNAL PATH BOARD

RESISTORS (all ¼W 1% metal film)

R1, 2	1k8
R3, 4	8k2
R5, 6, 23-26	10k
R7, 8	4k7
R9, 22, 27	47k
R10, 11, 28, 29	10R
RV1	10k linear rotary potentiometer

CAPACITORS

C1, 2	1n0 polystyrene
C3, 21, 25	100n polycarbonate
C4, 22, 26	22u 16V non-polarised radial electrolytic
C5, 6, 27, 28	100u 25v radial electrolytic
C7, 8, 29, 30	100n polyester
C23, 24	22p polystyrene

SEMICONDUCTORS

IC1	NE5532
IC4, 5	NE5534

MISCELLANEOUS

SK1	XLR or other three-pole connetor to choice — see text

PCB; IC sockets if desired.

Fig. 12 (left) Component overlay of the input stage and main signal path PCB.

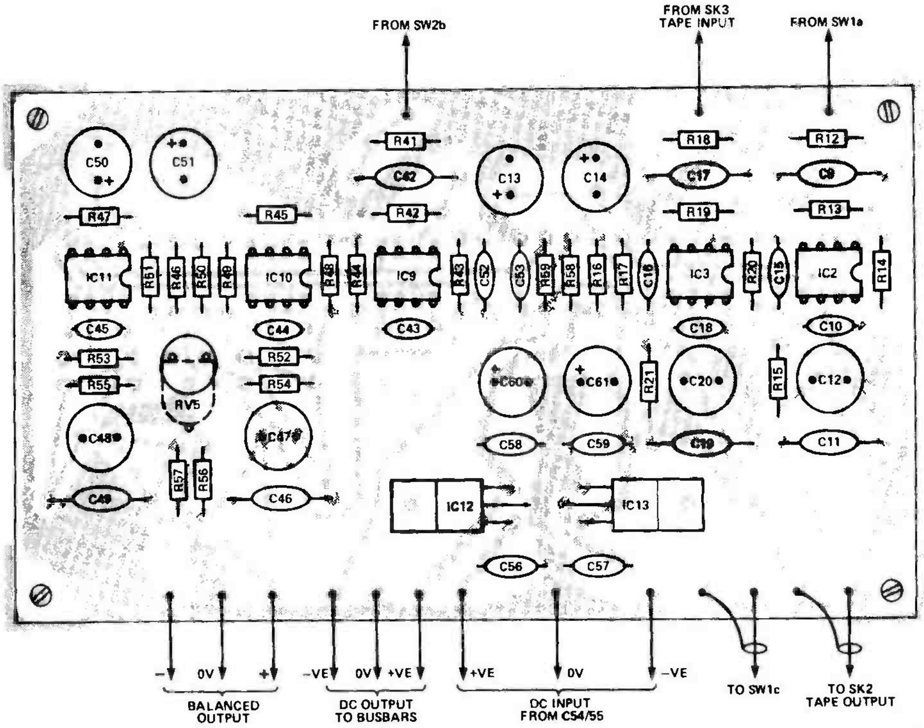


Fig. 13 Component overlay of the tape buffer, balanced output and PSU board.

The output stage and tape buffer amplifiers are on a separate circuit board, together with the power supply stabilizers (Fig. 13). This board may be mounted at any convenient point within the cabinet, but should be kept as far away as possible from the mains transformer and any mains wiring. Connections between the circuit boards and function switches should prove quite straightforward, using Fig. 1 as a reference. Due to the low impedance of the switched connections, unscreened wire may be used throughout.

If the recommended balanced inputs and outputs are employed, it is suggested that professional XLR 3 pin connectors are used. These can be obtained at a reasonable price from a number of sources, and will remain reliable for many years — unlike some of their lesser brethren. There is a permanent confusion, even in the professional world, over the correct wiring of these connectors, so the generally accepted standard is given here:-

all signal inputs — via XLR 3 way chassis mounting sockets (termed female)

all signal outputs — via XLR 3 way chassis mounting plugs (termed male)

wiring to both plugs and sockets

Pin 1 — Earth
Pin 2 — Signal +
Pin 3 — Signal −

For unbalanced inputs or outputs, connect pin 3 to pin 1.

Unbalanced versions may be fitted with DIN or Phono sockets. If the latter are used it is well worth tracking down some gold plated ones, and be sure to mount them with insulation bushes so there is no electrical contact between the cabinet metalwork and the socket body.

For safety reasons, the metal cabinet must be connected to earth via the mains lead. If the signal earth is connected to the cabinet in any way, a nice juicy hum loop will probably be formed whenever the ParaGraph is used with other equipment which has common mains and signal earths. The best approach to this problem is to experiment once the unit is working correctly, so as an interim measure, make sure that the signal earth is floating at this stage.

Testing

Once the construction and internal wiring is complete, the moment has arrived for power to be applied for the first time. The ParaGraph should be connected to an oscillator and an oscilloscope, so that when the initial switch-on takes place an immediate indication

PARTS LIST — TAPE BUFFERS, BALANCED OUTPUT AND PSU BOARD

RESISTORS (all ¼W 1% metal film)	
R12, 18, 41	100k
R13, 19, 42	330k
R14, 16, 17, 20, 43, 58, 59	10R
R15, 21, 56, 57	47k
R44 - 51	3k3
R52, 53	33R
R54, 55	1k0
RV5	10k moulded preset
CAPACITORS	
C9, 17, 42	330n polycarbonate
C10, 18, 43, 44, 45	22p polystyrene
C11, 19, 46, 49	100n polycarbonate
C12, 20, 47, 48	22u 16V non-polarised radial electrolytic
C13, 14, 50, 51 60, 61	100u 25V radial electrolytic
C15, 16, 52, 53, 56 - 59	100n polyester
C54, 55	4700u 25V can electrolytic
SEMICONDUCTORS	
IC2, 3, 9, 10, 11	NE5534
IC12	7815
IC13	7915
BR1	1A bridge rectifier

MISCELLANEOUS	
FS1	250mA anti-surge fuse and chassis-mounting holder
SK2, 3	phono or other sockets to choice — see text
SK4	XLR or other three-pole connector to choice — see text
SW1	4-pole 2-way toggle switch
SW2	DPDT toggle switch
SW3	SPDT toggle switch
T1	15-0-15V 25VA mains transformer, preferably toroidal

PCB; IC sockets if desired; 4U height 19" rack-mounting case or similar; mounting brackets or stand-off pillars for the tape buffers, balanced output and PSU board; mains input connector or cable strain-relief bush; knobs for rotary and slider potentiometers; tinned copper wire for busbars; nuts, bolts, etc.

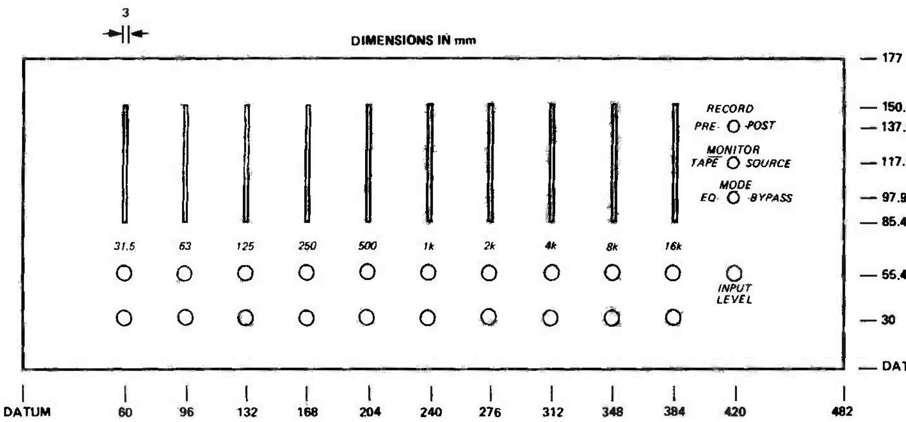


Fig. 14 Suggested front panel layout for the ParaGraph based on a 4U (7″) height 19″ racking case.

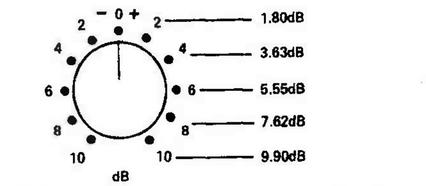


Fig. 15 Calibration of the input level control.

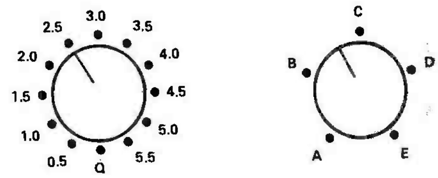
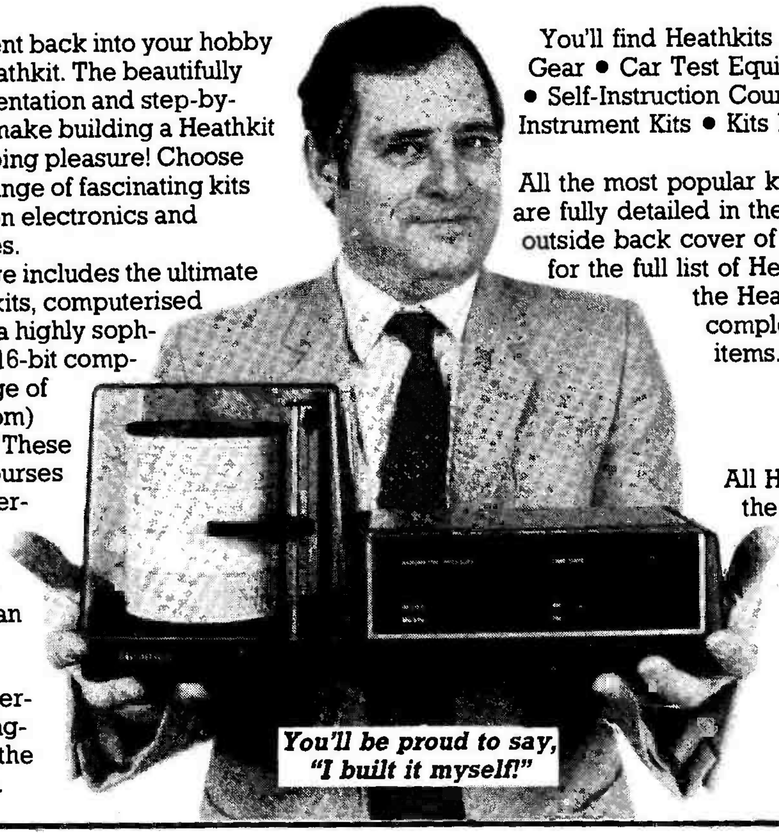


Fig. 16 Calibration of the Q and frequency controls.

is given of the unit's correct operation — or otherwise. If signal does not appear at the output, the golden rule is: Do Not Panic. Assuming that the unit is located behind the regulation 6ft wall of sandbags, crawl around and look for signs of smoke. You will probably find that in your excitement, you have forgotten to switch on the oscillator, but if, after taking a handful of Valium, you convince yourself that everything is as you intended and that your new example of turbo-technology really is not working, carry out the usual checks for correct DC voltage rails and IC inputs and outputs. If all appears healthy the signal should be traced, using your oscilloscope, from the input socket through the circuitry until it disappears.

Once any faults have been located and rectified the correct operation of all the control functions should be checked, and once you are satisfied that everything is working as intended, your ParaGraph may be fed its first dose of musical signal. You can then spend a pleasant hour twiddling the controls and discovering whether all the effort has been worthwhile. If so, you may wish to sally forth and build yourself another one, so that you can at least equalise yourself to distraction in stereo. **ETI**

Heathkit - *IT'S A PLEASURE TO BUILD*



Bring the enjoyment back into your hobby with a kit from Heathkit. The beautifully illustrated documentation and step-by-step instructions make building a Heathkit a relaxing, absorbing pleasure! Choose from their huge range of fascinating kits and self-instruction electronics and computing courses.
The Heathkit range includes the ultimate in amateur radio kits, computerised weather stations, a highly sophisticated robot, a 16-bit computer kit and a range of home (or classroom) learning courses. These state-of-the-art courses have easy-to-understand texts and illustrations, divided into sections so that you can progress at your own pace, whilst the hands-on experiments ensure long-term retention of the material covered.

You'll find Heathkits available for Amateur Radio Gear • Car Test Equipment • Kits For The Home • Self-Instruction Courses • Computer Kits • Test Instrument Kits • Kits For Weather Measurements.

All the most popular kits and educational products are fully detailed in the 1984 Maplin catalogue (see outside back cover of this magazine for details) or for the full list of Heathkit products send 50p for the Heathkit International Catalogue complete with a UK price list of all items.

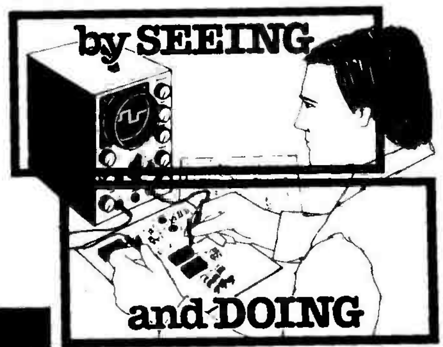
All Heathkit products available in the UK from:

Maplin Electronic Supplies Ltd.
P.O. Box 3, Rayleigh,
Essex, SS6 8LR.
Tel: (0702) 552911.

(For shop addresses see back cover.)

MASTER
Electronics - *Micro*processors - Now!
The PRACTICAL *Way*!

- Electronics — Microprocessors — Computer Technology is the career and hobby of the future. We can train you at home in a simple, practical and interesting way.
- Recognise and handle all current electronic components and 'chips'.
- Carry out full programme of experimental work on electronic & computer circuits including modern digital technology.
- Build an oscilloscope and master circuit diagrams.
- Testing and servicing radio — T.V. — hi-fi and all types of electronic/computer/industrial equipment.



New Job? New Career? New Hobby?

SEND THIS COUPON NOW.

Please send your brochure without any obligation to:—

NAME

ADDRESS

BLOCK CAPS PLEASE

I am interested in:

- ☐ ELECTRONICS
- ☐ MICROPROCESSORS
- ☐ RADIO AMATEUR LICENCE
- ☐ CITY & GUILDS EXAMS

Other Subjects . . . .

ETI/3

ACCREDITED BY COUNCIL FOR THE ACCREDITATION OF CORRESPONDENCE COLLEGES CACC

OR TELEPHONE US 062 687 2598
OR TELEX 22758
(24 HR SERVICE)

British National Radio & Electronics School P.O. Box 7, Teignmouth, Devon, TQ14 0HS

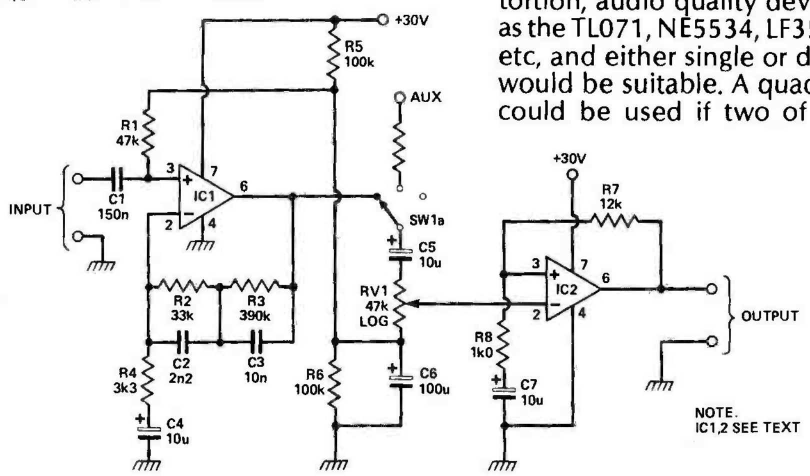
TECH TIPS

Pick-up Preamplifier

Jeff Macaulay, Crawley

Over the last few years, two schools of thought have emerged on the subject of audio pre-amplifier design. The 'British' approach, as it is sometimes termed, favours designs with the minimum of frills on the grounds that tone controls and the like introduce unnecessary distortion and phase shifts. The design described here is an example of this minimalist approach and possesses sufficient dynamic range to handle direct-cut and digitally mastered records without problems.

The circuit may be considered in two parts, each built around one of the op-amps. IC1 functions as an RIAA equaliser with R2, R3, C2 and C3 in the feedback loop providing the correct response. R4 sets the midrange gain at 10 while C4 prevents the stage amplifying DC. The input overload factor is greater than 40dB and this, combined with a signal to noise ratio of more than 70dB gives the circuit a dynamic range of 110dB.



IC2 has a flat frequency response and provides extra gain for the equaliser stage or for an auxiliary input selected by SW1. Both op-amps should be low noise, low distortion, audio quality devices such as the TL071, NE5534, LF351, OP27, etc, and either single or dual types would be suitable. A quad op-amp could be used if two of the preamplifiers were to be combined in a stereo arrangement. The pin numbers given are correct for 741-type single-packaged op-amps but it is advisable to check carefully the pinouts of the device you plan to use, and the arrangement will obviously be different if dual or quad devices are employed.

Low Cost Z80 DRAM Drive & Refresh

**D. Allen
Bolton**

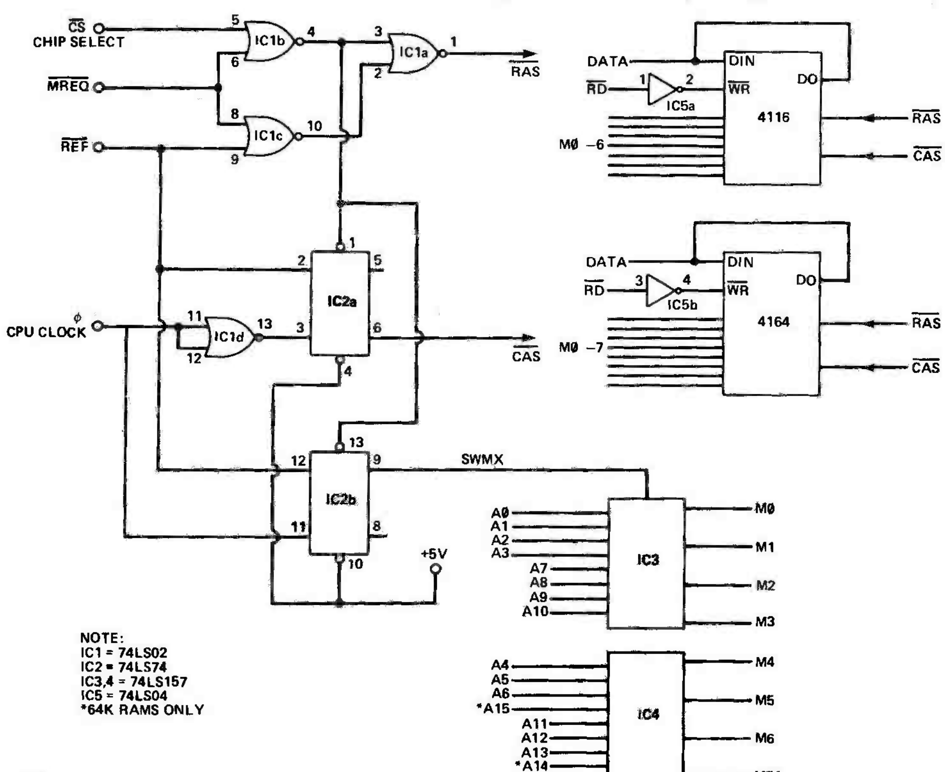
This circuit provides address multiplexing & refresh for 16K or 64K DRAMs using only four chips and one invertor.

Memory Cycle: In a normal memory access the cycle is started by MREQ & CS going low. This causes RAS to go low and the flip-flops are no longer held in reset. RAS gates the lower seven (or eight) row address lines into the memory. On the first positive going clock edge after MREQ the SWMX flip-flop IC2b clocks. The D input is REF which will be high during memory cycles. Therefore the SWMX signal goes high and switches the column address lines to the DRAM. On the next negative going clock pulse CAS goes low and gates in the column address. Data can then be written to or read from memory depending on the Z80 RD line. The WR line is not used. The cycle ends when MREQ goes high causing both flip-flops to reset.

Refresh: Dynamic RAMs require RAS low and CAS high and only the lower 7 address lines are used to refresh. The Z80 counts through the lower 7 address bits after each instruction fetch and sets REF low. MREQ and REF are gated together to produce RAS. Clock cycles do not change the state of IC2a because the D input is REF which is low. Therefore the multiplexer is not switched and CAS is not generated.

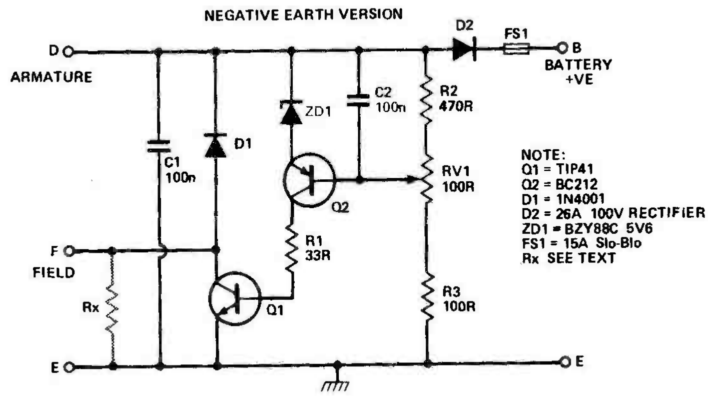
Addressing: For 16K DRAMs A14 & A15 are not connected to the multiplexer and will normally be gated to provide Chip Select (CS). In this case ground the inputs to the multiplexer.

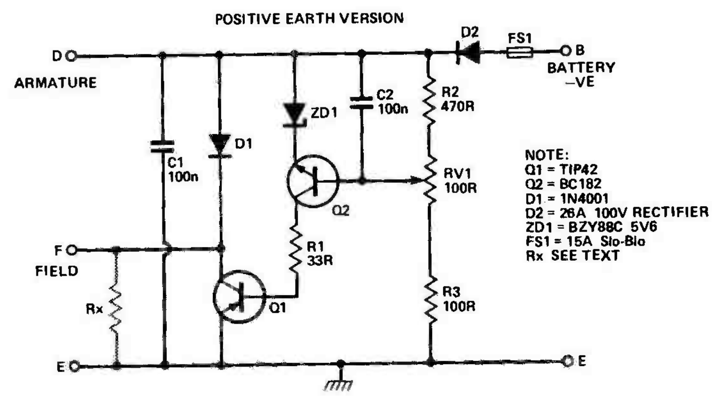
When 64K DRAMs are used the CS input may be a disabling signal to avoid double addressing with ROMs.



Regulator For DC Generators

J. Michael, Broadstone, Dorset





This circuit was developed to replace the regulator on a motorcycle when the original component failed and a replacement proved impossible to obtain. It is designed to control the output voltage of a 6V dynamo used for charging a lead-acid battery but it could easily be adapted to suit other voltages. Both positive and negative earth versions are illustrated and in either case the circuit will replace the original regulator without modification of the existing wiring.

Rx is the field current control resistor. On the original unit this was incorporated in the dynamo, but for most applications a separate resistor will have to be fitted in the regulator. A 10W wirewound type should be used. The series diode D2 replaces the cutout in the original regulator. D2 and Q1 should be mounted on a small heatsink.

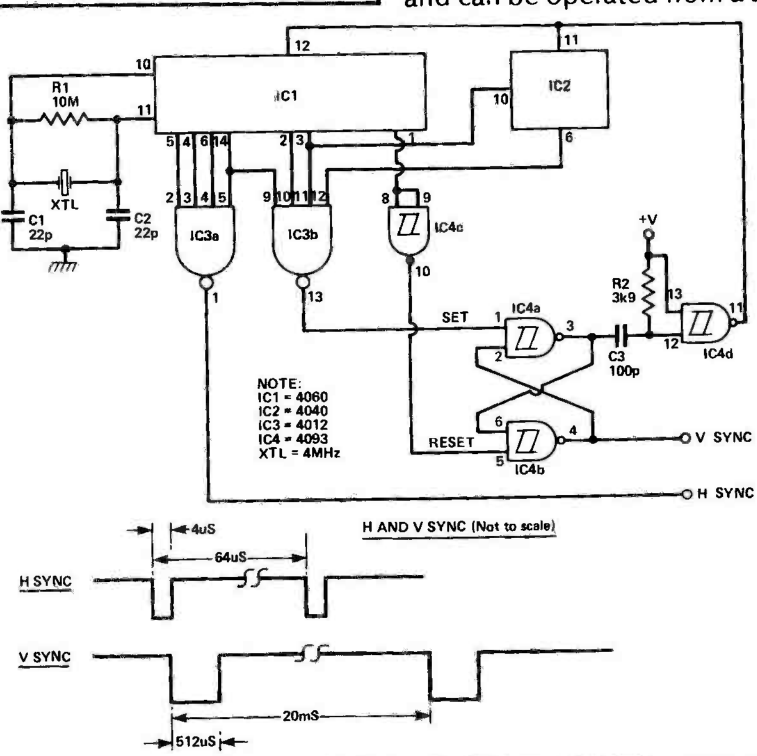
To set up the desired charging voltage (6.9V in the case of a 6V lead-acid battery) set RV1 fully clockwise and run the dynamo at maximum speed with a fully-charged battery connected. RV1 should then be adjusted until the battery voltage is correct.

TV Sync Generator

J. C. Barker, Morley

This crystal controlled sync generator uses only four cheap CMOS ICs, a 4MHz crystal and a few Rs and Cs, and can be operated from a supply of between 5 and 15V.

IC3a gates the Q5, Q6, Q7 and Q8 outputs from IC1 to generate the H sync pulses. The V sync is generated by IC3b which gates Q8, Q13, Q14 and Q17 (the third output of IC2) to set the latch IC4a and b after 19.488 ms. The latch is reset 512us later by the Q12 output of IC1 via IC4c. IC4d then generates a positive going pulse to reset the two counters and start the cycle all over again.



Attention!

Would the authors of the following Tech tips please get in touch with us:-

CRU Interface For The Cortex
Caravan Indicator Warning Light

In each case the address of the author has been mislaid and we need to contact them before using the items.

May we also take this opportunity of advising all Tech Tips authors to write their names and addresses on each sheet of their submissions rather than just on the title page. This ensures that, even if the sheets get separated, we will still know what belongs where. This is especially important with drawings which are treated separately from the text and therefore stand the most chance of going astray. With luck, if this advice is followed, even we won't be able to lose things!

AN ARGUS SPECIALIST PUBLICATION
electronics today INTERNATIONAL

THE FINAL LINK

Some people think of the loudspeaker as being the final link in the hi-fi chain, but it isn't. The final link is actually the ear, and the performance of this delicate piece of apparatus affects all the other items in the hi-fi chain. And we promise to do our best to avoid the appalling puns you've all been complaining about on the Readers' Survey forms. (Shouts of 'ear,! 'ear! from assembled ranks of readers.)

TELEPHONE CALL METER

Are you worried about your phone bill? Do you have an old calculator knocking around? Put the two together, and you could find yourself building the ETI telephone call meter. It's a real hackers' item.

RS232 FOR THE SPECTRUM/ZX81

Most RS232 ports are just one way, or at least, for these two machines they are. Ours is two way, enabling your computer to talk to other machines, modems, and anything else interactive that has an RS232 interface on it.

ELECTRONICS FOR PEACE?

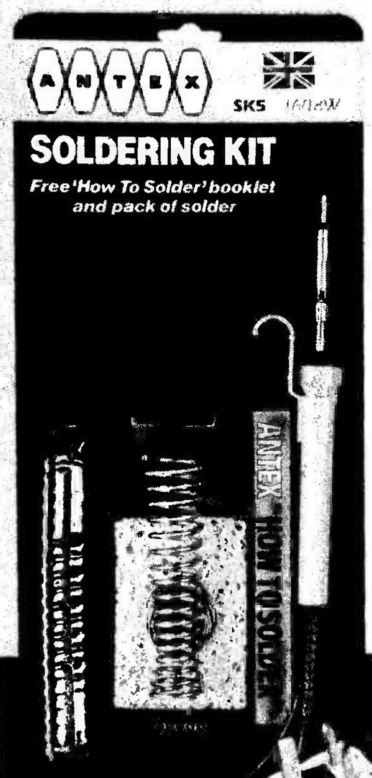
A very large number of electronics professionals are employed in the defence industry. Indeed, a large number of our readers must be employed in this way, either directly or indirectly, as sub-contractors to defence contractors. Is this a state of affairs we should be happy with? We'll be talking to one group who think not, to find out how they were set up and what their objectives are.

THE SECRETS OF TELECINE

It's not that easy to turn 'Towering Inferno' from a wide-screen epic into a small-screen Sunday matinee, and not all the difficulties are those of imagination. We'll be looking at the technicalities involved.

ALL THIS AND MORE IN THE APRIL ETI — ON SALE MARCH 1st

ANTEX
a world of soldering



Tomorrows Soldering Technology Today.

ANTEX has a worldwide reputation for quality & service & for many years has been one of the best known & most popular names in soldering. Always at the forefront of technology, ANTEX is continually researching new and better ways of achieving more accurate, reliable, and cost effective soldering. On ANTEX Soldering Irons, the advanced design of the interface between the element & the bit allows more efficient heat transfer to the bit and improved stability of the temperature at the point of contact with the work. Indeed, experiments have shown that an XS25 watt iron can be used for tasks where a 40 watt iron would normally have been required.

ANTEX Soldering Irons exhibit exceptionally low leakage currents & hence are suitable for use on Static Sensitive Devices. Sophisticated temperature controlled soldering units have recently been added to the ANTEX range.

Model C
– 15 Watts. Available for 250, 220, 115, 100, 50 or 24 volts.

Model XS
– 25 Watts. Available for 240, 220, 115, 100, 50, 24 or 12 volts.

Model XS-BP
– 25 Watts. 240 volts, fitted with British Plug.

ST4 Stand
– To suit all irons.

SK5 Soldering Kit. Contains model CS 240v Iron, an ST4 Stand and solder.

SK6 Soldering Kit. Contains model XS240v Iron, an ST4 Stand and solder.

SK5-BP and **SK6-BP**
Soldering Kits as above with British Plug.

Model CS
– 17 Watts. Available for 240, 220, 115, 100, 50, 24 or 12 volts.

Model CS-BP
– 17 Watts. 240 volts, fitted with British Plug.

TCSU1
– Very robust temperature controlled Soldering Unit, with a choice of 30 Watt (CSTC) or 40 Watt (XSTC) miniature irons.
Range 65°C to 420°C.
Accuracy 2%

TCSU-D
Elegant Temperature Controlled Soldering Unit with 50 W Iron (XSD) and built around FERRANTI custom-made ULA. Range Ambient to 450°C. Accuracy ± 5°C. Zero crossing switching. Detachable sponge tray.

ANTEX Made in England

ANTEX (Electronics) Ltd.,
Mayflower House, Plymouth, Devon. Tel: 0752 667377 Telex. 45296

Please send literature, price list and my nearest stockist to:

Name

Address

Telephone

ET1/3/85

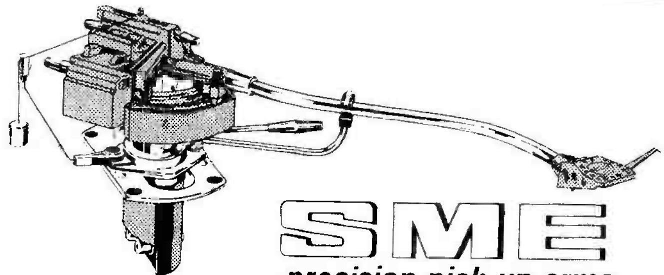
cortex

HARDWARE
SOFTWARE

MDEX disc O/S + BASIC	£95
MDEX Professional Dev. Sys.	£275
CORTEX POWER-BASIC disc extensions	£43
MDEX Extensions	
Editor	£35
Relocating Assembler/linker	£35
FORTH — screen editor, assembler	£55
— graphics — better than BASIC	£35
PASCAL — by Pre Brinch Hansen	£35
QBASIC — fast BASIC compiler	£150
UCSD Pascal, SPL, META, WINDOW, SPELL	
CORTEX tape software	
Pengo — fast machine code action	£6
Golf — excellent animation	£6
Micropede — rampant caterpillar	£6
Space Bugs, Pontoon, Breakout	each £6
Cassette/CDOS word processor	£13
Add £2 for software on CDOS disc	
Disc Drives	
80 track double-sided double-density	£190
40 track single-sided double density	£120
E-BUS Floppy/Winchester Controller	£135
E-BUS 64/128 Kbytes DRAM card	£145/£245
E-BUS 9995 Processor card	£145
80*24 Character video card	£48

State disc format and add VAT to all prices
!!Brainstem Issue 2 out soon!!

MICRO PROCESSOR ENG LTD
21 HANLEY ROAD SHIRLEY
SOUTHAMPTON
SO1 5AP
TEL: 0703 780084



SME

precision pick-up arms

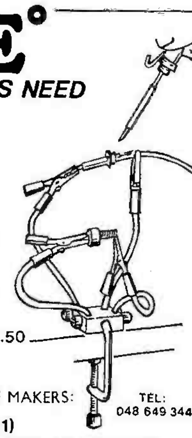
Please call or write:
SME Limited, Steyning, Sussex, BN4 3GY
Telephone: 0903 814321 Telex: 877808 G

NEW! 'GRIPMATE'

ELECTRONIC ENGINEERS NEED

'EXTRA HANDS' FOR SOLDERING GLUEING AND ASSEMBLING

This essential compact tool comes complete with 4 croc-clip flexi-arms to hold components positively and rapidly with infinite positioning.....



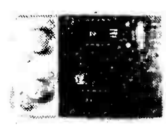
ONLY **£4.85**

USEFUL ACCESSORIES....
48mm 2.5x MAGNIFIER FLEXI-ARM £2.50
MAGNET FLEXI-ARM £1.50
ALL PRICES INCLUDE VAT· POST·PKG

SEND NOW! CHQ/PO OR SAE DETAILS DIRECT FROM THE MAKERS:
KEMPLANT LTD (DEPT. 1)
DURFOLD WOOD, PLAISTOW, BILLINGSHURST, WEST SUSSEX RH14 0PN
TEL: 048 649 344

AMPLIFICATION

CHOOSE CRIMSON. THE NAME THAT MEANS QUALITY



Before buying elsewhere check out the features of CRIMSON quality:-

ALL OUR MODULES:-
- superior p.c.b., component identification, solder resist.
- non-potted so non-disposable if damaged.
- metal film resistors.
- negligible noise and distortions.

OUR BIPOLAR POWER AMP MODULES:-
- fuseless electronic shut-down with re-set facility.
- reverse polarity protection.
- high output current capability (>25 Amps on CE1704).
- 18 transistors, 7 diodes.

OUR MOSFET POWER MODULES:- (FE908, FE1704)
- reponse down to d.c.
- j-fet inputs.
- common source output for highest efficiency.

OUR CPR2 PREAMPLIFIER
- ultmate sound quality.
- 42 semiconductors and perfect symmetry topology.
- anti-thump circuitry.
- selected passive components.

NEW PRODUCT: FET3 POWER MODULE UP TO 450W. 900W BRIDGED MODE. 100V R.M.S. BRIDGE. **£74.50**

Examples from our range of built, tested and guaranteed modules.

Module	**Power/Load**	**Price Inc. VAT & Delivery**
CE608	60W/8R	£21.00
CE1004	100W/4R	£24.50
CE1008	100W/8R	£27.50
CE1704	170W/4R	£35.00
CE1708	170W/8R	£35.00
FE908	120W/8R	£29.50
FE1704	240W/4R	£52.00
CE3004	300W/4R	£49.00
BO1	BRIDGER	£8.20
CPR2	PREAMP	£47.95

Write or phone for details:-
CRIMSON ELEKTRIK STOKE,
Phoenix Works, 500 King St.,
Longton,
Stoke-on-Trent ST2 1EZ.
Tel: 0782 330520

or contact our agents:-
BRADLEY-MARSHALL,
325 Edgeware Road, London
and (especially for demonstrations):-
WILMSLOW AUDIO,
35-39 Church St., Wilmslow, Cheshire.

DIGITAL FRAMESTORE

The project draws to a close with the last of the constructional details, suggestions on how to link the unit to a home micro and what to do with it when you've done this, and a mod to use an external sync source. All by Daniel Ogilvie.

Essentially the framestore is a large piece of memory. Various bits and bobs have been added to it to format the memory so that it can be easily written to and read from in a format compatible with a raster-scanned TV system. However at the heart of it all is a large piece (512K) of dynamic RAM just waiting to be got at by your home computer. The home computer itself can perform some quite powerful image processing routines.

We have seen that grey level manipulations can be performed by the lookup table and for the type of thing discussed that offers us a faster non-destructive method. It could equally have been performed by the home micro. Indeed, a micro with access to the framestore memory was essential to construct the grey level histogram. Image storage is another area where the home computer can be of some use, although your average floppy disk will throw a fit at having to cram on the 393K bytes necessary to store just one image. However parts of images may be stored and the more adventurous may choose to write some image compression routines, a 10:1 reduction being possible on simple images.

Getting At The RAM

Most home computers are based on either the 6502 or Z80 MPU's, with a smattering of 6809 and 68008 (just), amongst them. Mr Sinclair has chosen the right road with the QL for our average image processing buff, in that the 68008 can address 1Mbyte of memory directly. The 512K of the framestore can slot in nicely. Most micros are restricted to 64K and by the time we have added an operating system or two and some of its own RAM there may be little left to access the framestore. There is a lot to be said, therefore, for a dedicated micro providing a serial or, preferably, a faster parallel interface to the home computer, or providing a DMA interface to shift chunks of the framestore memory's data to and from the micro's own RAM.

We will not take this approach, however, but will make the assumption that at least a 16K block can be freed through which we can access the framestore RAM by bank selection. The popularity of the home micros has been reflected in two designs recently in ETI for dynamic RAM controllers for the 6502 and Z80. Also recommended is the excellent Texas TMS4500A DRAM controller user manual, which provides circuits to interface some other microprocessors to DRAM, including the 68000, 8085 and TMS9995.

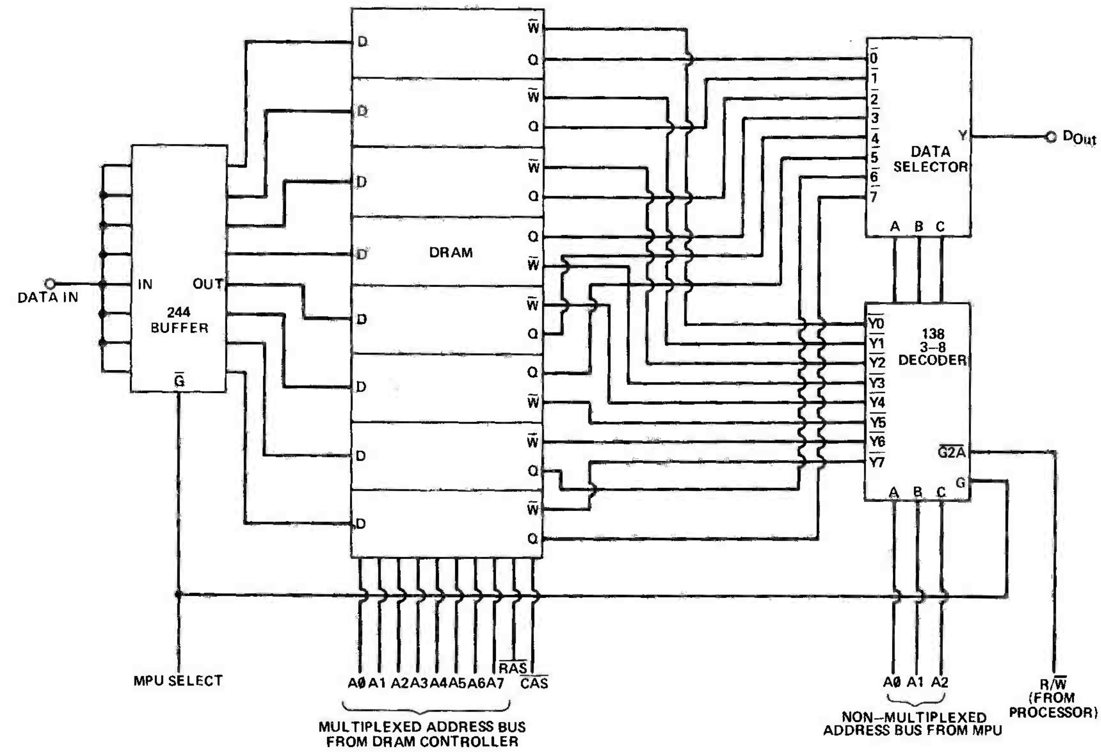
Other DRAM controllers are available, from AMD and Intel amongst others, with exhaustive application notes. We will concentrate therefore on the bank select logic and particular points regarding the interface to the framestore RAM.

You will remember that each RAM card stores one bit of data. There are eight 64K X 1 DRAMs on each card, which is configured to store 512K X 1 of data. We provide an eight bit shift register on the card which temporarily stores the incoming data before we parallel load this 8-bit byte into the RAM. This overcomes the relatively slow access time of the DRAM. Each DRAM therefore stores every eighth bit of the same DRAM address.

The facility has been provided on the card to turn off the drivers to the RAM address and control inputs. This allows access to an external DRAM controller. When the MPU line is pulled low (and MPU is high) the DRAM address multiplexors and W, RAS and CAS drivers are turned off, (high impedance) as is IC17, the latch that drives the data lines to the RAM.

We now have complete access to the RAM on the card and are free to access any of the 64K bits of RAM. We do, however, have to perform some muliplexing of the data and control lines to enable us to sequentially access pixels from the DRAM and not have to worry about the complications caused by the shift register. Were we not to do this, and, for example, tied each data line of the DRAMs to a separate MPU line, sequential pixels would appear on each line of the MPU data bus.

To access any of the remaining five data bits we would need to



select a separate part of memory. For example, assume we wish to read from the framestore memory. First set up the most significant address lines of the microprocessor bus (latching them into a port), then perform a memory read operation at the address we want to access. The DRAM controller performs the muliplexing of all but the lower three address lines and then strobes RAS and CAS low in turn. When CAS is strobed low, all eight dynamic RAMs turn on their output drivers and, after the CAS access time, the data at the address we have selected becomes valid.

In fact we access eight sequential pixels worth of data at the same time. The data outputs from the DRAM are taken to the eight to one muliplexor IC19. We select one of the eight DRAM outputs by means of the three lower address lines: the data bit appearing on the MPU data bus is thus just one of the selected pixels. If we wish to access the next sequential pixel we increment the address line by one. The address loaded in to the RAM is the same but the lower three address lines select the next bit from the next DRAM. This is performed on all six boards simultaneously — each board drives a separate MPU data line — only D0-D5 of the MPU data bus are used. This process is illustrated diagramatically in Fig. 17.

This method is not the most efficient to access the RAM, but it is simple. By strobing all of the CAS lines simultaneously (and thus turning on all of the RAM drivers simultaneously) maximum current is taken. We are turning on eight RAMs to access one per board. Ideally we should multiplex the CAS lines to the RAM's using the same method we use for writing.

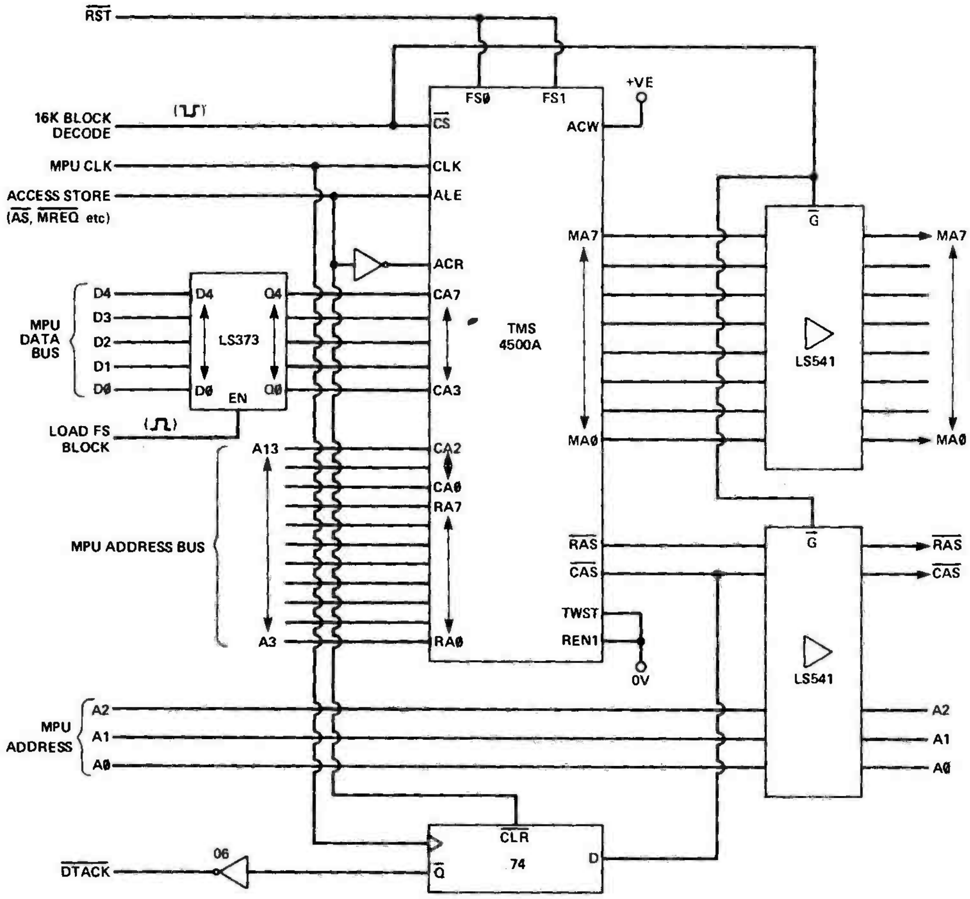
Writing to the RAM is performed much the same as reading. The DRAM controller responds to a write access request by strobing RAS and CAS low to latch the two eight bit address inputs. Because the R/W arrives before CAS (read/write is set up with the address lines by the MPU) the DRAMs perform an early write and the Q outputs will remain in a high impedance state. When R/W is low and a valid CS has been received, the 74LS138(IC14) decodes the lower three adddress lines and the appropriate Y output is strobed low driving the DRAM write line low, and latching in the data that has been set up on the D inputs (and buffered by IC18).

Although slightly more complicated, this method of accessing the DRAMs allows the MPU to "see" a logical memory map. The first pixel stored (top left of field 1) is at address 00000H, the next along the line is at 00001H, etc. The end of the first line (pixel number 639) is at 0027FH. The next line starts at address 640=00280H and ends at 004FFH=640+639. The end of the first field is at (640X-256)−1=27FFFH. The next field starts at 28001H and ends at (640X512)−1=327679=4FFFFH.

In this way, any dynamic RAM controller can access the framestore as if it were a conventional piece of memory. We have also seen that it is necessary to be able to address 327,679 bytes to have access to all of the framestore and this is beyond the addressing

PARTS LIST MEMORY CARD

RESISTORS (all ¼W 5%)	
R1-10	**33R**
R11	**2k2**
CAPACITORS	
Unmarked decoupling — all 100n ceramic	
SEMICONDUCTORS	
IC1, 10	**74LS257N**
IC2-9	**MCM666L20 (64K× 1 200ns DRAM — see text)**
IC11,12	**74LS08N**
IC13	**74LS244**
IC14	**74LS367 (8T97)**
IC15	**74LS138**
IC16	**74LS138N**
IC17,18	**74LS195N**
IC19	**74LS374N**
MISCELLANEOUS	
PCB: wire solder, etc.	



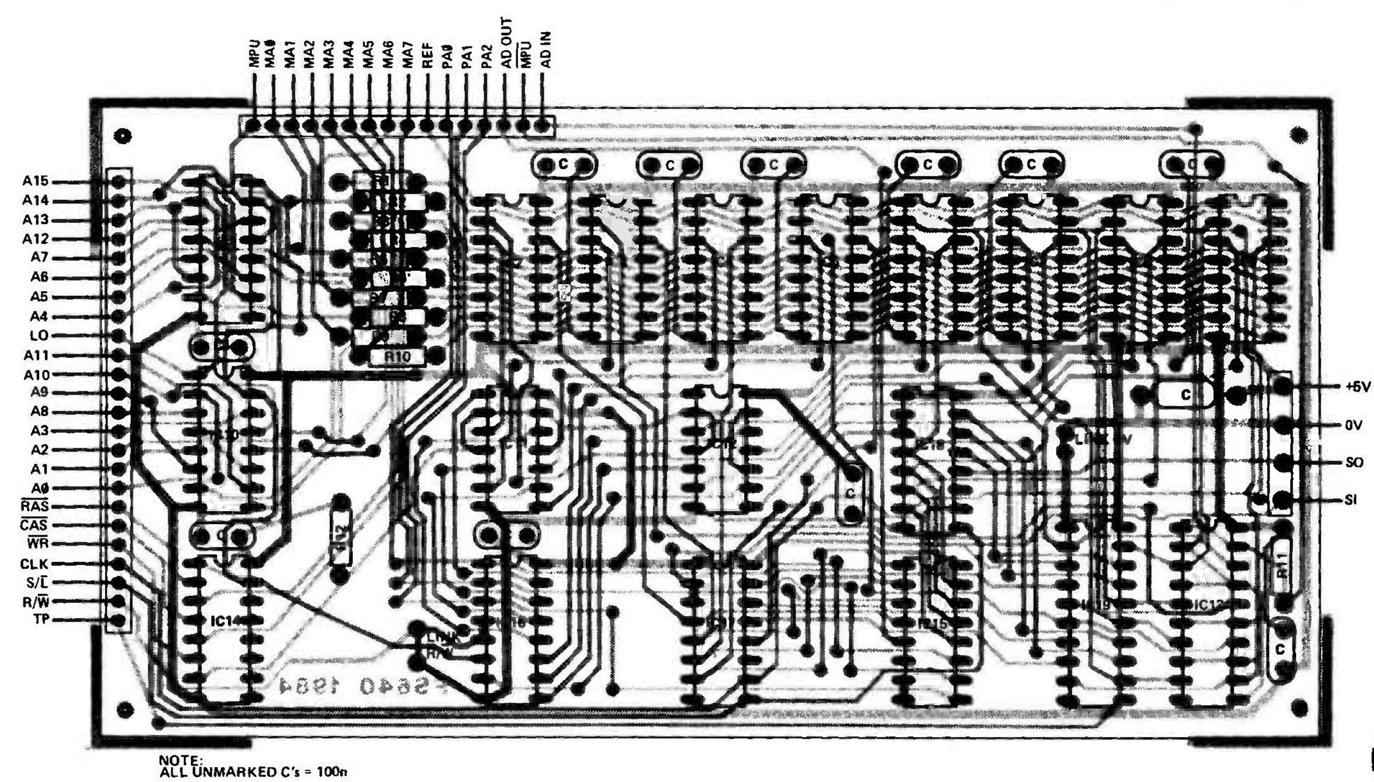
range of most 8-bit microprocessors, which makes it necessary to implement a bank selection technique to enable us to peer through a movable window at the framestore.

A suggested circuit for this is shown in Fig. 18. If we have, for example, only 16K of memory available in the micro, we will need to be able to select one of twenty blocks to access the complete framestore (20 X 16K = 327,679). The additional upper address lines we require can be stored in a latch by an additional MPU load instruction to select one of the twenty 16K blocks before we perform a memory read or write. Normal read or write operations can now be performed within the block selected.

Synchronising The Framestore

The framestore as it stands is intended to be the master sync generator, ie, it will provide the synchronisation for all the other units in the system connected to it. However, this is not always possible, for example, when using video recorders, off-air broadcasts and some cheap video cameras. The modification described here allows the framestore to be externally synchronised.

The modification works by replacing IC5 on the control card; IC5 is the sync pulse generator IC. The heart of the replacement circuitry is the TA6993W, which is itself a sync pulse generator, but with the facility to synchronise to an external reference. This IC normally runs off the 500kHz clock input to pin 23 (this should be derived from the 25MHz clock already on the control card). The TA6993W generates an odd field pulse instead of an even field pulse (as with IC5, ZNA134J) but

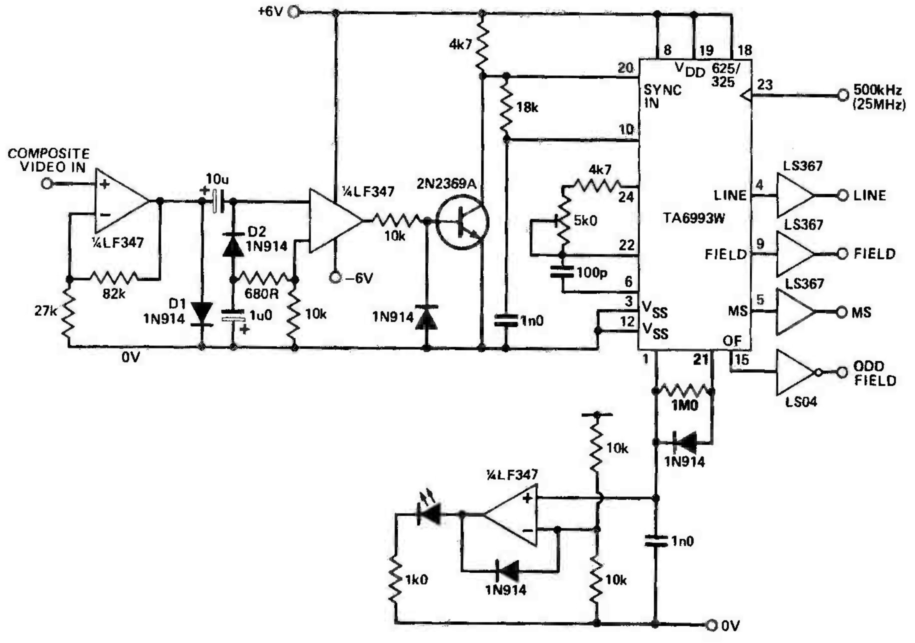


NOTE:
ALL UNMARKED C's = 100n

this is not important, it just shifts our reference point.

The TA6993W contains a phase comparator and a phase-locked loop. When negative going mixed sync pulses are presented on its pin 20 it switches over from the external oscillator to an internal voltage controlled oscillator formed by the RC network on pins 6,22,24. The frequency of this oscillator is varied until the internally generated line and external line input are locked in phase.

The vertical synchronization is achieved by integrating the mixed sync input via the 18k and 1nF capacitor, which generates a field pulse, and using this to reset the vertical line counter. This method produces a quite effective external lock but it will never be as stable as the original method. The trimmer should be adjusted until a stable lock is obtained; be careful to avoid twice line frequency. The switch over between internal and external oscillator is performed automatically and the sync source is indicated by detecing the voltage level on pin 1 and lighting an LED (+6V = external sync).



The front end of the circuit is a sync separator which strips the syncs from the composite video input. The composite video is amplified and clamped by diode D1. This is fed to a comparator formed by the op-amp. The other terminal of the op-amp is fed with a proportion of the signal from the peak detector formed by diode D2 and the capacitor. The comparator threshold is therefore set just up from the sync tips, preventing false triggering due to noise.

ETI

electronics today international

BOOK SERVICE

How to order: indicate the books required by ticking the boxes and send this page, together with your payment, to: ETI Book Service, Argus Specialist Publications Ltd, 1, Golden Square, London W1R 3AB. Make cheques payable to ETI Book Service. Payment in sterling only please. All prices include P & P. Prices may be subject to change without notice.

BEGINNERS GUIDE

Beginner's Guide to Basic Programming Stephenson	£5.35
Beginner's Guide to Digital Electronics	£5.35
Beginner's Guide to Electronics	£5.35
Beginner's Guide to Integrated Circuits	£5.35
Beginner's Guide to Computers	£5.35
Beginner's Guide to Microprocessors	£5.35

COOKBOOKS

Master IC Cookbook Hallmark	£10.15
Microprocessor Cookbook M. Hordeski	£9.50
IC Op Amp Cookbook Jung	£15.10
PLL Synthesiser Cookbook H. Kinley	£7.70
Active Filter Cookbook Lancaster	£14.30
TV Typewriter Cookbook Lancaster	£12.50
CMOS Cookbook Lancaster	£13.50
TTL Cookbook Lancaster	£13.50
Micro Cookbook Vol. 1 Lancaster	£15.30
BASIC Cookbook K. Tracton	£6.00
MC6809 Cookbook C. Warren	£7.25

ELECTRONICS

Principles of Transistor Circuits Amos	£9.00
Design of Active Filters with experiments Berlin	£11.30
Electronic Devices & Circuit Theory Boylestad	£14.45
49 Easy to Build Electronic Projects Brown	£6.00
How to build Electronic Kits Capel	£3.55
How to Design and build electronic instrumentation Carr	£9.35
Introduction to Microcomputers Daglecs	£7.20
Electronic Components and Systems Dennis	£15.00
Principles of Electronic Instrumentation De Sa	£11.45
Giant Handbook of Computer Software	£12.95
Giant Handbook of Electronic Circuits	£21.00
Giant Handbook of Electronic Projects	£13.60
Electronic Logic Circuits Gibson	£6.45
Analysis and Design of Analogue Integrated Circuits Gray	£42.50
Basic Electronics Grob	£11.30
Lasers – The Light Fantastic Hallmark	£7.70
Introduction to Digital Electronics & Logic Joynson	£6.25
Electronic Testing and Fault Diagnosis Loveday	£7.85
Electronic Fault Diagnosis Loveday	£6.25
Essential Electronics A-Z Guide Loveday	£7.50
Microelectronics Digital & Analogue circuits and systems Millman	£12.25
103 Projects for Electronics Experimenters Minis	£8.30
VLSI System Design Muroga	£34.10
Practical Solid State Circuit Design Olesky	£28.50
Power FETs and their application Oxner	£10.80
Master Handbook of IC Circuits Powers	£12.85
Electronic Drafting and Design Raskhodoff	£26.65
VOM – VTVM Handbook Risse	£8.50
Video and Digital Electronic Displays Sherr	£28.85
Understanding Electronic Components Sinclair	£7.50
Electronic Fault Diagnosis Sinclair	£4.50
Physics of Semiconductor Devices Sze	£16.90
Digital Circuits and Microprocessors Taub	£11.25
Active Filter Handbook	£8.50
Designing with TTL Integrated Circuits Texas	£15.20
Transistor Circuit Design Texas	£15.20
Digital Systems: Principles and Applications Tocci	£14.95
Master Handbook of Telephones Traister	£12.50
How to build Metal/Treasure Locators Traister	£6.00
99 Fun to Make Electronic Projects Tymony	£8.50
33 Electronic Music Projects you can build Winston	£6.95

COMPUTERS & MICROCOMPUTERS

BASIC Computer Games Ahl	£6.35
From BASIC to PASCAL Anderson	£11.30
UNIX – The Book Banaham	£9.00
Z80 Microcomputer Handbook Barden	£15.05
Microcomputer Maths Barden	£11.90
Digital Computer Fundamentals Barter	£11.75
Visicalc Book. APPLE Edition Bell	£15.55
Visicalc Book. ATARI Edition Bell	£15.55
Introduction to Microprocessors Brunner	£23.00
Programming your APPLE II Computer Bryan	£9.25
Microprocessor Interfacing Carr	£8.50
Microcomputer Interfacing Handbook A/D & D/A Carr	£10.50
Musical Applications of Microprocessors Chamberlain	£28.85
30 Computer Programs for the Home Owner in BASIC D. Chance	£9.25
Microcomputers Dirkson	£9.30
APPLE Personal Computer for Beginners Dunn	£9.50
Microcomputers/Microcomputers – An Intro Gioone	£36.50
Troubleshooting Microprocessors and Digital Logic Goodman	£11.25
Getting Acquainted with your VIC 20 Hartnell	£8.50
Getting Acquainted with your ZX81 Hartnell	£5.95
Let your BBC Micro Teach you to program Hartnell	£7.95
Programming your ZX Spectrum Hartnell	£8.50
The ZX Spectrum Explored Hartnell	£6.95
How to Design, Build and Program your own working Computer System Haviland	£10.50
BASIC Principles and Practice of Microprocessors Heffer	£8.00
Hints and Tips for the ZX81 Hewson	£5.25
What to do when you get your hand on a Microcomputer Holtzman	£9.95
34 More Tested Ready to Run Game Programs in BASIC Horn	£7.70
COBOL Jackson	£9.25
Microcomputer Builders' Bible Johnson	£14.75
Digital Circuits and Microcomputers Johnson	£16.95
PASCAL for Students Kemp	£6.95
The C – Programming Language Kernighan	£19.25
The ZX81 Companion Maunder	£9.50
Guide to Good Programming Practice Meek	£9.50
Principles of Interactive Computer Graphics Newman	£13.75
Theory and Practice of Microprocessors Nicholas	£11.45
Exploring the World of the Personal Computer Nilles	£12.95
Microprocessor Circuits Vol. 1. Fundamentals and Microcontrollers Noll	£9.80
Beginner's Guide to Microprocessors Parr	£5.35
Microcomputer Based Design Peatman	£11.45
Digital Hardware Design Peatman	£10.75
BBC Micro Reavealed Ruston	£9.45
Handbook of Advanced Robotics Safford	£14.45
1001 Things to do with your own personal computer Sawusch	£8.50
Easy Programming for the ZX Spectrum Stewart	£7.45
Microprocessor Applications Handbook Stout	£46.45
Handbook of Microprocessor Design and Applications Stout	£46.45
Programming the PET/CBM West	£16.40
An Introduction to Microcomputer Technology Williamson	£8.20
Computer Peripherals that you can build Wolfe	£14.75
Microprocessors and Microcomputers for Engineering Students and Technicians Wooland	£7.10

REFERENCE BOOKS

Electronic Engineers' Handbook Fink	£66.60
Electronic Designers' Handbook Giacoletto	£77.75
Illustrated Dictionary of Microcomputer Technology Hordeski	£8.45
Handbook for Electronic Engineering Technicians Kauffman	£40.50
Handbook of Electronic Calculators Kauffman	£35.00
Modern Electronic Circuit Reference Manual Marcus	£51.95
International Transistor Selector Towers	£14.50
International Microprocessor Selector Towers	£16.00
International MOS Power and other FET Selector	£10.95
International Digital IC Selector Towers	£10.95
International Op Amp Linear IC Selector Towers	£9.50
Illustrated Dictionary of Electronics Turner	£19.75

VIDEO

Servicing Home Video Cassette Recorders Hobbs	£14.50
Complete Handbook of Videocassette Recorders Kybett	£10.50
Theory and Servicing of Videocassette Recorders McGinty	£13.50
Beginner's Guide to Video Matthewson	£5.35
Video Recording: Theory and Practice Robinson	£16.00
Video Handbook Van Wezel	£24.00
Video Techniques White	£14.45

Please send me the books indicated. I enclose cheque/postal order for £.......... Prices include postage and packing

I wish to pay by Access/Barclaycard. Please debit my account.

5 2 2 4 ☐☐☐☐☐☐☐☐☐☐☐☐

4 9 2 9 ☐☐☐☐☐☐☐☐☐☐☐☐

Signed...

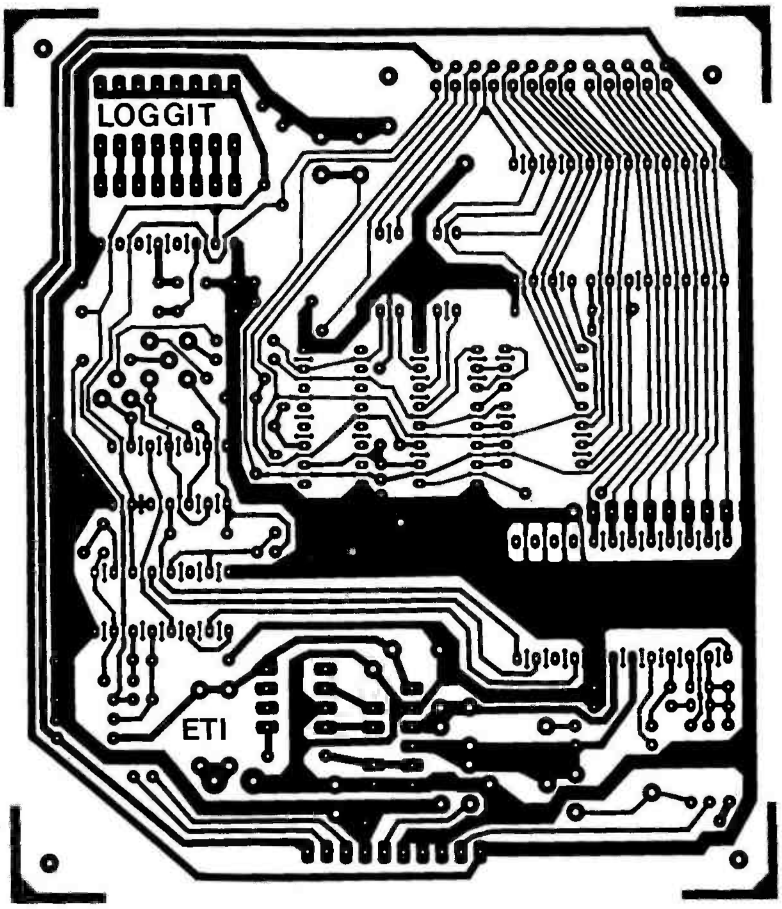
Name...

Address...

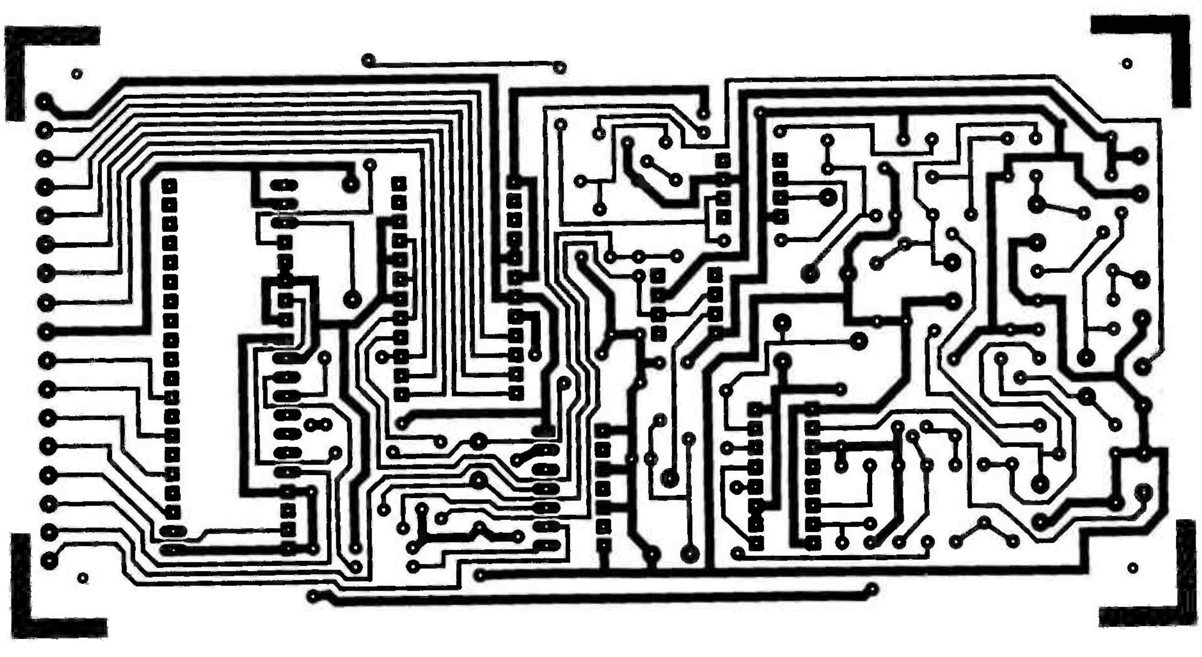
....

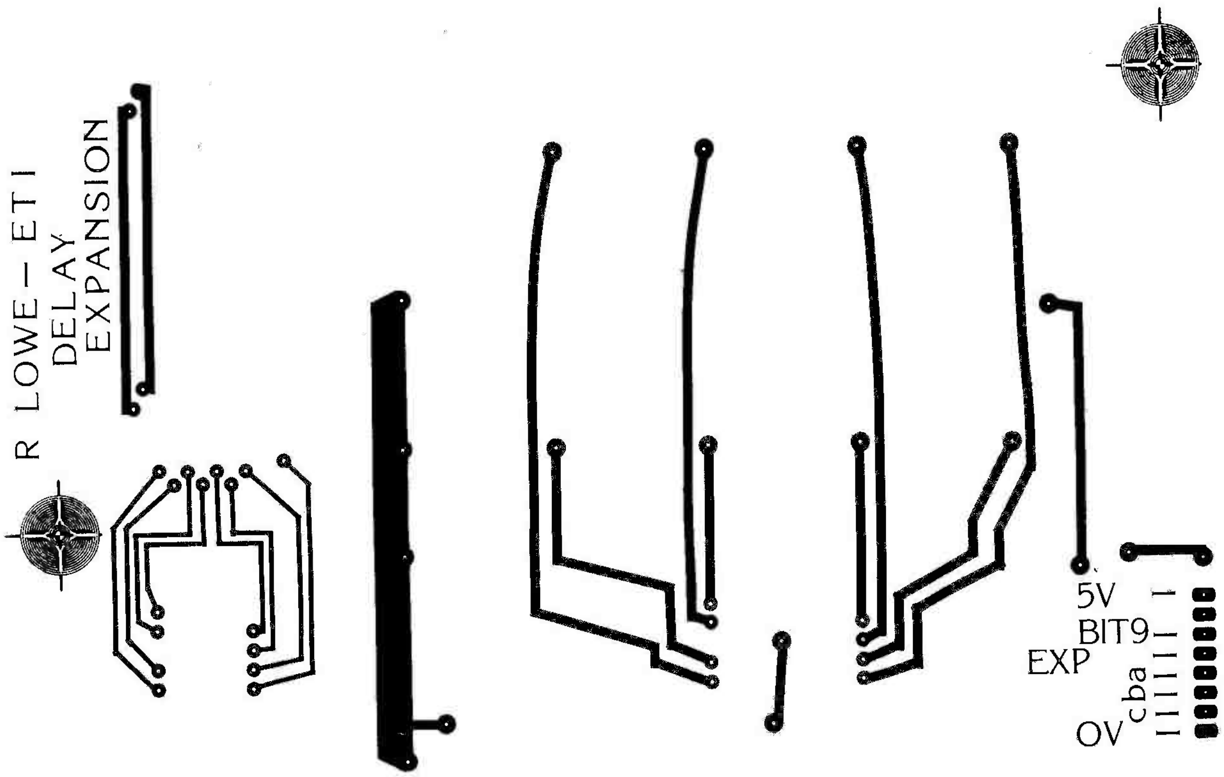
....

PCB FOIL PATTERNS

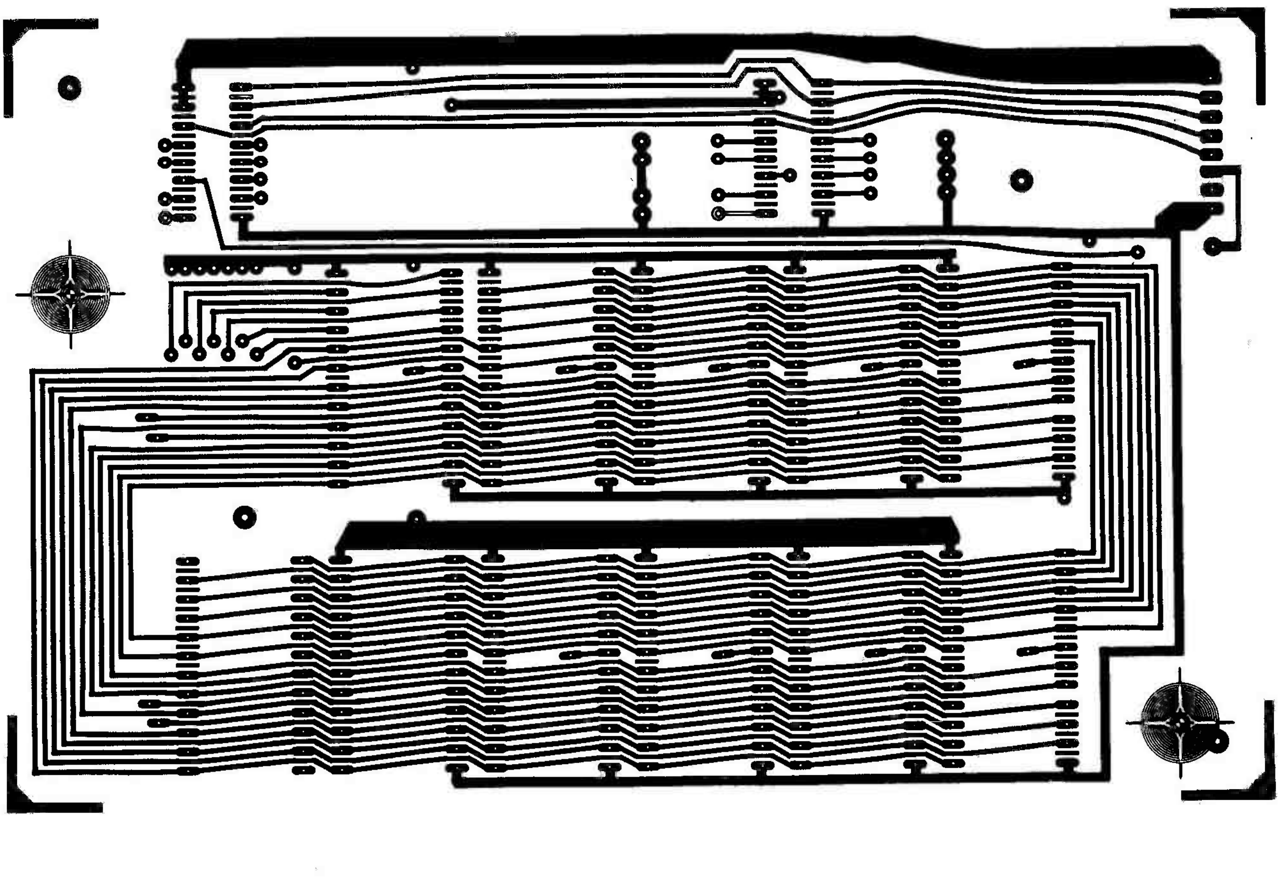


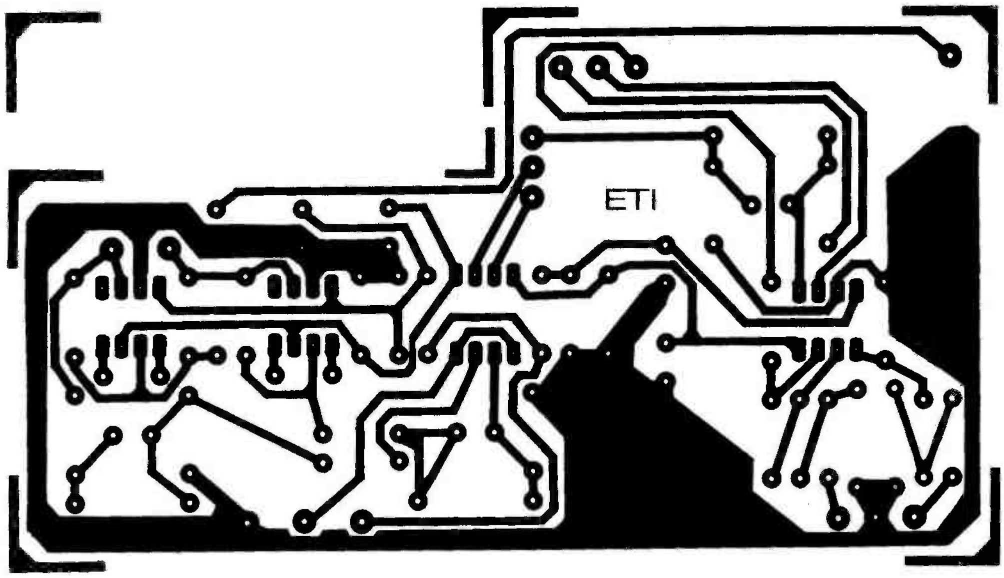
Two of the foil patterns held over from last month, the Data Logger board (left) and the Digital Framestore ADC/DAC board (below).



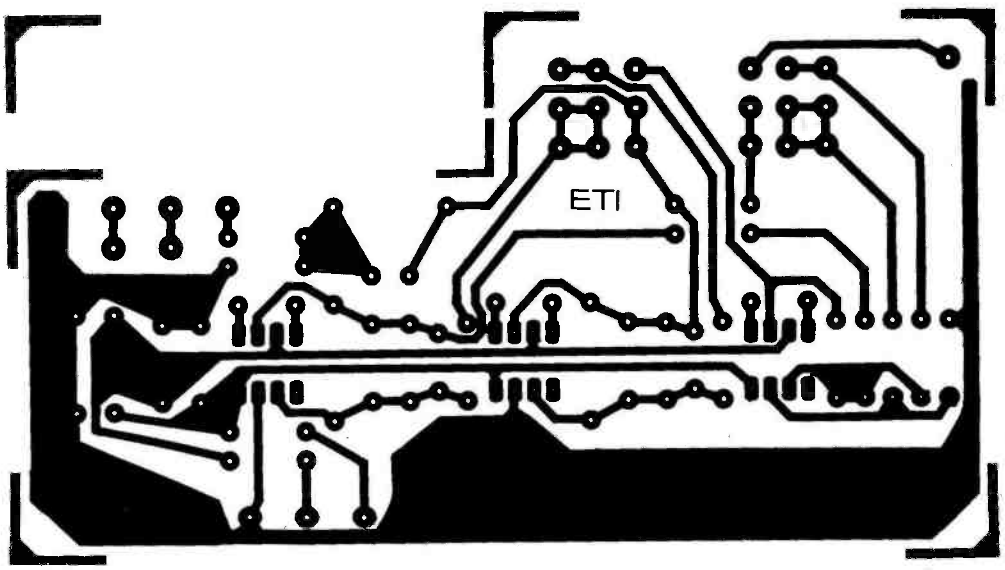


The top and bottom foils of the Digital Delay Line Expansion board, held over from last month.

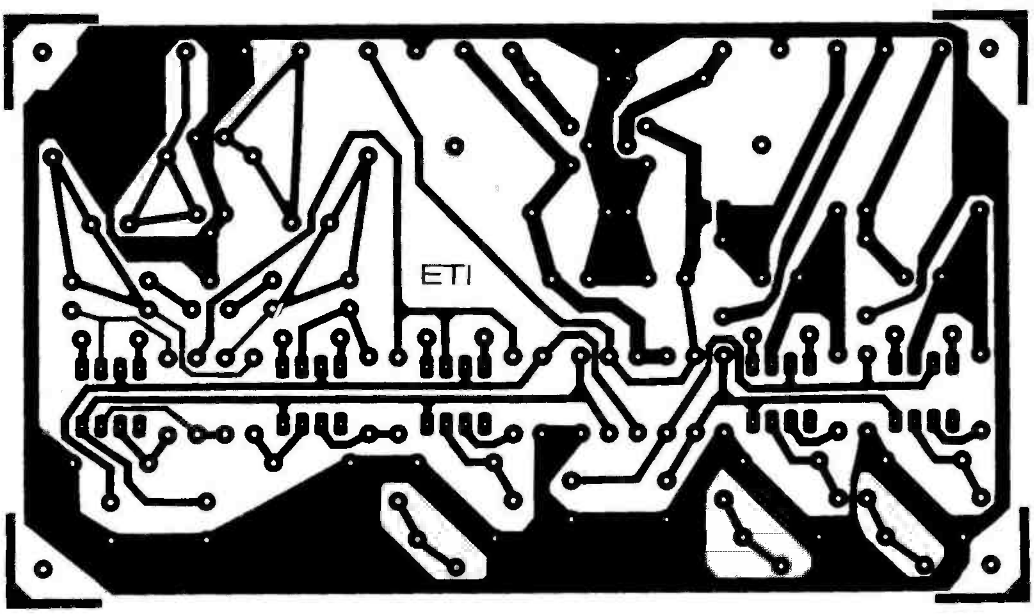




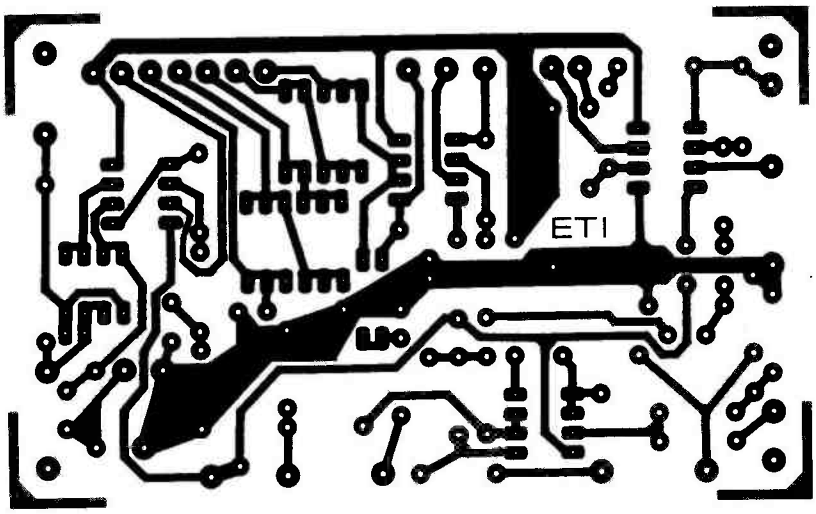
The ParaGraph Equaliser input stage and main signal path board.



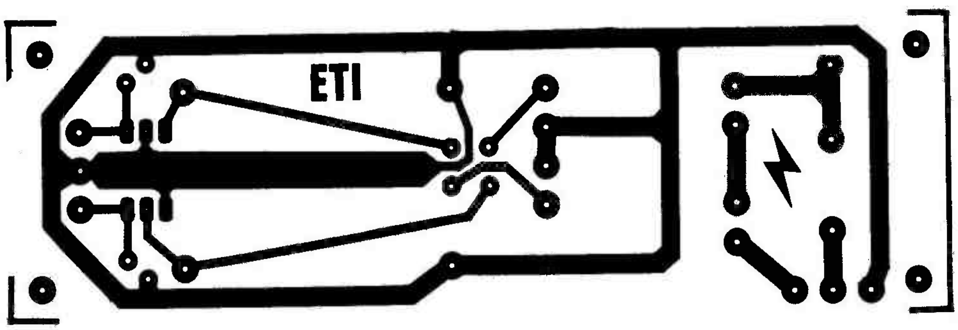
The ParaGraph Equaliser filter board.



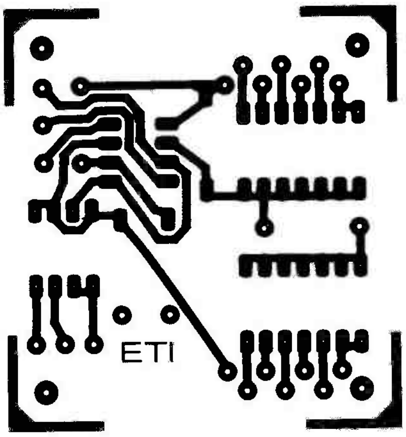
The ParaGraph Equaliser balanced output, tape buffers and regulated supply board.



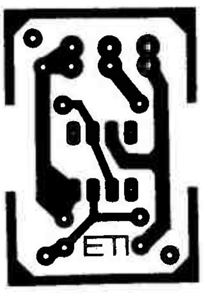
The THD and millivoltmeter board for the Distortion Meter.



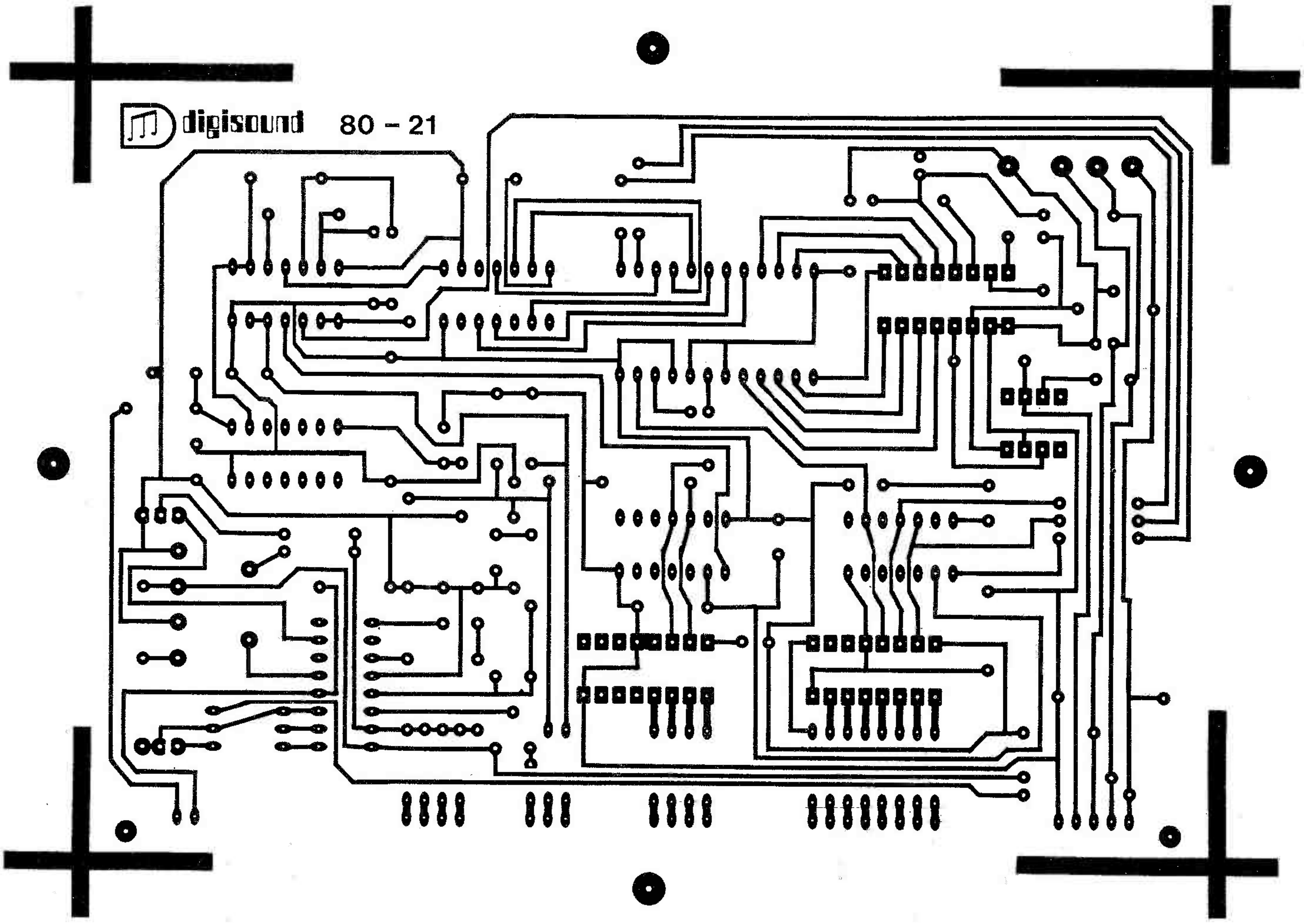
The Distortion Meter mains power supply board.



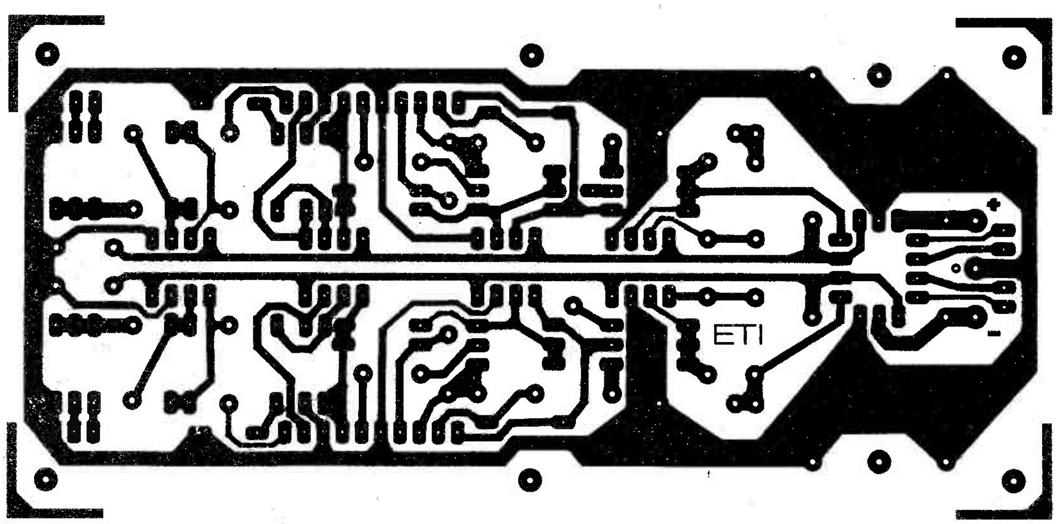
The Distortion Meter spot frequency oscillator board.



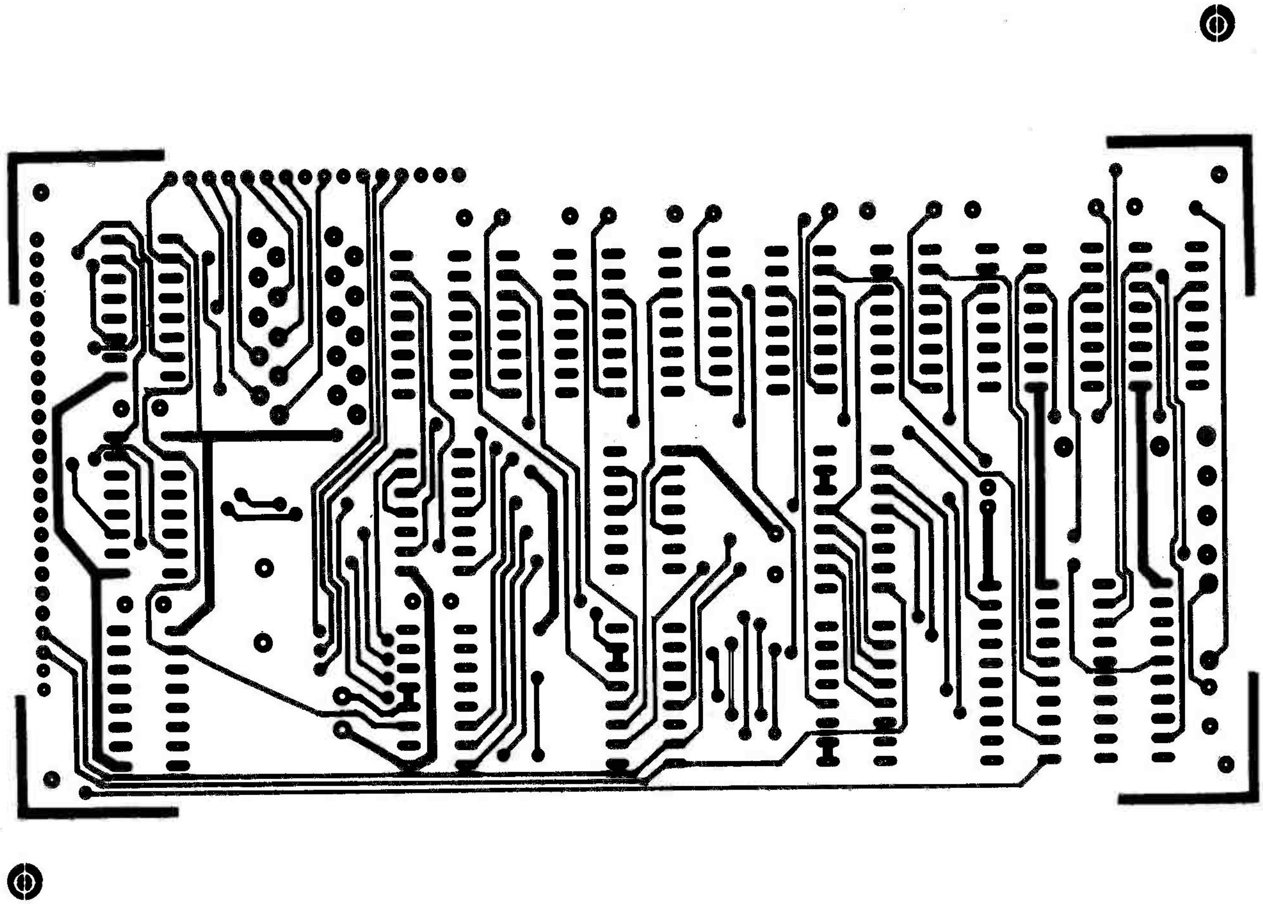
The Distortion Meter single battery supply board.



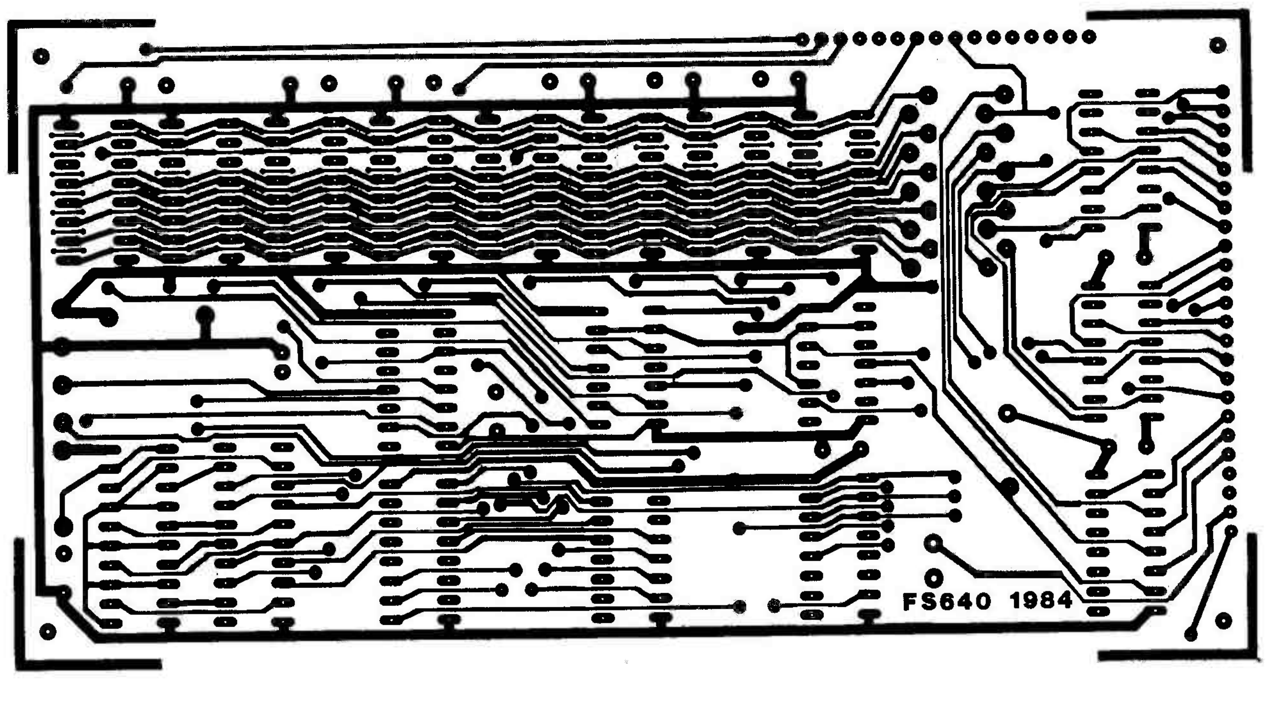
The Voltage Controlled Digital Oscillator board.



The preamplifier and regulator board for the combo.



The top and bottom foils for the Digital Framestore memory card.



ETI PCB SERVICE

In order to ensure that you get the correct board, you must quote the reference code when ordering. The code can also be used to identify the year and month in which a particular project appeared: the first two numbers are the year, the third and fourth are the month and the number after the hyphen indicates the particular project.

Note that these are all the boards that are available — if it isn't listed, we don't have it.

Our terms are strictly cash with order — we do not accept official orders. However, we can provide a pro-forma invoice for you to raise a cheque against, but we must stress that the goods will not be dispatched until after we receive payment.

1981
- ☐ E/8106-8 Waa-Phase.............. 1.76
- ☐ E/8106-9 Alien Attack............. 4.00
- ☐ E/8107-1 System A-Input (MM or MC).................... 3.05
- ☐ E/8107-2 System A — Preamp 5.95
- ☐ E/8107-3 Smart Battery Charger ... 2.27
- ☐ E/8108-5 Watchdog Home Security (2 boards) 6.11
- ☐ E/8109-1 Mains Audio Link (3 bds)... 8.45
- ☐ E/8109-4 Laboratory PSU 5.21
- ☐ E/8110-1 Enlarger Timer........... 3.91
- ☐ E/8110-2 Sound Bender........... 3.05
- ☐ E/8111-1 Voice Over Unit......... 4.57
- ☐ E/8111-3 Phone Bell Shifter........ 3.40
- ☐ E/8112-4 Component Tester....... 1.71

1982
- ☐ E/8202-2 Allez Cat Pest Repeller... 1.93
- ☐ E/8202-5 Moving Magnet Stage.... 4.01
- ☐ E/8202-6 Moving Coil Stage 4.01
- ☐ E/8203-4 Capacitance Meter (2 boards) 11.66
- ☐ E/8205-1 DV Meg 3.13
- ☐ E/8206-1 Ion Generator (3 bds) 9.20
- ☐ E/8206-4 MOSFET Amp Module ... 7.80
- ☐ E/8206-5 Logic Lock 3.52
- ☐ E/8206-6 Digital PWM 3.84
- ☐ E/8206-7 Optical Sensor 2.00
- ☐ E/8206-9 Oscilloscope (4 bds).... 13.34
- ☐ E/8212-2 Servo Interface (2 bds) ... 6.75
- ☐ E/8212-4 Spectracolumn 5.54

1983
- ☐ E/8301-1 Fuel Gauge.............. 3.45
- ☐ E/8301-2 ZX ADC................ 2.59
- ☐ E/8301-3 Programmable PSU...... 3.45
- ☐ E/8303-1 SoundBoard 12.83
- ☐ E/8303-2 Alarm Module........... 3.62
- ☐ E/8303-3 ZX81 User Graphics 1.07
- ☐ E/8303-4 Logic Probe............. 2.50
- ☐ E/8304-1 Real Time Clock......... 8.74
- ☐ E/8304-4 Stage Lighting — Main ... 13.73
- ☐ E/8304-5 Stage Lighting — Display 3.45
- ☐ E/8305-1 Compressor/Limiter 6.19
- ☐ E/8305-2 Single PSU.............. 3.16
- ☐ E/8305-3 Dual PSU 4.01
- ☐ E/8305-4.2 NDFL Amp 7.88
- ☐ E/8305-5 Balance Input Preamp.... 3.23
- ☐ E/8305-6 Stage Lighting Autofade........................ 6.19
- ☐ E/8305-7 Stage Lighting — Triac Board....................... 4.74
- ☐ E/8306-1 to 3 PseudoROM (3 boards) 3.62
- ☐ E/8306-5 Atom Keypad............ 5.18
- ☐ E/8307-1 Flash Sequencer......... 2.67
- ☐ E/8307-2 Trigger Unit Main Board... 2.67
- ☐ E/8307-3 Trigger Unit Transmitter 1.66
- ☐ E/8307-4 Switched Mode PSU.... 16.10
- ☐ E/8308-1 Graphic Equalisr......... 9.10
- ☐ E/8308-2 Servo Fail-Safe (four-off) 2.93
- ☐ E/8308-3 Universal EPROM prog ... 9.64
- ☐ E/8309-1 NiCad Charger/Regen ... 3.77
- ☐ E/8309-2 Digger.................. 3.40
- ☐ E/8309-3 64K DRAM 14.08
- ☐ E/8310-1 Supply Protector 2.19
- ☐ E/8310-2 Car Alarm.............. 3.98
- ☐ E/8310-3 Typewriter Interface 4.17
- ☐ E/8311-1 Mini Drum Synth 3.07
- ☐ E/8311-2 Alarm Extender.......... 3.21
- ☐ E/8311-3 Multiswitch 3.59
- ☐ E/8311-4 Multiple Port............ 4.34
- ☐ E/8311-5 DAC/ADC Filter 3.22
- ☐ E/8311-6 Light Pen 4.60
- ☐ E/8311-7 Logic Clip............... 2.51
- ☐ E/8311-8 MC Head (JLLH)......... 3.17
- ☐ E/8312-1 Lightsaver............... 1.85
- ☐ E/8312-2 A-to-D Board........... 12.83
- ☐ E/8312-3 Light Chaser (2 bds) 7.54
- ☐ E/8312-4 ZX Alarm 6.04

1984
- ☐ E/8401-1 Vector Graphics......... 8.27
- ☐ E/8402-1 Speech Board (Mini-Mynah) 10.97
- ☐ E/8402-2 MP (Modular Preamp) Disc input (mono) 3.73
- ☐ E/8402-3 MP Output stage (stereo) 3.73
- ☐ E/8402-4 MP Relay/PSU........... 3.73
- ☐ E/8402-5 MP Tone, main (mono) ... 3.73
- ☐ E/8402-6 MP Tone, filter (stereo)... 3.73
- ☐ E/8402-7 MP Balanced output (st) ... 3.73
- ☐ E/8402-8 MP Headphone amp (st) ... 3.73
- ☐ E/8402-9 MP Mother board........ 9.01
- ☐ E/8403-1 Power Meter............ 5.81
- ☐ E/8403-2 Z80 DRAM.............. 9.79
- ☐ E/8403-3 Obedient Die 3.76
- ☐ E/8404-1 School Timer............ 4.07
- ☐ E/8405-1 Auto Light Switch........ 4.01
- ☐ E/8405-2 ZX81 EPROM Prog. 10.53
- ☐ E/8405-3 Mains Borne RC......... 5.07
- ☐ E/8405-4 Centronics Interface 4.09
- ☐ E/8405-5 Vario.................. 6.62
- ☐ E/8405-6 Midi Drum Synth 3.59
- ☐ E/8406-1 Oric EPROM Bd........ 19.58
- ☐ E/8406-2 Spectrum Joystick 3.30
- ☐ E/8407-1 Warlock Alarm 8.19
- ☐ E/8408-1 Joystick Interface........ 3.07
- ☐ E/8408-2 EPROM Emulator........ 9.11
- ☐ E/8408-3 Infrared Transmitter 3.70
- ☐ E/8408-4 Infrared Receiver........ 3.98
- ☐ E/8408-5 CMOS Tester............ 4.60
- ☐ E/8409-1 EX42 Kybd. Interface 3.82
- ☐ E/8409-2 Bansheee Siren.......... 3.19
- ☐ E/8409-3 Dry Cell Charger......... 2.80
- ☐ E/8410-1 Echo Unit............... 3.92
- ☐ E/8410-2 Digital Cassette 9.80
- ☐ E/8410-3 Disco/Party Strobe 4.80
- ☐ E/8411-1 AM/FM Radio (4 bds)... 13.02
- ☐ E/8411-2 Control Port-control bd 12.15
- ☐ E/8411-3 Control Port-I/O bd 6.33
- ☐ E/8411-4 Capacitance Meter........ 3.55
- ☐ E/8411-5 Video Vandal (3 bds) ... 12.10
- ☐ E/8411-6 Temperature Controller... 2.88
- ☐ E/8411-7 Mains Failure Alarm...... 2.54
- ☐ E/8411-8 Knite Light............. 3.25
- ☐ E/8411-9 Stage Lighting Interface... 3.73
- ☐ E/8411-10 Perpetual Pendulum.... 3.14
- ☐ E/8412-1 Spectrum Centronics 3.51
- ☐ E/8412-2 Experimenter's DRAM... 14.08
- ☐ E/8412-3 Active-8: Motherboard ... 9.37
- ☐ E/8412-4 Active-8: Protection Unit 3.67
- ☐ E/8412-5 Active-8: Crossover 3.67
- ☐ E/8412-6 Active-8: LF EQ.......... 3.67
- ☐ E/8412-7 Active-8: Equaliser....... 3.67
- ☐ E/8412-8 Active-8: Delay Unit...... 3.67

1985
- ☐ E/8501-1 Active Bass Speaker...... 2.79
- ☐ E/8501-2 DRAM Card Update...... 3.66
- ☐ E/8501-3 Digital Delay (2 bds) ... 26.00
- ☐ E/8502-1 Digital Delay Expander.. 10.79
- ☐ E/8502-2 Data Logger 5.17
- ☐ E/8503-1 Combo preamplifier...... 4.49
- ☐ E/8503-2 THD meter mV & osc. bds 7.02
- ☐ E/8503-3 THD meter mains PSU ... 3.49
- ☐ E/8503-4 THD meter battery PSU ... 1.36
- ☐ E/8503-5 ParaGraph Equaliser IP/MSP & OP/PSU bds............ 9.30
- ☐ E/8503-6 ParaGraph Equaliser filter bd......................... 4.51

How to order: indicate the boards required by ticking the boxes and send this page, together with your payment, to: ETI PCB Service, Argus Specialist Publications Ltd, 1 Golden Square, London W1R 3AB. Make cheques payable to ETI PCB Service. Payment in sterling only please. Prices subject to change without notice.

Total for boards	£....................
Add 45p p&p	0.45
Total enclosed	£....................

PLEASE ALLOW 28 DAYS FOR DELIVERY

Signed ....

Name ....

Address ....

....

Lineage:
40p per word (minimum 15 words)
Semi Display: (minimum 2 cms)
£11.00 per single column centimetre
Ring for information on series bookings/discounts
All advertisements in this section must be prepaid.
Advertisements are accepted subject to the terms and conditions printed on the advertisement rate card (available on request)

01-437 0699

Send your requirements to:
Jason Inskip
ASP Ltd.,
1 Golden Square,
London W1.

SERVICES

FREELANCE ELECTRONICS ENGINEER

* QUALIFICATIONS *
H.N.C.; M.O.D. training

ANYTHING CONSIDERED

* **SPECIALITY** * Drafting and P.C.B. artwork, board productions and assembly.

FAULT FINDING AND TESTING UNDERTAKEN

HIGHEST QUALITY WORK * FULL COOPERATION.

Greg Heath, 'Pickwick'.
No 6 Hillbarn, Sanderstead,
Surrey, CR2 0RU

COMPONENTS

Betatran Electronics Supplies

Toroidal transformers primary 250V secondaries 0-40, 0-40V, 0-50, 0-50V, 0.55, 0-55V, 0-70, 0-70V at 300VA £17.55, 500VA **£24.70,** 625VA **£30.50. Can Electolytics 63V, 6800uF SA 2£4.35.** 10,000uF 7A **£5.45.** 100V 6800uF 8A **£6.23,** 4700uF 8A **£5.50.** 3300uF 7A **£4.20.** 2200uF 7A **£3.00. Computer Grade 10,000uF 15A £14.69.** MOS-FETs 2SJ 50/2SK 135 **£8.50.** 2SJ83/2SK 227 **£8.20** price per pair. 35A 200V bridge rectifiers **£3.25.** VAT inclusive £1.00 p&p under £7.00. Full spec. many more. Resistors, capacitors, trasnistors, heatsinks, amplifiers, speakers, transformers, etc. Send 4 x 9 self addressed envelope for large list.

Laver St., Cavendish, Suffolk CO10 8AP. Tel: 0787 280639.

IRISH READERS

MAIL ORDER COMPONENTS

Top quality components
Great prices
Return-of-post service

Write or phone for free price list
WAVEFORM ELECTRONICS
12 Effra Road, Rathmines, Dublin 6.
Phone (01) 0001 if England 987507
Mail order only please

CHEAP CASES

Absolute bargains, rack mounting & free standing. NEW, but manufacturers seconds. No damage.

Send s.a.e. for list.
C. Phillips, 'The Laurels' Tiptoe Road Wooton, New Milton, Hants BH25 5SJ
MAIL ORDER ONLY

VAT inclusive price list. LSTTL, from 28p, CMOS from 23p, Transistors, Resistors, Capacitors and more. Phone or write (0283) 703071. Hunt Electronics, P.O. Box 57, Derby, DE6 6SN.

TO FILL
THIS SPACE,
PHONE JASON
ON **01-437 0699**

RESISTORS, CAPACITORS. 1,000 mixed carbon film ⅛W, ¼W, ½W, 2%, 5%, 10% resistors £2.95. 50 mixed ceramic tube capacitors £1.00. P&P 50p. D.J. Hooker, Romney Marsh Electronics, Pennywood, Clark Road, Greatstone, Romney Marsh, Kent TN28 8PB.

WIRES 'N CABLES

THE SCIENTIFIC WIRE COMPANY
811 Forest Road, London E17
01-531.1568

ENAMELLED COPPER WIRE				
SWG	1lb	8oz	4oz	2oz
8-34	3.63	2.09	1.10	88p
35-39	3.82	2.30	1.26	93p
42-43	5.20	2.91	2.25	1.60
44-47	8.56	5.80	3.49	2.75
48	15.96	9.58	6.38	3.69
SILVER-PLATED COPPER WIRE				
14-30	9.09	5.20	2.93	1.97
TINNED COPPER WIRE				
14-30	3.97	2.41	1.39	0.94

Prices include P&P and VAT. Orders under £2 add 20p. Dealer inquiries welcome.

WANTED

TURN YOUR SURPLUS transistors, IC's etc into cash. Contact Coles Harding & Co., 103 South Brink, Wisbech, Cambs. Tel: 0945 584188. Immediate settlement.

EDUCATIONAL

IMPROVE YOUR PROSPECTS

with skills that employers want – learn the easy way with modern home study courses from Ideal Schools.

MODERN ELECTRONICS
Train for success in the fastest ever growing industrial sector.

COMPUTER PROGRAMMING
The demand for Programmers is increasing constantly – don't miss out!

For free booklet write today to

IDEAL

IDEAL SCHOOLS
(Ref. ETD2)
60 St. Enoch Sq
Glasgow G1 UK.
Tel: 041-248 5200

MICROCOMPUTER REPAIRS

ZX SPECTRUM. Vic20, C64, BBC, QL 15 40/41, Commodore computers, printers and floppy discs. Send faulty machine to: Trident Enterprises Ltd., 37 Linden House, Common Road, Langley, Slough, Berks. Tel: (0753) 48785.

PLANS 'N DESIGN

AMAZING ELECTRONIC plans, lasers, gas, ruby, light shows, high voltage teslas, van de graph surveillance devices, ultrasonics, pyrotechnics, new solar generator, 150 more projects, catalogue. S.A.E. Plancentre, Bromyard Road Industrial Estate, Ledbury HR8.

ADD-ONS

TANGERINE OWNERS at last 2 **6809** C.P.U. board with expandable monitor in colour. FLEX compatible. Also 14K RAM card to free EPROM space on TANEX S.A.E. For details . . . Ralph Allen Engineering; Forncett-End, Norwich. Tel: (095 389) 420.

EQUIPMENT

EPROM COPIER — STAND ALONE
2716-27128 .... **£175.00**
TELEPHONE CONVERSATION RECORDER **£75.00**
2 LINES INTO 1 ANSWERING MACHINE
Switching Unit **£30.00**
From L.K.F. Systems Ltd
St. Albans. Tel: 55084

COMPONENTS

WHOLESALE. Electronics components price list now ready. No min. order quantity. Send SAE or call JPG Electronics, 276 Chatsworth Road, Chesterfield S40 2BH.

ELECTROMART

ESSEX

R JONES ELECTRONICS
267 Rectory Rd., Grays, Essex
Tel: (0375) 33158 — *24hr answer phone*
Components, IC's. Full After Sales Services
Electronic repairs — Industrial & Domestic
Open 9-5.30pm 6 days a week.

LANCASHIRE

ETESON ELECTRONICS
E•E•
15B Lower Green,
Poulton-le-Fylde, Blackpool
Tel: (0253) 885107
Open: 9.30am-12.30. 1.30-5.30. Closed Wed & Sun.
Electronic Component Specialists.

MERSEYSIDE

PROGRESSIVE RADIO
93 Dale Street. Tel 051 236 0982
47 Whitechapel, Tel 051 236 5489
Liverpool 2
'THE ELECTRONICS SPECIALISTS'
Open: Tues-Sat 9.30-5.30

TYNE & WEAR

E.S.R.

13A STATION ROAD
CULLERCOTES, N. SHIELDS,
TYNE & WEAR

ELECTROMART

CLASSIFIED ADVERTISEMENT ORDER FORM

Rate 40p per word (min 15 words)
Post to: **ETI, 1 Golden Square, London W1**

Please use BLOCK CAPITALS and include post codes.

Classification ....
Name (Mr/Mrs/Miss/Ms) ....
(delete accordingly)
Address ....
....
Signature .... **Date** ....
Daytime Tel. No. ....

ADVERTISERS INDEX
ETI, MARCH 1985

Please mention **E.T.I.** when replying to all adverts

YOU'LL ENJOY THE EXPERIENCE

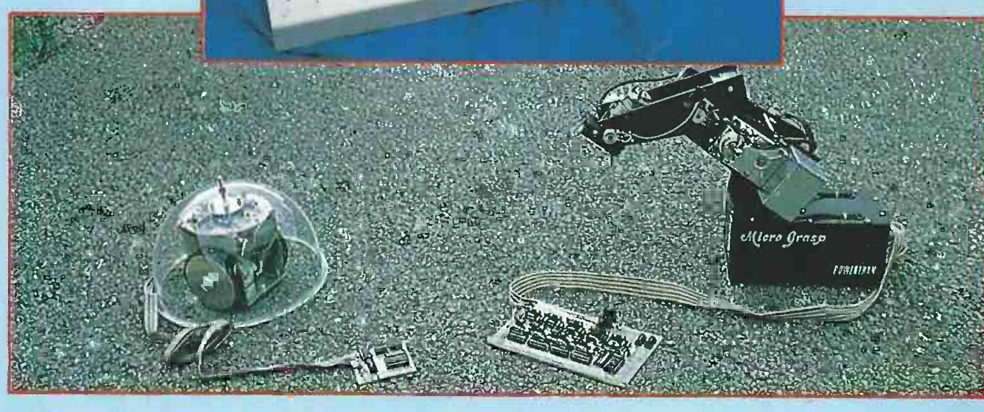
GENESIS P102 MK 2 from
Hydraulic Robot System
from £1625

GENESIS P101 MK2
Hydraulic Robot arm
from £825

CORTEX II
16 bit microcomputer
Ready-Built
from £399

CORTEX II
16 bit microcomputer
from £299 in kit form

HEBOT II
Robot Turtle
From £95.00



MICROGRASP
Electric Robot
from £215

Powertran's educational robots and the remarkable Cortex microcomputer have been tried and tested in universities, colleges, schools and homes throughout the world.

Our own experience in the field of electronics kits has been supplemented by the Feedback Group's 25 years of supplying technical equipment to the Educational sector. Our first year as a member of the Group has seen numerous improvements to our already popular products.

All the products illustrated can be supplied either factory-built or in kit form for added economy. Contact our Sales Office for details.

(Prices quoted are exclusive of VAT and apply to the UK only.)

POWERTRAN cybernetics ltd.

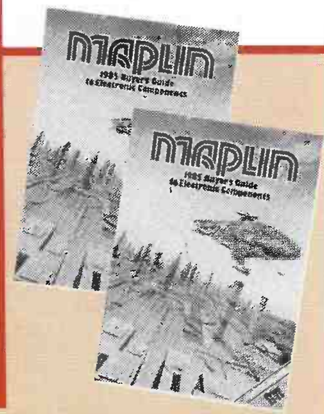
BARCLAYCARD VISA

Access

PORTWAY INDUSTRIAL ESTATE, ANDOVER, HANTS SP10 3ET Tel: 0264 64455

From a gentle purr to a mighty roar, the tightly controlled power of the beast is yours to command!

All new in the 1985 Catalogue



PROFESSIONAL QUALITY HIGH POWER LOUDSPEAKERS

A new range of superb quality loudspeakers.

- ★ *Virtually indestructible high temperature voice-coil reinforced with glass-fibre*
- ★ *100% heat overload tolerance*
- ★ *Advanced technology magnet system*
- ★ *Rigid cast alloy chassis*
- ★ *Linen or Plastiflex elastomer surrounds*
- ★ *5-year guarantee (in addition to statutory rights)*

Available in 5, 8, 10, 12, 15 and 18 inch models with 8Ω and some 16Ω impedances and with input powers ranging from 50W to 300W e.g.

5in. 50W 95dB 8Ω: XG39N / 16Ω: XG40T £17.95§
8in. 100W 98dB 8Ω: XG43W £29.95§
10in. 100W 100dB 8Ω: XG46A £29.95§
12in. 100W 101dB 8Ω: XG49D £29.95§
12in. Twin Cone 100W 100dB 8Ω: XG50E / 16Ω: XG51F £31.95§

Note - the output power doubles for each 3dB increase (ref 1W @ 1m).

PRECISION GOLD MULTIMETERS

A new range of very high quality multimeters offering truly amazing quality at the price.

Pocket Multimeter, 16 ranges, 2000Ω/V DC/AC £6.95§ (YJ06G)
M-102BZ with Continuity buzzer, battery tester and 10A DC range, 23 ranges, 20,000Ω/V DC £14.95§ (YJ07H)
M-2020S with Transistor, Diode & LED tester and 10A DC range, 27 ranges 20,000Ω/V DC £19.95§ (YJ08J)
M-5050E Electronic Multimeter with very high impedance, FET input, 53 ranges including peak-to-peak AC, centre-zero and 12A AC/DC ranges £34.95§ (YJ09K)
M-5010 Digital Multimeter with 31 ranges including 20Ω and 20μA DC/AC FSD ranges, continuity buzzer, diode test, and gold-plated PCB for long-term reliability and consistent high accuracy (0.25% +1 digit DCV) £42.50§ (YJ10L)

N.B. All our prices include VAT and Carriage. A 50p handling charge must be added if your total order is less than £5 on mail order (except catalogue).

MAPLIN ELECTRONIC SUPPLIES LTD.

Mail Order: P.O. Box 3, Rayleigh, Essex SS6 8LR. Tel: Southend (0702) 552911

SHOPS
- BIRMINGHAM Lynton Square, Perry Barr. Tel: 021-356 7292.
- LONDON 159-161 King Street, Hammersmith, W6. Tel: 01-748 0926.
- MANCHESTER 8 Oxford Road, Tel: 061-236 0281.
- SOUTHAMPTON 46-48 Bevois Valley Road. Tel: 0703 25831.
- SOUTHEND 282-284 London Rd. Westcliff-on-Sea, Essex. Tel: 0702-554000

Shops closed all day Monday.

Our huge range of top quality electronic components at very competitive prices are all detailed in our catalogue, and with well over 600 new lines in our 1985 edition and many design improvements, it's well worth getting a copy. Here are just a few examples from the catalogue. (The items below are NOT kits).

★ Most phono and jack plugs now with integral strain relief sleeve - gold-plated types also available from 14p (gold from 70p)

★ Stereo Disco Mixer with cross-fade, talk-over, cue monitoring, aux input, slide controls. Only £58.95 (AF99H)

★ 10-Channel Stereo Graphic Equalisers - 3 models - basic; with peak level meter; and with spectrum analyser - from £77.95

★ Digital Delay Line permits Slap-back, Doubling, Flanging, Chorus and Echo. 11 controls. Only £195.00 (AF98G)

★ Video Enhancer improves picture quality when recording from one VTR to another, and with TV's with monitor input. Only 28.95 (XG59P)

★ Detailed descriptions of the exciting new 74HC range of IC's which combine the advantages of CMOS and TTL. From 46p

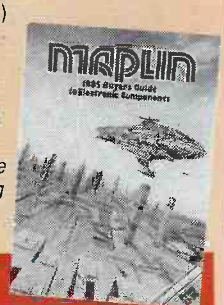
★ Keyboards: sloping keys, two-tone grey, mounted in steel frame, very smart cases (extra) available. 61 keys, only £33.95 (YJ12N)
79 keys, only £37.95 (YJ13P)

★ 1% Resistors now 50ppm/°C, 0.4W, only 2p each!

★ Auto transformers 120/240V 50VA, £10.75§ (YJ56L). 100VA £14.95§ (YJ57M). 150VA £16.95§ (YJ58N). 250VA £21.95§ (YJ59P).

★ Digital Clinical Thermometer. Only £13.95 (FK51F)

Check our 1985 Catalogue for all our other fascinating new lines.



AMERICAN EXPRESS · Access · VISA

☎ *Phone before 2pm for same day despatch.*

1985 CATALOGUE

Pick up a copy now at any branch of W.H. Smith or in one of our shops. The price is still just £1.35, or £1.75 by post from our Rayleigh address (quote CA02C).

Post this coupon now for your copy of the 1985 catalogue.
Price £1.35 + 40p post and packing. If you live outside the U.K. send £2.40 or 11 International Reply Coupons. I enclose £1.75.

Name ....

Address ....

....

....

ETI 3 85

§ Indicates that a lower price is available in our shops. ***All offers subject to availability.*** ***Prices firm until Feb 9th 1985.***